APA 2025
Udaipur

APA International Conference on

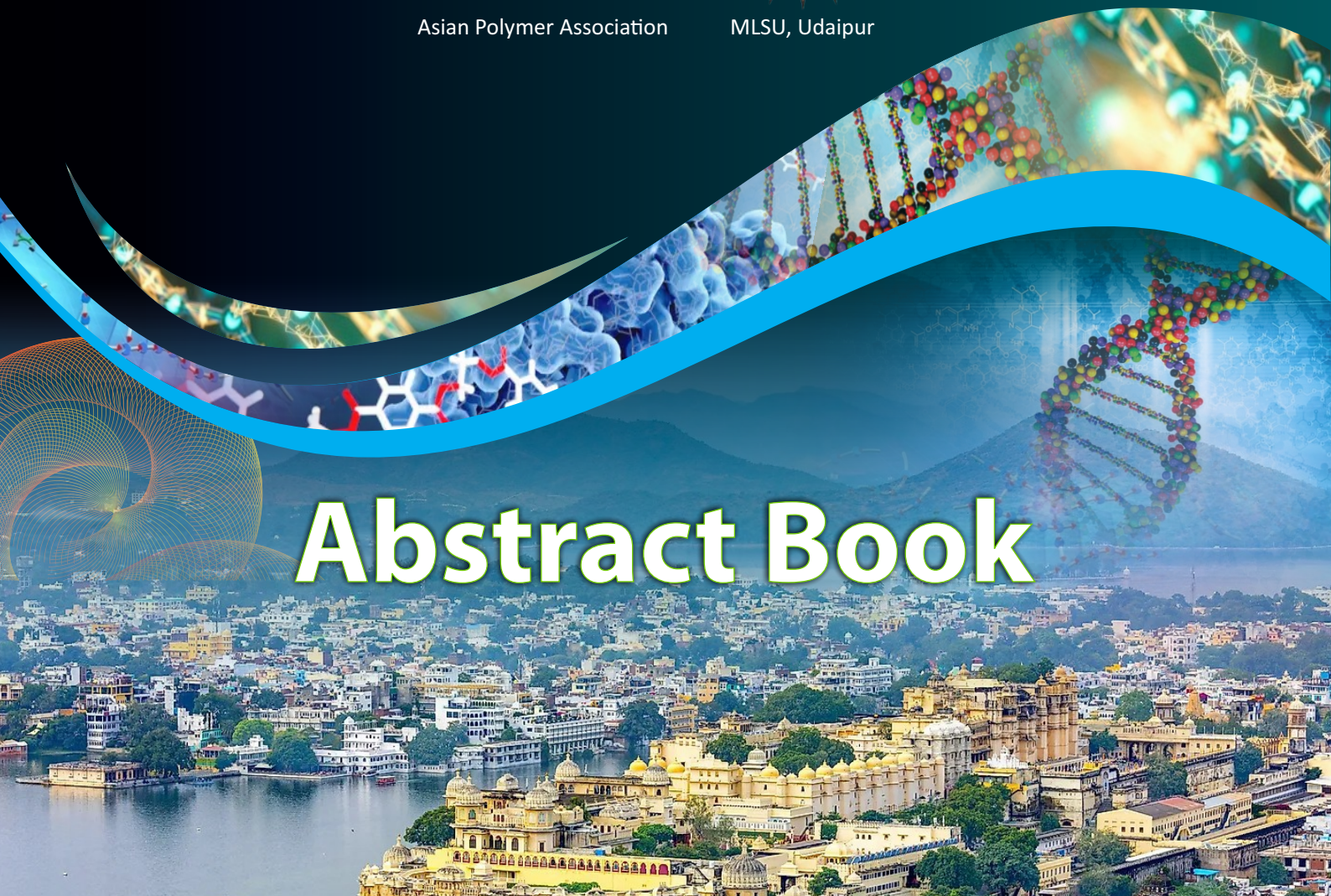
Polymers for Advanced Technology

13-15 October, 2025 | Udaipur, Rajasthan, India

Organised by

Asian Polymer Association

MLSU, Udaipur



Abstract Book

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Plenary Speakers

Jonathan C. Knowles
Univ. College London, UK

Daniel Grande
ICS, Strasbourg
France

Kapil Malhotra
GFL, India

Kohzo Ito
University of Tokyo
Japan

Ashwini Agrawal
IIT Delhi, India

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APA Awards 2025

Jonathan C. Knowles
UCL, UK

Mayank Dwivedi
DRDO, India

Vishal Malhotra
Presto Stantest Pvt Ltd, India

Ravi Kant Pathak
Bharat Uday Gurukul, India

Kirtiraj Gaikwad
IIT Roorkee, India

Dakuri Ramakanth
IIT Roorkee, India

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APA DISTINGUISHED AWARD 2025

Jonathan C. Knowles
UCL, UK

Professor Jonathan Campbell Knowles is a prominent figure in the field of Biomaterials Science. Since 2003, he has served as Professor and Head of the Division of Biomaterials and Tissue Engineering at the UCL Eastman Dental Institute. He also holds a Visiting Professorship at Dankook University in South Korea, focusing on nanobiomedical science and regenerative medicine. With over 700 peer-reviewed papers and an h-index of 96, Professor Knowles has garnered approximately 30,000 citations on Google Scholar. His research interests encompass biomaterials, tissue engineering, nanomaterials, and drug delivery. He holds multiple patents in these areas, including innovations related to 3D printing of polymers. Additionally, he serves as the Editor-in-Chief of the Journal of Biomaterials Applications and the Journal of Tissue Engineering, while also being a member of the editorial boards of several prestigious journals.

His contributions to the field have earned him several accolades, including the IADR Young Investigator Award, the Biocompatibles Endowed Award, and elected as a Fellow of the American Institute of Medical & Biological Engineers in 2018. Professor Knowles continues to significantly impact biomaterials and tissue engineering, fostering collaboration between academia and industry.

APA ICON AWARD 2025

Mayank Dwivedi
DRDO, India

Dr. Mayank Dwivedi, a distinguished Scientist 'H' and Outstanding Scientist, has graciously taken on the role of Director General (HR) at DRDO Headquarters as of June 1, 2025. Prior to this esteemed appointment, he adeptly served as the Director of the Defence Materials and Stores Research & Development Establishment (DMSRDE) in Kanpur. Dr. Mayank Dwivedi is a distinguished scholar, holding a Master's degree in Polymer Technology from DCE Delhi, as well as a PhD in Advanced Composites from IIT Delhi, where he was honored with a Gold Medal. He is also a valued alumnus of the National Defence College in New Delhi. His leadership at the Directorate of Industry Interface & Technology Management (DIITM) for over five years has been marked by his commitment to fostering collaboration, and made significant contributions as the Director of the Defence Technology Commission (DTC).

Under his exceptional guidance, DMSRDE has led several noteworthy innovations, such as Ramjet Fuel, Bulletproof Jackets, Stealth Materials, and Nanoporous Membranes for desalination. Dr. Dwivedi commenced his professional journey in a DST project in 1989 and became a part of DRDO in 1992. Since then, he has devoted his expertise to advancing polymeric composites and nanocomposites, making invaluable contributions to crucial projects, including the Agni and BrahMos missiles. His significant contributions to the field have been acknowledged with various prestigious awards, including the UNDP's 'Water Sustainability Award 2022-23' and the 'Agni Award for Excellence in Self-Reliance' in 2018, reflecting his commitment to excellence and innovation in his field.

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APA INDUSTRY AWARD 2025

Vishal Malhotra
Presto Stantest Pvt Ltd, India

Over the past 25 years, Vishal Malhotra has played a pivotal role in assisting entrepreneurs and companies in saving over 180 crores by guiding them toward achieving zero or minimal rejections. His expertise lies in leveraging technology and testing instruments that empower customers to manufacture or procure high-quality goods. This significant contribution has been recognized by the Government of India, which honored him with the National Award for Quality in 2017.

After dedicating numerous years to studying the underlying causes of rejections and quality-related issues, he developed the 7 QP Framework of Quality. This framework serves as a valuable resource for individuals seeking to understand the factors behind rejections and offers comprehensive strategies for addressing these challenges effectively.

APA SOCIAL AWARD 2025

Ravi Kant Pathak
Bharat Uday Gurukul, India

Dr Ravi Kant Pathak is a highly esteemed non-resident Indian (NRI) who holds the position of Professor of Air Pollution and Climate Change at the University of Gothenburg in Sweden. He is widely regarded for his exceptional contributions to science, social reform, and environmental stewardship, all guided by his principled commitment to the philosophy of "Nation First." Dr. Pathak exemplifies the ethos of a Karmayogi, blending his role as a climate scientist with a genuine dedication to social reform. With a remarkable academic background that includes degrees from IIT Bombay, a Ph.D. from Hong Kong University of Science and Technology (HKUST), and postdoctoral work at Carnegie Mellon University, USA. In 2007, motivated by the ideals of Swami Vivekananda and the resolve of India's freedom fighters, Dr. Pathak made the admirable decision to return to rural India, prioritizing service over personal comfort.

Dr. Pathak founded the Bharat Uday Karmayogi Ashram in Bundelkhand, Uttar Pradesh. For the past 18 years, he has led transformative grassroots initiatives in sustainability, rural empowerment, and education. His key efforts include, promoting organic farming and rural upliftment, Establishing IGP-CARE, a center for air pollution research in Ruri Para, UP, Creating essential oil units, Farmer Producer Organizations, and Gaushalas, Transforming 1,000 acres of barren land into organic food forests through the Van Gram Prakalp initiative. As an educationist, he launched modern-day Gurukuls to nurture youth through a blend of science, ancient wisdom, and moral values. His holistic work also includes animal welfare, renewable energy, and climate resilience. Looking ahead, Dr. Pathak envisions the world's first Water University in Bundelkhand to address global water issues and establish "Pani ki Pathshala" (Water Schools) across India. Dr. Pathak is a beacon of science, service, and spirituality, leaving behind a legacy of hope and transformation.

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APA YOUNG SCIENTIST AWARD 2025

Kirtiraj Gaikwad
IIT Roorkee, India

Dr. Kirtiraj K. Gaikwad is an associate professor and head of the paper and packaging technology department at IIT Roorkee, India. He earned his Ph.D. in packaging from Yonsei University, South Korea, in 2018, and has degrees in packaging and food science from Michigan State University and Dr. Panjabrao Deshmukh Agriculture University, respectively. A fellow of the Linnean Society of London, he previously worked as a postdoctoral fellow at École Polytechnique de Montréal.

Dr. Gaikwad has received multiple awards, including the APA Young Scientist Award and ILSI Young Scientist Award, as well as the Outstanding Young Faculty Award from IIT Roorkee. He has published over 140 papers and holds four patents in his field. He has edited three books on food packaging and leads research projects valued at over 12 million Indian rupees supported by the Government of India.

Currently, he serves as an associate editor for various international journals and teaches graduate and doctoral students in Food Packaging Technology. His research focuses on sustainable active materials and smart packaging, benefiting both society and the environment. He has supervised three Ph.D. students and is guiding twelve more in related areas.

APA YOUNG RESEARCHER AWARD 2025

Dakuri Ramakanth
IIT Roorkee, India

Dr. Dakuri Ramakanth is a polymer and packaging scientist dedicated to the advancement of sustainable and intelligent food packaging systems. His research expertise lies in the integration of polymer nanocomposites, cellulose-based materials, oxygen scavengers, and life cycle assessment, all aimed at promoting green packaging technologies that enhance food safety while reducing plastic waste. Dr. Ramakanth received his Ph.D. in Polymer and Process Engineering from IIT Roorkee in 2024, where he notably developed UV-activated oxygen scavenging systems for active packaging applications. Prior to his doctoral studies, he achieved Gold Medal for his M.Tech. in Packaging Technology at IIT Roorkee in 2018 and also holds a B.Tech. in Chemical Engineering from JNTU Hyderabad, completed in 2014. His professional journey has been enriched by valuable experiences at ALPLA India Pvt. Ltd. and India Pesticides Ltd., and he has further honed his skills through prestigious fellowships at TU Dresden and envoPAP Deutschland. Dr. Ramakanth has contributed significantly to the field with over 30 publications in respected journals and the filing of four patents related to sustainable packaging solutions. With a strong commitment to shaping next-generation packaging technologies, Dr. Ramakanth aspires to make meaningful contributions to the circular economy and address pressing global sustainability challenges.

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Springer Oral Contest

Chairs: Anurag Kulshreshtha, IITR, Saharanpur, India & Susheel Kalia, IMA, Dehradun, India

Nishi Gandha (91)	Indian Institute of Technology, Roorkee
Kuldeep Rajpurohit (120)	Kishinchand Chellaram College, HSNC University, Mumbai
Anumita Dey (147)	University of Calcutta
Kabita Sarkar (170)	Indian Institute of Technology, Delhi
Areeba Khayal (173)	Aligarh Muslim University, Aligarh
Priyanka Dagar (237)	Indian Institute of Technology, Mandi
Ruchika Sharma (382)	Thapar Institute of Engineering and Technology, Patiala
Satyabrata Sahoo (460)	Ravenshaw University Cuttack
Niranjan Chatterjee (465)	Indian Institute of Technology, Mandi

Wiley Oral Contest

Chairs: Sarvendra Rana, UPES, Dehradun, India & Susheel Kalia, IMA, Dehradun, India

Saurav Kumar (130)	Indian Institute of Technology, Mandi
Blesson Tom Mathew (141)	Indian Institute of Technology, Delhi
Jiwanjot Sharma (168)	Thapar Institute of Engineering & Technology, Patiala
Varsha Pai V. (230)	Manipal Centre for Biotherapeutics Research
Jinsu Mariya Sam (240)	Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram
Sumit Suprabhat Behera (243)	Indian Institute of Technology, Mandi
Vaibhav Sanjay Darekar (261)	Malaviya National Institute of Technology, Jaipur
Akash Siotey (417)	Netaji Subhash University of Technology, Delhi
Km Mansi Aditya (419)	Indian Institute of Technology, Jammu

Poster Evaluation Committee

Coordinators: Susheel Kalia, IMA Dehradun, India & Manali Somani, IIP, New Delhi, India

Panelist | Day-1 | 13 Oct, 2025	
Rabab Fatima	UPES, Dehradun, India
Sumit Murab	IIT Mandi, India
Yashveer Singh	IIT Ropar, India
Ankur Goswami	IIT Delhi, India
Pralay Maiti	IIT BHU, India
Anupama Kumar	VNIT, Nagpur, India
Gunjan Sirohi	BCAS, DU, New Delhi
Sarvendra Rana	UPES, Dehradun, India
Bhawana Gupta	UPES, Dehradun, India
Anurag Kulshreshta	IIT, Roorkee, India

Panelist | Day-2 | 14 Oct, 2025	
Prabhat Barolia	MLSU Udaipur, India
Rakesh K. Sharma	MSU, Vadodara, India
M.C Purohit	HNBGU, Srinagar, India
Arpit Sand	MRU, Faridabad, India
Siddharth Sharma	MLSU Udaipur, India
Chetna Ameta	MLSU Udaipur, India
Sikha Agarwal	MLSU Udaipur, India
Dinesh K. Yadav	MLSU Udaipur, India
Ruchi Mishra Tiwari	Symbiosis International, Pune, India
Alka Gupta	CSJM University, Kanpur, Inida

Wisdom Contest

14th Oct. 2025 | Time: 12:00-13:00

On the spot Registration of participants

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Programme

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13-15 October, 2025 | Udaipur, Rajasthan, India

Day-1 | 13th Oct, 2025 | Programme

08:00-onwards | Registration
Inauguration (Main Hall) *Time: 09:00 - 10:15*
Bouquet Presentation/ Lamp Lighting *Time: 09:00-09:05*
Welcome Address **Jyoti Chaudhary** *(Conference Chair, MLSU, Udaipur)* *Time: 09:05-09:10*
Presidential Address **Bhuvanesh Gupta** *(Conference Patron, APA President)* *Time: 09:10-09:15*
APA Address **Anup K. Ghosh** *(Conference Chair, IIP, New Delhi)* *Time: 09:15-09:20*
Theme Address **Sanjay Nayak** *(Conference Chair, Vice Chancellor, Ravenshaw University, Cuttack)* *Time: 09:20-09:25*
Conference Address **Deepak Sharma** *(Guest of Honor, Global Business Head, Gujarat Fluorochemicals Ltd, Noida)* *Time: 09:25-09:35*
Conference Address **Anupam Goel** *(Guest of Honor, General Manager, Survival Technologies Ltd., Mumbai)* *Time: 09:35-09:45*
Inaugural Address **Ram Sharma** *(Chief Guest, Vice Chancellor, UPES, Dehradun)* *Time: 09:45-10:10*
Time: 10:10-10:15 | Memento Presentation
Vote of Thanks **Susheel Kalia** *(Conference Secretary, IMA, Dehradun)* *Time: 10:15-10:20*

Time: 10:20-11:00 | Inaugural Tea

Session 1 | Venue: Main Hall
Plenary Lectures
Chairs: Guenther G. Scherer, *Switzerland &* *Anup K. Ghosh, IIP, New Delhi*
Time: 11:00-11:30 *Insights into Thermostable Cyanurate- and Benzoxazine-Containing Thermosetting Polymers and Composites* **Daniel Grande**, *CNRS, Strasbourg, France*
Time: 11:30-12:00 *Strategic Evolution of Fluoropolymers within the Framework of Global Materials Innovation* **Deepak Sharma**, *Gujarat Fluorochemicals Limited, India*

Session 2 | Venue: Main Hall
Industry Plenary Session
Chairs: Kohzo Ito, Univ. of Tokyo, Tokyo, Japan, & *Manohar V. Badiger, NCL Pune, India*
Time: 12:00-12:30 *TBA* **Sumit Basu,** *IOCL, New Delhi, India*
Time: 12:30-13:00 Innovative Polyolefins for Next-Gen Applications **Alakesh Ghosh**, *HMEL, Noida, India*

13:00-14:00 | Lunch Break

Session 3 : Microsymposium on Herbal Bioengineering

Chairs: Yashveer Singh, IIT Ropar, India &
Padma Venkat, UPES, Dehradun, India

Venue: Main Hall

Time	Lecture	Title/Author
14:00-14:20	IL	Herbal Bioengineering: A Convergence of Ayurveda and Modern Science for Wound Healing and Human Health **Rahul Sherkhane** *Institute of Medical Sciences, Banaras Hindu University, Varanasi, India*
14:20-14:40	IL	Controlled Drug Delivery for Better Healthcare **Pralay Maiti** *Indian Institute of Technology (BHU), Varanasi, India*
14:40-15:00	IL	Plant Bio-actives, Drug Combinations, and Processing for Novel Drug Leads: An Integrated Approach from Tradition to Technology **Binay Sen** *Banaras Hindu University, Varanasi, India*

Session 4 : Microsymposium on Sustainability

Chairs: K. C. Trehan, Adeka Groups, Mumbai, India &
S. M. Tauseef, UPES, Dehradun, India
Venue: Hall-1

Time	Lecture	Title/Author
14:00-14:20	IL	Sugarcane Bagasse Derived Hemicellulose-Clay Nanocomposite Aerogel for Controlled Release of Fertilizer **Deepak Pathania** *Central University of Jammu, Jammu & Kashmir, India*
14:20-14:40	IL	Revolutionizing Food Packaging with Sustainable Polymers: Indian Innovations and Challenges **Kirtiraj K Gaikwad** *Indian Institute of Technology, Roorkee, India*
14:40-15:00	IL	Polyurethane polymers from bio-based building blocks and their multifaceted applications **Rakesh K. Sharma** *The Maharaja Sayajirao University of Baroda, Vadodara, India*

Session 5 : Microsymposium on Bio-based polymers

Chairs: Alakesh Ghosh, HMEL, Noida, India &
D. S. Bag, DMSRDE, Kanpur, India
Venue: Hall-2

Time	Lecture	Title/Author
14:00-14:20	IL	Sustainable Valorization of Textile and Agro-Wastes into functional Cellulosic Materials **Archana Samanta** *Indian Institute of Technology Delhi, New Delhi, India*
14:20-14:40	IL	Orange Waste Valorization to design a sustainable Biomaterial, as Nutraceutical Health Supplement by Molecular Imprinting **Anupama Kumar** *Visvesvaraya National Institute of Technology, Nagpur, India*
14:40-15:00	IL	Cellulosic paper-polymethyl methacrylate device for heavy metal detection **Ashish Kapoor** *Harcourt Butler Technical University, Kanpur, India*

Session 6 : GFL Microsymposium on hydrogen energy

Chairs: Yash Gupta, GFL, Noida, India &
Devesh Avasthi, UPES, Dehradun, India
Venue: Hall-3

Time	Lecture	Title/Author
14:00-14:20	IL	Hydrogen Energy and CSIR: Connecting Deep Science with Technologies **Sreekumar Kurungot** *CSIR-National Chemical Laboratory, Pune, India*
14:20-14:40	IL	Harnessing Fluoropolymers for Advanced Corrosion Mitigation in Industrial Applications **Raxit Rodiya** *Gujarat Fluorochemicals Limited, Vadodara, India*
14:40-15:00	IL	Flexible Devices Beyond Triboelectricity: Combating Charge Artifacts for Antistatic and True Piezoelectric Performance **Tridib Kumar Sinha** *Department of Chemistry, Applied Science Cluster, School of Advanced Engineering, UPES, Dehradun, India*

Session 7 : Biomaterials & Bioengineering

Chairs: Rahul Sherkhane, IIT BHU, India &
Ashish Mathur, UPES, Dehradun, India

Venue: Main Hall

Time	Lecture	Title/Author
15:00-15:20	IL	Biomaterials for tissue regeneration applications **Yashveer Singh** *Indian Institute of Technology, Ropar, India*
15:20-15:40	IL	Mucoadhesive Polymers as In-Situ Gels and 3D Printed Films for Buccal Delivery of Cannabinoids **Ali Seyfoddin** *Auckland University of Technology, Glenbrook, New Zealand*
15:40-16:00	IL	Fabrication of Biosensors for Food toxins and food adulterants **Sumana Gajjala** *National Physical Laboratory, New Delhi, India*
16:00-16:10	OL	Biomaterials Integrated with Phage Therapy and Phytochemicals for Wound Healing Applications **Ruchi Mishra Tiwari** *Symbiosis International (Deemed University), Pune, India*
16:10-16:20	OL	Next Generation 2-Dimensional Materials and Nano-Bio Composites for Biosensing, Food Safety and other Health-Care Applications **Kanchan Yadav** *Department of Materials Engg., Indian Institute of Science, Bengaluru, India*
16:20-16:30	OL	Designing Bioinspired Multicomponent Supramolecular Peptide-Biopolymer Based Composite Scaffold To Recapitulate Differential Cellular Microenvironment **Shambhavi Kashyap** *INST Mohali, Mohali, India*

Session 8 : Polymer Synthesis

Chairs: Anupama Kumar, NIT Nagpur, India &
Himansu Sekhar Nanda, IIITDM, Jabalpur, India

Venue: Hall-1

Time	Lecture	Title/Author
15:00-15:20	IL	Polymerization reactions in the atmosphere **Ravi Kant Pathak** *University of Gothenburg, Sweden*
15:20-15:40	IL	Toward Sustainable Self-Healing Materials: Vitrimer Composite Systems **Sravendra Rana** *UPES, Dehradun, India*
15:40-16:00	IL	Smart Polymeric Systems for Sustainable Delivery and Protection: Advances in Microencapsulation, Hydrogels, and Self-Healing Materials **Vikas Vitthal Gite** *School of Chemical Sciences, KBC North Maharashtra Univ., Jalgaon, India*
16:00-16:10	OL	Radiation and Plasma Assisted Development of Efficient Catalytic Systems for water pollutant remediation **Swarnima Rawat** *Bhabha Atomic Research Centre, Mumbai, India*
16:10-16:20	OL	Condensation Polymerisation of Nylon 66 for flame retardant application **Sundaramoorthy Palanisamy** *Northern India Textile Research Association, Ghaziabad, India*
16:20-16:30	OL	Broad molecular weight HDPE by a two-step slurry polymerization process **Sanket Shah** *Relaince Industries Ltd., Mumbai, India*

Session 9 : Nanomaterials & Nanotechnology

Chairs: R. K. Goyal, MNIT, Jaipur, India &
Rajesh, NPL, New Delhi, India

Venue: Hall-2

Time	Lecture	Title/Author
15:00-15:20	IL	Supersonic solution blowing: a novel method in nonwoven to produce 50 nm fibers en masse **Sumit Sinha Ray** *Indian Institute of Technology Delhi, New Delhi, India*
15:20-15:40	IL	Energy Augmentation of Triboelectric Nanogenerator by Interface Engineering in Polymer and Polymer Composites **Ankur Goswami** *Indian Institute of Technology Delhi, New Delhi, India*
15:40-16:00	IL	Wound Healing Efficacy of a Drug-Free Nanocomposite Hydrogels in Drosophila and Rat Models **Sarat Kumar Swain** *Veer Surendra Sai University of Technology, Sambalpur, India*
16:00-16:10	OL	Fe_3O_4 -Decorated Sulfonated Graphene Oxide Nanocomposites: A Dual-Action System for Dye Degradation and Microbial Inhibition **Himanshu Sharma** *Mohanlal Sukhadia University, Udaipur, India*
16:10-16:20	OL	Development and Characterization of Jackfruit Seed Starch-Based Nanocomposite Films for Sustainable Active Packaging Applications **Rashmi B J** *M. S Ramaiah University of Applied Sciences, Bengaluru, India*

Session 10 : Functional & Smart Materials

Chairs: : Anil K. Sharma, BKT, Mumbai, India &
Kirti Gaikwad, IIT Roorkee, India

Venue: Hall-3

Time	Lecture	Title/Author
15:00-15:20	IL	Smart and Multifunctional Polymers: Bridging Innovation and Application **Dibyendu Sekhar Bag** *Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur, India*
15:20-15:40	IL	Agriwaste-derived biopolymers: A Sustainable and Effective Substrate for Immobilizing Enzymes for Wastewater Remediation **Anupama Sharma** *Panjab University, Chandigarh, India*
15:40-16:00	IL	Closed-loop recyclable crosslinked polymeric materials via dynamic transetherification **Ramkrishna Sarkar** *Indian Institute of Technology, Kanpur, India*
16:00-16:10	OL	Nadimide-substituted phthalonitrile resin (NPRs) and their structure-property evaluation for high temperature applications **Ajit Shankar Singh** *DMSRDE, Kanpur, India*
16:10-16:20	OL	Engineering Smart Actuating Microgels for Stimuli-Triggered Drug Delivery **Divya Dheer** *Chitkara University, Panchkula, India*
16:20-16:30	OL	Agarose hydrogel-based sensing platform for rapid detection of food toxicants **Anjali Awasthi** *HBTU, Kanpur, India*

Session 11 | Tea Break & Poster Session (Venue: Green Lawn)
Time: 16:30-17:30
Coordinators: Susheel Kalia, IMA, Dehradun, India & *Manali Somani, Indian Institute of Packaging, New Delhi, India*

Session 12 | APA Distinguished Plenary (Venue: Main Hall)
Time: 17:30-18:15
Chairs: Daniel Grande, CNRS, Strasbourg, France & Ashwini K. Nangia, UPES, Dehradun, India
Polymers for Hard and Soft Tissue Regeneration and Repair
Jonathan C. Knowles *University College London, London, UK*

18:15-19:00 – Group Photo & Networking

Time: 19:00-22:00
Cultural Programme, APA Award presentation (Main Hall) | Conference Dinner (Green Lawns)

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Day-2 | 14th Oct, 2025 | Programme

08:00-onwards | Registration

Session 13 : Plenary Lectures

Chairs: Jonathan C. Knowles, UCL, London, UK &
Ravi Kant Pathak, Univ. of Gothenburg, Sweden

Venue: Main Hall

Time	Lecture	Title/Author
09:00-09:30	PL	Slide-Ring Materials for Circular Economy **Kohzo Ito** *The University of Tokyo and National Institute for Materials Science, Japan*
09:30-10:00	PL	Wearable e-Textiles for Gait Analysis **Ashwini Agrawal** *Indian Institute of Technology Delhi, New Delhi, India*

10:00-10:30 | Tea Break

Session 14 : Biomaterials & Bioengineering

Chairs: Pralay Maiti, IIT BHU, Varanasi, India &
Ankur Goswami , IIT Delhi, New Delhi, India

Venue: Main Hall

Time	Lecture	Title/Author
10:30-10:50	IL	Pellet Extrusion 3D Printing of Polymer-Ceramic Composites for Cleft Palate Repair: Design, Fabrication, and Preliminary Evaluation **Shiny Velayudhan** *Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, India*
10:50-11:10	IL	Improving Mechanical Performance of Bioactive Chitosanâ€"Hydroxyapatite Membranes Using Functionalized MWCNTs for Guided Bone Regeneration **Himansu Sekhar Nanda** *IIITDM, Jabalpur, India*
11:10-11:30	IL	Smart Molecularly Imprinted Polymers: Next-Generation Recognition Platforms for Biosensing Applications **Ashish Mathur** *UPES, Dehradun, India*
11:30-11:40	OL	Preparation and Characterization of Bacterial Cellulose based Shape Memory Aerogels for Rapid Hemostasis **Ankita Sharma** *Indian Institute of Technology Delhi, New Delhi, India*
11:40-11:50	OL	Melt Electrowriting of PCL-BaTiOâ‚ƒ Scaffolds: Advancing Print Fidelity, Mechanical Performance, and Biofunctionality **Dhrmendra Sablaniya** *IISc, Bangalore, India*
11:50-12:00	OL	V Amylose: An Intestine Targeted Delivery System for Controlled Release of Flufenamic Acid **Rabab Fatima** *UPES, Dehradun, India*

Session 15 : Start-up India Conclave

Chairs: Smita Mohanty, CIPET, Bhubaneswar, India &
Anupam Gupta, SmartBio Innovations Pvt Ltd, New Delhi, India

Venue: Hall-1

Time	Industry Names
10:30-10:40	**Carbonout Technologies**
10:40-10:50	**White Shark Polymers**
10:50-11:00	**Sal Robotics**
11:00-11:10	**SBio Sciences**
11:10-11:20	**Nature Safety Sol. Pvt. Ltd.**
11:20-12:00	**Round Table Discussion**

Session 16 : Advanced Materials

Chairs: Pankaj Kumar, UPES, Dehradun, India &
Drarmesh Varade, Navrachana Univ. Vadodara, India

Venue: Hall-2

Time	Lecture	Title/Author
10:30-10:50	IL	Sustainability and Circularity in Plastics Waste: Assessment, Opportunities and Challenges in Biobased, Biodegradable and Recycled Plastics **Smita Mohanty** *CIPET, Bhubaneswar, India*
10:50-11:10	IL	Fabrication of nanostructured chitosan - based films for food preservation applications: An investigation of graphene stacks on mechanical and barrier properties **Sidhharth Sirohi** *Bhaskaracharya College Of Applied Sciences (Univ. Of Delhi), Delhi, India*
11:10-11:30	IL	Advances in Polymeric Nanocomposite - Based Functional Membranes for Water Purification **Shikha Wadhwa** *UPES, Dehradun, India*
11:30-11:40	OL	Development of CMC-Starch-Based Biodegradable Films for Sustainable Packaging Applications **Manali Somani** *Indian Institute of Packaging, Delhi, India*
11:40-11:50	OL	Dielectric relaxation and electrical conductivity of Magnetic Iron Oxide nanoparticle reinforced silicone elastomer nanocomposites **Abhishek Sharma** *Dr. C.V. Raman University, Bilaspur (C.G.) Bilaspur, India*
11:50-12:00	OL	Efficient Energy Harvesting Using Processed Poly(vinylidene fluoride) Nanogenerator **Anupama Gaur** *Indian Institute of Technology, Patna, India*

Session 17 : Wiley Student Oral Contest

Chairs: Sarvendra Rana, UPES, Dehradun, India &
Susheel Kalia, IMA, Dehradun, India

Venue: Hall-3

Time	Lecture	Title/Author
10:30-10:40	OL	Pro-angiogenic self-assembled peptide gel for wound healing application **Saurav Kumar** *Indian Institute of Technology, Mandi, India*
10:40-10:50	OL	Green Synthesis of Thermoregulating Regenerated Cellulosic Fibers from Textile Waste for Sustainable Polymer Applications **Blesson Tom Mathew** *Indian Institute of Technology Delhi, Delhi, India*
10:50-11:00	OL	Development of Chemically Modified Hollow Nanospheres for Targeted Delivery of Anti-Cancer Agents **Jiwanjot Sharma** *Thapar Institute of Engineering & Technology, Patiala, India*
11:00-11:10	OL	Development of a 3D Neural Tissue Model for In Vitro Brain Aging Studies **Varsha Pai V** *Manipal Centre for Biotherapeutics Research, Manipal, India*
11:10-11:20	OL	Synthesis and Characterization of Zein based Biodegradable radiopaque Microbeads for Trans Arterial Chemoembolization **Jinsu Mariya Sam** *Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, India*
11:20-11:30	OL	4D Bioprinted pH-responsive Hydrogel Scaffold with Tannic Acid and Srâ€" Se Co-doped Bioglass for Targeted Osteosarcoma Treatment **Sumit Suprabhat Behera** *Indian Institute of Technology, Mandi, India*
11:30-11:40	OL	Waste to wealth: Productive use of agricultural waste for microwave absorption and achieving circular economy **Vaibhav Sanjay Darekar** *Malaviya National Institute of Technology Jaipur, Jaipur, India*
11:40-11:50	OL	Development of Chitosan-azo-vanillin Schiff bases for photochromic and antimicrobial applications **Akash Siotey** *Netaji Subhash University of Technology, New Delhi, India*
11:50-12:00	OL	pH-Sensitive Electrospun Fibrous Films for Food Spoilage Monitoring **K. M. Mansi Aditya** *Indian Institute of Technology, Jammu, India*

Wisdom Contest

Time: 12:00-13:00

Coordinators: Ankita Sharma, IIT Delhi , New Delhi, India

13:00 -14:00 | Lunch Break

Session 18 : Biomaterials & Bioengineering

Chairs: Ali Seyfoddin, New Zealand &
Anupama Sharma, Punjab Univ., Chandigarh, India

Venue: Main Hall

Time	Lecture	Title/Author
14:00-14:20	IL	Self-assembled Hydroxyapatite Nano-spicule Coating on 3D Printed PLA Scaffolds with Bactericidal Activity for Bone Regeneration **Sumit Murab** *Indian Institute of Technology, Mandi, India*
14:20-14:40	IL	Synthesis and Characterisation of Kaolin integrated Gellan gum based composite sponge **Ashika Suresh** *Sree Chitra Tirunal Institute for Medical Science and Tech, Trivandrum, India*
14:40-15:00	IL	Development of in vitro Tissue Engineered Model for Giant Cell Tumour of Long Bones **Amit Kumar Jaiswal** *Vellore Institute of Technology Vellore, Vellore, India*
15:00-15:10	OL	Formulation and Evaluation of electrospun Antimicrobial Scaffolds for biomedical applications **Aditya Ramchandra Nemade** *MS Ramaiah University of Applied Sciences, Bengaluru, India*
15:10-15:20	OL	Kaempferia galanga herbal supplementation alleviates hyperglycemia-induced dyslipidemia, oxidative stress, and apoptosis in BALB/c diabetic mice **Flavius Phranagsngi Nonglang** *North Eastern Hill University, Shillong, India*
15:20-15:30	OL	Synthesis of binary films Chitosan/Starch using glutaric acid and its Characterization **Virpal Singh** *M.J.P Rohilkhand university Bareilly, India*
15:30-15:40	OL	Multiwell hydrogel for in vitro 3D cancer model fidelity **Rajesh Vasita** *Central University of Gujarat, Vadodara, India*

Session 19 : Nanomaterials & Nanotechnology

Chairs: Rakesh Kumar, CUSB, Gaya, India &
Deepak Pathania, Central Univ., Jammu, India

Venue: Hall-1

Time	Lecture	Title/Author
14:00-14:20	IL	Effect of Rice Husk Ash particles on Mechanical Properties and Microwave Absorption of Glass Fiber Reinforced Epoxy Hybrids **Rajendra Kumar Goyal** *MNIT, Jaipur, India*
14:20-14:40	IL	Clay Based Nanocomposite Hydrogels Containing Metal Nanoparticles **Dharmesh Varade** *Navrachana University, Vadodara, India*
14:40-15:00	IL	Liquid crystal Based Dielectric Nucleic acid Biosensor for Label-Free Detection of Neisseria gonorrhoeae **Rajesh** *CSIR-National Physical Laboratory, New Delhi, India*

15:00-15:10	OL	Eco-Friendly Synthesis of Alâ,,Oâ,ƒ/CeOâ,,-Biochar Nanocomposites for Efficient Water Purification: Targeting PbÂ²â º and Pharmaceutical Pollutant **Arush Sharma** *Baddi University of Emerging Sciences and Technology (BUEST), Solan, India*
15:10-15:20	OL	Green synthesized AgNPs embellished on crumpled surface of thiazole modified g-C3N4: A heterocatalyst for the photodegradation of pharmaceutical effluent Itraconazole **Ajay Kumar** *School of Basic and Applied Sciences, Maharaja Agrasen University, Himachal Pradesh, India*
15:20-15:30	OL	RSC: Integrating Chemical Sciences Community and Beyond **Aayushi Arora** *Royal Society of Chemistry, India*
15:30-15:40	OL	Technical Development of boron doped carbon dots/ reduced graphene oxide solution gated field effect transistor for the detection of tumor marker **Arun Kant Singh** *CSIR-National Physical Laboratory, New Delhi, India*

Session 20 : Advanced Materials

Chairs: Sumit Sinha Ray, IIT Delhi, New Delhi, India &
Tridib K. Sinha, UPES, Dehradun, India

Venue: Hall-2

Time	Lecture	Title/Author
14:00-14:20	IL	Toward Sustainable Quaternary Hydrogels: Multithiol-Lignin Crosslinkers and Green Quaternization Approaches **Kalpana Chauhan** *Central University of Haryana, Mahendergarh, Mahendergarh, India*
14:20-14:40	IL	Electroactive polymer and carbon materials for bipolar/wireless actuation **Bhavana Gupta** *UPES, Dehradun, India*
14:40-15:00	IL	Synthesis & Application of the Azo-based Metallopolymers as Novel Electrocatalysts for Hydrogen Evolution Reaction **Anasuya Bandyopadhyay** *Indian Institute of Technology, Roorkee, India*
15:00-15:10	OL	Concentration Dependant Porosity of Torlon Membranes Obtained by Phase Inversion Method for Gas Separation Applications **Kingshuk Kundu** *DEBEL-DRDO, Bangalore, India*
15:10-15:20	OL	Molecular Insights into Polymer Membranes and Non-Stoichiometric Electrolytes **Anurag Prakash Sunda** *J. C. Bose University of Science and Technology, YMCA, Faridabad, India*
15:20-15:30	OL	Enhancing the surface integrity of additively manufactured Nickel-based alloy using novel polymer based viscoelastic abrasive finishing process **Shanmuka Srinivas M.** *Indian Institute of Technology, Tirupati, India*
15:30-15:40	OL	Keratin nanofibers scaffold as a potential candidate for tissue engineering application **Keshaw Ram Aadil** *Govt. Digvijay Autonomous PG COllege Rajnandgaon, Chhattisgarh, India*

Session 21 : Springer Student Oral Contest

Chairs: Anurag Kulshreshtha, IITR, Saharanpur, India & Susheel Kalia, IMA, Dehradun, India

Venue: Hall-3

Time	Lecture	Title/Author
14:00-14:10	OL	Turning Agricultural Waste into Microplastic Adsorbents: A Path Toward Sustainable Water Purification **Nishi Gandha** *Indian Institute of Technology, Roorkee, India*
14:10-14:20	OL	Hydrogel Fabrication by Eco-Friendly Sono-Polymerization of Acrylamide with Dual-Function 2-Acrylamido-2-methyl-1-propane sulfonic acid **Kuldeep Rajpurohit** *Kishinchand Chellaram College, HSNC University, Mumbai, India*
14:20-14:30	OL	Assessment of bioengineered polyherbal formulation against Rheumatoid Arthritis â€" Traditional concept in a modern approach **Anumita Dey** *University of Calcutta, Kolkata, India*
14:30-14:40	OL	Development of Angiogenic and Osteoinductive Multivesicular Liposomes Loaded Bioink for Bone Regeneration **Priyanka Dagar** *Indian Institute of Technology, Mandi, India*
14:40-14:50	OL	Synthesis and Characterization of Disulfide-Containing Poly(urethane-urea) for Self-Healing Applications **Kabita Sarkar** *Indian Institute of Technology Delhi, New Delhi, India*
14:50-15:00	OL	Tuning of electromagnetic interference shielding properties by oxidant variation in polyaniline **Ruchika Sharma** *Thapar Institute of Engineering and Technology, Patiala, India*
15:00-15:10	OL	Smartly passivated Nanocarbon-Enforced Poly(N-isopropylacrylamide) Hydrogel for Effective Healing of Damaged Skeletal Muscle **Niranjan Chatterjee** *Indian Institute of Technology, Kanpur, India*
15:10-15:20	OL	Multifunctional Hydrogels: Pioneering Soft, Conductive Materials for Wearable Electronics **Areeba Khayal** *Aligarh Muslim University, Aligarh, India*
15:20-15:30	OL	Electrospun nanofiber derived from X-ray film functionalized with ZnO nanoparticle and crystalline nano cellulose: converting biomedical waste into high performance antibacterial membrane **Satyabrata Sahoo** *Ravenshaw University, Cuttack, India*

Session 22

15:30-17:30 | Poster Presentation & Tea

Coordinators: Chetna Verma, IIT Delhi, New Delhi, India & Manali Somani, Indian Institute of Packaging, New Delhi, India

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Session 23 : Advanced Materials

Chairs: Nitin Kumar, MLSU, Udaipur, India &
Siddharth Sirohi, BCAS, Dwarka, New Delhi, India

Venue: Main Hall

Time	Lecture	Title/Author
09:00-09:20	IL	Isolation and characterization of dyes molecules from the plant parts, procedure optimization and up gradation of the traditional system of natural dyeing using the natural and metallic mordant's - A sustainable and green approach **Mahesh Chandra Purohit** *H.N.B. Garhwal Central University, BGR Campus, Pauri, India*
09:20-09:40	IL	Metal Ion Cross-Linked Mechanically Robust and Stretchable Polymer Hydrogels for Strain sensing and Flexible Energy Storage Devices **Rajat Kumar Das** *Indian Institute of Technology, Kharagpur, India*
09:40-09:50	OL	Development of High-Performance Thermally Conductive Epoxy Adhesives Using Conducting Polymers and CNTs **Prakash Chandra** *Bundelkhand University, Jhansi, India*
09:50-10:00	OL	Study of Polyaniline Embedded Transition Metal Substituted Strontium Titanate for Energy Applications **Tithi Sen** *Defence Materials and Stores Research and Development Establishment (DMSRDE), DRDO, Kanpur, India*
10:00-10:10	OL	Cellulose acetate, a source from discarded cigarette butts for the development of mixed matrix loose nanofiltration membranes for selective separation **Moucham Borpatra Gohain** *CSIR-North East Institute of Science and Technology, Jorhat, Jorhat, India*
10:10-10:20	OL	Sustainable Packaging via Electrospun Films Functionalized with Nitrogen-Doped Carbon Dots **Ankit Tyagi** *Indian Institute of Technology, Jammu, India*

Session 24 : Bioactive Materials

Chairs: Shikha Agarwal, MLSU, Udaipur, India &
Amit Kumar Jaiswal, VIT, Vellore, India

Venue: Hall-1

Time	Lecture	Title/Author
09:00-09:20	IL	Multifunctional Chitosanâ€"Azo Schiff Bases with Photoresponsive and Antimicrobial Properties **Swapnil Laxman Sonawane** *Netaji Subhas University of Technology (NSUT), New Delhi, India*
09:20-09:40	IL	Advancement in Environmental and Health Monitoring: Customization of Organic-Doped Polyethyleneimines for Improved Durability and Performance **Nilanjan Dey** *Birla Institute of Technology and Science Pilani, Hyderabad, India*
09:40-09:50	OL	Synthesis of Isoxazole-isoxazoline Derivatives of Eugenol as Potential Inhibitors of VEGFR2 **Poonam Khandelwal** *Mohanlal Sukhadia University, Udaipur, India*
09:50-10:00	OL	Halloysite nanoclay incorporated gelatin electrospun fibre for bio-separations: synthesis, characterization and biological studies **Ashwini Wali** *MS Ramaiah Institute of Technology, Bangalore, India*
10:00-10:10	OL	Analogs of 6-Arylvinyl-1,2,4-trioxanes as potential antimalarial leads **Dinesh Kumar Yadav** *Mohanlal Sukhadia University, Udaipur, India*
10:10-10:20	OL	Synthesis, Characterization and Evaluation of Biological Activities of Azines based Schiff Bases and their Sn(II) Complexes **Kiran Meena** *Mohanlal Sukhadia University, Udaipur, India*

Session 25 : Sustainable Materials

Chairs: Saurabh Singh, MLVG, Bhilwara, India &
Shikha Wadhwa, UPES, Dehradun, India

Venue: Hall-2

Time	Lecture	Title/Author
09:00-09:20	IL	Hydrogel-filled synthetic polymer membranes for water, energy and healthcare applications **Ashok Kumar Pandey** *Principal Sci-Advisor and Chairman R&D cell, HSNC Univ., Mumbai, India*
09:20-09:40	IL	Role of Plant-Based Polymers in Sustainable and Eco-Conscious Smart Packaging **Dakuri Ramakanth** *Indian institute of Technology, Roorkee, India*
09:40-09:50	OL	Xerophytic to Bioplastic: Development and Characterization of Bioplastic from Opuntia ficus pulp **Bhagyashri S. Watve** *Walchand College of Engineering, Sangli, India*
09:50-10:00	OL	Transforming Lignin into Polymer Film with Improved Physicochemical Properties via Itaconic Acid Modification and Polycaprolactone Grafting **Ajit Singh** *CSIR-NEIST, Jorhat, India*

10:00-10:10	OL	Self-powered Supramolecular Micropumps for On-chip Sensing **Debabrata Patra** *Institute of Nano Science and Technology, Mohali, India*
10:10-10:20	OL	Flame retardant PP bio composites filled with ATH and reinforced with surface modified sisal fiber (SF): Investigation of the mechanical, thermal, morphological and flammability properties of thermoplastic polymer PP/ATH bio-composites **Malaya Ranjan Parida** *CIPET:SARP-LARPM, Bhubaneswar, India*

Session 26 : Smart Materials

Chairs: Sumit Murab, IIT Mandi, India &
Vikas V. Gite, NMU, Jalgaon, India

Venue: Hall-3

Time	Lecture	Title/Author
09:00-09:20	IL	Exploring Processing Parameters for the Preparation of Polyaniline Incorporated Soy Protein Isolate Film **Rakesh Kumar** *Central University of South Bihar, Gaya, India*
09:20-09:40	IL	Synthesis and Study of Conjugated Polymers via a Green Indophenine Polymerization Strategy **Arunkumar Patel** *The Maharaja Sayajirao University of Baroda, Vadodara, India*
09:40-09:50	OL	Strength and Load-Bearing Studies of Diamond Reinforced Zinc Composite Coatings for Heat Sink Applications: Approaches from Experiments and Genetic Algorithm-Particle Swarm Optimization **Ashish Goyal** *Manipal University Jaipur, Jaipur, India*
09:50-10:00	OL	Catalytic Synthesis of Quinoxalines Using THS and their In Silico Biological Activity Against Î±-Amylase and Î±-Glucosidase **Lokesh Kumar Agarwal** *Mohanlal Sukhadia University, Udaipur, India*
10:00-10:10	OL	Self-healing Behaviour of Sodium Ionomer/Styrene-Isoprene-Styrene Blend Materials by Ballistic Test **Shilpi Tiwari** *DMSRDE, Kanpur, India*

10:20 -10:40 | Tea Break

Session 27 : Green Chemistry

Chairs: Dinesh K. Yadav, MLSU, India &
Mahesh Chandra Purohit, H.N.B.G.C.U., Pauri, India

Venue: Hall-1

Time	Lecture	Title/Author
10:40-11:00	IL	Biodegradable Polymer Nanocomposites for Self-Powered Smart Systems: A Sustainable Leap in Energy Harvesting and Biomechanical Sensing **Kalappa Prashantha** *Adichunchanagiri University, B. G. Nagar, India*
11:00-11:10	OL	Biogenic Zinc Oxide Nanoparticles from Moringa oleifera: A Promising Green Antibacterial Strategy **Giriraj Tailor** *Mewar University, Gangrar, Chittorgarh, India*
11:10-11:20	OL	Optimizing Sustainable Nanomaterials: The Transformative Role of AI and ML in Green Nanotechnology **Avinash Marwal** *Mohanlal Sukhadia University, Udaipur, India*
11:20-11:30	OL	Green synthesis of metallic nanoparticles using plant extract **Laxmi Narain Jatolia** *S. D. Govt. College, Beawar Raj. Beawar (Raj.), India*
11:30-11:40	OL	Biogenic Synthesis of Nano Fertilizers and Their Foliar Studies on Legume Crops Production **Saurabh Singh** *M.L.V. Government College, Bhilwara, India*
11:40-11:50	OL	Graphitic Carbon Nitride Based Materials and Their Applications in Organic Synthesis **Shikha Agarwal** *Mohanlal Sukhadia University, Udaipur, India*
11:50-12:00	OL	Anti-inflammatory and analgesic activity of ethanolic extract and different fractions of Eulophia nuda Lindl **Neetu Kumari** *Mohanlal Sukhadia University, Udaipur, India*

Session 28 : Advanced Materials

Chairs: Kalpana Chauhan, CUH, Mahendragarh, India &
Rakesh K. Sharma, MSU, Vadodara, India

Venue: Hall-2

Time	Lecture	Title/Author
10:40-11:00	IL	Sustainable Waste Management via Recycled Cigarette Butts for Advanced Tactile Sensors: Electro Spun PVDF (Poly Vinylidene Fluoride)/Cellulose Acetate/MWCNT (Multi Walled Carbon Nanotubes) Nanofiber Composites **Alka Gupta** *CSJM University, Kanpur, India*
11:00-11:10	OL	Development and Characterization of a Green Superabsorbent Polymer Based on Diatomaceous Earth **Arpit Sand** *Manav Rachna University, Faridabad, India*
11:10-11:20	OL	Development of fire-resistant Safe sSBR Based Green Compounds utilizing LPCA and HPCA **Nitin Kumar** *Mohanlal Sukhadia University, Udaipur, India*
11:20-11:30	OL	Environmentally Benign Polymers as Effective Corrosion Mitigators **Ambrish Singh** *Nagaland University, Lumami, India*

11:30-11:40	OL	Understanding chemical composition of hydrogel additives on Portland cement chemistry **Sabrina Afzal Shaikh** *Kishinchand Chellaram College, HSNC University, Mumbai, India*
11:40-11:50	OL	Preparation and Properties of Carbon Fiber-Reinforced Epoxy-Aluminum alloy laminates **M. Balasubramanian** *Indian Institute of Technology Madras, Chennai, India*
11:50-12:00	OL	Synthesis of ZnMnâ‚‚Oâ‚„ Nanofleets via Surface Modification Using Citric Acid and Polyvinyl Alcohol: Enhanced Photocatalytic, Photoelectrochemical, and Antimicrobial Performance under Visible Light Irradiation **Karthiga Rajendaran** *Madurai Kamaraj University, Madurai, India*

Session 29 : Miscellaneous Applications

Chairs: Chetna Ameta, MLSU, Udaipur, India &
P. K. Baroliya, MLSU, Udaipur, India

Venue: Hall-3

Time	Lecture	Title/Author
10:40-11:00	IL	Physiochemical and antimicrobial properties of chitosan/gelatin/Ag@TiO2 nanocomposites for food packaging applications **Santosh Kumar** *Harcourt Butler Technical University, Kanpur, India*
11:00-11:10	OL	Electrochemical Decarboxylative Ketone Synthesis from NHPI Esters and Vinyl Azides **Bhawana Jat** *Mohanlal Sukhadia University, Udaipur, India*
11:10-11:20	OL	Effective Research Publication in Wiley Polymer Portfolio and the Usage of Artificial Intelligence **Anurag Mukherjee** *Wiley, APAC, India*
11:20-11:30	OL	Study of curing kinetics of hydrazide -substitute phthalonitrile (HYZ-PN) resin through model-based and model-Free kinetic methods **Jeetendra Kumar** *Banshiwal, DMSRDE, Kanpur, India*
11:30-11:40	OL	Service Life Estimation of Weathered 3D-Printed Stereolithography Photocured Resin Parts **Raghu Raja Pandiyan Kuppusamy** *National Institute of Technology, Warangal, India*
11:40-11:50	OL	Electrochemical Post-Ugi Cyclization Enabled by In-cell Generated Hypervalent Iodine(III) Intermediates for the Synthesis of Imidazolidin-4-one and Oxazolidin-4-one **Dinesh Suwalka** *Mohanlal Sukhadia University, Udaipur, India*
11:50-12:00	OL	Comparative Analysis of Biochar Derived from Coconut Shell and Rice Husk for Soil Amendment and Carbon Sequestration **Ashish Sharma** *S. N. K. P. Govt.College, Jaipur, India*

12:00-13:00 | Valedictory Session (Main Hall)
Time: 12:00-12:05
Welcome Address
Manohar V. Badiger, *Organising Chair*
Time: 12:05-12:10
Conference Address
Jyoti Chaudhary, Conference Chair
Time: 12:10-12:15
APA Address
Bhuvanesh Gupta, *Conference Patron*
Time: 12:15-12:20
Theme Address
Anup K. Ghosh, *Conference Chair*
Time: 12:20-12:25
Special Address
Sanjay K Nayak,*Conference Chair*
Chief Guest Address
Mukul Jain, *(VP-Works), JK Tyre & Industries Ltd., Kankroli*
Award ceremony
Vote of Thanks
Sushil Kalia, *Organising Secretary*

13:00 -14:00 | Lunch

14:00 | CONFERENCE ENDS

Plenary Talks

Wearable e-Textiles for Gait Analysis

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SMITA Research Lab, A COE in Smart Textiles, Department of Textile and Fibre Engineering, Indian Institute of Technology Delhi, Hauz Khas, New Delhi-110016, India
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Abstract

Gait Analysis is used to diagnose, treat and monitor various orthopaedic, neurological and physical health issues. Traditional Gait labs, while precise, are unable to capture real-world movement patterns due to spatial constraints (limited walking space of 2–2.5 m or use of a treadmill which tends to alter the walking pattern of an individual). This hinders its ability to simulate natural walking patterns. Further, this equipment is expensive and bulky and can only be made available to patients in a tertiary hospital setting, and therefore, is not accessible to the population at large. In this study, we have developed wearable textile-based sensors which are able to address such critical issues in variety of medical diagnostic tools with ease. We have used these sensors along with wire-less communication device to develop wearable smart socks, which offer a portable, precise solution for continuous, real-world Gait analysis.

The wearable smart socks have the potential to transform Gait assessment for patients with neurological and musculoskeletal disorders such as ataxia, stroke, Parkinson's disease, movement disorders, and orthopedic problems. The easy availability of Gait analysis at the doorsteps of a clinician in an OPD setting is likely to improve assessment and treatment protocol of a patient and help in achieving better treatment outcomes of these patients in Tier 1, 2, 3, and 4 level cities. This conforms to the national goal of healthcare for all.

Slide-Ring Materials for Circular Economy

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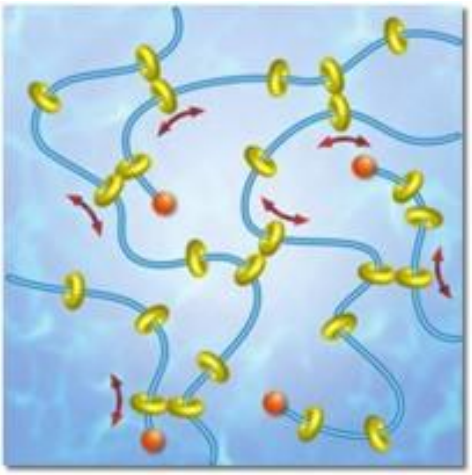
Abstract

We have developed a novel type of polymeric materials such as slide-ring (SR) materials and pseudo-polyrotaxane (PPR) nanosheet with cyclodextrins (CyDs) for sustainable engineering. In the SR materials, polymer chains are topologically interlocked by figure-of-eight cross-links.1) Hence, these cross-links can pass along the polymer chains freely to equalize the tension of the threading polymer chains similarly to pulleys. Recently, we have just reported the stretch induced crystallization of the SR gel, which leads to extremely high toughness and recoverability.2) The concept of the slide-ring gel is not limited to cross-linked gels but also includes elastomer3), resins4), and composites5). Accordingly, it can be applied to wide area such as paints, rubbers, soft actuator, batteries, and so on.6.7) The slide-ring materials were used as a key technology to create tough and sustainable polymers for circular economy.



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Insights into Thermostable Cyanurate- and Benzoxazine-Containing Thermosetting Polymers and Composites

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Abstract

Thermostable polymer matrices are widely used in aerospace industry and microelectronics. Among them, thermosetting Benzoxazines (BOAs) and Cyanate Ester Resins (CERs) expand the high-temperature operation regime, thus constituting the most promising materials.

It is well known that the benzoxazine ring is stable at low temperature, but a ring opening reaction occurs at high temperature, and novolac type oligomers having both phenolic hydroxyl group and tertiary amine group are produced. Polybenzoxazines (PBZs), a new type of phenolic resin that releases no volatiles during curing reaction and needs no catalysts is thus developed. Benzoxazine monomers exhibit many other attractive properties, such as low melt viscosity. In addition, the polymer is characterized by low volumetric shrinkage upon polymerization, low moisture absorption, excellent chemical resistance, flame retardancy, electrical properties, thermal stability, mechanical properties; and very rich molecular design flexibility [1]. On the other hand, CERs differ from others by a very regular structure of the resulting polymer networks, namely polycyanurates (PCNs), obtained by their polycyclotrimerization. They have received much attention because of their unique combination of physical properties, including high thermal stability (> 400oC), high glass transition temperature (> 270oC), high fire-, radiation and chemical resistance, low water absorption and low outgassing, high adhesion to different substrates, and excellent dielectric properties (ε = 2.6−3.1) [2,3]. As a result, CERs are currently used as structural or functional materials in aeronautics, printed circuit boards or adhesives.

In this lecture, we address the copolymerization of CERs and BOAs by FTIR and DSC in order to get an insight into the structure and properties of resulting hybrid thermosets based on PCNs and PBZs. Novel POSS-containing nanocomposites derived from such hybrid thermosets are developed. Insights into several pore generation approaches to (nano)porous PCN systems are also given [4].

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Polymers for Hard and Soft Tissue Regeneration and Repair

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Abstract

Polymeric materials have contributed to healthcare advances and continue to improve patient lives. There are still areas where innovations in polymers (both new polymeric system and processing polymers in innovative ways) can lead to improved recovery. This talk will cover some areas we have worked on and will highlight the varied polymeric systems as well as the differing tissues and clinical problems we have tried to address.

This presentation will cover three areas we have worked on. The first is for peripheral central nerve regeneration. This will describe the innovative methods we have used to process degradable polymers to give unique architecture suitable for neural regeneration (1). This work has given rise to a first, second and third generation series of implant, currently undergoing phase I clinical trials

The second area has been the development of new and innovative resins that are light curable and degradable. These have been developed for 3D printing (2, 3) and have been shown to have excellent printability as well as good biocompatibility both in vitro and in vivo.

The third area is the utilization of polyhydroxyalkanoates (PHA's) for the development of patches for the treatment of oral lichen planus, which occurs in the mucosal tissues of the mouth. The clinical requirements in this application are demanding but we have utilized their intrinsic adhesive properties which we have also further improved as well as being able to process into highly flexible patches for drug delivery (4).

In summary hopefully this presentation will highlight the very varied ways polymers continue to be modified and utilized to reduces clinical costs and bring more rapid resolution to the clinical problems.

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Strategic Evolution of Fluoropolymers within the Framework of Global Materials Innovation

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Abstract

The polymer industry stands at a pivotal juncture where performance, sustainability, and innovation intersect to address the complex demands of next-generation technologies. Fluoropolymers, as high-performance materials, are increasingly central to critical sectors including clean energy, semiconductors, mobility, and medical applications.

This plenary session will explore the strategic evolution of fluoropolymers within the broader framework of global materials innovation, with a special emphasis on India's rapidly strengthening position in the global value chain. The talk will examine three key transitions—strategic, structural, and sustainable that are redefining how the industry must respond to evolving technological, regulatory, and environmental imperatives.

Drawing from GFL's journey as one of the world's leading fluoropolymer manufacturers, the talk will also offer insights into how Indian industry can forge stronger links between R&D, application development, and customer co-creation. Finally, it will address how academia, policymakers, and industry can collaborate to shape a talent-rich, innovation-first ecosystem capable of delivering global impact through polymers for advanced technology.

Invited Talks

Development of in vitro Tissue Engineered Model for Giant Cell Tumour of Long Bones

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Abstract

Giant cell tumor of bone (GCTB) is a benign tumor, occurs in the most productive age group (20-40 years), and has a relatively high recurrence rate with metastases occurring in 1% to 9% of patients. It leads to pain, difficulty in walking and doing physical activities and impart a risk of fracture in that area. GCTB is characterized by the presence of several reactive nuclei which can be observed microscopically. GCTB is more common in India and China accounting to 4% of all bone tumors and 10% of all malignant bone tumors, and hence it is very critical to develop better drugs and treatment regimens. This study aims to develop in vitro tissue engineered models of GCTB, which is advantageous in mimicking the tumor microenvironment. Three-dimensional (3D) scaffold containing natural polymers and hydroxyapatite (HAp), was fabricated. Schiff base method was employed to synthesize HAp, where Schiff base is employed as a template to react calcium and phosphate precursors yielding nano-rod like morphology like HAp found in human bone. The scaffold was fabricated by freeze-drying method and tested for its chemical, biological and mechanical properties as its use in vitro model. Primary cell cultures obtained from GCTB patients were digested and cultured in two-dimensional (2D) dishes and 3D culture with the fabricated scaffolds to obtain in vitro model. The presence of multinucleated cells in 2D and 3D GCTB culture was characterized by confocal microscopy with fluorescent stains, and immunofluorescence for biomarkers. The efficiency of in vitro model was investigated thoroughly before and after the drug exposure by ELISA, histology, immunohistology and PCR. This in vitro GCTB model will serve as a proof-of-concept that tissue engineered construct can be used obtain a 3D tissue-engineered GCTB model with a tumour population and microenvironment like the diseased tissue.

Keywords: Tumour model, In vitro, Bone tissue engineering, Hydroxyapatite, Carboxymethyl cellulose, Collagen, Freeze-drying, Scaffold, Giant cell tumour of bone.

Smart Polymeric Nano/Microgels for Good Health and Zero Hunger

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Abstract

Microgels are aqueous, three dimensionally crosslinked polymeric networks. Microgels belong to a special class of colloids that exhibit various attractive features including adjustable size and size distribution, chemical functionality, surface charge, and swelling degree.[1] Additionally, ease of post-modification, their large surface area, flexibility and softness, superior colloidal stability and stimuli responsive behaviour (sensitivity to T, pH, ionic strength) enable them as a versatile platform for diverse interdisciplinary applications.[1,2] In our laboratory, various synthetic strategies are employed to develop multifunctional polymers and colloidal particles with controlled chemical structure and morphology. The key objective of our research is to design smart biodegradable materials including nano/microgels and to harness their potential for societal benefit keeping sustainable development as a central point.[2]

In general, the presentation would encompass a few contemporary themes in the domain of biodegradable stimuli responsive nano/microgels for controlled release.[2,3,4] In keeping with the latest developments in multidisciplinary research, we have been trying to tap the potential of smart nano/microgels for sustainable agriculture and cancer therapy.[2,3] An overview of how multifunctional nano/microgels, built on intuitively chosen molecular/macromolecular building blocks, could be exploited for controlled release under complex conditions as a way to develop smart sustainable carriers of fertilizers or drugs will be presented.[4,5] The capability of such nano/microgels to perform multiple tasks, in terms of value addition even after their degradation, will also be discussed.[6]

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Orange waste valorization to design a sustainable biomaterial as nutraceutical health supplement by Molecular Imprinting

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Abstract

Nagpur, Maharashtra's third-largest city, is famous for its high-quality Mandarins, earning it the title "orange city." India produces about 7.8 million tons of citrus waste annually. This waste, rich in polyphenolic antioxidants, can be sustainably repurposed for plant-based nutraceuticals, benefiting both the environment and sustainable health practices. Hesperetin, a citrus-derived flavonoid, offers antioxidant and anti-inflammatory benefits. Recent studies highlight its therapeutic potential for heart disease, vascular issues, and metabolic disorders like diabetes. Despite the hopeful therapeutic outcomes of Hst, its poor aqueous solubility, and bioavailability have limited its oral delivery. In the present study, the molecular imprinting technique was used to develop a Hesperetin-loaded nutraceutical health supplement from citrus waste pomace.

Here, Molecularly Imprinted Polymer (MIP) were synthesized using a dummy template strategy with hesperetin (Hst) as a template molecule (to check loading potential with hesperidin as well), Chitosan as a functional monomer, and Calcium Chloride and STPP as crosslinkers, zinc acetate dihydrate as an additional supplement. Similarly, a control polymer, NIP (non-imprinted polymer), was synthesized without a template molecule for comparative studies. The successful synthesis of both Hst-MIP and NIP was confirmed using FTIR, XRD, and SEM analysis techniques, along with their parent compounds. The optimal conditions for maximum hesperetin uptake using Hst-MIP/NIP were determined as follows: 30 mg adsorbent dose, 120 minutes equilibrium time, pH 5, and 200 ppm analyte concentration. The higher adsorption efficiency of Hst-MIP compared to NIP is likely due to the imprinting effect of hesperetin, a structural analog of hesperidin. This observation was further validated through various adsorption and kinetic models. The adsorption data closely aligned with the Langmuir isotherm model, confirming monolayer adsorption of hesperidin on Hst-MIP/NIP surfaces. Similarly, kinetic studies indicated that the synthesized Hst-MIPs/NIPs follow a pseudo-second-order kinetics model for the effective adsorption of hesperetin from OPW. Our biomaterial was subjected to further investigation for in vitro activity, and in vivo hypoglycemic activity on STZ-induced diabetic rats. Both the results demonstrated that Hst-MIP has potent antihyperglycemic activity. In conclusion, Hst-MIP could be regarded as a hopeful oral delivery system with enhanced antidiabetic activity.

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Sustainable Valorization of Textile and Agro-Wastes into functional Cellulosic Materials

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Abstract

The increasing accumulation of textile and agricultural wastes presents both environmental challenges and opportunities for resource recovery through sustainable material innovation. This work explores the valorization of such lignocellulosic wastes into high-performance cellulosic materials. Cellulose is extracted using eco-friendly methods from diverse waste sources and transformed into multifunctional products. High-strength cellulosic fibers are developed with tailored mechanical and functional properties suitable for textiles and structural composites. Optically responsive cellulose films are fabricated for use in smart coatings and sensing applications. Additionally, biodegradable cellulose-based packaging materials are engineered, offering sustainable alternatives to conventional plastics with excellent barrier and mechanical properties. Porous cellulose membranes are produced for water purification, demonstrating selective filtration and antimicrobial activity. Furthermore, the inherent electrochemical properties of cellulose are harnessed to create bio-based electrodes and separators for supercapacitors, ensuring high ionic conductivity, thermal stability, and environmental compatibility. Collectively, these innovations contribute to a circular bioeconomy by converting waste into value-added, biodegradable products. This holistic approach not only reduces environmental burdens but also promotes the development of next-generation sustainable materials for applications spanning textiles, electronics, environmental remediation, and packaging.

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Supersonic solution blowing: a novel method in nonwoven to produce 50 nm fibers en masse

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Abstract

Polymer nanofibers have immense potential in several fields like textiles [1], wound dressing [2], tissue engineering [3], drug delivery [4], and filtration [5], especially because of their high surface area, high porosity and small pore sizes. Over the years, electrospinning [6] has gained immense popularity for the production of nanofibers in micron to sub-micron size range. However, electrospinning cannot produce nanofibers in the ~50 nm range on demand. Such small-scale nanofibers hold great promises in different applications like bio-separation, energy storage, batteries, capacitors, electronic media etc. In this work a novel methodology in nonwoven practices is introduced to produce ultrafine 50 nm nanofibers in mass scale. The method is called supersonic solution blowing, a combination of electrospinning and supersonic gas blowing, where polymer jets undergo a vigorous stretching at the rate of the order of 1010 s-1 in this process, confining polymer macromolecules to a constricting 1D morphology. The capability of this method was demonstrated using Nylon 6 where nanofibers of mean diameter 53.3 nm for 15 wt% solution and 42.8 nm for 12.5 wt% solution were produced [7]. A new crystalline phase of Nylon 6 was also discovered in [7], namely the □-phase, which is at least an order of magnitude stiffer than other phases. Such a phase was discovered with d-spacing of 0.156 nm, much smaller than the α and □-phases. Experimental and theoretical study conducted by the authors shows such ultrafine nanofibers' immense potential as a filtration membrane to catch most penetrating particles of 100-300 nm size in a convection water medium [5]. Such nanofibers intercept 100-300 nm particles either in windward or in leeward direction. Not only Nylon 6, polymers like PVA and PEO, which have greater significance in biological and sensor applications were also used to fabricate ultrafine nanofibers, where mean diameter of 47.8 nm for former and 44.7 nm for latter was measured [refer to Fig. 2]. Such nanofibers hold the key for enhanced wound dressing and drug delivery applications for their highly porous and aligned structure. Piezoelectric polymer like PVDF was fabricated into ultrafine nanofiber of 50.3 nm, opening a Pandora's box for several applications involving energy harvesting, filtration, adsorption etc.

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Exploring Processing Parameters for the Preparation of Polyaniline Incorporated Soy Protein Isolate Film

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Abstract

Bioplastics with conducting properties can be explored for its use in the production of sensors, batteries, capacitors and other devices in addition to the intelligent packaging. These types of bioplastics can be produced by incorporation of conducting polymers which are a class of organic polymers along with the property of electrical conductivity. One such conducting polymer is polyaniline (PANI) which comes with unique properties such as efficient electrical conductivity, light weight, better stability etc. In this research work, PANI incorporated soy protein isolate (SPI) films were prepared by solution casting method with PANI concentration ranging from 0-2.5% w/w and plasticizer (glycerol) concentration ranging from 30-50% w/w. Intact PANI incorporated SPI films were prepared with plasticizer concentration 50% w/w of 7% SPI unlike at 30% and 40% plasticizer. Structural characterization of PANI-incorporated SPI films was done by FTIR and UV-Vis spectroscopy. The increasing trend in UV barrier properties was observed for PANI incorporated SPI films with increasing concentration of PANI, whereas in the visible region, the transparency was decreasing with increasing PANI concentration. PANI incorporated SPI films were characterized for mechanical properties and water uptake. The tensile strength of 1% PANI incorporated SPI film was 1.67 MPa as compared to neat SPI film showing tensile strength of 0.831 MPa. The water uptake properties of PANI incorporated SPI films showed a descending trend from 80 % (for neat SPI film) to 45% (for 2.5% PANI in SPI).

Wound Healing Efficacy of a Drug-Free Nanocomposite Hydrogels in Drosophila and Rat Models

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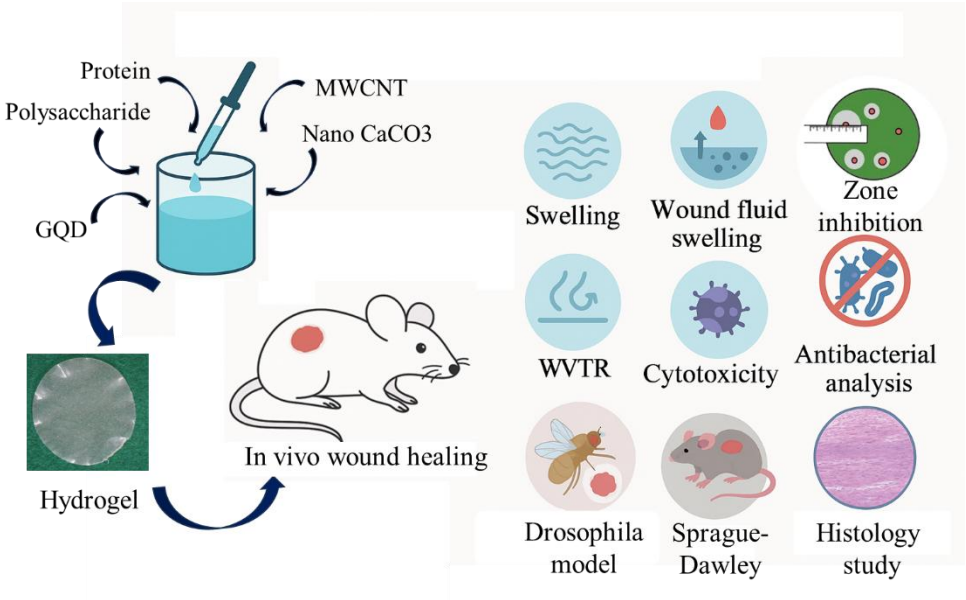
Abstract

Delayed wound healing and fibrotic responses continue to pose significant obstacles in effective wound management, highlighting the urgent need for innovative therapeutic materials. In this study, we developed a nanocomposite hydrogel composed of polysaccharides and proteins, reinforced with functionalized nanoparticles, aimed at enhancing the wound healing process. The engineered hydrogel demonstrates a strong synergistic antibacterial effect, particularly against Gram-negative bacteria. Its porous architecture enhances swelling capacity and optimizes water vapor transmission rate (WVTR), creating a favourable environment for tissue regeneration. Biocompatibility evaluations confirm that the hydrogel is non-toxic to living cells. In vivo experiments in Drosophila melanogaster and Sprague Dawley rat excision wound models show complete wound closure, confirming its therapeutic potential. These findings highlight the hydrogel's promise as a next-generation wound dressing, combining advances in nanotechnology and biomaterials to improve clinical outcomes in wound care.

Keywords: Wound healing; GQD; Protein; Cytotoxicity: Drosophila; Rat.



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Clay Based Nanocomposite Hydrogels Containing Metal Nanoparticles

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Abstract

Monometallic and bimetallic nanocrystals (NCs) are currently used in many areas of nanoscience and technology. Numerous studies have been reported on the design of these nanomaterials with different sizes, shapes, and compositions. Here, we report the synthesis, structure, and properties of a novel gel-based nanostructured mono- and bimetallic material, Metal-NC gel, consisting of NCs strongly immobilized within a unique polymer-clay network. The combination of fine NCs and mechanically tough NC gel may open up new possibilities for designing functional nanocomposite materials.1

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Smart Molecularly Imprinted Polymers: Next-Generation Recognition Platforms for Biosensing Applications

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Abstract

Molecularly Imprinted Polymers (MIPs) have emerged as a powerful class of synthetic receptors with biomimetic recognition capabilities, offering exceptional selectivity, stability, and cost-effectiveness compared to traditional biological sensing elements. This talk presents recent advances in the design and application of MIPs for high-performance biosensors targeting medical diagnostics, environmental monitoring, and food safety.

We will highlight molecular imprinting strategies—from bulk and surface imprinting to novel techniques like nanoimprinting and electro polymerization—tailored for detecting small molecules, proteins, pathogens, and biomarkers. Emphasis will be placed on transduction mechanisms including electrochemical, optical, and piezoelectric approaches, with real-world examples such as MIP-based sensors for cancer biomarkers, viral antigens, and endocrine disruptors.

Particular focus will be given to nanostructured MIP composites, including hybrid materials combining MIPs with graphene, quantum dots, or magnetic nanoparticles, which significantly enhance sensitivity and real-time detection capabilities. We will also discuss challenges and future perspectives in achieving regulatory-grade reproducibility, miniaturization, and integration into wearable or point-of-care diagnostic platforms.

The presentation aims to demonstrate how the rational design of MIP-based biosensors is not only advancing molecular diagnostics but also contributing toward sustainable, low-cost sensing solutions in the broader context of healthcare and environmental stewardship.

Keywords: Molecularly Imprinted Polymers (MIPs), Smart Polymers, Biomimetic Sensors, Environmental Monitoring.

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Pellet Extrusion 3D Printing of Polymer-Ceramic Composites for Cleft Palate Repair: Design, Fabrication, and Preliminary Evaluation

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Abstract

Cleft palate, a common congenital craniofacial defect, poses significant clinical challenges due to the complexity of tissue reconstruction and the need for precise anatomical restoration. Traditional grafting methods are constrained by issues such as donor site morbidity, graft resorption, and limited conformability to irregular defect geometries. To address these limitations, this study explores the development of a 3D printed, self-expandable polymer-ceramic composite scaffold using pellet extrusion-based additive manufacturing for cleft palate repair.

A biodegradable polymer matrix was combined with bioactive ceramic fillers to create a composite with enhanced osteoconductivity and mechanical strength. The formulation was tailored for pellet-based extrusion printing, enabling the direct fabrication of patient-specific implants with high material throughput and tunable architecture. The scaffold design incorporated a porous, interconnected network to promote tissue ingrowth and was engineered to undergo self-expansion upon hydration, allowing for better conformity to the defect site and reducing the need for fixation.

Mechanical characterization revealed compressive strength and modulus values within the optimal range for craniofacial applications, while degradation studies indicated predictable resorption profiles over clinically relevant timeframes. In vitro biocompatibility assessments confirmed that the composite supports cell viability, proliferation, and early osteogenic differentiation of pre-osteoblasts. Microstructural analysis showed uniform pore distribution and consistent print quality.

In conclusion, pellet extrusion 3D printing of a polymer-ceramic composite scaffold offers a promising, scalable approach for cleft palate repair. The bioactive construct effectively addresses the anatomical and biological challenges associated with palatal reconstruction. Future work will focus on long-term in vivo evaluations and process optimization for regulatory translation and clinical deployment.

Cellulosic paper-polymethyl methacrylate device for heavy metal detection

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Abstract

Heavy metal pollution in water sources poses a significant threat to human health and the environment. Nickel, in particular, is a potentially toxic metal often found in industrial effluents, with prolonged exposure linked to severe health issues such as organ damage and allergic reactions. Portable, onsite detection systems are essential for rapid and timely monitoring of such pollutants, especially in remote or resource-limited areas where conventional laboratory testing is not feasible. In this work, we develop a hybrid cellulosic paper-polymethyl methacrylate (PMMA) device for the colorimetric detection of heavy metals in water, demonstrated here for nickel ions. The device integrates a porous cellulosic paper substrate with a rigid PMMA support, combining capillary-driven fluid flow with mechanical durability and structural integrity. Nickel, if present in the fluid sample, reacts with a colorimetric reagent immobilized on the paper surface to produce a visible color change, which forms the basis for qualitative and quantitative analysis. Detection parameters are optimized to ensure sensitive determination of the heavy metal in aqueous samples. Quantitative analysis is performed using smartphone-based imaging and digital colorimetry, enabling accurate concentration determination without the need for laboratory instrumentation. The device is simple to use, low-cost, and involves solvent-free assembly, making it suitable for real-time environmental monitoring. This study highlights a promising approach for the sustainable, field-deployable detection of heavy metals in water using polymer-integrated paper-based platforms.*Keywords: Molecularly Imprinted Polymers (MIPs), Smart Polymers, Biomimetic Sensors, Environmental Monitoring.*

Biomaterials for tissue regeneration applications

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Abstract

Biomaterials owing to their excellent ability to interact with the biological system and biocompatibility are used for various biomedical applications, like drug delivery and tissue engineering. Hydrogels and self-assembled peptide gels have outstanding water-holding and extracellular matrix (ECM)-mimicking potential that helps in promoting cell adhesion and cell proliferation. Our group's major focus is on the development of hydrogels/ gels/ nanomaterials for wound healing and bone tissue regeneration applications. We have successfully developed anti-inflammatory drug-conjugated peptide gels with excellent antibacterial and anti-biofilm potential against S. aureus1. The gels showed anti-inflammatory and wound healing ability. We also developed acemannan-coated, cobalt-doped biphasic calcium phosphate nanoparticles to promote osteogenesis and modulate macrophage polarization to provide a pro-healing microenvironment for bone regeneration2. Our current work involves the development of melatonin-functionalized bioactive self-assembled peptide gels for antibacterial and wound healing applications and gallic acid-functionalized, MgO nanoparticle-loaded hydrogels with antioxidant and anti-inflammatory ability to suppress inflammation and promote bone regeneration in rheumatoid arthritis affected joints. The nanoparticle-loaded hydrogels also exhibit apoptotic ability against fibroblast-like synoviocytes to aid alleviation of rheumatoid arthritis. The biomaterials developed have excellent potential for tissue engineering applications. *Keywords: Molecularly Imprinted Polymers (MIPs), Smart Polymers, Biomimetic Sensors, Environmental Monitoring*.

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Isolation and characterization of dyes molecules from the plant parts, procedure optimization and up gradation of the traditional system of natural dyeing using the natural and metallic mordant's – A sustainable and green approach

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Abstract

The current study deals with the selection of some chemically unexplored dye yielding plants of Uttarakhand and extraction of natural dyes in different solvents including aqueous extract. Dye molecules were isolated from plant extract, purified and characterised by modern spectroscopic technique viz UV-Visible, FT-IR, Mass and 1HNMR and 13CNMR. The aqueous extract was used for dyeing of wool and cotton samples. Fairly good to excellent qualities of shades/colours were obtained using natural mordants. The optimization was carried out for the different variables: concentration of dye material, time for extraction of dye, dyeing time, concentration of mordants and methods of mordanting. Out of the three methods of mordanting, the best shades for dye were obtained using pre-mordanting with ferrous sulphate and potassium dichromate and post-mordanting with copper sulphate and stannous chloride. The colour fastness tests indicated that all samples change in colour on exposure to light. The light coloured samples were affected more rapidly as compared to the dark ones. The Tung leaf dyed samples exhibited fairly good to good fastness to light and the results of washing fastness tests showed that dyed samples had good to excellent fastness to washing.

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Hydrogel-filled synthetic polymer membranes for water, energy and healthcare applications

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Abstract

Synthetic polymer membranes are advancing beyond conventional filtration roles to enable multifunctional solutions in water treatment, energy systems, and healthcare. A key innovation in this space is pore-filled membranes, which combine the mechanical strength of microporous hosts with the functional versatility of guest components such as hydrogels, polyelectrolytes, and nanoparticles. These hybrid membranes allow precise tuning of transport, selectivity, and reactivity properties for a wide range of applications. Pore-filling is typically achieved through (i) in situ polymerization of monomers with crosslinkers or (ii) in situ crosslinking of preformed polymers. The former generally results in higher pore-filling efficiency, enhancing functional group distribution and interaction with target species. Nanoparticles, such as metal oxides, carbon nanomaterials, or noble metals, can be embedded within the hydrogel matrix to further boost performance. These nanoparticles impart additional functionalities, including antimicrobial action, catalytic activity, enhanced adsorption, or improved charge transport. For example, membranes developed for low-pressure nanofiltration demonstrate efficient water softening due to embedded ion-exchange groups. In nuclear waste remediation, high-capacity anion-exchange membranes filled with functional polymers and nanoparticles facilitate selective nitric acid recovery, utilizing Donnan exclusion and Grotthuss proton hopping for high transport efficiency. Hydrophobic fixed-site membranes with tethered carriers and nanoparticles are used in facilitated transport without feed-receiver mixing. We have synthesized a range of functional membranes via in situ UV-initiated polymerization of functionalized monomers and nanoparticle-hydrogel composites within microfiltration supports. Applications include alpha-radionuclide scintillating sensors, metal-adsorptive membranes, and egg-shell mimicking catalytic membranes hosting noble metal nanoparticles for redox transformations. This talk will discuss how the rational design of hydrogel-nanoparticle filled membranes offers powerful platforms for next-generation.

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Metal Ion Cross-Linked Mechanically Robust and Stretchable Polymer Hydrogels for Strain sensing and Flexible Energy Storage Devices

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Abstract

Polymer hydrogel-based electronic materials often suffer from issues such as low mechanical strength and lack of reversibility during repeated load-bearing applications, which can affect their durability and efficiency. Ionically conducting hydrogels also swell under water, limiting their applications for underwater monitoring of human limb movement, or for soft robotics application underwater. Moreover, the water in the hydrogel freezes at sub-zero temperature, limiting its application in flexible electronic devices at low temperature. Additionally, ability of the hydrogel to efficiently adhere to different substrates is a highly desired property as that would facilitate the integration of the hydrogel during device fabrication. Our group has employed different strategies centred around metal ion-ligand cross-linking to address these issues. We have reported PVA based mechanically strong but highly stretchable composite hydrogels,1 Ca2+-dicarboxylate in situ metal ion-ligand cross-links to access freeze-resistant, adhesive and anti-drying self-healable hydrogel materials,2 employing the strategy of anisotropic orientation and hydrophobic association to obtain anti-swelling hydrogels for underwater motion sensing3,4 etc. Application of these hydrogel materials in flexible energy storage device like supercapacitor has also been demonstrated. In this talk, some of these the design strategies and applications of these ionically conducting tough hydrogels in flexible electronic applications will be discussed.

Keywords: Stretchable, Resistive sensing, Flexible electronics, Adhesive, Anti-freezing.

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Fabrication of nanostructured chitosan based films for food preservation applications: An investigation of graphene stacks on mechanical and barrier properties

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Abstract

Adopting bio-based materials for food packaging as a sustainable alternative to conventional plastics reduces adverse environmental impact, enhance food preservation, and encourage the use of renewable resources in the packaging industry.

The bio-based chitosan/ graphene nanocomposites offer optimum properties which harmonize with modern technological advancements. Herein, nanocomposite films consisting of chitosan (CS) and different concentrations of graphene nanoplatelet (GNP) were fabricated using solvent casting technique. The obtained films were characterized by FT-IR spectroscopy, which revealed that the interaction of amine groups of chitosan with the carboxylic groups of GNPs. XRD analysis showed significant improvement in the crystallinity of nanocomposite film with the GNP concentrations. Furthermore, adding GNP enhanced the mechanical properties (tensile strength and elongation at break) considerably of the fabricated films. The 0.6% GNP-containing nanocomposite film showed notable ($p < 0.05$) decrease in oxygen permeability and water vapour transmission rate by ~ 73% and ~ 60%, respectively. The film with 0.6% GNP concentration exhibited remarkable antibacterial behaviour against Escherichia coli (Gram-negative) bacteria compared to Cellulosimicrobium aquatile (Gram-positive) bacteria. Additionally, the radical scavenging activity, as measured by the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay, increased ($p < 0.05$) with the concentrations of GNP. Moreover, the optimized nanocomposite film (0.6% GNP) effectively prolonged the shelf life of high-moisture green chilies with a promising biodegradability rate (12 days), showcasing its potential as sustainable packaging alternative compared to traditional plastics for food preservation.

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2. *S. Moalla, I. Ammar, M. L. Fauconnier, S. Danthine, C. Blecker, S. Besbes, & H. Attia, 2021, Int. J. Biol. Macromol., 183, 254-266.*

Smart Polymeric Systems for Sustainable Delivery and Protection: Advances in Microencapsulation, Hydrogels, and Self-Healing Materials

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Abstract

Recent advancements in polymer science have enabled the development of multifunctional delivery systems tailored for enhanced performance in agriculture, food, healthcare, pesticides, and protective coatings. This work presents an integrated approach involving biopolymer-based microencapsulation, stimuli-responsive hydrogels, and self-healing coatings designed to offer controlled release, environmental responsiveness, and extended material life cycles. In agricultural formulations, microencapsulation techniques have been employed to enclose herbicides and pesticides within polymeric shells fabricated from renewable resources. These microcapsules, prepared through in situ and interfacial polymerization, (Prepared resorcinol based phenol formaldehyde microcapsules and novel polyurea microcapsules for tailor release of pendimethalin) exhibit high encapsulation efficiency and controlled active release triggered by pH or environmental conditions. Such systems reduce volatilization and degradation losses while ensuring targeted action with minimal environmental burden.

Hydrogel matrices derived from natural polymers, including guar gum, sodium alginate, and modified polysaccharides, have been engineered to encapsulate bio-actives and micronutrients. These hydrogels respond to external stimuli such as pH, ionic strength, and moisture levels, enabling the slow and sustained release of curcumin, fertilizers, or essential trace elements. Their swelling capacity and water retention properties also make them ideal for soil conditioning and drug delivery applications.

In the domain of surface protection, self-healing coating technologies have been realized by embedding healing agents such as linseed or cardanol oils within polymeric microcapsules dispersed in polyurethane networks. Upon mechanical damage, the rupture of these capsules leads to the release of the healing agent, which undergoes polymerization or film formation, effectively repairing the damaged area and restoring protective functionality.

Together, these polymeric systems demonstrate the potential to bridge the gap between sustainability and functionality by enabling precision delivery, reduced material loss, and self-repairing behavior. Their adaptability across diverse fields highlights their significance as next-generation solutions for improving efficiency and longevity in real-world applications.

Keywords: Controlled Release, Microencapsulation, Hydrogels, Self-Healing Coatings, Natural Polymers, Agrochemical Delivery, Drug Carriers, Smart Coatings.

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Fabrication of Biosensors for Food Toxins and Food Adulternat detection

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Abstract

For the management and prevention of many chronic and acute diseases, the rapid quantification of toxicity in food and feed products have become a significant concern. Technology advancements in the area of biosensors, bioelectronics, miniaturization techniques, and microfluidics have shown a significant impact than conventional methods which have given a boost to improve the sensing performance towards food analyte detection. Efforts have been made to fabricate biosensors using various nanomaterials and transduction techniques for achieving higher detection range, limit of detection, shelf-life of the biosensor by integrating nanomaterials for AFB 1 detection using electrical and optical transduction mechanism. The advanced developments for the sensor development at CSIR-NPL will be discussed in detail in the conference.

Liquid crystal Based Dielectric Nucleic acid Biosensor for Label-Free Detection of Neisseria gonorrhoeae

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Abstract

A liquid crystal dielectric nucleic acid biosensor was developed for the detection of Neisseria gonorrhoeae, a sexually transmitted pathogen. The LC-dielectric sensing platform was fabricated by biomolecular immobilization of N. gonorrhoeae specific DNA probe sequence on pre-treated liquid crystal cell for the detection of genomic DNA of N. gonorrhoeae using low frequency dielectric transduction mechanism. The detection mechanism is based on the dielectric spectroscopic analysis at 100 Hz revealing a significant increase in dielectric permittivity, attributed to the accumulation of DNA hybridization complexes at LC-solid interface in the LC cell. The LC-dielectric biosensor demonstrated a linear dielectric response over a wide range 1 pM to 100 nM genomic DNA of N. gonorrhoeae with a low detection limit down up to 0.1 pM with a sensitivity (ε') of 9.3 per decade of DNAN.g concentration. The Dielectric sensing performance of LC biosensor was compared with the optical transduction observed under polarized optical microscopy (POM) and LOD was found to be two orders lower than optical LOD (10 pM). Specificity studies were performed on potential interferents non N. gonorrhoeae Neisseria species such as Neisseria sicca, Neisseria mucosa, Neisseria meningitides and other bacterial species like Escherichia coli, Pseudomonas aeruginosa, and Staphylococcus aureus. The observation of insignificant dielectric response with the potential interferents demonstrated the good selectivity of LC biosensor for N. gonorrhoeae. The Comparatively higher sensitivity of dielectric transduction over the optical transduction indicates the suitability of LC dielectric biosensor as a promising tool for the rapid and sensitive detection of N. gonorrhoeae that may contribute to improved diagnostic capabilities and infection management.

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Polyurethane polymers from bio-based building blocks and their multifaceted applications

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Abstract

Polyurethanes (PUs) are the only class of polymers that display thermoplastic, elastomeric, and thermoset behavior depending on their chemical and morphological makeup. PUs are incredibly adaptable materials and offer varied applications in the form of adhesives, coatings, and foams. But there is the constant need to develop sustainable PUs using "green" components and feasible processes, as mostly polyols generated from petrochemicals and hazardous isocyanates are used as the building blocks for the synthesis of PU in general. Therefore, to overcome environmental issues, bio-based resources like vegetable oils (VOs) and lignin-based compounds have been researched well for the development of bio-based PUs. Non-edible vegetable oils (NEVOs) are natural liquids, easily available, renewable, high in heat content, low in sulfur-based aromatic content, and therefore largely applied as polyols for the development of bio-based PUs. Not only that, many processes that involved hazardous solvents and catalysts for the synthesis of PUs are to be replaced with an eco-friendly approach to the execution of the development of PU materials.

The present presentation highlights the various NEVOs, such as castor oil (CO) and mahua oil (MO), as bio-based building blocks for preparation of PUs, waterborne PUs, and PU foams. Various techniques like ATR-FTIR, NMR, XPS, SEM, TEM, DSC, TGA, and so on are discussed systematically to characterize the structural, thermal, mechanical, and chemical properties of developed PUs. The synthesized bio-based PUs will be discussed for their prospective applications in antimicrobial activity, packaging, and eco-friendly coatings, highlighting their potential for sustainable material development.

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Self-assembled Hydroxyapatite Nano-spicule Coating on 3D Printed PLA Scaffolds with Bactericidal Activity for Bone Regeneration

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Abstract

Critical-sized bone defects, often resulting from trauma or disease, impact a significant portion of the global population. The currently available treatments include bone grafting and prosthetic implantation. However, these methods have downsides like an immunological response, post-operative problems, stress shielding, and anatomic mismatch. Large bone defects are associated with an increased risk of infection and delayed healing. 3D-printed scaffolds with antibacterial and osteoinductive properties can be used for treating implant-associated infections. 3D printing offers the fabrication of patient-specific, geometrically complex, and porous scaffolds directly from clinical images. Thermoplastic polymers such as PCL and PLA are biocompatible, bioresorbable, and cost-effective with bone-mimetic mechanical strength. Due to their hydrophobicity and low surface energy, these scaffolds do not provide biological activity and don't initiate functional bone regeneration. The objective of the study is to develop a bone-mimetic coating that promotes bone growth and inhibits bacterial infection. The study involves a bone-mimetic surface coating on 3D-printed PLA scaffolds which includes the synthesis of hydroxyapatite (HA) nano spicules through a hydrothermal treatment (HT) method on surface-activated scaffolds. Particularly, alkali-treated (AT) scaffolds were dipped in the solution of CaCl2, and NaH2PO4 and treated hydrothermally for 12 hours at 95 °C. Digital images indicated that the AT scaffolds were completely covered with a layer of hydroxyapatite. SEM analysis showed ~5µm long needle-shaped self-assembled HA crystals with floral patterns (~1 mm in thickness). AT-PLA had a Ca/P ratio of 1.7 similar to bioapatite (1.6) whereas PLA had a ratio of 2.3. ATR-FTIR showed absorbance at 3570 cm-1 due to OH- ion and CO3-2 peak at 1573 cm-1 in all the test groups after HT. Amorphous PLA crystallized after HT and two sharp peaks appeared at 16.86° and 19.24° in all the groups. The intensity of PLA peaks decreased as the HA coating increased. Additionally, sharp HA characteristic peaks appeared at 32° (121) and 32.4° (300) in AT-PLA whereas no sharp peak in PLA. These studies confirmed that surface treatment of PLA scaffolds improved nano-HA coating, which can improve their osteogenic properties. Alkali treatment and hydrothermal methods showed no effect on the compressive modulus of PLA scaffolds. A significantly higher number of bacterial cells were observed on PLA scaffolds, maintaining their original structure. In contrast, HA-coated PLA scaffolds exhibited distorted cell morphology and a markedly reduced bacterial population. The in vitro cellular studies indicated that MG-63 cells exhibited significantly enhanced adhesion, proliferation, and mineral deposition when cultured on hydroxyapatite (HA)-coated scaffolds compared to PLA and AT-PLA. The current technique can be utilized for making osteogenic and antibacterial HA coatings on 3D printed thermoplastic scaffolds, also enhancing their surface for cellular adhesion and osteointegration. The same can also be used to enhance the above said properties of commercially available bone and dental metallic implants, especially in the case of stainless-steel implants that are widely used in developing countries but have limited osteointegrative properties. The low-temperature hydrothermal treatment successfully deposited a well-integrated, crystallized HA coating, enhancing cell adhesion, proliferation, osteogenic potential, and exhibiting antibacterial properties. Future work will focus on in vivo studies in mice models with calvarial bone defects to assess the long-term efficacy and safety of these HA-coated PLA scaffolds.

Synthesis And Characterisation Of Kaolin Integrated Gellan Gum Based Hemostatic Sponge

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Abstract

The demand for products which can induce rapid hemostasis is growing, particularly in surgeries to prevent the excess blood loss and reduce operation time. The use of natural polymers for the development of hemostatic materials hold a substantial promise due to their biocompatible and biodegradable nature. The development of composite hemostatic sponge prepared via incorporation of active agents like fibrin, thrombin and clay particles (e.g. kaolin), which can activate coagulation cascade will provide excellent hemostatic properties.

The present study aims to develop a composite hemostat sponge based on kaolin integrated gellan gum (GGK). The gellan gum matrix was prepared by ionic crosslinking using aluminum ammonium sulfate. Further kaolin powder was added to the cross linked gellan gum and integrated well into the polymer network.

Different weight ratios of gellan gum and kaolin were used (say 1:0.5, 1:1, 1:2) for the preparation of these composite sponges and labeled as GGK 1:0.5, GGK 1:1 and GGK 1:2. The Raman mapping confirmed the uniform distribution of kaolin throughout the sponge. The infrared spectra showed specific peaks for kaolin around 3685 cm−1, 3600 cm−1, 910 cm−1, 750 cm−1 and 530 cm−1. The average compressive strength obtained was 41.24 KPa for GGK 1:2, 15.72 KPa for GGK 1:1, 26.72 KPa for GGK 1:0.5. While in the wet state, GGK showed a compressive strength of ~ 2.63, 3.01, 4.74 and 1.01 KPa for GG1:2, GGK 1:1, GGK 1:0.5 and GGK 0 respectively. The data also showed that the swelling capacity decreased with increasing kaolin content in the composite sponge. More interestingly, GGK 1:1 showed a Partial Thromboplastin Time (PTT value) of 92.5 ± 59.7 s only. The lower PTT value compared to the control confirmed its ability to interact with intrinsic pathways of blood clotting and exhibit better hemostatic properties.

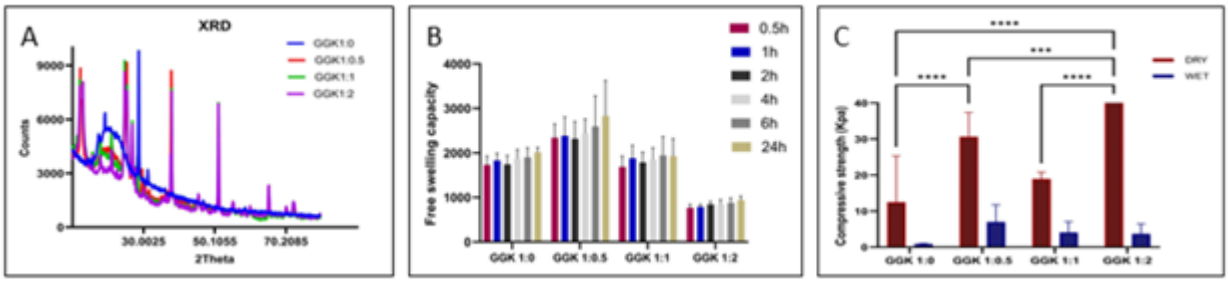

Figure1: A) XRD spectra B) Free swelling capacity C) Compressive strength of composite hemostat sponges

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Sustainable Waste Management via Recycled Cigarette Butts for Advanced Tactile Sensors: Electro Spun PVDF (Poly Vinylidene Fluoride)/Cellulose Acetate/MWCNT (Multi Walled Carbon Nanotubes) Nanofiber Composites

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Abstract

The pressing issue of waste management necessitates innovative solutions to mitigate environmental degradation. This study explores the potential of transforming recycled materials into valuable resources promoting to circular economy and reducing waste disposal's ecological footprint. The scientific community is becoming more interested in piezoelectric polymers in search of ways to enhance flexible piezoelectric polymer sensors as a result of the current demands for effective, self-powered and environmentally friendly, devices. Due to its high sensitivity, wide working range, and exceptional flexibility, the flexible sensor has grabbed a lot of interest. It can be affixed to human skin, integrated into apparel, or mounted on electronic skin. Due to its high sensitivity, wide working range, and exceptional flexibility, the flexible sensor has attained a lot of interest. PVDF is one of the most researched polymers for the creation of wearable sensors and nanogenerators due to its ease of fabrication into thin, pliable films and comparatively low cost. PVDF's electroactive polar phases, (β phase), are unique in their piezoelectric qualities, which in turn affect its sensing and energy harvesting capabilities. This can be possible through the usage of nanofillers structures and innovative and novel electrospinning technique. In the present study, a novel piezoelectric nanofiber composite was developed using recycled cellulose acetate (CA) from cigarette butts, PVDF, and Multi-Walled Carbon Nanotubes (MWCNTs) for advanced tactile sensing applications. Cigarette butts were washed, dried, and dissolved in acetone to isolate and purify cellulose acetate. PVDF, CA, and MWCNTs were dissolved in Di Methyl Formamide (DMF) and Acetone at various concentrations and ratios to create a homogeneous solution. Optimized electrospinning parameters were applied to fabricate uniform nanofibers with diameters ranging from ~200-400 nm. These Nanofiber composites are characterized via Field Emission Scanning Electron Microscopy (FESEM), confirmed bead-free nanofibers, while Energy Dispersive X-ray (EDX) and Fourier Transform Infrared Spectroscopy (FTIR) validated elemental composition. X-ray diffraction (XRD) analysis revealed enhanced β-phase formation in PVDF, leading to superior piezoelectric performance. Mechanical testing demonstrated the nanofibers' excellent tensile strength and flexibility, making them ideal for wearable electronics, motion detection, and pressure sensing. This study highlights an innovative approach to recycling cigarette butts and incorporating MWCNTs for sustainable, high-performance tactile sensing materials, promoting environmental sustainability and the circular economy.

Keywords: Cellulose, PVDF, Sensor, MWCNT.

Role of Plant-Based Polymers in Sustainable and Eco-Conscious Smart Packaging

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Abstract

Smart packaging has become a promising new area in food packaging in response to customer demands for sustainable and safe food as well as growing environmental concerns. While traditional packaging consumes an extensive amount of non-renewable resources, which frequently results in pollution and environmental damage, plant-based packaging adopts a more comprehensive strategy. The transition to plant-based substitutes represents a break from the "take, make, dispose" linear model and a move toward a circular economy that places an emphasis on natural resources' capacity for regeneration. This packaging technique creates a sustainable loop where waste is reduced and resources are continuously replenished by using materials obtained from plants. Here, we explore the synergistic function of plant-based sustainable materials and examine how smart, biodegradable packaging solutions are created. Plant-based materials such as Natural rubber, cellulose nanocrystals (CNCs), starch, pectin, bioplastics, natural gums, and mycelium offer renewable, compostable solutions with excellent film-forming and barrier capabilities. In addition to lessening their negative effects on the environment, these biopolymers operate as carriers for clever features like oxygen scavengers, high barriers, and anticounterfeiting. We will focus on a number of new developments that combine both materials and technologies to create eco-functional hybrid systems, such as plant-derived UV-activated oxygen scavenging films. Natural rubber and polymyrcene1 are promising plant-based materials with huge potential for scavenging oxygen available in the headspace of the package, ultimately improving the shelf life extension of food products2,3. Waste valorization is another key aspect in promoting sustainability and circularity. Hence, chemically tailored cellulose nanocrystal-based invisible inks made from agricultural waste. The potential to use these materials as anticounterfeiting agents is examined via screen printing and spray coating4. In continuation, spoilage indicators were made by doping cellulosic materials with carbon dots derived from agricultural waste5. In addition to supporting the circular economy and zero-waste goals, this multidisciplinary approach promotes the creation of safe, intelligent, and sustainable packaging for the future.

Keywords: Smart packaging; Cellulose; Sustainability; Oxygen scavengers; natural materials.

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Energy Augmentation of Triboelectric Nanogenerator by Interface Engineering in Polymer and Polymer Composites

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Abstract

Despite knowing for millenniums triboelectricity has not gain attention till the last decade until Pro. Z.L. Wang has showed first triboelectric nanogenerator in 20121. Although the method has huge potential to generate very high voltage as have been demonstrated Van de Graaff generator in early twentieth century it has not got traction till people investigated to enhance the process of charge transfer with the function of time, in other word current, which is the basis of driving any devices along with voltage. Despite many combinations of materials polymer and polymer composites became a usual choice of triboelectric nanogenerator (TENG) over the decades and have been found to be great choice for wearable devices for energy harvesting and self powered IoT based sensors. In this I would like to focus on how polymers(such as PAN, PDMS, PVDF, Nylon, lignin, fluropolymer-CYTOP)2-5 and their composites (MWCNT, MAX phase as filler) of different triboelectric series (a series which assist to generate type of charges depending on the combination of materials) processed in different conditions (mostly solution casting and electrospun) affect the charge generation and transfer process, in other words the entire triboelectric process as a whole by using in house developed horizontal triboelectric set up6. I will also touch upon certain figure of merits of triboelectric charge generations of various devices which in turn gives a sense of the potential output performance depending on the various combination of device architecture.

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Toward Sustainable Quaternary Hydrogels: Multithiol-Lignin Crosslinkers and Green Quaternization Approaches

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Abstract

Biopolymer-based hydrogels are emerging as sustainable alternatives for environmental and biomedical applications, however, their broader adoption remains constrained by poor mechanical robustness, batch-to-batch variability, and scalability challenges. In this study, we present a versatile, two-step, gram-scale protocol that overcomes these barriers by integrating abundant thiol functionalities into the lignin backbone, followed by UV initiated thiol-ene "click" reactions to introduce high-affinity functional groups (-CO_2H, -$N(CH_3)_3^+$, and others). Comprehensive structural and morphological characterization via SEM, FTIR, and 1H /13C-NMR confirms uniform network formation and quantitative functionalization. Surface wettability (contact angle) and particle size analysis demonstrate precise tunability of hydrophilic/hydrophobic balance across the hydrogel matrix. This scalable and reproducible platform enables the fabrication of mechanically robust quaternary hydrogels suitable for applications in ion-exchange systems, antimicrobial coatings, and advanced separation technologies. The concept and performance of these hydrogels will be further elaborated during the presentation.

Keywords: Multithiol, Quaternary group, Thiol-ene reaction.

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Harnessing Fluoropolymers for Advanced Corrosion Mitigation in Industrial Applications

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Abstract

Corrosion of metallic components represents a persistent and costly challenge across numerous industrial sectors, leading to significant economic losses, operational failures and safety hazards. This paper examines the critical role of fluoropolymers, a class of high-performance carbon-fluorine backbone polymer materials, in combating aggressive chemical corrosion.

By analyzing the fundamental mechanisms of corrosion, we highlight the unique physicochemical properties of fluoropolymers such as Polytetrafluoroethylene (PTFE) and Perfluoroalkoxy Alkanes (PFA) that make them exceptionally effective as protective barriers. Key properties, including near-universal chemical inertness, high thermal stability and low surface energy, are discussed.

The paper presents a comparative analysis of fluoropolymers against other traditional materials, including various polymers and corrosion-resistant metal alloys, particularly within the demanding environment of the various speciality chemicals plants like Chlor-alkali, Epichlorohydrin, Ethylene Dichloride, Vinyl Chloride Monomer, Hydrochloric Acid etc. Furthermore, recent advancements, such as the development of antistatic fluoropolymers to mitigate ignition risks from electrostatic discharge in highly exothermic processes are reviewed.

Ultimately, this paper propounds that the strategic implementation of fluoropolymer technology not only enhances equipment longevity and operational safety but also provides a significant return on investment and substantial environmental and public health benefits.

Curcuma caesia supplementation attenuates hyperglycemia-induced oxidative stress and apoptosis in STZ-induced diabetic mice

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Abstract

The continuous strive to find a natural product for the treatment of one of the growing global health emergencies in diabetes is a never-ending one. Curcuma caesia (C. caesia) is an important traditional medicinal plant that has been found to confer different pharmacological activities. Thus, our aim was to conduct an in-depth study of the therapeutic effect of C. caesia supplementation on the heart and brain tissue of diabetic mice, enabling a more comprehensive evaluation of its potential as a therapeutic adjuvant. Swiss albino mice Balb/c mice were subjected to a streptozotocin (STZ) induced diabetic state. C. caesia extract supplementation in diabetic mice shows that it significantly reduced fasting blood glucose, improved glucose tolerance, and lowered glycosylated hemoglobin levels, comparable to metformin. It also restored glucose transporter-4 (GLUT-4) expression, thus enhancing glucose uptake. Additionally, C. caesia extract supplementation significantly alleviated oxidative stress by upregulating the activity of various antioxidant enzymes (superoxide dismutase, catalase, and glutathione peroxidase) and by reducing lipid peroxidation. Furthermore, C. caesia extract supplementation mitigated apoptosis by downregulating Bax and upregulating Bcl-Xl, preventing tissue damage in the heart and brain. Terminal deoxynucleotidyl transferase-mediated dUTP nick end labeling (TUNEL) assay confirms that fewer apoptotic cells were present in C. caesia-treated diabetic mice, indicating its anti-apoptotic activity. Histological analysis further confirms that C. caesia extract supplementation provides protective effects on the cardiac and neuronal tissue, thus maintaining tissue integrity. In conclusion, these findings highlight that C. caesia supplementation could be beneficial in the amelioration of some aspects of diabetic complications by protecting the heart and brain tissues of diabetic mice through its anti-hyperglycemia, anti-oxidant and anti-apoptotic effects.

Keywords: Curcuma Caesia, Anti-hyperglycemia, Anti-oxidant, Anti-apoptosis, Therapeutics.

Improving Mechanical Performance of Bioactive Chitosan–Hydroxyapatite Membranes Using Functionalized MWCNTs for Guided Bone Regeneration

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Abstract

Dental implant failure is often associated with bone resorption and insufficient osseointegration. Guided bone regeneration (GBR) techniques employ barrier membranes to prevent the invasion of non-osteogenic tissues during healing. Recent advancements have shifted membrane design from passive barriers to bioactive systems that actively support bone regeneration. In this study, we developed a composite membrane that emulates the native extracellular matrix using chitosan and 5% hydroxyapatite for their biocompatibility and osteoconductivity. To improve mechanical performance, multi-walled carbon nanotubes (MWCNTs) were incorporated at varying concentrations (0.5%–2%). Due to the chemical inertness, poor solubility, and tendency of pristine MWCNTs to aggregate, carboxyl-functionalization was employed to enhance their dispersion, reduce toxicity, and improve interaction with the polymer matrix. The membranes were fabricated via solvent casting and characterized for their morphological, structural, mechanical, and thermal properties. Incorporation of 0.5% functionalized MWCNTs resulted in uniform nanoparticle dispersion and a marked improvement in tensile strength (from 5.25 MPa to 17.84 MPa) and Young's modulus (from 66.89 MPa to 747.02 MPa), albeit with a slight reduction in thermal stability. The membranes maintained a mildly alkaline pH, released no toxic leachates, and supported over 50% cell viability, demonstrating their strong potential for dental GBR applications.

Keywords: Chitosan, hydroxyapatite, multi-walled carbon nanotubes, composite membrane, guided bone regeneration.

Electroactive polymer and carbon materials for bipolar/wireless actuation

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Abstract

Wireless activity in electroactive materials is in high demand as it can open possibility of their wide performance. In this direction, we achieve wireless actuation of conducting polymers and carbon fibre through bipolar electrochemistry. The distinctive aspect of electrochemical actuation involves two essential requirements—an external power supply and a bilayer structure which constrain operational flexibility while increasing cost and processing time. Those are generally required in wired electromechanical deformation of conducting polymers. [1-4] Amongst these two requirements, contact between the polymer and the power can severely limit their application

For wireless electromechanical deformation, we employed electrochemically synthesized polypyrrole (PPy) doped with dodecyl benzene sulfonate (DBS), along with commercially available carbon fiber, to enable bipolar electrochemistry. The inherent asymmetry in the morphology of these two materials plays a crucial role in generating directional bending or actuation under a constant electric field. The actuation mechanism arises from the asymmetric movement of ions caused by contrasting electrochemical reactions at the two ends. These end-region reactions also support the dual functionality of electroactive materials in various applications, including the integration of electronic devices. [5-8] Looking ahead, such systems hold promise for the development of wireless (micro) soft robotics, with potential applications in grippers, valves, pumps, and more enabled by tailoring the actuator's shape and size.

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Toward Sustainable Self-Healing Materials: Vitrimer Composite Systems

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Abstract

Vitrimer, a new generation of polymers has been introduced by Leibler et al., where associative dynamic covalent adaptive network exchange (ADCAN) based self-healing polymers were generated. This introduction has extended the thermal based classification (thermoplastic and thermoset) in polymer material, where these materials exhibit a thermoset polymer like mechanical properties/ durability and thermoplastic like malleability/ processability. Due to their associative dynamic covalent adaptive networks, vitrimers can reform their cleaved bonds rapidly without failure. The associative dynamic covalent adaptive network exchange behavior of vitrimers allows their reprocessing/recycling in most of the performed material. Given the large amount of thermoset-materials in polymer technology the perspective to use recyclable materials in the vitrimeric concept is attractive, as modern regulations for polymers, their recyclabilities, together with the need to reduce CO2-emission is pressing. In the present study, the developed carbon fiber reinforced polymer (CFRP) vitrimer composites can be rapidly dissolved in solvent, resulting in the efficient recycling of carbon fibers (CFs). Scanning electron microscopy, X-ray diffraction, and Raman spectroscopy show that the recycled CFs have almost the same chemical structure and composition as the virgin CFs. The recycled CFs can be used to prepare “2nd generation” composite materials with excellent mechanical properties for non-structural applications (e.g., sports, automotive etc.).

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Advancement in Environmental and Health Monitoring: Customization of Organic-Doped Polyethyleneimines for Improved Durability and Performance

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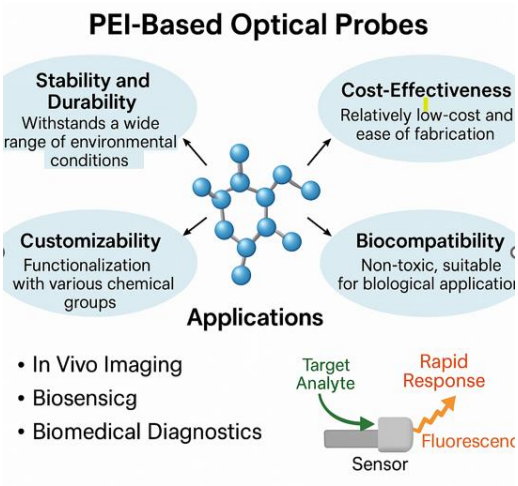
Abstract

Polyethyleneimine (PEI)-based optical probes offer several advantages over small-molecule or synthetic polymer-based sensory systems, particularly for long-term applications, due to their excellent stability and durability. PEI can withstand a wide range of environmental conditions and is resistant to degradation, ensuring both reliability and longevity. Its relatively low cost and ease of fabrication also contribute to the overall cost-effectiveness of PEI-based fluorescence sensors.



Functionalization of PEI with various chemical groups is straightforward, enabling the customization of sensors to meet specific requirements—such as enhanced sensitivity, selectivity, or compatibility with different detection platforms. Additionally, PEI is generally considered non-toxic, biocompatible, and non-immunogenic, making it well-suited for use in biological and medical applications. These attributes support the development of PEI-based fluorescence sensors for in vivo imaging, biosensing, and biomedical diagnostics. PEI-based fluorescence sensors also typically exhibit fast response times, facilitating real-time monitoring and analysis. The interaction between the target analyte and the sensor often leads to a rapid fluorescence signal change, allowing for quick and timely detection.
In this lecture, I will share our recent research on the design and synthesis of organic-doped PEI composites tailored to detect ionic analytes relevant to environmental and public health concerns.[1-3] In addition, we have evaluated the mechanical properties of PEI-based hydrogels in the context of their applicability in sensing platforms.[4]

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Synthesis & Application of the Azo-based Metallopolymers as Novel Electrocatalysts for Hydrogen Evolution Reaction

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Abstract

As the global demand for clean energy increases, hydrogen has gained significant attention due to its potential to be used as a carbon-free fuel in combustion engines and its versatility in energy storage, transportation, and industrial applications without producing harmful greenhouse gases. The Hydrogen Evolution Reaction (HER) is a fundamental electrochemical process in an acid medium that involves the reduction of protons (H^+) to form hydrogen gas (H_2). This reaction is central to the production of hydrogen, which is emerging as a key energy source in the transition towards sustainable and renewable energy systems.4 When HER is done by using renewable energy sources like solar, wind, or hydropower, this process creates "green hydrogen," a type of hydrogen produced with minimal environmental impact. The development of efficient and cost-effective catalysts for HER is critical to enhancing the overall efficiency of water electrolysis and making green hydrogen a competitive alternative to fossil fuels. Hydrogen gas (H2) has an ultra-high energy density of 146 kJ/g, which can be utilized by fuel cells to produce electricity, with water being produced as a byproduct.

This research focuses on the strategic design of efficient Metal-based electrocatalysts for hydrogen evolution reactions in an acidic medium. An asymmetric azo ligand was synthesized and used as a building block to prepare Ru(II)/ Os(II) compounds by varying the metal:ligand ratio.1 All the newly developed compounds were characterized through different characterization techniques to confirm their structures and to understand the structure-property relationship. The newly synthesized azo-based ligand and all the metal complexes demonstrated reversible electrochemical properties, which are prime requirements for developing a new electrocatalyst. The electrocatalytic performance of these novel materials for the hydrogen evolution reaction (HER) was evaluated using linear sweep voltammetry (LSV), potentiodynamic polarization, electrochemical impedance spectroscopy (EIS), and chronopotentiometry in a 0.5M aqueous H2SO4 solution. It is possible to vary the metal: ligand ratio to produce a Metal coordination complex (L:M::1:0.5), where a single metal center is coordinated to two ligands and a metallopolymers (L:M::1:3), where a ditopic ligand is working as a bridge between 2/3 different metal centers. This synthetic route was chosen to investigate the influence of bridging ligands and alterations in the coordination sphere surrounding the central metal ion, as well as the impact of higher concentrations of the metal center on electrocatalytic performance as the metal centers serve as active sites for the transfer of electrons to H+ ions in an acidic medium.

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Waste Rice Straw: A Sustainable and Effective Substrate for Immobilizing Enzymes for Wastewater Remediation

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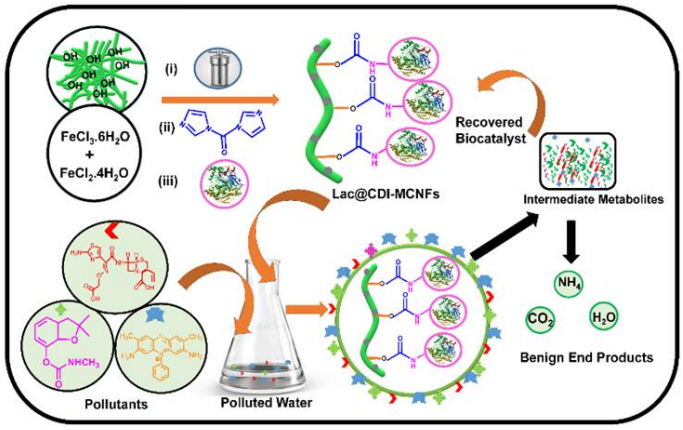
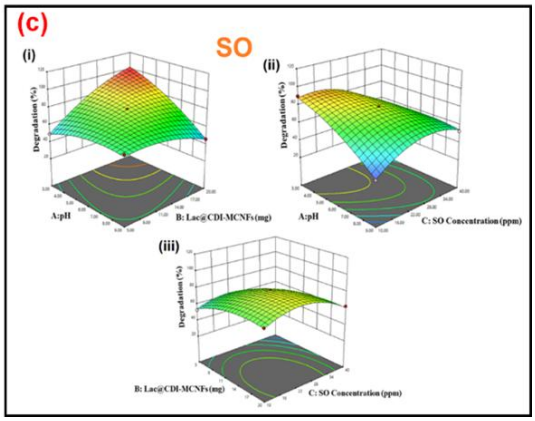
Abstract

In India, with the surge in rice production, there is a substantial increase in the non-edible part left after harvesting i.e. rice straw. The straw is low in lignin and high in silica imparting low crude protein and poor digestibility, limiting its use as cattle feed. The straw is a complex biopolymer consisting of cellulose fibers embedded in an amorphous matrix of lignin, pectin, and hemicelluloses. This research work focuses on the simultaneous extraction of lignin and cellulose nanofibers (CNFs) from rice straw using chemical-mechanical treatment. The extracted CNFs were used as substrates for enzyme immobilization to yield high-performance catalysts for the degradation of multifarious pollutants [1].

In this work, an easily recyclable biocatalyst (Lac@CDI-MCNFs) was synthesized by immobilizing laccase on rice straw-derived carbonyldiimidazole mediated magnetized CNFs (MCNFs). Lac@CDI-MCNFs were utilized for bioremediation of cefixime antibiotic (CT), carbofuran pesticide (CF), and safranin O dye (SO) via oxidation-reduction reactions in wastewater. MCNFs provided enhanced pH, temperature, and storage stability to laccase and allowed reusability for up to 25 cycles with a mere 20% decline in efficacy. The Lac@CDI-MCNFs effectively degraded 98.2 % CT and 96.8% CF into benign metabolites within 20 h and completely degraded SO in just 7 h. Response surface modeling (RSM) was employed based on the Box Behnken Design to evaluate the effect of various parameters i.e. pH, the concentration of catalyst, and the pollutants which were further validated with experimental studies. The degradation products were identified using LCMS, which determined the degradation pathway. The degradation of all pollutants followed first-order kinetics with rate constants of 0.1775, 0.0832, and 0.958 h-1 and half-life of 3.9, 5.0, and 0.723 h for CT, CF, and SO, respectively. Lac@CDI-MCNFs were demonstrated to be an effective catalyst for the degradation of multifarious pollutants.





Keywords. Waste biomass conversion, enzyme immobilization, waste water remediation, RSM.

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Controlled Drug Delivery for Better Healthcare

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Abstract

Controlled drug delivery technology is one of the most rapidly growing areas of science in which chemists, pharmaceutics and chemical engineers are contributing to human healthcare. Controlled drug delivery systems provide several advantages as compared to conventional dosages in terms of improved efficacy, reduced toxicity, improved patient compliance and convenience. A variety of synthetic and natural polymers are extensively used for designing the control drug delivery systems but precise control of drug requires modification of polymer either to regulate the release rate or to target delivery of drugs. In this report, we emphasize on the chemical and physical modifications of synthetic and polymers from renewable resources to realize the regulated delivery of drug. Various forms of vehicles like hydrogel, scaffold, patches are developed for improved healthcare focused on wound healing and cancer treatment. Cellular studies and animal models are explored to understand the mechanism of action and efficacy of the delivery vehicles.

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Effect of Rice Husk Ash particles on Mechanical Properties and Microwave Absorption of Glass Fiber Reinforced Epoxy Hybrids

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Abstract

Rice husk is a major agricultural waste generated every year globally. Its open-air burning produces rice husk ash (RHA) which has a severe impact on soil, air, and human health. However, the use of its fine particles in the polymer matrices can make value addition. Current study discusses the use of RHA obtained after pyrolysis for the printed circuit boards (PCBs), electronic substrates, radar absorbing materials (RAMs) etc. Amorphous RHA containing more than 94 wt.% SiO_2 with remaining amounts of other oxides were synthesized and ball milled to reduce its particle size. The resultant powder was used as a reinforcement in the polymer matrices. The thermal, electrical, and mechanical properties of the resultant hybrids were investigated. Scanning electron microscopy was used to examine the degree of RHA dispersion in the matrix and nature of interfacial adhesion. The addition of RHA particles into the epoxy/glass fabric matrix increased the thermal stability, dimensional stability, thermal conductivity and dielectric properties which indicated that the composites have potential applications for the PCBs. Moreover, epoxy/glass fiber/RHA hybrids exhibited significantly improved microwave absorbing properties (in the X-band) as well as mechanical properties, thus, making resultant hybrids as potential candidates for the radar absorbing materials.

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Mucoadhesive Polymers as In-Situ Gels and 3D Printed Films for Buccal Delivery of Cannabinoids

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Abstract

Buccal drug delivery presents a promising route for systemic administration of cannabinoids by bypassing hepatic first-pass metabolism, offering improved bioavailability and rapid onset of action. This study explores the development of advanced mucoadhesive polymeric systems for buccal delivery, formulated either as thermoresponsive or ion-activated in-situ gels, or as 3D-printed mucoadhesive films.

Polymers such as poloxamers, gellan gum, carrageenans, HPMC, and carbopol were optimised to enhance gelation kinetics, mucoadhesive strength, and controlled release profiles. Inclusion complexes of cannabidiol (CBD) and tetrahydrocannabinol (THC) with cyclodextrins, along with terpene-based permeation enhancers, were investigated to improve solubility and mucosal absorption. 3D-printable bioinks incorporating these complexes were fabricated using HPMC/carbopol matrices and printed using extrusion-based techniques.

The optimised formulations exhibited favourable physicochemical properties, sustained drug release, and efficient permeation across porcine buccal mucosa. Long-term stability studies were conducted over six months under various conditions.

The results provide a comprehensive understanding of formulation strategies using mucoadhesive polymers for cannabinoid delivery, and open pathways for future clinical translation of buccal polymeric systems.

Sustainability and Circularity in Plastics Waste: Assessment, Opportunities and Challenges in Biobased, Biodegradable and Recycled Plastics

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Abstract

Plastics, a ubiquitous material of choice, has become an integral part of our modern lives and plays a significant role in various application sectors. Understanding the importance of plastics is crucial for comprehending their wide-ranging applications and the challenges associated with their use. However, plastic wastes often regarded as a global menace are generated at an alarming rate in India. Currently, the generates around 4.12 MT of plastics waste which is largely driven by population growth, urbanization, and the prevalence of single-use plastics. Efforts have been made by various sectors to address the issue of plastics waste through the adoption of Bio-based, Biodegradable and Recycled plastics. Several key sectors, including packaging, construction, automotive, and textiles, have recognized the need for sustainable practices and are actively incorporating recycled plastics into their manufacturing processes. Additionally, collaboration among key stakeholders, including Government Bodies, Industries, Academia and Consumers, to drive sustainable practices and promote the use of Bio-based, Biodegradable and Recycled plastics, have been prevalent in the current scenario. Use of renewable resources such as sugarcane bagasse, starch, corn, cellulose, sea weed have been recognised as a potential alternatives to synthesise Plastics. Also, materials with a key intention of Design for Environment (DFR) have been the 'mantra' for promoting Circularity and Sustainability. On the contrary, challenges faced, such as limited recycling infrastructure, lack of awareness, and the need for effective waste management policies requires crucial efforts for addressing the plastic waste crisis and moving towards a more environmentally conscious and resource-efficient economy.

Keywords: Bio-based, Biodegradable, Recycled, Circularity, Sustainability.

Multifunctional Chitosan–Azo Schiff Bases with Photoresponsive and Antimicrobial Properties

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Abstract

Considering the impact of pathogenic infection on living systems there is a huge demand in the development of responsive biomaterials as it offers a promising solution with respect to their unique properties such as biocompatibility, biodegradability, nontoxicity, surface modification, ease of flexibility. In this study, we have developed a photochromic Chitosan Azo-Schiff Base by condensation reactions of chitosan and three derivatives of azobenzene. The biopolymers were characterized by Fourier-transform infrared spectroscopy (FTIR), Thermogravimetric analysis (TGA), Differential scanning calorimetry (DSC), Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD) and UV-Visible spectroscopy technique. The results showed good thermal stability, amorphous nature and belt-like morphology for Schiff bases. Absorption and UV light irradiation study shows the photoresponsive behavior of the Schiff bases. The synthesized Schiff bases inhibited the growth of fungal and bacterial pathogens at concentrations lower than that of clinically used antifungals and antibacterial drugs, respectively. Interestingly, none of the Schiff bases showed significant hemolytic activity (< 5%) in Red blood cell (RBC) hemolysis assay and were found to be hemocompatible. The finding opens a new door for developing biodegradable polymers comprising azo dyes based photoresponsive material necessary for bio-interface applications.

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Smart and Multifunctional Polymers: Bridging Innovation and Application

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Abstract

Now-a-days, smart polymeric materials have attracted special attention for the need in cutting edge technologies for their smart or intelligent functions, self-healing action, morphing structures and other functionalities like optical, non-linear optical, photo-switching, liquid crystal behavior and others. Such materials have the capability to respond adaptably by the influence of an external stimulus like temperature, pressure, light intensity, chemical trigger, electric and magnetic field etc. and have gained significant attention for their adoptive applications in various cutting-edge technologies [1-3]. On the other hand, self-healing polymers can repair themselves when they are damaged and can provide safety aspect of the components in its use as well as their longevity and sustainability [4-5]. Multi-functional polymers are demanded to fulfill multi-mission objectives by a single polymeric material or a structure.
Smart, self-healing and multifunctional polymers are important classes of innovative materials that are required for the high-tech technologies in defence, aerospace, space program, navy, missiles, railways, sophisticated biomedical and industrial applications. Moreover, such polymeric materials are essential part for the sustainable development of any technology and are playing major role towards the creation of 'smart world'. However, for the successful application of such materials, lots of challenges must have to overcome. This presentation includes the frontiers research in the field of smart, self-healing and multifunctional polymeric materials as well as the research findings and material development such as smart hydrogels, thermoplastic elastomers, ionomers etc. at authors' laboratory for defence applications.

Keywords: Smart polymers, Self-healing polymers, Multifunctional Polymers.

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Revolutionizing Food Packaging with Sustainable Polymers: Indian Innovations and Challenges

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Abstract

The growing global emphasis on sustainability and food safety has intensified the need for innovative, eco-friendly packaging technologies. This presentation explores recent advances in green food packaging, with a focus on biopolymer-based solutions that enhance food quality, shelf life, and nutritional preservation. Highlighting breakthrough research from the Indian Institute of Technology Roorkee, the talk presents a range of sustainable packaging technologies, including antimicrobial films derived from cactus mucilage, millet-based edible cups, catechu-based edible inks, and molded paper products developed from pine needle waste. These innovations offer viable alternatives to conventional plastic and thermocol packaging, addressing the urgent need to reduce microplastic pollution and environmental harm. Additionally, smart packaging technologies such as thermochromic temperature indicators, tamper-evident labels, and plant-based oxygen scavengers demonstrate how intelligent systems can reduce food waste and ensure product integrity during transportation and storage. The talk also critically examines the challenges in adopting green packaging, including material sourcing, performance limitations, cost, regulatory constraints, and consumer acceptance. By integrating sustainable materials, functional design, and smart sensing technologies, green packaging has the potential to redefine food safety and nutrition in the context of climate-smart food systems. These advancements underscore the role of polymers in building a circular economy for the packaging sector supporting the vision of “Better Packaging, Better Living.”

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Hydrogen Energy and CSIR: Connecting Deep Science with Technologies

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Abstract

As part of the major green energy initiatives of the Government of India, the Council of Scientific and Industrial Research (CSIR) has recently initiated the National Green Hydrogen Mission with an aim towards indigenization of the key technologies and enabling self-reliance in establishing the hydrogen economy for the country. The process of establishing the hydrogen economy requires capacity building in the three critical areas, viz., hydrogen generation, storage/supply/distribution, and its utilization. CSIR has already made significant contributions in these sectors. Among these, the efforts of CSIR in building and demonstrating polymer electrolyte membrane fuel cells (PEMFCs) for both stationary and automotive applications have gained substantial momentum. The presentation will cover both the basic research and technology development aspects involved in the successful demonstrations of the PEMFC technologies for the stationary and transportation applications. A major factor affecting the nation's effective transition to hydrogen energy is the supply chain problems involving the vital components needed for the systems. India's reliance on foreign manufacturers for nearly all hydrogen technologies and essential materials like platinum catalysts, membranes, bipolar plates, gas-diffusion layers, separators, carbon fibers, epoxy resin, and other materials seriously jeopardizes our deployment efforts in terms of cost-effectiveness and practical technology management for end-to-end solutions. The PEMFC programs have evolved by maintaining an effective balance between deep science and technology demonstrations, with close collaborations with industries. A focus on gradually moving towards zero dependencies on imported components has been achieved by substituting the constrained supply chains with self-reliant local capabilities. This approach has ultimately helped CSIR to realize completely indigenized PEMFC stacks for various applications. The presentation will give an overall overview of how the CSIR team could gradually establish a reliable PEMFC technology for the country by connecting deep science and technological advancements involving facility creation for locally manufacturing the critical components.

Synthesis and Study of Conjugated Polymers via a Green Indophenine Polymerization Strategy

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Abstract

Indophenine reaction is extensively used for the synthesis of various of small molecules.1 The indophenine reaction conditions is known for its facile and environmentally friendly synthetic approach. Recently, we have reported fused bis-isatins and investigated their application in the indophenine reaction,2 revealing synthesized polymers with potential for use in organic electronic devices. Encouraged by these results, we embarked on the synthesis of indophenine-based conjugated polymers. In the present work, we synthesized four bis-isatin-based molecules and subjected them to indophenine reaction conditions with dialkoxy thiophene to produce indophenine polymers. Photophysical and electrochemical analyses were conducted on the polymers. Additionally, polymers were analyzed using GPC, TGA, AFM, PXRD and DFT calculations. Furthermore, the space charge limited current (SCLC) hole mobilities and the organic field-effect transistor (OFET) mobilities of polymers were evaluated.3

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Advances in Polymeric Nanocomposite - Based Functional Membranes for Water Purification

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Abstract

Water deficiency, a global concern of twenty-first century, marks the urgency to develop & advance technologies for treatment of wastewater. Amidst varied techniques for water purification, membrane filtration is of significant interest due to lesser energy consumption. Osmotically driven membrane process is a productive approach to produce clean water through semi-permeable membrane rejecting a broad range of contaminants including molecules, small ions and microorganisms. Forward osmosis (FO) utilizes osmotic pressure difference between feed and draw solutions to produce drinking water in an energy-efficient setting. It has process has comparatively lower fouling tendency. Nanoparticles embedded within thin polymeric films seem to be a favorable modified version of conventional polymeric membranes for water purification, with three main attributes viz. improved rejection, enhanced permeation and reduced fouling. The development of advanced polymeric membranes such as cellulose acetate thin films incorporated with titania (TiO_2) nanoparticles and alpha-manganese dioxide (α- MnO_2) nanofibers have demonstrated promising results with an average water flux of about 58.2 L/m2.h, and 52.5 Lm2/h respectively. The reverse salt flux was found to be 16.28 g/m2.h and 10.9 g.m2/h for TiO_2 and α- MnO_2 incorporated membranes respectively. Greater hydrophilicity introduced by TiO_2 and α-MnO_2 nanoparticles improved the membrane performance. Further, addition of α-MnO_2 improved the structural features of the membrane, such as water permeability and the membrane's surface roughness, causing high salt rejection. The work reveals that the polymeric nanocomposite membranes are at par with the current FO membranes and enable the use of energy-efficient and cost-effective FO membranes to meet the rising global demand of clean water supply.

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Sugarcane Bagasse Derived Hemicellulose-Clay Nanocomposite Aerogel for Controlled Release of Fertilizer

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Abstract

In this study, the hemicellulose derived from sugarcane bagasse was modified into dialdehyde hemicellulose (DAHC). The DAHC was converted into three- dimensional aerogel (DAHC-CS-NA@aero) using chitosan and montmorillonite clay. Using swelling kinetics, DAHC-CS-NA@aero was reported to be extremely porous and has a great swelling capacity. DAHC-CS-NA@aero was characterized using techniques like FTIR, XRD, FE-SEM, TEM and TGA. Characterization techniques also demonstrate the sustained release of nutrients and ammonium dihydrogen phosphate (ADP) fertilizer. The percentage release of nutrients in water after 48 hrs and 120 hrs were reported to be 63.47% and 74.5%, respectively in soil. These values were found excellent for conditioning of soil. The release kinetics of ADP fertilizer followed Higuchi model and Korsmeyer peppas model demonstrate the controlled release of fertilizer governed by both diffusion and dissolution.

Keywords: Sugarcane, Chitosan, Fertilizer, Release, Kinetics.

Physiochemical and antimicrobial properties of chitosan/gelatin/Ag@TiO2 nanocomposites for food packaging applications

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Abstract

The development of sustainable and effective food packaging materials is an important for extending shelf life and ensuring food safety. In this study, a novel nanocomposite based on chitosan, gelatin, and silver-loaded titanium dioxide ($Ag@TiO_2$) nanoparticles was synthesized and characterized for its physiochemical and antimicrobial properties relevant to food packaging applications. The structural, morphological, thermal, and mechanical properties of the composite films were analyzed using techniques such as FTIR, XRD, SEM, TGA, and tensile testing. The incorporation of $Ag@TiO_2$ significantly enhanced the antimicrobial activity, UV-blocking capacity, and thermal stability of the biopolymer matrix, while maintaining good biodegradability. The synergy between chitosan and gelatin provided improved film-forming properties and flexibility, whereas $Ag@TiO_2$ contributed to enhance the antimicrobial efficiency. Overall, the chitosan/gelatin/$Ag@TiO_2$ nanocomposite exhibits promising potential as an eco-friendly, multifunctional material for active food packaging applications.

Closed-loop recyclable crosslinked polymeric materials via dynamic transetherification

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Abstract

The crosslinked polymers are widely used across diverse applications due to their outstanding thermal and mechanical properties. Their limited recyclability, a major challenge arising from permanent covalent crosslinking, can be addressed by incorporating dynamic covalent linkages. Yet these linkages often compromise the thermal and chemical robustness of the material.

Thus, designing chemistries that impart both robustness and dynamicity to polymer networks is a key challenge. To this end, we recently introduced benzyl ether-based trans-ether exchange as a robust dynamic chemistry to design dynamically crosslinked polymers.1 Inspired by the ether linkages' robustness and versatility, we explore this linkage towards the development of robust and recyclable crosslinked polymers. The polymers exhibited excellent thermal and chemical robustness owing to the presence of robust dynamic ether linkages. The dynamic linkages enable malleability and reprocessability.

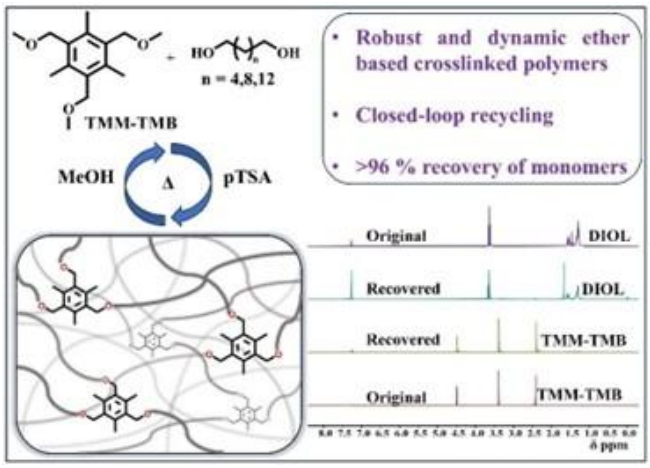

Fig. 1: Schematic illustrations of dynamic ether-based closed-loop recyclable crosslinked polymers.

Besides providing malleability upon activation, dynamic linkages in a crosslinked polymer can also enable its chemical recycling in a closed-loop fashion, offering a solution to the challenges associated with the end-of-life management of these materials. Yet, designing dynamic bonds that enable effective bonding, robustness, and reversible cleavage for monomer generation remains a significant challenge in developing crosslinked polymers. Addressing this, we demonstrate the closed-loop recyclability of the crosslinked polymers using our recently developed robust trans-ether exchange chemistry (Fig.1).2 The networks were degraded chemically, and monomers were recovered with high yields. The recovered monomers were utilized to prepare a fresh polymer with near retention of its properties, thus enabling closed-loop recyclability. Furthermore, the effect of crosslink density on the dynamic property of these networks has also been explored. Besides, I will also discuss our group's recent efforts in upcycling waste polymers via covalent adaptable networks and their closed-loop recyclability.3-4

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Plant Bio-actives, Drug Combinations, and Processing for Novel Drug Leads: An Integrated Approach from Tradition to Technology

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Abstra

Ayurveda has a deep root of many traditional and ethno-medicinal wisdom being in practice since ages with plant and plant's product empirically for health and wellbeing. Polyherbal (herbal or herbo-mineral) formulations are often preferred to treat complexity of disease (e.g., lifestyle diseases, cancer, diabetes, antimicrobial resistance) pathogenesis which is based on many factors related to the patient, disease and drug itself. The drug combinations have been found to have synergistic, antagonism, additive, bio-enhancing, and toxicity reducing effects. Traditional formulation, namely Kshara, Sneha, Bhasma, etc. preparation, plays an important role in quality and pharmacodynamic enhancing activity of Ayurvedic drugs. Similarly, traditional processing (eg. Samskara) and adjuvants/ Anupana (e.g., ghee, honey, jaggery, long pepper) influence the bio-availability (Yogavahi/ vehicle/ carrier substances) and pharmacokinetics of drugs. Plant bio-actives are well known for their nutritional and pharmacological activities, which are now areas of new drug lead in the pharmaceutical sector. In the course of modern sophistication and advanced drug delivery systems, many a times, the traditional drug delivery or drug formulations are not at par with patient compliance and demands technology intervention to have alternatives that have advantage over the existing practices, sustainability, and eco-friendly. Nano-formulations made of green pharmacy and bio-degradable nano particles for targeted drug delivery is a potential and emerging area of technology and traditional integration. Ayurvedic Rasayana (adaptogens) and Kshara (alkalinizer) have preventive and multi-disease applications either as single or add on therapy, and may be strategically integrated for novel drug lead and drug discovery.

Keywords: Medicinal plants, Rasayana, Kshara, Nano-formulations, Sustainable sourcing.

Biodegradable Polymer Nanocomposites for Self-Powered Smart Systems: A Sustainable Leap in Energy Harvesting and Biomechanical Sensing

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Abstract

The development of sustainable, multifunctional materials for energy harvesting, biomechanical sensing, and additive manufacturing has attracted significant interest, particularly with the rise of triboelectric nanogenerators (TENGs) and 3D printing technologies. This study presents a biodegradable tribo-positive material composed of poly(butylene adipate-co-terephthalate) (PBAT) and Poly (Lactic acid) (PLA), enhanced with various metal oxide nanoparticles synthesized via the combustion method. These nanoparticles were incorporated into PLA and PBAT through solvent casting to form nanocomposite films, with the 0.8g of nanofillers yeilded an output voltage of 45.45 V and a current of 4.5 µA. The PBAT and PLA based nanocomposites demonstrated efficacy in powering electronic devices, charging capacitors, and functioning as a self-powered biomechanical sensor. This highlights the potential of biodegradable materials for portable electronics and energy harvesting applications.

Further, advances in additive manufacturing, particularly in the 3D printing of biopolymers, have enabled the fabrication of materials that respond to external stimuli. Polylactic acid (PLA) ocomposites with various composition ratios were processed using Fused Filament Fabrication (FFF). Mechanical properties were evaluated by adjusting printing parameters such as infill percentage and raster angle. Results showed that increasing the infill percentage enhanced elastic modulus and tensile strength, while decreasing the print angle further improved these properties. The printed composite material demonstrated the potential for creating next-generation triboelectric nanogenerators.

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Oral Presentations

Fabrication of a Dry Biopolymer-Based Contact Drawn Fiber Sheet for Rapid Blood Clotting

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Abstract

Uncontrolled hemorrhage continues to be a leading cause of morbidity and mortality in trauma, surgical, and emergency care settings. Conventional hemostatic sealants, particularly those based on fibrin, have been widely adopted due to their clinical efficacy in promoting natural clot formation. However, most of the currently available formulations are supplied as injectable gels or sprayable powders, which present challenges of stability, storage, and limited applicability in emergency or resource-limited environments. These limitations highlight the critical need for a next-generation hemostatic material that is biocompatible, easy to handle, rapidly effective, and broadly deployable.

In this study, we design a dry biopolymer-based fiber sheet fabricated through a simple contact-drawing technique. The sheet exhibited a microfibrous morphology as confirmed by scanning electron microscopy (SEM), revealing fiber networks that facilitate rapid interaction with blood. Fourier-transform infrared spectroscopy (FTIR) confirmed the presence of characteristic functional groups, validating successful incorporation of the bioactive components. Preliminary evaluation demonstrated that the sheet supports safe storage at a wide range of environmental conditions, rapid blood coagulation, offers a faster hemostatic response compared to commercial available sheet. The structural and functional attributes of the fiber mesh thus provide a unique advantage for addressing hemorrhage management in surgical procedures, civilian emergencies, and military applications. This work highlights the translational potential of contact-drawn fibrin-based fibers as a next-generation hemostatic material that combines stability, ease of use, and rapid clotting efficiency.

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Environmentally Benign Polymers as Effective Corrosion Mitigators

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Abstract

Corrosion poses a significant threat to the integrity and longevity of metallic structures across various industries, leading to substantial economic losses and environmental concerns. The demand for sustainable, non-toxic corrosion inhibitors has accelerated the exploration of environmentally benign polymers as viable alternatives to conventional chemical treatments. This study investigates the potential of biodegradable and renewable polymeric materials, such as polysaccharides, polyesters, and polypeptides, in mitigating corrosion in corrosive environments. Through electrochemical impedance spectroscopy (EIS), potentiodynamic polarization, and surface morphology analyses (SEM/AFM), the performance of these polymers as corrosion inhibitors was systematically evaluated on metals. The results demonstrate that these eco-friendly polymers offer excellent corrosion resistance by forming stable protective films, exhibiting high inhibition efficiency, and maintaining performance under varying environmental conditions. This work underscores the importance of integrating green chemistry principles into corrosion protection strategies and opens avenues for the development of next-generation sustainable materials.

Keywords:
1. *Corrosion Inhibition*
2. *Green Polymers*
3. *Biodegradable Materials*
4. *Electrochemical Analysis*
5. *Surface Protection*
6. *Sustainable Coatings*

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Molecular Insights into Polymer Membranes and Non-Stoichiometric Electrolytes

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Abstract

The oral presentation will highlight the molecular mechanisms governing the performance of polymer membranes and non-stoichiometric electrolytes in advanced energy systems. We investigate the structural and chemical properties of polymer membranes, focusing on their interactions with non-stoichiometric electrolytes, which deviate from ideal stoichiometry due to the presence of defect sites or excess ions. By employing molecular modeling, we uncover key insights through the molecular dynamics for charge transport, and ion clustering that influence the performance of these materials in applications such as fuel cells, batteries, and super-capacitors etc. The study discussion will provide a comprehensive framework for optimizing the design of polymeric membranes and electrolytes, highlighting their role in enhancing efficiency.

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Service Life Estimation of Weathered 3D-Printed Stereolithography Photocured Resin Parts

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Abstract

Photocured resins, fabricated using Stereolithography (SLA) 3D printing, are gaining traction in functional applications owing to their high resolution, material efficiency, and design adaptability. However, the long-term mechanical performance of these materials under environmental stressors such as ultraviolet (UV) radiation, elevated temperature, and humidity remains a key challenge for their reliability in real-world conditions.

This study investigates the service life of SLA 3D-printed parts through a systematic evaluation of mechanical strength retention across three print orientations (0°, 45°, and 90°) and three layer thicknesses (0.1 mm, 0.05 mm, and 0.025 mm). Tensile, flexural, and compressive tests were conducted on both unweathered and accelerated weathered samples, which subjected to 500 and 1008 hours of exposure to UV, heat, and 100% humidity. Results indicated that the finest layer thickness (0.025 mm) consistently provided the highest mechanical strength and post-weathering retention. Unweathered samples at 0° orientation demonstrated peak tensile and flexural strength due to aligned load paths, whereas 90° orientation maximized compressive resistance through favorable stress distribution.

Weathered samples exhibited strength losses ranging from 20% to 37% for 0.025 mm layer thickness. Linear degradation models were developed to estimate real-time service life, revealing that parts printed at 0.025 mm thickness can retain 50% of initial strength for up to 1.835 years under environmental conditions equivalent to natural aging.
This work underscores the critical influence of print parameters on environmental durability and offers a predictive framework for designing SLA-fabricated polymer parts in automotive, biomedical, and electronic applications requiring moderate service lifespans.

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Synthesis Of Binari Films Chitosan/Starch Using Glutaric Acid And Its Characterization

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Abstract

Binari films were synthesized using Glutaric acid with different variations of concentration of Chitosan/starch was 0.1/0.9 from 0.9/0.1. These films were characterized by percentage of swelling, FTIR. The swelling study of binary films were conducted in pH 2.2 and 7.4.The percentage of swelling of film was increased with increasing the concentration of chitosan and also increased with release time increasing. The percentage of swelling of film is more in basic medium at pH 7.4.The cryastalinity of films were increased as adding starch and also increased cryastalinity of films with crosslinking glutaric acid. FTIR study also supported that the films were crosslinked with different crosslinking agents.

Development of fire-resistant Safe sSBR Based Green Compounds utilizing LPCA and HPCA

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Abstract

The flash point of a volatile liquid is the lowest temperature at which it can vaporize to form an ignitable mixture in air. Measuring a liquid's spark point requires an ignition source. At the spark point, the vapor may cease to burn when the source of ignition is removed. The flash point is not to be confused with the auto ignition temperature, which does not require an ignition source. The fire point, a higher temperature, is defined as the temperature at which the vapor continues to burn after being ignited. Neither the spark point nor the fire point is related to the temperature of the ignition source or of the burning liquid, which are much higher[1-2].

Keywords: low PCA oils, Polycyclic Aromatics, Carcinogenesis, PAH, Risk Assessment.

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Condensation Polymerisation of Nylon 66 for flame retardant application

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Abstract

Nylon 66, a widely used synthetic polymer, is valued for its excellent mechanical strength, durability, heat resistance, and chemical resistance, but it has the drawback of flammability. Its versatility has made it a key material in industries such as automotive, textiles, and protective equipment.

In this work, the nylon 66 polymer is synthesised through a condensation polymerisation reaction. In the polymerisation of nylon 66, the adipic acid and hexamethylenediamine react in equimolar quantities to form nylon salt. Then, the salt concentration is reduced to 75-85% in the condensation reactor, and the polymerisation reaction takes place at a higher temperature and high pressure under an inert atmosphere. After the polymerisation reaction, the molten polymer is decompressed to atmospheric pressure and heated up to remove the volatile substances and water molecules. At last, the product was removed from the reactor, cut into chips, and dried in a vacuum oven at 110 °C for 24 h.

The nylon 66 chips and flame retardant (FR) master batch (which is halogen-free) were added together in the melt spinning to manufacture the FR nylon 66 filament yarn. FR master batch is added at three different ratios to find out the optimal range for FR applications. The properties of nylon chips and FR nylon filament yarns were investigated by intrinsic viscosity, relative viscosity, melt flow index (MFI), differential scanning calorimetry (DSC), and tensile test. For analysing the flammability as per IS 11871 method A of FR nylon 66, a non-woven fabric was prepared using staple fibre with 25 mm of staple length. The melting points of nylon salt and nylon chips are 205 °C and 256.78 °C, respectively. The pure nylon 66 filament sample was completely burnt during the vertical flammability test, and melt dripping was also noticed.

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Synthesis of $ZnMn_2O_4$ Nanofleets via Surface Modification Using Citric Acid and Polyvinyl Alcohol: Enhanced Photocatalytic, Photoelectrochemical, and Antimicrobial Performance under Visible Light Irradiation

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Abstract

In this study, a novel nanofleet architecture of $ZnMn_2O_4$ was synthesized through a controlled co-precipitation route followed by surface modification using citric acid (CA) and polyvinyl alcohol (PVA). The impact of these surface functionalizes on the structural, morphological, optical, and electronic properties of $ZnMn_2O_4$ nanostructures was thoroughly investigated. Characterization techniques including XRD, FTIR, SEM, TEM, BET, and UV-Vis DRS were employed to elucidate the influence of surface modifiers on particle size distribution, porosity, bandgap narrowing, and electron-hole recombination behavior. The photocatalytic activity of the modified $ZnMn_2O_4$ was evaluated for the degradation of methylene blue under visible light irradiation, while photoelectrochemical (PEC) performance was assessed via linear sweep voltammetry and transient photocurrent measurements. Additionally, the antimicrobial efficacy was examined against Gram-positive and Gram-negative bacterial strains, demonstrating a strong correlation between surface modification and reactive oxygen species (ROS) generation. The CA-modified $ZnMn_2O_4$ exhibited superior photocatalytic degradation efficiency (up to 95% in 60 minutes), enhanced photocurrent density, and significant antimicrobial activity, attributed to increased surface area, better charge separation.

Keywords: $ZnMn_2O_4$ nanofleets; Citric acid; Polyvinyl alcohol; Visible light photocatalysis; Photoelectrochemical activity; Antimicrobial nanomaterials; Surface modification.

Electrochemical Post-Ugi Cyclization Enabled by In-cell Generated Hypervalent Iodine(III) Intermediates for the Synthesis of Imidazolidin-4-one and Oxazolidin-4-one

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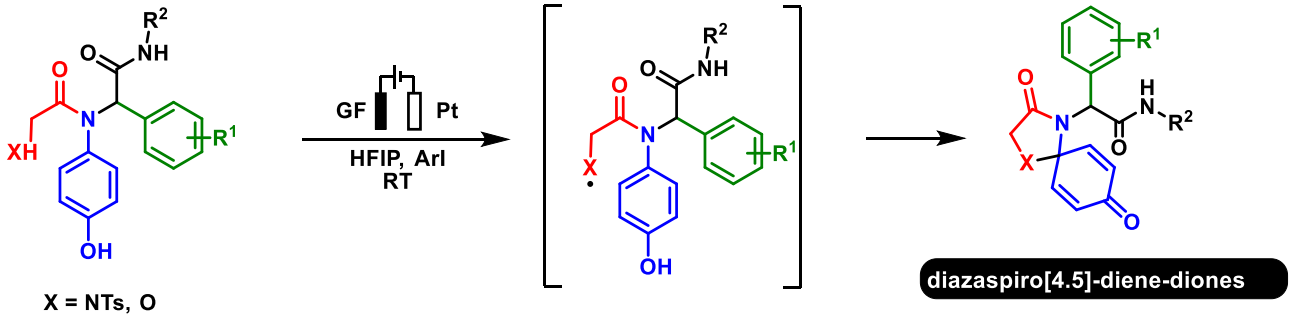
Abstract

An electrochemical approach integrates the Ugi multicomponent reaction (Ugi-MCR) with post-reaction cyclization, leveraging anodically generated hypervalent iodine(III) intermediates for efficient C–N and C–O bond formation via ipso-cyclization. This strategy enables the synthesis of diverse spirocyclic diazaspiro[4.5]-diene-diones. The method efficiently generates hypervalent iodine(III) species in situ, offering opportunities to couple various substrate functionalization mechanisms to a unified interfacial electron transfer process. This promotes a wide range of functionalizations compatible with the multicomponent assembly of the Ugi reaction. The reactions were performed under constant current conditions in a simple undivided cell using a reticulated vitreous carbon (RVC) anode as the working electrode and a platinum plate as the cathode.



One pot cascade post-Ugi dearomative ipso-cyclization

Electrochemical Decarboxylative Ketone Synthesis from NHPI Esters and Vinyl Azides

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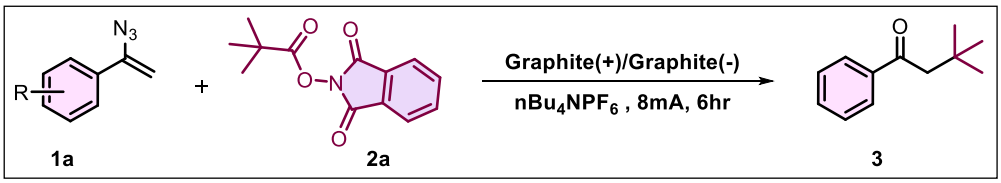
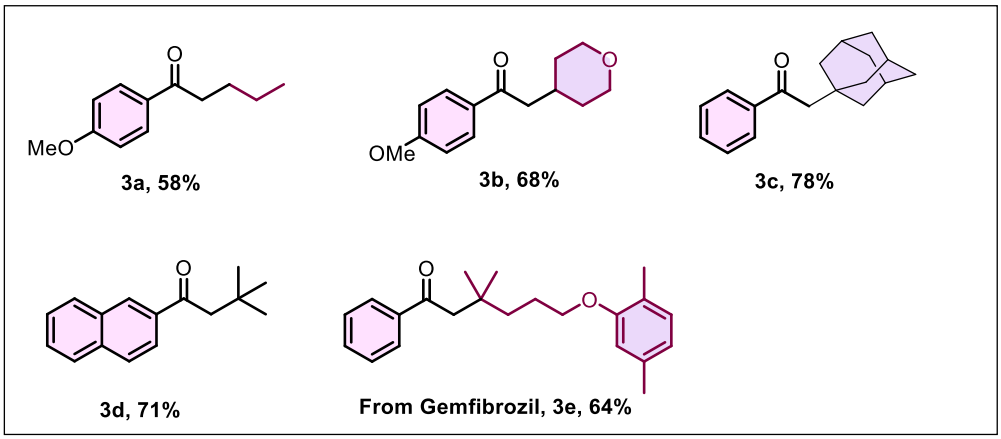
Abstract

We've developed a clean and efficient metal-free method to build carbon–carbon bonds by coupling NHPI esters with vinyl azides using electrochemistry. Instead of relying on metal catalysts, this approach uses NHPI esters—easily made from carboxylic acids—as radical precursors to drive the reaction. It's a versatile method that works with a wide range of substrates, including those with halogens or heteroatoms. Overall, it offers a practical and sustainable way to synthesize complex ketones and other valuable molecules.





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Development and Characterization of a Green Superabsorbent Polymer Based on Diatomaceous Earth

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Abstract

The presence of toxic hydrated micro-elements in conventional superabsorbent polymers (SAPs), particularly during large-scale manufacturing, poses significant challenges. These contaminants can adversely affect seed germination, plant growth, crop yields, and the development of root and shoot systems. As a result, the agricultural use of SAPs has declined.

In this study, we present the development of a modified, eco-friendly superabsorbent polymer, termed AD-SAP. This polymer was synthesized using acrylic acid neutralized with ammonia solution, and subsequently grafted onto sodium-modified diatomaceous earth. Notably, ammonia solution was used in place of sodium hydroxide—a strong alkali—to enhance grafting efficiency and reduce environmental impact.

The synthesized AD-SAP was characterized using Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), Thermogravimetric Analysis (TGA), and Scanning Electron Microscopy (SEM). In addition, an analysis of residual hydrated toxic components in the AD-SAP was conducted to evaluate its environmental safety and agricultural viability.

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Keratin nanofibers scaffold as a potential candidate for tissue engineering application

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Abstract

In the current study, keratin-based nanofibers are produced using the electrospinning technique, and their potential as scaffolds for tissue engineering has been investigated. Human hair keratin was combined with poly(vinyl alcohol) (PVA) in an aqueous solution. Some advanced methods were used to characterize the nanofibers. The resulting PVA-keratin nanofiber was smooth, random, and had a three-dimensional network structure that mimicked a web, according to SEM assessment. The average diameter of the nanofibers was between 100 and 200 nm. FTIR study has demonstrated the presence of a hydrogen bond interaction between keratin and PVA. Dermal fibroblasts (NHDF) and mouse embryonic stem cells have been employed in in vitro cell culture investigations of the scaffold. Keratin scaffolds were found to support NHDF cells and mouse ESCs in in vitro experiments, indicating their biocompatibility and non-toxicity.

Additionally, immunocytochemical research demonstrated that NHDF cells and ESCs could adhere to and proliferate on scaffolds made of keratin nanofibers. Ultimately, the keratin-PVA nanofiber scaffold demonstrated promise for use in a wide range of tissue engineering applications.

Keywords: Biomaterials; Keratin; Electrospinning; Nanofiber scaffolds; Tissue engineering.

Graphitic Carbon Nitride Based Materials and Their Applications in Organic Synthesis

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Abstract

Development of graphitic carbon nitride (g-C3N4) based materials and their applications in different fields, especially catalysis, has captivated researchers worldwide. Its various structural parameters, such as interlayer spacing, π-conjugation length, surface area, and functional groups, significantly influence its electronic structure, charge mobility, and catalytic activity, emphasizing the importance of surface engineering for optimal performance. Several approaches have been developed to design these highly efficient materials by controlling the interaction between the support material and active species. Several nitrogen-rich precursors like urea, dicyandiamide, melamine, and thiourea have been utilized for g-C_3N_4 synthesis, each offering distinct advantages in terms of precursor availability, reactivity, and product morphology. The synthesized materials have been well characterized by FT-IR, SEM, EDX, TGA, and XRD, confirming their successful synthesis. They serve as an important domain in sustainable chemistry as they enable an eco-friendly catalytic process. In the ongoing research, these materials have been used in the synthesis of biologically active 1,1-dihomoarylmethane scaffolds and oxygen-containing heterocycles. All the synthesized derivatives were achieved in excellent yields in less reaction time, along with easy setup and no tedious workup. The synthesis also adheres to the principles of green chemistry. The green chemistry metrics, such as E-factor, atom economy, and reaction mass efficiency, have also been evaluated for all the synthesized derivatives.

Keywords: g-C3N4-based materials, catalysis, organic synthesis, green chemistry.

Agarose hydrogel-based sensing platform for rapid detection of food toxicants

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Abstract

The widespread presence of toxic compounds such as bisphenol A (BPA) in food and water poses serious public health risks. This has necessitated the efforts towards the development of efficient, sustainable, and affordable detection methods. In this work, we present an eco-friendly, low-cost, biopolymer-based sensing platform using agarose hydrogel for rapid colorimetric detection of BPA. The sensor shows a visible color change when BPA interacts with reagents embedded in the hydrogel matrix, allowing easy visual interpretation. For quantification, images of the color change are captured using a smartphone. These images are then analyzed using digital image colorimetry, enabling accurate detection without the need for complex instruments. The platform demonstrates high sensitivity towards the analyte, with detection limits in the low micromolar range. The agarose hydrogel is derived from renewable sources and is synthesized using environmentally friendly methods. Further, a cellulosic substrate is used as a support for platform designs. This aligns with green chemistry principles such as reduced chemical use and biodegradability. The proposed sensor is tested with real samples, including beverages and drinking water, and shows reliable performance with minimal sample preparation. The use of a smartphone eliminates bulky analytical tools, making the system suitable for portable applications. This study demonstrates the potential of combining biopolymer materials with digital tools to develop sustainable, on-site sensing platforms for monitoring food and water safety.

Melt Electrowriting of PCL-$BaTiO_3$ Scaffolds: Advancing Print Fidelity, Mechanical Performance, and Biofunctionality

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Abstract

Melt electro-writing (MEW) is an emerging additive manufacturing technique with significant potential for fabricating tissue-engineered scaffolds with controlled microarchitecture. A key advantage of MEW is its ability to produce ultrafine fiber strands, which are challenging to achieve with conventional methods like electrospinning. However, ensuring both mechanical integrity and bioactivity remains a challenge. We explore the 3D printability of polycaprolactone (PCL)–barium titanate ($BaTiO_3$) composite scaffolds using MEW. PCL composites with 10–30 wt.% $BaTiO_3$ were melt-compounded and processed via MEW. Process parameters, including voltage, collector speed, and pressure, were optimized for consistent fiber deposition. PCL/10BT scaffolds exhibited improved printability, while higher $BaTiO_3$ concentrations (≥20 wt.%) led to inconsistent deposition. Tensile testing confirmed enhanced strength and stiffness in PCL/10BT compared to pristine PCL. Multi-layered scaffolds exhibited anisotropic mechanical properties. Cytocompatibility assessments using NIH-3T3 fibroblast cells showed higher cell viability on PCL/10BT, likely due to improved elastic stiffness. These findings demonstrate the potential of $BaTiO_3$ incorporation to enhance mechanical and biological properties in MEW-processed PCL scaffolds, though higher filler content limits printability.

Keywords: Melt Electro-Writing (MEW), Polycaprolactone (PCL), Barium Titanate ($BaTiO_3$), Tissue Engineering, Scaffold, Tensile Properties, L929 Fibroblasts.

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Sustainable Packaging via Electrospun Films Functionalized with Nitrogen-Doped Carbon Dots

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Abstract

Carbon dots (CDs) are zero-dimensional nanomaterials used in food packaging films as an active filler owing to their low toxicity, biocompatibility, strong antioxidant and antimicrobial activity.1 The antioxidant and antimicrobial properties of CDs can be improved by heteroatom doping, such as nitrogen and sulfur. Many studies investigated the use of heteroatom-doped CDs as antimicrobial agents.2,3 However, the application of CDs to improve the fruit's shelf life using fibrous films has not been reported yet.

Nitrogen-doped carbon dots (NCDs) were synthesized using a one-step hydrothermal reactor with Neem leaves as a precursor material. The synthesized NCDs had a quasi-spherical morphology with a diameter of 1.6 to 3.4 nm, as confirmed by HR-TEM. The NCDs showed a clear color change from dark brown to green under UV light owing to the quantum confinement effect. The N 1s peak at 399.8 eV in the XPS survey confirmed the presence of nitrogen groups in the synthesized CDs. The NCDs exhibited antioxidant activity of ~81% in the DPPH method. Further, the NCDs were incorporated into ethyl cellulose and polyethylene oxide (PEO) to prepare fibrous films using the electrospinning technique. The effect of various concentrations of NCDs (0.5, 1,1.5, and 2 mg/mL) on water swelling, stability, water contact angle, permeability, mechanical and thermal properties of fibrous films were discussed. In addition, the fibrous films were examined for their antioxidant activity using DPPH and ABTS assays, as well as for their antimicrobial properties. The shelf life of strawberries stored in the fibrous films was observed to improve significantly. Thus, the prepared fibrous packaging films could extend the fresh fruit product's shelf life in storage.

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Study of curing kinetics of hydrazide-substituted phthalonitrile (HYZ-PN) resin through model-based and model-free kinetic methods

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Abstract

The current presentation includes the curing of 3,4-dicyano-N'-(3,4-dicyanobenzoyl) benzo-hydrazide (HYZ-PN) resin by meta-aminophenoxydiphenylsulfone (m-APDS) as a curing catalyst which is investigated using differential scanning calorimetry (DSC) at heating rates of 5, 10, 15, and 20 °C min−1. The kinetic parameters of the curing reaction such as activation energy (Ea), reaction order (n), reaction rate constant (k), and Arrhenius factor (A) were calculated from non-isothermal kinetic methods. The curing kinetics of HYZ-PN resinwas computed through model-based and model-free kinetic methods. Model-based methods include Ozawa and Kissinger methods. MFK methods include FWO, Friedmann and KAS methods. The Ea for curing of HYZ-PN resin was evaluated to be ~ 137.763 kJ mol−1 and ~135.3 kJ mol−1 via Ozawa and Kissinger methods, respectively. TheCrane's equation was used to evaluate reaction order and was found to be~ 0.94. The Kissinger method was also used to estimate the frequency factor (A) value of ~ 1.1255E+12 and ultimately the rate constant at various peak heat release temperatures (Tp) to compute the rate equation for the HYZ-PN resin system.For phthalonitrile reactions the Ea have varied with degree of conversion and determined by Flynn Wall Ozawa (~125-185 kJ/mol) and Kissinger Akahira-Sunose (~121-180 kJ/mol) methods. The HYZ-PN resin shows high thermal parameters such as high thermal stability (> 350 °C), high char yield (~ 65 % at 850 °C) and high LOI (%) (> 40) which signifies that the resin is high temperature resistance.

Keywords: Phthalonitrile, Ozawa, Kissinger, FWO, KAS.

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Nadimide-substituted phthalonitrile resins (NPRs), and their structure-property evaluation for high-temperature applications

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Abstract

The current embodiment includesfive synthesis and structure-property evaluation of different phthalonitrile resin derivatives substituted with nadimide functionality. The synthesized NPRs resins have been characterized through NMR, FTIR, TGA and DSC. These NPRs have been synthesized via multi-step synthetic route involving nadimization of self-curing amino-phthalonitriles. These resins showwide processing window (> 90 °C) which may facilitate ease of processing for composites fabrications. The cured polymer networks of resins didn't show any glass transition temperature upto 350 °C during DSC scan. The thermoset polymers show high thermal stability (> 350 °C)with char yield of ~ 55 % at 800 °C. The empirical value of > 40 % have been obtained for LOI which show the self-extinguishing behaviour of cured polymer. During polymerization NPRs formed highly thermal stable units like isoindoline, triazines, and phthalocyanine. During flame retardance these moieties act as heat sink which dissipate the thermal energy through long-range conjugation. By virtue of aforementioned high thermal parameters, NPRs may be applicable to high temperature applications.

Keywords: Nadimide, phthalonitrile, triazines, phthalocyanine.

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Kaempferia galanga herbal supplementation alleviates hyperglycemia-induced dyslipidemia, oxidative stress, and apoptosis in BALB/c diabetic mice

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Abstract

Diabetes mellitus, a prevalent metabolic disorder, is characterized by chronic hyperglycemia resulting from impaired insulin secretion or action, leading to dyslipidemia, oxidative stress, and apoptosis. Kaempferia galanga (K. galanga), a widely used medicinal herb, is known for its diverse traditional pharmacological properties. The present study aims to scientifically evaluate the therapeutic potential of herbal Kaempferia galanga (KGE) supplementation in ameliorating hyperglycemia-induced oxidative stress and apoptosis in streptozotocin (STZ)-induced diabetic mice. Herbal KGE supplementation (350 mg/kg b.w) for 21 days in STZ-induced diabetic mice significantly prevents an increase in blood glucose level and also prevents altered lipid profile, thus indicating its potent anti-hyperglycemic and anti-hyperlipidemic activity. Herbal KGE supplementation significantly improved glycemic control in diabetic mice by acting through various targets involved in various metabolic pathways, such as AKT/PKB activation, glycogen synthase kinase-3 (GSK-3) inhibition, glucokinase (GK) stimulation, and downregulation of phosphoenolpyruvate carboxykinase (PEPCK). Antioxidant defense mechanisms were enhanced via upregulation of the expression of endogenous anti-oxidant enzymes such as superoxide dismutase (SOD) and catalase (CAT). Histological and ultrastructural analyses revealed preservation of the pancreatic, hepatic, renal, cardiac tissue, and blood cells architecture. Furthermore, herbal KGE supplementation reduced DNA fragmentation and apoptosis by modulating the expression of apoptotic markers—upregulating anti-apoptotic BCL-2, and downregulating pro-apoptotic BAX and apoptosis executioner caspase-3 (CAS-3). Serum and pancreatic insulin levels were also maintained in the herbal KGE-treated diabetic mice group, indicating protection of β-cell function. These findings suggest that herbal KGE supplementation exerts multifaceted anti-diabetic therapeutic effects and may serve as a promising adjunct therapy in the management of diabetes mellitus.

Keywords: Hyperglycemia, Oxidative stress, Apoptosis, Kaempferia galanga, Herbal medicine, Therapeutics.

Radiation and Plasma Assisted Development of Efficient Catalytic Systems for water pollutant remediation

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Abstract

Biodegradable and renewable polymers such as cellulose have attracted significant attention as sustainable platforms for the design of functional materials. Their physico-chemical properties and versatile processability make them suitable candidates for chemical modification and functional material development for range of applications [1]. Among the various modification strategies, radiation-induced grafting has emerged as a powerful tool to impart targeted functionalities through covalent attachment of monomers to cellulose without compromising its inherent structural integrity. These grafted cellulose templates can serve as efficient scaffolds for anchoring catalytic species, including metal nanoparticles (NPs), thereby aiding in the development of robust, reusable, and eco-friendly catalytic systems. Such materials are of growing interest for environmental remediation, organic synthesis, and green chemical processes, where efficiency, reusability, and environmental compatibility are critical.

Gamma radiation assisted grafting of glycidyl methacrylate (GMA) onto cellulose templates provides epoxy functionalized templates suitable for anchoring metal NPs like Au, Pd, etc. The radiation grafting process was optimized by studying the effect of various parameters: solvent type, solvent composition, monomer concentration and radiation dose. Subsequently, Au and Pd NPs were synthesized and simultaneously immobilized onto the functionalized cellulose template using a non-thermal plasma [Fig. 1]. This novel approach is devoid of any external stabilizers or reducing agent and ensures minimal wastage of expensive metal precursors [2]. The samples were thoroughly characterized by 13C-NMR, FTIR, SEM, TGA, XPS, ED-XRF, etc. Subsequently, the catalytic systems were employed for catalytic reduction-based remediation of pollutants (nitro compounds and dyes in case of Au NPs based catalyst, Cr(VI) in case of Pd NPs based catalyst, etc.). The catalytic systems could be reused for multiple cycles (>10) without any significant compromise in catalytic activity and displayed a storage stability of more that >8 months. Moreover, the catalytic systems were also studied in continuous flow column mode, further highlighting their potential for practical applications.

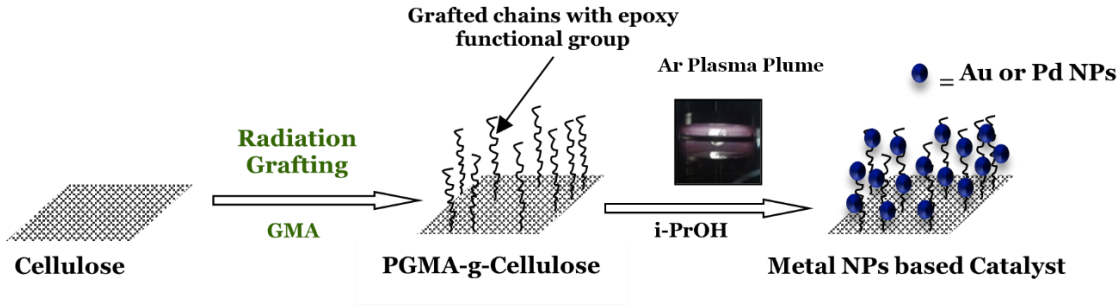

Fig. 1. Functionalization of cellulose template and fabrication of metal NPs based catalyst

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Synthesis, Characterization and Evaluation of Biological Activities of Azines based Schiff Bases and their Sn(II) Complexes

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Abstract

A new series of tin (II) complexes (C1 to C4) of the type [Sn(L)2(Cl)2] has been prepared by the reaction of tin dichloride and azines Schiff base ligands (L1 to L4) in 1:2 molar ratio. The azine ligands (L1 to L4) were prepared by condensation reaction of carbonyl compounds with hydrazine hydrate. The prepared ligands and their complexes were characterized by spectral characterization using 1H &13C NMR, FT-IR and mass spectral studies, which revealed that the ligand acts as bi and tridentate chelating ligand and coordinates via azomethine nitrogen and heteroatom or aryl carbon with the metal ion. Moreover, Schiff bases and their tin (II) complexes have been screened for antibacterial and antifungal activities. Azines based ligands and their Sn complexes shows good antimicrobial and antibacterial and antifungal activities.

Keywords: Antibacterial activity, Antifungal activity, tin complex, Schiff base.

Understanding chemical composition of hydrogel additives on Portland cement chemistry

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Abstract

The influence of chemically tailored hydrogel additives on the hydration behavior and mechanical performance of Ordinary Portland Cement (OPC) was investigated, focusing on the interaction between hydrogel composition and cementitious properties. Hydrogels are studied as smart carriers for incorporating self-healing mechanisms, through either, bacterial or chemical means into cementitious systems. Crosslinked hydrogels composed of 2-acrylamido-2-methyl-1-propanesulfonic acid (AMPS) and (3-acrylamidopropyl) trimethylammonium chloride (APMAC) were synthesized and incorporated into OPC at varying dosages (0.3–1.0 wt.%), with and without rice husk ash (RHA). The performance was benchmarked against AMPS-only hydrogels and unmodified OPC. Results demonstrated that AMPS+APMAC hydrogels provided improved long-term compressive strength, with 28-day values reaching 54 ± 3 MPa at 0.5 wt.%, nearly matching the control (57 ± 3 MPa), despite early-age reductions. In contrast, AMPS-only hydrogels led to significant strength deterioration (22 MPa at 7 days; 43 MPa at 28 days) due to excessive water retention and disrupted ion diffusion. The incorporation of RHA further decreased performance, likely due to suboptimal pozzolanic activity and increased heterogeneity. Fluidity and setting time were moderately affected, with AMPS+APMAC maintaining acceptable workability (211–212 mm) and set times (~240 min). These findings highlight the critical role of hydrogel chemistry, particularly the balance between anionic and zwitterionic moieties, in modulating cement hydration kinetics and matrix integrity. The synergy between AMPS and APMAC enabled internal curing without significant retardation, whereas improper compositions led to pore structure disruption and mechanical compromise. The study emphasizes that precise formulation and dosage optimization are key to leveraging hydrogels as functional cement additives for sustainable and durable construction materials.

Keywords: Hydrogel, Portland Cement, AMPS, APMAC, Curing.

6-Arylvinyl-1,2,4-trioxanes as potential antimalarial leads

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Abstract

Since ancient times, humankind has had to struggle against the persistent onslaught of pathogenic microorganisms and is still suffering. Malaria, a vector-borne disease caused by Plasmodium sp., is still one of the world's most deadly diseases that threaten nearly 40% of the world's population, putting 3.2 billion people at risk in 107 countries, and infects approximately 300−500 million people annually worldwide, mainly in tropical and subtropical areas.

As part of an endeavor to develop synthetic substitutes for artemisinin and its derivatives, we had earlier reported a photooxygenation route for the preparation of 6-arylvinyl- 1,2,4 trioxanes. Novel 6-arylethyl-1,2,4-trioxanes 6a−i and 7a−i are easily accessible in one step from the diimide reduction of 6- arylvinyl-1,2,4-trioxanes 5a−i. All these new trioxanes were assessed for their oral antimalarial activity against multidrug-resistant Plasmodium yoelii nigeriensis in a Swiss mice model. Most of the saturated trioxanes 6c, 6f, 6g, 6h, and 6i, the active compounds of the series, provided 100% protection to the malaria-infected mice at a dose of 24 mg/kg × 4 days. Further, trioxane 6i, the most active compound of the series, also showed 100% protection even at a dose of 12 mg/kg × 4 days and 20% protection at a dose of 6 mg/kg × 4 days. In this model, β-arteether provided 100% protection at a dose of 48 mg/kg × 4 days and only 20% protection at a dose of 24 mg/kg × 4 days via the oral route, which was found to exhibit 4-fold antimalarial activity compared with the currently used drug β-arteether.

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Preparation And Properties Of Carbon Fiber-Reinforced Epoxy-Aluminum Alloy Laminates

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Abstract

Fiber metal laminates are hybrid composites that consist of an alternate layer of thin metallic sheets and fiber-reinforced composites. The combination of both metal and composites enhances stiffness, impact resistance, fatigue resistance, and corrosion resistance. Fiber metal laminates are of three types: aramid fiber-reinforced aluminum laminates (ARALL), glass fiber-reinforced aluminum laminates (GLARE), and carbon fiber-reinforced epoxy aluminum laminates (CARALL). CARALL exhibits the highest specific modulus, impact resistance, and fatigue resistance. In the present work CARALL with an AA6061-T6 sheet of thickness of 1 mm was fabricated by compression molding method and studied the effect of volume fraction of fiber on tensile, flexural, and fatigue properties of CARALL. Two types of stacking configurations were considered. In the first type (AA/CF[0o/90o/0o]/AA), between two aluminum alloy (AA) sheets and three layers of carbon fibers (CF) with 0o orientation in the first layer, 90o orientation in the second layer, and then 0o orientation in the third layer were placed, denoted as CARALL-1. Similarly, another laminate, with the stacking configuration (AA/CF[0o/90o/0o/90o/0o]/AA), denoted as CARALL-2, was prepared. The tensile strength and fatigue strength of CARALL laminates are higher than that of AA6061-T6 sheet. The flexural strength of CARALL-1 is higher than CARALL-2. Scanning electron microscopy was used to analyze the failure mechanism in CARALL. Failure mechanisms in CARALL are due to delamination, fiber breakage, fiber pullout, and fiber/matrix debonding.

Green synthesis of metallic nanoparticles using plant extract

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Abstract

Nanoparticles (NPs) are any material that has a minimum one dimension in nano range 1 to100 nm. Nanoparticles due to there nanoscale size and high surface area enhanced chemical reactivity, energy absorption and biological mobility. Different methods used to synthesize NPs including Physical, Chemical and Green synthesis. Physical and chemical methods need high grade resources, high budgets and toxicity due to harmful residues. The green synthesis method a sustainable and biocompatible alternative. Green synthesis is an emerging area in the field of bio-nanotechnology. Green synthesis, A bottom up approach is similar to chemical reduction where an expensive chemical reducing agent is replaced by extract of natural products such as leaves of tree or fruits and other part of plant. for synthesis of metal NPs. The green method for synthesis of metal NPs include the use of plant extract from plant parts like root, leaves, stem and fruits . This techniques cost effective, ecofriendly, relatively reproducible and avoid toxic chemicals. From these techniques synthesize different metal NPs like-AgNPs, AuNPs, CuNPs etc.

Keywords Nanoparticle . Nanoscale. Green approach. Sustainable. Plant extract.

Biogenic Zinc Oxide Nanoparticles from Moringa oleifera: A Promising Green Antibacterial Strategy

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Abstract

Nanotechnology has emerged as a significant area of study within modern material science in recent decades. Green synthesised nanoparticles have attracted a lot of attention because of its intrinsic qualities, which include speed, cost-effectiveness, and environmental friendliness. Therefore, the manufacture of zinc oxide nanoparticles utilising leaf extract from Moringa oleifera is reported in this paper. Using SEM and EDX, the shape of the zinc oxide nanoparticles was described. The crystalline nature and purity of zinc oxide nanoparticles were demonstrated by X-ray diffraction (XRD) experiments. The precise functional groups in the nanoparticles that are in charge of reduction, stabilisation, and capping agents were examined using FTIR spectroscopy. Using the agar well diffusion method, the success-ability of bacteria with synthesised ZnO nanoparticles was examined. The synthesised ZnO NPs' antibacterial properties were tested against Gram-negative species Escherichia coli, Pseudomonas aeruginosa, and S. marcescens, as well as Gram-positive bacteria Staphylococcus aureus, Micrococcus luteus, and Bacillus subtilis. After a 24-hour incubation period, the zone of inhibition (ZOI) on the species under study showed how effective this nanoparticle was against them. According to the findings, ZnO-NPs exhibit extremely effective antibacterial activity and are being explored as a possible additive to replace harmful chemical and physical antibacterial agents.

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Cellulose acetate, a source from 6discarded cigarette butts for the development of mixed matrix loose nanofiltration membranes for selective separation

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Abstract

This study introduces a sustainable approach for extracting cellulose acetate (CA) from discarded cigarette filters, which is then used to fabricate cellulose-based membranes with high water flux and pollutant rejection capabilities. While CA membranes are effective for removing dyes and ions, their efficiency tends to drop at very low contaminant concentrations. To overcome this limitation, graphene oxide (GO) and carboxylated titanium dioxide (COOH-TiO_2) nanoparticles were incorporated into the CA matrix to form mixed matrix membranes (MMMs). These modified membranes were evaluated for their performance in removing various commonly used dyes and salts [1]. The CA extracted from cigarette butts was blended with GO and COOH-TiO_2 to produce the MMMs. The resulting membranes demonstrated effective separation of five dyes methyl orange, methyl violet, methylene blue, cresol red, and malachite green—as well as two salts: NaCl and Na_2SO_4. The rejection rates for the dyes were as follows: 94.94% for methyl violet, 91.28% for methyl orange, 88.28% for methylene blue, 89.91% for cresol red, and 91.70% for malachite green. For the salts, the membranes achieved ~40.40% rejection of NaCl and ~42.97% of Na_2SO_4. Additionally, the membranes exhibited a tensile strength of up to 1.54 MPa. To better understand the properties of the membranes, various characterization techniques were employed. Their antibacterial properties were also tested using the Muller-Hinton Disk diffusion method against both gram-positive Staphylococcus aureus and gram-negative Escherichia coli. This research highlights a promising method for turning waste into valuable, eco-friendly membrane materials for water purification applications [2, 3].

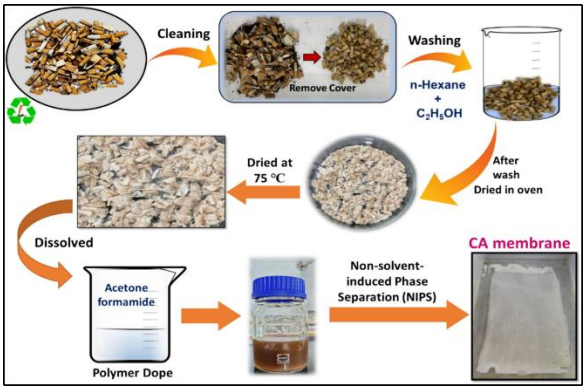

Fig. Diagram showing the entire procedure for creating CA membranes from cigarette butts using the phase inversion method

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Flame retardant PP bio composites filled with ATH and reinforced with surface modified sisal fiber (SF): Investigation of the mechanical, thermal, morphological and flammability properties of thermoplastic polymer PP/ATH bio-composites

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Abstract

The current study focuses on the development of flame-retardant bio-composites based on polypropylene (PP) reinforced with surface-modified sisal fibers (SF) and filled with aluminum trihydrate (ATH). An indepth study on the mechanical, thermal, morphological and flammability properties of the PP/ATH bio-composites has been undertaken[1]. Experimental findings revealed that incorporation of 30 wt% of surface modified SF and 3 wt% of ATH has led to 57% increase in tensile strength and a 176% in impact strength as compared with neat PP. Differential scanning calorimetry (DSC) analysis showed higher crystallinity in the biocomposites due to nucleating effects of ATH, restricting the mobility of the matrix polymer chains. Thermogravimetric analysis (TGA) revealed improved thermal stability in the biocomposites, increase in final degradation temperature. Scanning electron microscopy (SEM) analysis confirmed uniform fiber dispersion and strong fiber-matrix bonding. Flammability tests in the biocomposites employing UL-94 showed V-2 rating with nearly 29% decreased rate of burning. Limiting oxygen index (LOI) studies showed increase from 18% (neat PP) to 24%, in case of the biocomposites with a decreased PHRR to the tune of 22%. These results demonstrate the synergistic effect of ATH and modified SF in enhancing fire resistance while maintaining mechanical integrity in the PP/ATH/SF biocomposites [2].

Keywords: sisal, polypropylene, aluminium trihydrate, polymer composites.

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Development of High-Performance Thermally Conductive Epoxy Adhesives Using Conducting Polymers and CNTs

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Abstract

Thermally conductive adhesives are specialized materials designed to efficiently transfer heat between surfaces while providing adhesion. The combination of carbon nanotubes (CNTs), polyaniline (PANI), and epoxy resin (EP) holds significant promise for developing thermally conductive adhesives used in electronics. When integrated into adhesives, this CNT/PANI/EP system can facilitate efficient heat transfer while providing strong bonding and durability. This makes it highly suitable for applications in electronic assemblies where effective thermal management is critical, such as in high-power components and semiconductor devices. This study investigates the impact of carbon nanotubes (CNTs) and polyaniline (PANI) in epoxy adhesives. The CNTs were functionalized with polyaniline (PANI) and these PANI-modified CNTs were then integrated into an epoxy resin matrix to create epoxy PANI-CNT composite adhesives. The electrical, thermal, morphological, and mechanical properties of the hybrid CNT/PANI/epoxy composite were evaluated and compared with those of binary adhesives containing only CNTs or PANI. The surface morphology, structural, chemical, electrical and thermal properties are meticulously investigated using scanning electron microscopy (SEM), fourier transform infrared spectroscopy (FT-IR), differential scanning calorimetry (DSC), gel permeation chromatography (GPC), dynamic mechanical analysis (DMA), thermogravimetric analysis (TGA)and conductivity measurements. The outstanding properties of the hybrid adhesive present significant potential of the adhesive to meet the demanding adhesive applications where traditional adhesives might fail, thus ensuring long-term reliability and performance.

Keywords: Polyaniline, carbon nanotubes, epoxy, adhesives.

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Development and Characterization of Jackfruit Seed Starch-Based Nanocomposite Films for Sustainable Active Packaging Applications

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Abstract

The growing demand for sustainable materials has driven the development of biodegradable and compostable polymers as alternatives to conventional fossil-derived plastics. This study focuses on the fabrication and characterization of jackfruit seed (JFS) starch-based nanocomposite films intended for active packaging applications. Nanocomposite films were prepared with varying concentrations of halloysite nanotubes (HNT) and bioactive additives, and evaluated for their morphological, mechanical, water uptake, antimicrobial, and antioxidant properties.

Water uptake analysis indicated that the film containing 3 wt% HNT and 5 wt% additive showed the lowest water absorption (4.33%), demonstrating enhanced water resistance. Scanning electron microscopy (SEM) revealed a smooth, homogeneous film surface without phase separation. Fourier-transform infrared spectroscopy (FTIR) confirmed strong interactions between starch and the incorporated active agents, with increased additive concentration and reduced HNT content enhancing bonding efficiency. The synergistic interaction between HNT and the additives improved mechanical performance, while the additives also conferred notable antimicrobial and antioxidant activities—features that may contribute to extending the shelf life of packaged foods. SEM images revealed the uniform surface, X-ray diffraction (XRD) analysis provided insights into the crystalline structure of the nanocomposites, supporting the observed enhancements in film properties.

Overall results indicated that, jackfruit seed starch-based nanocomposites as promising candidates for sustainable active packaging, offering a functional and eco-friendly alternative to synthetic plastics.

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Efficient Energy Harvesting Using Processed Poly (vinylidene fluoride) Nanogenerator

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Abstract

Poly(vinylidene fluoride) (PVDF) is processed at high temperature to generate energy from waste mechanical energy. The piezoelectric β phase has been induced through uniaxial elongation of polymer films at high temperature. The extent of β-phase has been confirmed from a deconvoluted XRD pattern, found to be ∼75% of the electroactive phase, and able to demonstrate high piezoelectric effect as evident from the measured piezoelectric coefficient of −30 pC/N after a suitably processed and poled specimen. Bulk morphology and spectroscopic studies support the structural alteration. Following the direct piezoelectric effect, energy harvesting devices have been fabricated which show very high-power output of 55.2 μW/cm2 using the processed and poled specimen. Thus, robust and easily processable polymeric material having very high energy conversion efficiency is demonstrated which is sufficient to power miniaturized devices.

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Next Generation 2-Dimensional Materials and Nano-Bio Composites for Biosensing, Food Safety and other Health-Care Applications

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Abstract

Our research study is based on the employment of next generation nano-materials for different bio-applications. The first part of study is based on the employment of 2-Dimensional Nano-sheets (2D NSs) for Fluorescence Biosensing of prostate specific antigen (prostate cancer biomarker) where picomolar sensitivity was obtained in PBS buffer. Further, we have employed biopolymer polyethylene glycol (PEG) to minimize the non-specific binding in the multiplexed biosensing system of food toxins (i.e. Aflatoxins B1 (AFB1) and Aflatoxins M1 (AFM1)). The designed PEGylated Ternary transition metal sulfides 2D NSs based fluorescent sensor exhibited ultrasensitive detections (~ pM) and a wide linear range (≥ 5 orders) for AFB1 and AFM1 in complex matrix (e.g., low fat milk and human serum), which can serve as a unique platform for facile, ultra-sensitive, selective, cost-effective, and quick multiplexed detection of food toxins and disease biomarkers in complex-matrix. In the second part of research study, UCNPs have been applied for optogenetics as health-care applications. The Optogenetics combines “Optics” and “Genetics” for the study of light sensitive proteins for neurological disorders. In the present study, non-invasive light source for deep-tissue optogenetic purposes has been studied by employing PEG modified UCNPs which absorbs NIR radiation and emit visible light to study light sensitive proteins. Further, our future research endeavour is based on employment of unexplored 2D NSs and other types of nano-bio composites for food safety and developing a biodegradable or eco-friendly Intelligent Packaging Materials to enable real-time food quality monitoring during storage and transportation. In addition, we further aim to develop a portable point-of-care device for the early detection of dreadful diseases such as cancer which provides a generic approach for other types of disease and food toxins detection. Overall, our project focuses on food and health safety and overall well-being of society.

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Biomaterials Integrated with Phage Therapy and Phytochemicals for Wound Healing Applications

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Abstract

Chronic wounds and antibiotic resistance are worldwide health concerns. Bacteriophage therapy is an emerging option that serves as an alternative to antibiotics, particularly for multidrug-resistant infections. Bacteriophage therapy provides a tuneable, targeted, and possibly safer approach to combat complex antibiotic-resistant infections. On the other hand, phytochemicals have been shown to have anti-inflammatory and antimicrobial properties. However, the currently available treatments fall short for the treatment of chronic infections, and there is an unmet need for alternatives to the current strategies. In this direction, the proposed work combines the biomaterial, along with phage therapy and phytocomponents within a single-biomaterial matrix to provide a synergistic effect through antibacterial and wound-healing properties. Hence, a chitosan-based biomaterial system incorporating phytocomponents and a phage cocktail is developed, and its physicochemical, biological, and antimicrobial potential are analyzed for chronic wound applications.

For the proposed study, biomaterials were fabricated using chitosan as a base matrix and loaded with powdered Berberis aristata and an oil-based phytocomponent. Along with phytocomponents, a phage cocktail targeting Klebsiella pneumoniae strains was also incorporated in the biomaterial matrix. Further, the biomaterial were assessed for swelling ratio and water uptake capacity, mechanical strength, antimicrobial activity, and biocompatibility using fibroblast cell lines.

The proposed approach demonstrates enhanced antimicrobial properties via phage therapy. The biomaterials also showed favourable mechanical and swelling properties. Further, biocompatibility studies displayed the highest fibroblast cell proliferation in the phytocomponent containing groups showing uniform and flattened cell morphology, indicating the synergistic role of incorporated components in enhancing the wound healing potential of the biomaterials. In conclusion, the developed combinatorial approach is expected to form a potential strategy for overcoming the challenges currently being faced during the treatment of chronic wounds.

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Halloysite nanoclay incorporated gelatin electrospun fibre for bio-separations: synthesis, characterization and biological studies

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Abstract

Biopolymer-based electrospun fibres are attracting increasing attention in separation applications. For the separation of impu rities like small-sized unwanted molecules from blood, we have designed and fabricated a new filter medium from gelatine which is cost effective and biodegradable. Gelatin fibres obtained from an electro-spinning process were incorporated with halloysite nanoclay. The morphology of the filter medium was examined by SEM and the fibre average diameter was found to be 1–3 µm. The in silico permeation studies, pore size, porosity and flow velocity studies were done using three-dimensional X-ray micro-tomography. The evaluation of the mechanical strength showed an increase in tensile properties with the addition of halloysite nanoclay. The in vitro 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay for cell viability of the L929 fibroblast cells showed no toxicity which was confirmed by haemolysis study. The preliminary results indicated that these filter media showed good potential separation of small-sized molecules and could possibly be a replacement of synthetic membranes for dialysis treatment in the near future.

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Formulation and Evaluation of electrospun Antimicrobial Scaffolds for biomedical applications

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Abstract

To reduce possible antimicrobial resistance against antibiotics, development and characterization of composite scaffolds based on Carboxymethyl Chitosan (CmCh.) and Gelatine (Gel.) was carried out. Scaffolds were fabricated via electrospinning using three varying CmCh.:Gel. ratios as well as the addition of polyvinyl alcohol to lower the surface tension and facilitate fiber formation. The crosslinker was Vanillin, chosen by docking score against Farnesyl Diphosphate Synthase, and incorporated by vapour phase deposition.

The scaffolds were thoroughly characterized by FTIR, DSC, X-ray Crystallography, SEM, HR-TEM, Optical Profilometry/Micro System Analyzer (OP/MSA), Goniometry, and Universal Testing Machine (UTM). Further evaluations involving swelling index, hydrolytic degradation, water-vapour exchange, percent porosity and followed by antimicrobial assay against strains of Enterococcus faecalis, S. aureus and Streptococcus mutans using well diffusion method were performed. Satisfactory crosslinking was confirmed by FTIR, whereas DSC thermograms demonstrated thermal stability up to 556.05 °C and retention of crystalline-amorphous composition. SEM images showed nanofibrous structures and aligned pore structure. By means of examination of diffractograms the transition in the crystallinity of nanofibers in composites towards amorphous nature could be observed and was associated with HR-TEM images. OP/MSA showed a perfect roughness profile (<10 µm), which is optimal for bio-adhesion in nature. Contact angles were low indicating hydrophilic nature by goniometric analysis. UTM tests established that all formulations had tensile strength exceeding 1 N. The scaffolds maintained prolonged swelling up to 15 days and they started to degrade slowly after 5 days. The water-vapour exchange was found to be effective during 21 days, and the high porosity, proved by alcohol displacement, favours the absorption of fluids. In the antimicrobial assay, it was observed that scaffolds exhibited optimal sensitivity to the growth of the tested bacterial strains relative to Ciprofloxacin (500 µg/mL). The compatibility of the scaffolds with the skin was assessed through Rabbit Dermal Irritation Test and it was revealed that the scaffolds do not elicit any significant inflammatory reaction. In general, the CmCh.-Gel. composite scaffold displayed very good physicochemical and mechanical characteristics, which would make it a good option to consider in future biomedical practice.

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Self-powered Supramolecular Micropumps for On-chip Sensing

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Abstract

Self-powered micropumps that can turn "on" in response to specific analytes and providing precise control over the flow rate without aid of any external power source offer considerable promises in next generation smart devices. Recently, autonomous motion that arises from the catalytic harnessing of chemical free energy from the surrounding environment has been demonstrated at the nano- and microscale. Tethering these catalytic systems to surfaces enables the transfer of the mechanical force to the surrounding fluid. For example, surface-bound enzymes act as pumps in the presence of their specific substrates and driving large scale fluid flows. Despite the impressive progress, these micropumps are still fuel specific which limits their practical applications.

In this work, we introduce a self-powered supramolecular lab-on-a-chip platform driven by "host-guest" interactions, which serve as the fundamental mechanism for micropump activation. In this system, a variety of "guest" molecules function as chemical fuels, initiating fluid motion upon binding with complementary "host" molecules. Specifically, we employ ferrocene-grafted polyethyleneimine (PEI-Fc) films, assembled via a layer-by-layer technique on glass substrates. When exposed to "host" molecules such as Cucurbit[7]uril (CB[7]), inward fluid flow is generated because of localized density changes near the film surface due to "host-guest" complexation. Crucially, the introduction of a competitive "guest" molecule with higher binding affinity such as amantadine displaces the pre-bound "guest", allowing fine-tuned modulation of fluid flow based on analyte concentration. Utilizing this competitive displacement assay, we demonstrate sensitive detection of amantadine, a therapeutic agent for Parkinson's disease and Influenza, down to nanomolar levels in both urine and plasma. The system performs effectively in complex biological fluids, highlighting its potential for real-time, point-of-care drug monitoring in biomedical applications.

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Optimizing Sustainable Nanomaterials: The Transformative Role of AI and ML in Green Nanotechnology

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Abstract

The marriage of machine learning (ML) and artificial intelligence (AI) is increasingly aiding the rapidly emerging multidisciplinary field of green nanotechnology, which is focused on the development of eco-friendly applications and sustainable nanomaterials. Through yield improvement (up to 98%), reduction of energy consumption by 20–35%, and reduction in the use of harmful solvents by over 50%, these computational approaches are vital for maximizing the nanomaterial synthesis while accurately estimating environmental impacts. For example, silver nanoparticles (AgNPs) synthesized from Azadirachta indica extract under ML-maximized conditions exhibited remarkable antibacterial activity (zone of inhibition: 21 mm vs. E. coli) and stable spherical morphology (mean diameter 28.5 ± 2.3 nm). Similarly, ZnO nanoparticles synthesized using green chemistry from Moringa oleifera exhibited enhanced photocatalytic degradation of methylene blue dye (92.4% degradation yield in 60 minutes under sunlight). Reliable forecasts of nanoparticle properties such as zeta potential (+/- 25–35 mV for colloidal stability), band gap energy (2.7–3.2 eV, for example, for ZnO/TiO_2 composites), and cytotoxicity thresholds (e.g., IC_{50} > 100 µg/mL in HEK293 cells) are enabled by big machine learning training datasets, which comprise over 15,000 synthesis entries. High-throughput screening of over 120,000 inorganic compounds is enabled by AI-based platforms like Citrine Informatics and The Materials Project that accelerate biodegradable nanomaterials with low ecotoxicity (e.g., LC_{50} > 200 mg/L for Daphnia manga). The performance of TiO_2-based photocatalytic reactors for water treatment in environmental remediation is enhanced by AI systems, which ensure 99.1% elimination of organic contaminants (e.g., phenol 10 mg/L) within 90 minutes of UV exposure. Predictive maintenance by AI reduces downtime in the system by 30–40%. CNN-based models for detecting defects have 95%+ accuracy in real-time monitoring of nanostructure integrity. The choice of nanomaterials with better environmental safety profiles is also facilitated by AI-aided simulations like density functional theory (DFT) and molecular dynamics (MD). These include carbon quantum dots, which have been found to be toxic-free in zebrafish embryos up to 500 µg/mL, and bio-polymeric nanocarriers, which possess sustained release kinetics and more than 85% drug encapsulation efficiency. Scientists can greatly enhance the design, performance, and sustainability of drug delivery, pollution abatement, and energy storage applications (e.g., lithium-sulfur batteries with nanoengineered cathodes that have 1200 mAh/g capacity at 100 cycles) through the integration of AI and ML into green nanotechnology. A greener, smarter age of technology is likely to evolve as a consequence of this convergence, which promises to reduce environmental risks by up to 45%.

Keywords: Nanomaterial, Computational Models, Sustainable, Applications, Renewable.

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Dielectric relaxation and electrical conductivity of Magnetic Iron Oxide nanoparticle reinforced silicone elastomer nanocomposites.

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Abstract

Silicone elastomer nanocomposites were fabricated by mechanical mixing and compression molding by reinforcing the Magnetic Iron Oxide (Fe3O4) nanoparticles at various concentrations (1, 3, 5, and 7 wt%) in to the pure silicone elastomer. The dielectric relaxation behavior of silicone elastomer nanocomposites with different Magnetic Iron Oxide (Fe3O4) nanoparticles concentrations has been investigated over a frequency range of 10-1-105 Hz. The effect of Magnetic Iron Oxide (Fe3O4) loading on both the real and imaginary sections of impedance is clearly seen. The considerable change in impedance parameters with filler loading is explained in terms of interfacial polarization in a heterogeneous medium and polymer chain relaxing. The capacitance of the nanocomposite is represented in terms of dielectric permittivity and explained using the polarization of the Fe3O4 NPs in the silicone matrix. The system's conductivity and relaxation phenomena were investigated using the electrical modulus formalism. The effects of Fe3O4 NPs concentrations on dielectric permittivity and electrical conductivity were also investigated. The dielectric permittivity of the composites is greatly dependent on the amount of Fe3O4 nanoparticle concentration. The scanning electron micrographs (SEM) indicate that Fe3O4 NPs agglomerate above 5 phr concentration and form a continuous network structure.

Keywords: Elastomer, nanocomposite, morphology, dielectric, impedance, relaxation.

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Anti-inflammatory and analgesic activity of ethanolic extract and different fractions of Eulophia nuda Lindl.

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Abstract

Recently, in human and animal diseases, inflammation and pain have become the focus of scientific research as it affects more people than any other disease. Inflammation is the natural phenomenon of the immune response to remove stimuli when the body is exposed to external/internal injury. Eulophia nuda Lindl. is a perennial orchid and belongs to the family Orchidaceae. This plant is used according to folklore for the treatment of human breast cancer, inflammation, pain and as an antioxidant. The present study aims to evaluate the anti-inflammatory and analgesic potential of the ethanolic extract of tubers and different fractions of Eulophia nuda. The ethanolic extract (ENEE) and different fractions of E. nuda were prepared by liquid-liquid extraction. ENEE and obtained fractions were used to evaluate anti-inflammatory activity assessed on carrageenan-induced inflammation using the cotton pellet method. The ENEE and different fractions were also used to evaluate analgesic activity by assessing via the tail immersion test and hot plate method. The significant results from the present study indicate that ethanolic extract and its different fractions possess anti-inflammatory and analgesic potential, supporting the traditional uses of the plant. Further investigation is required to reveal the exact metabolites responsible for the observed result.

Multiwell hydrogel for in vitro 3D cancer model fidelity

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Abstract

In the revolutionizing era of in vitro cancer modeling, the 2D cell culture technique has been now left behind because of its deviated tumorigenic properties. 3D in vitro models mimicking physiologically relevant tumor characteristics inclusive of the various tumor promoting factors (TPFs) is desirable. Additionally, the features like Extra Cellular Matrix (ECM) mimicry (compositional as well as topographical) and tissue stiffness resemblance in the 3D substrate which can avail high throughput multiple 3D in vitro cancer model is whoppingly coveted to dive down to precision personalized medicine. Such combinatorial in vitro system is the current demand for advance pursuit in cancer biology research.

In the current study, two biocompatible and biodegradable ECM mimicking polysaccharides – Dextran and Chitosan where chemically modified to Oxidized dextran and Thiolated chitosan (MDC), aiding them self-crosslinking property in aqueous medium. The macroporous (avg. pore size - 4721.599 µm2) freeze-dried scaffold attained topographical, stiffness (young's modulus – 11 kPa) and compositional resemblance compared to that of TCPS substrate, former to be more biologically pertinent to ECM. According to GLOBOCAN 2020 data, occurrence of Breast cancer ranks first amongst females with 2.3 million new cases worldwide. Furthermore, American Cancer Society in its report of 2022 states; Triple Negative Breast Cancer (TNBC) accounts 10-15% of all the breast cancer cases. Thus, in this study MDA-MB-231, a TNBC cell line was used to evaluate development of MW-MDC hydrogel aided 3D tumoroids to be possessing TNBC relevant tumor microenvironment (TME) along with the TPFs. Due to the non-fouling surface trait of MDC, cell aggregates post 6 days of cell seeding forms 3D tumoroids which showed significantly less proliferation potential; measured using CCK8 assay compared to 2D cultured cells at 2nd ($p< .001$), 4th ($p< 0.0001$), and 6th day ($p< 0.001$). The TPFs such as IL10 ($p< 0.05$), IL6 ($p< 0.001$), TNFA ($p< 0.05$), and total TGFB ($p< 0.0001$) secreted were statistically higher in 3D tumoroids compared to 2D cultured cells. Moreover, the pivotal TPF – Hypoxia estimated through HIF1A differential gene expression was 1.4 fold more in 3D tumoroids than in the 2D cultured cells. This result corroborated with the outcome deduced through fluorescence images; reflecting Hypoxia specific EF5 binding adducts in 3D tumoroids. Additionally, Cancer stemness in the 3D tumoroids were determined by Florescence assisted cell sorting (FACS) for % cell population expressing stemness marker CD24, CD44 and CD 133. Further, the incremental cancer stemness was verified with NANOG (3.33 fold↑), SOX2 (0.42 fold↑) and ALDH1A1 (1.8 fold↑) in 3D tumoroids compared to 2D cultured cells. Furthermore, whole transcriptome sequencing was performed to screen out differential gene expression in 3D tumoroids compared to 2D cultured cells, where 5,765 genes were upregulated and 5,363 genes were downregulated. Deduced from that, key signaling pathways involved in regulation of tumor progression were studied through bioinformatic analysis. Overall, the TPFs analyzed in MDC hydrogel aided 3D tumoroids proven it to be mimicking the physiological TNBC micro tumor mass compared to 2D cultured cells. Importantly, drug cocktail treatment of Doxorubicin and Paclitaxel 2 µM (1:1) post 72 hours of treatment showed significant reduction ($p< 0.01$) in drug cocktail efficacy on 3D tumoroids than the 2D cultured cells. Thus, the TPFs and TME of the MDC hydrogel aided TNBC 3D tumoroids effectively reflected the drug resistance observed during in vitro to clinical chemotherapeutic translation. The multiwell MDC scaffold (MMS) was derived using casting method using mould. Henceforth, the MW-MDC hydrogel comes into light as potent 3D substrate with unique combination of macroporosity, ECM mimicking polymeric composition, desired stiffness and multiwell design. Also, the 3D tumoroids aided through it emerged as the relevant in vitro TNBC 3D in vitro model platform to study cancer biology, to screen for personalized medicine and to develop promising therapeutic strategies to combat Triple Negative Breast Cancer.

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Synthesis of Isoxazole-isoxazoline Derivatives of Eugenol as Potential Inhibitors of VEGFR2

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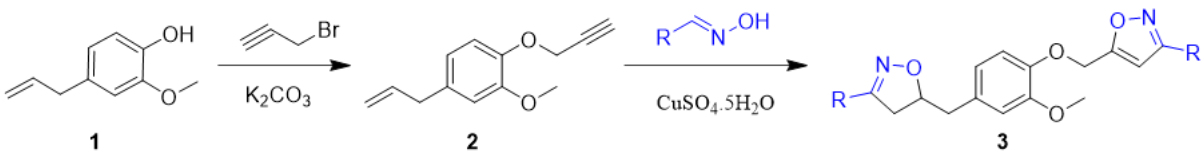
Abstract

Present study explores the synthesis of isoxazole-isoxazoline derivatives of eugenol (1).1 These derivatives have been synthesized by employing copper-catalyzed cycloaddition, commonly referred to as click reaction, and subsequently assessed for their binding affinity to the vascular endothelial growth factor receptor 2 (VEGFR2) protein, which is crucial in angiogenesis and tumour growth.2 Among the synthesized derivatives, several displayed significant binding affinity to VEGFR2, compared to FDA-approved drug Sorafenib.3 These promising results highlight that eugenol derivatives hold significant potential as VEGFR2 inhibitors, hence paving the way for new therapeutic approaches in cancer treatment.



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Fe_3O_4-Decorated Sulfonated Graphene Oxide Nanocomposites: A Dual-Action System for Dye Degradation and Microbial Inhibition

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Abstract

Nanocomposites composed of metal nanoparticles and sulfonated graphene oxide (SGO) have drawn increasing research interest due to their diverse applications in the field of materials science. This study focuses on the development of a highly efficient photocatalyst synthesized via the co-precipitation method incorporating Fe_3O_4 nanoparticles with SGO to form a Fe_3O_4@SGO (FSGO) nanocomposite. A range of characterization techniques—X-ray diffraction (XRD), thermogravimetric analysis (TGA), energy-dispersive X-ray spectroscopy (EDX), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and Fourier-transform infrared spectroscopy (FT-IR) were used to analyze the properties of the synthesized material. The FSGO nanoparticles were found to have an average diameter of approximately 8.2 nm. Optical analysis revealed a bandgap energy of 2.3 eV. UV–Vis spectroscopy confirmed that the reduced bandgap enhances the photocatalytic activity of the composite, attributed to the uniform dispersion of metal oxide nanoparticles on the high-surface-area SGO sheets. This structural arrangement facilitates efficient charge transport between the metal oxides and surrounding organic molecules resulting in improved degradation performance.

The prepared nanocomposite displayed advantageous features such as high surface area, good stability and effective recyclability. Rose Bengal (RB) dye was used as a model contaminant to assess photocatalytic performance, with results indicating an impressive 95% degradation rate within 90 minutes. The reaction followed pseudo-first-order kinetics with a calculated rate constant of 0.0326 min^{-1}.

Beyond photocatalysis the nanocomposite also exhibited antimicrobial properties. It demonstrated a minimum inhibitory concentration (MIC) of 50 µg/mL against Staphylococcus aureus showing comparable efficacy to standard antibiotics like chloramphenicol and ciprofloxacin. Furthermore, antifungal activity against Candida albicans was observed with an MIC of 500 µg/mL suggesting better performance than the reference antifungal agent griseofulvin.

Keywords: Photocatalyst, Ferrite, dye degradation, antimicrobial activity.

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Eco-Friendly Synthesis of Al_2O_3/CeO_2-Biochar Nanocomposites for Efficient Water Purification: Targeting Pb^{2+} and Pharmaceutical Pollutant

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Abstract

The present research investigates the eco-friendly synthesis of a biochar-supported nanocomposite utilizing Hibiscus rosa-sinensis leaf extract and biochar derived from Cassia fistula pods. The synthesized nanocomposite was comprehensively characterized using Fourier-transform infrared spectroscopy (FTIR), field emission scanning electron microscopy (FESEM), high-resolution transmission electron microscopy (HRTEM), photoluminescence (PL) spectroscopy, ultraviolet-visible (UV–vis) spectroscopy, X-ray diffraction (XRD), thermogravimetric analysis (TGA), Brunauer-Emmett-Teller (BET) surface area analysis, energy-dispersive X-ray spectroscopy (EDX) with elemental mapping, and X-ray photoelectron spectroscopy (XPS). The nanocomposite was explored for its dual functionality in the adsorption and degradation of toxic Pb^{2+} ions and the pharmaceutical contaminant sulfamethoxazole (SMX) from wastewater. BET analysis revealed a significantly enhanced surface area for nanocomposite (143.52 m^2/g) compared to nanoparticles alone (103.50 m^2/g), contributing to improved adsorption efficiency. XRD and HRTEM analyses confirmed the nano-crystalline structure of the composite. Under optimized experimental conditions, the nanocomposite exhibited remarkable adsorption efficiencies of 95.78% for Pb^{2+} ions and 97.47% for SMX. Isotherm studies indicated that the adsorption process followed the Langmuir model, with a high regression coefficient (R^2 = 0.99), confirming monolayer adsorption behavior for both contaminants. Kinetic analysis revealed that the adsorption mechanism adhered to a pseudo-second-order model, suggesting a chemisorption-dominated, spontaneous, and feasible process. The successful adsorption of Pb^{2+} and SMX was further validated by post-adsorption FTIR spectra and EDX/elemental mapping. Additionally, the photocatalytic activity of the nanocomposite was enhanced due to its narrow bandgap energy of 2.2 eV, achieving 93.35% degradation of SMX under visible light irradiation. Overall, the synthesized nanocomposite presents itself as an efficient, sustainable, and multifunctional material for wastewater treatment.

Keywords: Hibiscus rosa-sinensis, Adsorption, Degradation, Desorption-recycle.

Decoration of 1,3 oxazole modified g- C3N4 by Bio-synthesized Ag nanoparticle for the photodegradation of pharmaceutical effluent: Clotrimazole

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Abstract

The current work demonstrates the fabrication of Ag nanoparticle (Ag nps) loaded oxazole modified g- C3N4(COA) photo catalysts. A novel green method was opted to synthesize silver nanoparticles using seed extract of Nigella sativa. The photo catalyst was comprehensively characterized by Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), Scanning electron microscopy/energy dispersive X-ray spectroscopy (SEM/EDS), High-resolution transmission electron microscopy (HR-TEM) and X-ray photoelectron spectroscopy (XPS). The optical activities were analysed by double beam UV- Vis and photoluminescence. The catalytic potential of synthesized COA have been tested for degradation of Clotrimazole (CTZ) pharmaceutical effluent as model pollutant. The photo degradation results have shown that about 94.5% of CTZ get degraded over the duration of 120 min. To explore the real scale application, the effect of catalysts dosage and pH have been studied. The major active radical species responsible for the degradation have been identified by radical scavenging experiments.

Keywords: Bio-synthesized, Ag nanoparticle, oxazole modified g- C3N4, Photodegradation, Clotrimazole.

Xerophytic to Bioplastic: Development and Characterization of Bioplastic from Opuntia ficus Pulp

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Abstract

The global reliance on petroleum-based plastics has led to the annual production of approximately 300 million metric tons of plastic, with nearly 50% ending up in the environment as waste. This accumulation contributes significantly to ecological degradation and poses serious health risks. In response to these challenges, the need for sustainable, biodegradable alternatives to conventional plastics has become increasingly urgent.

This study explores the potential of Opuntia ficus, a xerophytic plant, as a novel source for bioplastic production. A biopolymer was developed using the pulp of Opuntia ficus, aiming to provide an eco-friendly, renewable, and cost-effective substitute for synthetic plastics. The bioplastic was subjected to comprehensive testing, including tensile strength, water solubility, water absorption, water contact angle, biodegradability and morphological analysis. The results demonstrated that the Opuntia ficus-based bioplastic exhibits promising mechanical and environmental properties, making it a viable and sustainable alternative to conventional plastics for both industrial and commercial applications.

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Enhancing the surface integrity of additively manufactured Nickel-based alloy using novel polymer based viscoelastic abrasive finishing process

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Abstract

Additively manufactured (AM) Nickel-based superalloy IN718 often exhibits poor surface integrity, characterized by high roughness, surface/sub-surface defects, and detrimental residual stresses, limiting its performance in critical applications. This study investigates the efficacy of a novel Polymer-based Viscoelastic Abrasive Finishing (P-VAF) process for enhancing the surface integrity of AM IN718 components. The P-VAF process utilizes a specially formulated viscoelastic polymer medium impregnated with fine abrasive particles, capable of conforming to complex AM geometries and providing controlled, gentle material removal. Experiments were conducted on laser powder bed fusion (LPBF) IN718 specimens. Results demonstrate that P-VAF significantly reduces average surface roughness (Ra) and eliminates adhered particles and micro-tears characteristic of the as-built AM surface. Furthermore, the process induces beneficial compressive residual stresses in the near-surface region and refines the microstructure, contributing to improved microhardness and fatigue performance. Comprehensive characterization using surface profilometry, scanning electron microscopy (SEM), X-ray diffraction (XRD) residual stress analysis, and microhardness testing confirms the substantial enhancement in surface integrity. The P-VAF process presents a promising, efficient post-processing solution for achieving superior surface quality and functional performance in high-value AM IN718 components.

Transforming Lignin into Polymer Film with Improved Physicochemical Properties via Itaconic Acid Modification and Polycaprolactone Grafting

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Abstract

Owing to lignin's renewability and abundance, the development of lignin-based copolymers has shown significant potential in renewable film applications. In response to the growing global demand for such sustainable materials, this study proposes a two-stage modification strategy to enhance the physicochemical properties of alkali lignin (AL). Initially, AL was chemically modified with itaconic acid (IA) to improve its reactivity and compatibility. In the second stage, the IAL was further grafted with the ε-caprolactone (CL) to synthesize a lignin-grafted polycaprolactone copolymer (IAL-PCL). The chemical modification and grafting were confirmed by FT-IR, NMR, and XPS analyses. Thermal properties were evaluated using TGA and DSC, indicating enhanced thermal stability post-modification. Furthermore, the water contact angle increased from 65° to 87° with higher CL content, suggesting improved hydrophobicity and grafting efficiency. Mechanical testing of the IAL-PCL copolymer films demonstrated excellent flexibility, with a tensile strength of 2.2 MPa and an elastic modulus exceeding 38 MPa. These enhancements reflect the improved compatibility between lignin and the PCL segments, primarily attributed to the introduction of IA, which facilitated better grafting and interfacial interaction.

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Concentration Dependant Porosity of Torlon Membranes Obtained by Phase Inversion Method for Gas Separation Applications

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Abstract

In the preparation of asymmetric membranes by phase inversion, one of the parameters by which the membrane properties can be tuned is by changing the concentration of polymer in the casting solution. This study investigates how varying concentrations (10% to 30% solution) of Torlon® (polyamide-imide) membranes obtained from phase inversion using N-methyl-2-pyrrolidone (NMP) as solvent affect their water vapour permeability. The surface morphology reveals decreased pore size with increase in concentration (please see Fig.1 A-E). When the Torlon concentration increased, the casting solution becomes more viscous as evident from the viscosity results. In fact the viscosity raises by more than seven fold when the concentration changes from 10% to 30%. The change in viscosity of the solution offers resistance to non-solvent diffusion and thereby alters the porosity of the membrane.

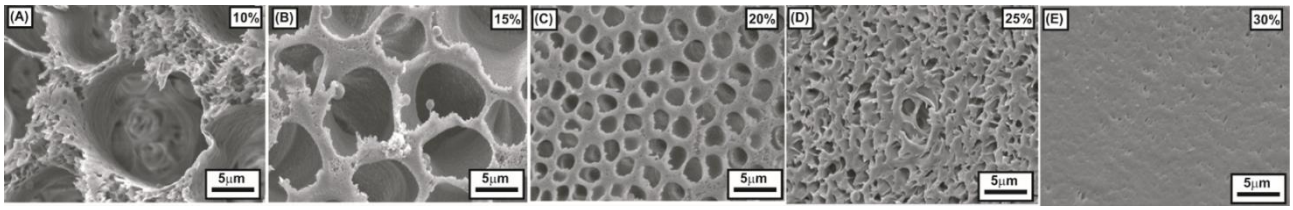

Fig.1. Surface *morphology* of Torlon membrane with change in polymer concentration

The XRD profiles reveal broad amorphous halo for all the samples, which is a typical profile for polymers like poly(amide-imide), indicating lack of long range ordering of chains. The increase in concentration increases the probability of intermolecular interactions in polymer chains such as hydrogen bonding between imide groups and π-π interaction among aromatic groups, which increases the dense packing of chains, leading to decreased inter-domain 'd' spacing as evidenced from XRD results. The increased chain packing and reduced segmental mobility at higher concentrations limit the migration of hydrophilic groups such as amide-imides leading to higher water contact angles inferring their change towards hydrophobic nature. The modification in porosity is further confirmed by dielectric measurements. Since the dielectric constant of air is close to one, densification of Torlon membrane results to decrease in porosity. Thus, there is an increase in dielectric constant (□□) of the membranes with increase in concentration. The water vapour permeability of the membranes were tested which revealed a clear inverse relationship between polymer concentration and water vapour transmission.

These findings highlight the essential role of polymer concentration in shaping the microstructure of the membranes, the diffusion pathways and provide a foundation for optimising this polymeric membrane for use in gas separation applications.

Keywords: Torlon, Polyamide-imide, Structure–property relationship, Porous Membrane Water vapour permeability, Gas separation.

Engineering Smart Actuating Microgels for Stimuli-Triggered Drug Delivery

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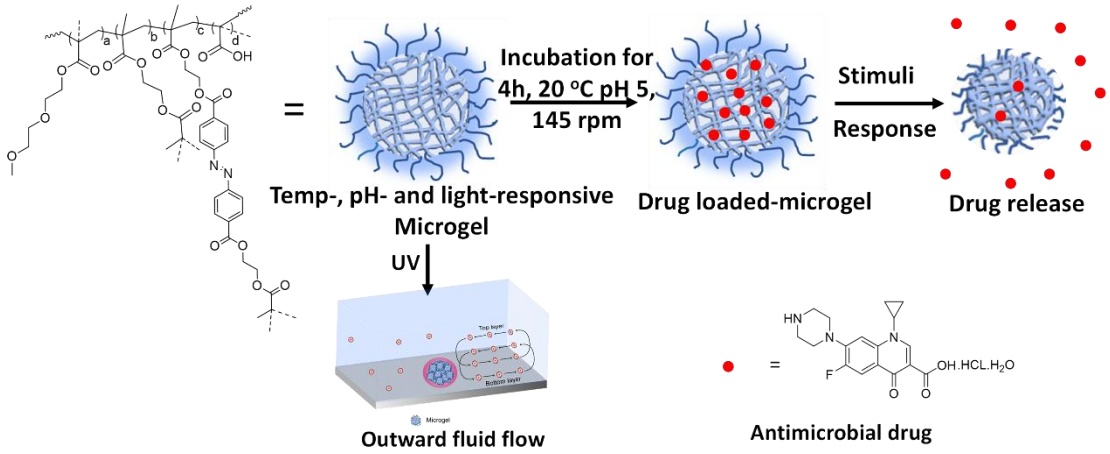
Abstract

Stimuli-responsive microgels have garnered a lot of interest because of their pivotal role in bioengineering applications including drug delivery and antimicrobial wound healing. In this work, different microgel systems have been synthesized by incorporating ethylene glycol dimethacrylate (EGDMA), methacrylic acid (MAA), diethylene glycol methyl ether methacrylate along with varying concentrations of substituted azobenzene, AZ (1%, 0.5% and 0%) by precipitation polymerisation method. The behaviour of the microgels in response to temperature-, pH- and light was thoroughly investigated by using spectroscopic, microscopic and light scattering techniques. Interestingly, the microgels deswelled with increase in temperature, decrease in pH and with the irradiation of UV light. Such a reversible swelling/deswelling behaviour was exploited for microgel M2 showing better photoactuation at pH 5 with higher fluid pumping velocity. The actuating microgel M2 was optimized for the loading of ciprofloxacin drug to study the release at different temperature, pH and light conditions. Finally, microgel M2 exhibited photoresponsive drug release in pH 5 and 37 oC toward application in on-demand drug release. Acknowledgement: Dr. Divya Dheer thanks ANRF-DST for Teachers Associateship for Research Excellence (TARE) Grant no. TAR/2022/000526 for presenting this work at APA-2025, Udaipur.



Schematic illustration of drug loading and its release from multi-responsive microgels in the presence of stimuli

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Preparation and Characterization of Bacterial Cellulose based Shape Memory Aerogels for Rapid Hemostasis

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Abstract

Wound management materials play a critical role in improving patient outcomes across healthcare settings. However, the high cost of many advanced dressings limits their accessibility, particularly for underprivileged populations. Developing affordable biomaterials is therefore essential to reduce healthcare costs, broaden access, and support better wound care. Infections at injury sites pose a major challenge, as microbial invasion can lead to biofilm formation and delayed healing. To address these issues, wound dressings must combine properties such as high exudate absorption, biocompatibility, biodegradability, and effective infection control.

Among various biopolymers, bacterial cellulose (BC), produced by Acetobacter xylinum, has gained attention due to its unique nanofibrous architecture, mechanical strength, purity, and remarkable water-holding capacity. In this study, BC pellicles were prepared through a simple and eco-friendly aerobic fermentation process using a symbiotic culture of bacteria and yeast (SCOBY). The pellicles were thoroughly washed to remove residual bacterial cells and dried at 60 °C for 24 h. Key fermentation parameters, including time, pH, and temperature, were optimized for maximum yield. FTIR analysis confirmed the presence of characteristic functional groups, while XRD revealed high crystallinity. SEM imaging highlighted the nanofibrous structure, with fiber diameters ranging from 20–50 nm. Swelling studies demonstrated excellent water retention (>900%). To impart antimicrobial functionality, the BC pellicles were further functionalized with herbal extract. Antibacterial testing, including zone of inhibition and colony count assays, showed over 85% reduction in viable colonies of S. aureus and E. coli. These findings suggest that BC can be developed into a multifunctional, sustainable material with strong potential for infection control in diverse healthcare applications.

Diamond-Reinforced Zinc Coatings for Heat Sinks: Experimental and GA-PSO-Based Strength and Load-Bearing Analysis

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Abstract

The performance of copper can be significantly enhanced by incorporating diamond and zinc coatings, particularly when fabricated through electrochemical processes. This improvement is primarily due to the enhanced mechanical properties, corrosion resistance, and adhesion provided by the composite coatings. In the present work, electrodeposition techniques have been used to fabricate the specimens. The electrodeposition method offers an economical alternative to high-temperature methods, but optimising parameters such as particle size and distribution remains critical for achieving the desired properties. The composition of diamond powder, voltage, coating time and zinc concentration have varied during the fabrication of specimens. The multi-criteria decision-making approach was used to analyse the experimental results. The wear and hardness have been used as a response and optimum values have been identified by utilizing a genetic algorithm (GA) and particle swarm optimization approach (PSO). The combined effect of hybrid GA-PSO has also been analysed which provides the best results, with a wear of 0.1338 micron/sec and a hardness at Rockwell scale of 51.009. Thus, the current research offers a comprehensive experimental and optimization techniques to investigate a potential Zn-diamond coating for heat sink applications.

Keywords: Wear; Hardness; GA; PSO; Electrodeposition Coating.

Catalytic Synthesis of Quinoxalines Using THS and their In Silico Biological Activity Against α-Amylase and α-Glucosidase

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Abstract

Diabetes Mellitus (DM) is a globally prevalent and chronic metabolic disorder, with Type 2 DM (T2DM) comprising approximately 90-95% of all diagnosed cases. Considerable research has been directed toward identifying safe and effective inhibitors of α-amylase and α-glucosidase as potential therapeutic agents for managing T2DM. The quinoxaline moiety continues to attract attention as a privileged structure in medicinal chemistry, particularly in the context of antidiabetic agent development. This study outlines an efficient and environmentally benign synthesis of sixteen quinoxaline derivatives through a one-pot method employing theophylline hydrogen sulfate (THS) as a recyclable solid acid catalyst. Reactions were performed at room temperature in an ethanol-water (1:1) via the cyclocondensation of 1,2-diketones/ ninhydrin with substituted o-phenylenediamines. This method features excellent yields (91-98%), a simplified work-up process, and reusability of the catalyst up to six times. The synthesized compounds were confirmed via 1H NMR, 13C NMR and mass spectrometry. Molecular docking studies with diabetic targets (PDB: 4GQR and 5NN6) highlighted their potential as enzyme inhibitors.

Keywords: Quinoxaline; Theophylline hydrogen sulfate; Recyclability; Green synthesis; Molecular docking.

Comparative Analysis of Biochar Derived from Coconut Shell and Rice Husk for Soil Amendment and Carbon Sequestration

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Abstract

This study investigates the physicochemical properties of biochar produced from coconut shells and rice husk using slow pyrolysis at varying temperatures (350°C–550°C). The impact of biochar on soil pH, moisture retention, and carbon content was evaluated through pot experiments with maize plants. Results indicate that coconut shell biochar exhibits higher carbon retention, while rice husk biochar enhances nutrient availability. This research highlights biochar's dual role in improving soil fertility and acting as a long-term carbon sink.Methodology consist of (i)feedstock preparation of rice husk and coconut shells (ii)Pyrolysis conditions of these feedstock (iii)Biochar characterization by pH,surface area(BET method),ash content,fixed carbon,elemental analysis and (iv) Soil amendment test by mixing of biochar with soil (5% w/w). Expected outcomes are formation of high-quality biochar with improved porosity and carbon content,improved soil fertility metrics (pH balance, water holding, nutrient availability) and baseline data for large-scale biochar applications in sustainable farming.

Designing Bioinspired Multicomponent Supramolecular Peptide-Biopolymer Based Composite Scaffold To Recapitulate Differential Cellular Microenvironment

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Abstract

Supramolecular bioactive peptide hydrogels fabricated through molecular self-assembly strategy utilizing diverse non-covalent interactions are emerging as promising translational biomaterials for tissue engineering applications. Inspired by biology, these hydrogels offer unique properties, including biocompatibility, tunable mechanical and physicochemical properties resulting in diverse supramolecular nanostructures. Their ability to mimic the structural and functional complexity of the ECM makes them highly suitable as cell-instructive scaffolds in biomedical applications. In this context, we explored two bio-inspired hydrogel scaffolds based on laminin as a minimalistic building block, where the self-assembly was triggered by the solvent-switch method at different concentrations of DMSO (2% and 5%), respectively, for the development of a neural bioactive peptide scaffold. Further, to mimic the ideal microenvironment of ECM consisting of both peptides and polysaccharides, it was highly desirable to do the post-assembly modification of the LMP's hydrogel with nanofibrillar cellulose. We explored the noncovalent interactions between the TEMPO-oxidized nanofibrous cellulose and laminin mimetic peptides to develop advanced composite scaffolds that can recapitulate the functional attributes of the native ECM. Such multi-component self-assembly provides an innovative platform for synthesizing nanomaterials with enhanced physical and biological characteristics. Moreover, the co-assembly approach is expected to overcome the limitations of each of the biomolecular components while retaining their individual functions in the composite matrix. These advanced composite scaffolds could significantly aid in the field of soft biomaterials, thereby making them promising candidates for repairing damaged tissue and organs and offering an innovative approach to improve patient outcomes and quality of life.

Keywords: ECM biomimics, Laminin Mimetic Peptides, TEMPO-oxidized Nanofibrillar Cellulose, Biocomposite Scaffold.

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Development of CMC-Starch-Based Biodegradable Films for Sustainable Packaging Applications

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Abstract

The environmental concerns associated with conventional plastic packaging have prompted the development of biodegradable alternatives using naturally derived polymers. In this study, biodegradable films were developed using a blend of starch and carboxymethyl cellulose (CMC), with glycerol added as a plasticizer to enhance flexibility. Among the various starch-to-CMC ratios studied, the 70:30 blend demonstrated optimal mechanical performance in terms of tensile strength and elongation. However, the films exhibited high water solubility, necessitating modification for improved water resistance. To address this, citric acid was incorporated at varying concentrations (0.5%, 1%, 2%, and 4%) as a cross-linking agent. Films were evaluated using a series of physicochemical and mechanical characterization techniques, including gel content analysis, water contact angle measurement, swelling behavior analysis, tensile strength testing, elongation percentage determination, and water vapor transmission rate (WVTR) measurement, as well as surface morphology analysis via scanning electron microscopy (SEM). Results indicated that 1% citric acid provided the best overall performance, offering improved water resistance and mechanical integrity. Further testing, such as soil burial and overall migration, confirmed the biodegradability and food safety compliance of the optimized film. These findings support the potential application of starch-CMC films cross-linked with citric acid as sustainable packaging materials, particularly for use in baking applications and as food wrapping films.

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Study of Polyaniline Embedded Transition Metal Substituted Strontium Titanate for Energy Applications

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Abstract

Energy materials are one of the main foci in materials research. In the pursuit, high-permittivity ceramic fillers have attracted attention for advanced energy generation and storage devices. This study explores the structural and dielectric properties of polyaniline (PANI) embedded strontium titanate (SrTiO3) ceramics substituted with divalent cations likeZn^{2+}, $Cd^{2+}$and Hg^{2+}at the Sr^{2+}sites. These materials were synthesized via a sol-gel method using acrylic acid as the gelating agent. Further, such materials were embedded into polyaniline by in-situ redox polymerization of aniline using APS and HCl. Such materials were characterized by FTIR, XRD, TGA, SEM and also evaluated for their dielectric properties. FTIR peaks at 538.72 cm-1, 538.72 cm-1 and 533.56 cm-1 affirmed the synthesis of the nanocomposites. X-ray diffraction (XRD) analysis revealed successful incorporation of Zn, Cd, and Hg cations into the SrTiO3 lattice, retaining a nearly cubic perovskite structure with 0.2 peak shifts at major intense peak of 32.72 value, indicating lattice distortions. SEM investigations showed a significant influence of the substituted cations on grain morphology and size. SEM studies of the nanocomposites also showed uniform distribution of the nanofillers into the polymer matrix. Notably, Cd-substituted SrTiO3 exhibited refined, uniformly distributed grains, features favorable for dielectric enhancement.Dielectric measurements over a wide frequency range (1 Hz to 10 MHz) demonstrated that Cd-substituted SrTiO3 achieved the highest dielectric constant (~6000 at l03-1 Hz frequency), likely due to increased grain boundary density and Maxwell–Wagner interfacial polarization. Hence, polyaniline embedded with different weight percentages of Cd -substituted Strontium titanate was studied in detail for the dielectric properties. These nanocomposites demonstrated higher permittivity which could be explained by their relatively larger grains and fewer grain boundaries. These trends suggest that the ionic radii of the substituted cations not only influence crystal structure but also tailor microstructural features critical for dielectric behavior.The observed dielectric enhancement and stability marks PANI-Cd-substituted SrTiO3 nanocomposite as a promising candidate for embedded capacitors, flexible electronics, and next-generation energy storage devices. This work provides fundamental insights into cation substitution strategies for tuning the structure–property relationships of titanate-based dielectrics for integration into energy-relevant polymer systems.

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Self-healing Behaviour of Sodium Ionomer /Styrene-Isoprene-Styrene Blend Materials by Ballistic Test

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Abstract

Recent trend of materials research is of using lightweight structures for aerospace and defence applications. Moreover, the potential of using self-healing materials to create load-bearing, damage-tolerant structures is a challenge today [1-4].In this study, Na-neutralized poly (ethylene-co-methacrylic acid) (Na-EMA) ionomers and thermoplastic elastomer styrene-isoprene-styrene (SIS) were melt blended to achieve self-healing properties. The developed blend materials, having different compositions of Na-EMA and SIS, were characterized by various techniques. To gain insights into the self-healing behaviour of the ionomer and their respective blends, 170 mm x 170 cm x 3.2 mm thick panels were penetrated with a bullet having dimensions of 7.62x39 mmAK-47 with the projectile velocity of 750 m/sec.

Optical microscope and scanning electron microscope were employed to compare the healing of the damaged area of the samples before and after the healing process. The healing behaviour was also confirmed by water leakage test, kerosene leakage and light pass test.

The blend samples showed no mass loss, no light pass through, no water leakage, and no kerosene leakage after ballistic test. Besides the ballistic test, the cut and heal approach in tensile specimens was also followed to study the self-healing behaviour of the blend samples using tensile test method. Interestingly, these blends exhibit complete self-repairing behaviour. Thermo-reversible ionic interactions in Na-EMA ionomer provide self-healing properties to the developed blend materials. In addition, the healing efficiency was improved by increasing the content of SIS in the blend. The thermoplastic elastomers consist of good flexibility and high resilience which may facilitate the self-healing processes in the blend system. All blend samples showed self-healing behaviour and achieved maximum healing efficiency of ~94% (as measured in the tensile strength measurement). FTIR analysis confirmed the presence of various coordinated structures in the blends. The blend materials were thermally stable up to 361°C. Such novel blend materials having self-healing behaviour may have potential applications such as armour, aerospace, and other applications [5-6].

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Effective Research Publication in Wiley Polymer Portfolio and the Usage of Artificial Intelligence

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Abstract

Wiley stands as one of the leading scientific publishers, with a legacy spanning over 200 years and a global mission to enable discovery, power education, and shape the workforce. Renowned for its high-quality journals across fundamental and interdisciplinary research domains, Wiley consistently delivers publications with well-deserved recognition.

Along with its enriched repertoire of journals, Wiley's polymer portfolio is one of the most diverse and strategically curated in academic publishing domain. It encompasses titles that cover fundamental polymer science, synthesis, polymer physics, biomedical applications and functional materials related research. Given the growing interest in polymeric materials owing to their versatile molecular structures and potential to revolutionize materials science, medicine, energy and environmental technologies, it is essential to provide researchers with both recognition and inspiration for further exploration.

This talk will feature Wiley as a leading scientific publishing house, with a special focus on its Macromolecular portfolio and its active engagement with Indian polymer researchers. Additionally, insights from the editor's desk will be shared to guide effective research publication in Wiley's Macromolecular titles. As AI-driven generative language models increasingly influence the publication landscape, the session will also briefly address the ethical use of AI tools in peer-reviewed scientific publishing.

RSC: Integrating Chemical Sciences Community and Beyond

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Abstract

Royal Society of Chemistry (RSC) is one of the leading society publishers serving the community since mid 1800s. The products range from journals to books to e-books, periodicals and many others. The portfolio comprises of more than 60 journals which encompasses core chemistry, energy and environmental sciences, engineering and interface, pharmacy, analytical chemistry and several others integrated together.

The presentation also focusses on the initiatives that the Royal Society of Chemistry undertakes as a society publisher to enable change in chemical science education and practice to ensure a diverse and skilled workforce. We also endeavour to provide the opportunities and tools for the chemical science community to network, create and exchange knowledge, adapt and thrive. In my talk I would focus on portfolios that include polymers, applied journals, biomaterials, resources and opportunities for authors for journals & books, including various research grants and nominations for members and related topics.

Poster Presentations

Plasma Grafting of Itaconic acid on Polypropylene Mesh: An Insight into the Grafting Mechanism

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Abstract

Plasma grafting of itaconic acid was performed on polypropylene (PP) to investigate the nature of the graft-initiating sites in the system. It has been observed that grafting is initiated through three different mechanisms: peroxy, alkoxy, and alkyl linkages. The relative contribution of these routes indicates that the alkoxy linkage plays a significant role in graft initiation. The investigations used various techniques, such as Energy Dispersive X-ray Spectroscopy (EDX) and X-ray Photoelectron Spectroscopy (XPS), which provided supportive evidence. While a small fraction of grafting was initiated by alkyl and peroxide linkages, the predominant observations in our system highlight the importance of alkoxy linkages. This study presents an interesting perspective on graft functionalization of polymeric materials, which can aid in designing material surfaces for specific applications. Notably, nearly 68% of the grafts follow the hydroperoxide decomposition route, resulting in alkoxy linkages.

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Development of antimicrobial nano silver impregnated polyethylene terephthalate fabric

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Abstract

Polyethylene terephthalate (PET) fabric is extensively utilized in various applications due to its exceptional chemical and physical properties such as high strength, resistance to numerous chemicals, and dimensional stability. However, the porous 3D structure of PET fabric makes it more prone to the adhesion of microorganisms and promote its growth. Due to this limitation, PET fabric is challenging to use as a material in healthcare. Plasma technology is employed to enhance the hydrophilicity to make it a functional fabric, by modifying its surface without impacting its bulk properties. The plasma treatment is not only efficient but also environment friendly.

In this research, the hydrophilicity of PET fabric was increased by CO_2 plasma exposure. Subsequently, the plasma-treated PET fabric was immersed in $AgNO_3$ solution, followed by Ar plasma to immobilize silver nanoparticles on the surface. The silver concentration was varied from (0.1%- 0.5%). A series of analyses were performed to evaluate the size of the nanoparticles and the physicochemical properties of the nano-silver-immobilized fabric, employing techniques such as high-resolution transmission electron microscopy (HR-TEM), field emission scanning electron microscopy (FE-SEM), nanoparticle tracking analysis (NTA), and transmission electron microscopy (TEM). Additionally, antimicrobial studies were conducted to assess the antimicrobial effectiveness of the nano-silver-immobilized fabric, demonstrating a significant improvement in its antimicrobial properties.

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Passive Heat Management via Recycled PET-Derived Functional Fibers

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Abstract

Polyethylene terephthalate (PET) waste—originating from textiles, bottles, and other consumer products—has emerged as a serious environmental threat due to its non-biodegradable nature and increasing global accumulation. With millions of tons of PET discarded annually, there is an urgent need for sustainable strategies that go beyond conventional recycling. This work presents an advanced upcycling pathway that transforms post-consumer PET into high-performance, thermoregulatory fibers for smart textile applications. Recycled polyester chips are melt-spun into fibers embedded with phase change materials (PCMs), which enable passive thermal regulation by absorbing, storing, and releasing heat. The integration of PCMs within the fiber matrix provides thermal buffering, enhancing wearer comfort and reducing dependence on active climate control systems. Mechanical characterization confirms that these recycled fibers retain performance properties comparable to virgin polyester, supporting their reintegration into functional apparel and technical textiles. By aligning waste valorization with functional material innovation, this approach supports circular economy goals and contributes to the development of sustainable, climate-resilient fiber-based composites.

Keywords: Recycled polyester, Phase change materials, Melt spinning, Smart textiles, Sustainable composites.

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Ultralight and robust biobased composite aerogel coated fabrics having high insulation properties for protection against cold weather conditions.

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Abstract

Recent advances in the clothing for thermal management have opened up prospects for its exploration in heat and mass transfer from the human skin to the environment via textile as a medium by simply tuning the physical properties of the material or modifying the chemistries during the development stages. Development of new functional materials and structures are being exploited for fabricating advanced textiles and clothing structures being light in weight and flexible in nature through integration of aerogels which have mesoporous structure with porosities reaching up to 99 %.. Apart from these properties aerogels are known to have a large specific surface area (500-1500 m2/g), low density (0.003 g/cm3), low thermal insulation values (0.015 W/m·K), fire retardant properties and so on. Owing to these superior properties aerogels have found multiple applications in the real time application domains such as thermal and acoustic insulation, fire fighter clothing, aerospace applications, packaging, cryogenic insulation, sensors, biomedical applications, environmental remediation, etc. For a past decade now there has been a growing interest in developing sustainable bio-based aerogels and its integration into textile garments and recently the precursors that have been employed for developing biobased aerogels include cellulose, alginate, starch, chitosan, pectin, protein, etc. Aerogels developed from biobased precursors are extracted due to numerous available functional groups, tunable properties, sustainable extraction process, non-toxic solvents and environmentally friendly crosslinking procedures. Here in we have developed aerogels using a sea-weed derived biopolymeric precursor as the matrix agent and a crystalline cellulose derived material as a reinforcing agent to enhance its mechanical properties. The developed aerogels would show densities from 0.025- 0.060 g/cm3and the porosities ranging from 96-98 %. Although light in weight the developed aerogels can withstand more than 1500 times its own weight and can undergo deformation at upto 80 % strain rate showing around 500 kPa compressive strength. Due to its low density and highly porous structure the thermal conductivities of the monolithic aerogels showed in the range of 0.015-0.045 W/m·K and the fabrics showed the thermal resistance values of 0.085-0.117 m2·K/W with a Clo value reaching near to 1 Clo for the nonwoven fabrics.

Keywords: Aerogels, Thermal Management, Sustainable, Thermal conductivity, Textile garments.

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Photocatalytic degradation of some water-soluble dye by using Z-scheme based photocatalyst

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Abstract

The field of solar energy harvesting for both energy generation and environmental applications continues to be a captivating area of research [1-2]. Recently, Z-scheme photocatalysts have attracted significant research interest owing to their robust redox characteristics, effective separation of charge carriers, and enhanced capability to harness visible light [3-4]. In this research articles synthesis of Z-scheme photocatalyst was synthesized through a hydrothermal method, followed by characterization using FESEM, XRD, FTIR, and EDX techniques. The photocatalytic degradation of some water-soluble dyes was investigated under visible light with photocatalysts. Various parameters, including pH, dye concentration, photocatalyst quantity, and light intensity, were examined to assess their impact on the degradation rate of the dye. The most significant degradation rate of the dye in the presence of Z-scheme photocatalyst was recorded in a basic medium. A proposed mechanism for the photocatalytic degradation of some dyes has been outlined.

Keywords: Hydrothermal, Photocatalyst, dye, light intensity.

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Chitosan based film decorated with Co-Gallic acid MOF for Ethylene scavenging for the shelf life management of Mangoes

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Abstract

Polysaccharide based edible films have gained significant attention in sustainable food packaging due to their biodegradability, reduced toxicity and, an alternative to conventional plastic packaging. However, these biopolymer based films have some limitations such as poor mechanical strength, and high permeability to gases such as oxygen and ethylene, making them ineffective in controlling the ripening and spoilage rate of fresh produce. The present study focuses on the development of advanced composite edible film incorporating Cobalt-Gallic acid(Co-GA) metal organic framework, synthesized using Hydrothermal method, into chitosan- Sodium alginate (CH/SA-1:1 ratio) matrix by casting method, with Tween 20 as emulsifier and glycerol as plasticizer with the objective to enhance the structural integrity, and gas barrier properties. Co-GA/CH/SA film was characterized by structural, functional and physical studies. Also, Co-GA MOF was observed to uniformly disperse into CH/SA matrix and depicted improvement in tensile strength, toughness, thermal stability, UV-blocking efficiency, and resistance to water vapor transmission. Co-GA/CH/SA film was tested for the shelf life management of mangoes, and its effectiveness was compared with the control, and the film without MOF. During the 7 days storage studies, Co-GA/CH/SA film significantly delaying the ripening rate suggesting the shelf life improvement. This study supports multiple green chemistry principles; safer material design (Principle 4), renewable feedstock (Principle 7), and real time analysis for pollution prevention (Principle 11).

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Valorization of orange peels: Activated carbon composite for high performance supercapacitor application

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Abstract

In this study, a novel composite of Iron Phosphate and Orange peel activated carbon(OPAC/FePO4) was successfully synthesized via a hydrothermal route, followed by pyrolysis of chemically impregnated orange peel. This process not only enhances the electrochemical properties of composite but also demonstrates an effective strategy for waste valorization by transforming agricultural waste into high performance electrode materials. Microscopic analysis confirmed the homogeneous dispersion of OPACs within the spongy ball FePO4 matrix, enhancing structural properties and charge storage efficiency. Powder XRD and FTIR spectroscopy further validate the successful formation of the composite. Electrochemical characterization revealed exceptional performance of the OPAC/FePO4 composite, achieving high specific capacitance 769.6 F/gat a scan rate of 5mV/s, attributed to its high surface area 102.01m2/g and significant gas adsorption volume 23.43cm3/g. The material also demonstrated excellent cycling stability, retaining 80% of its initial capacitance after 5000 charge/discharge cycle. The high porosity and conductivity provided by OPAC significantly enhance ion diffusion and electron transport, making the composite a promising candidate for supercapacitor application. This work underscores the potential of orange peel, a commonly discarded biowaste, as valuable carbon precursor, promoting circular economy principle and addressing environmental concerns associated with organic waste management.

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Designing of Bioactive Polyvinyl Alcohol Nanocomposite Membranes for Drinking Water Disinfection

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Abstract

Waterborne microbial infection is one of the major threats to the drinking water supply in the urban, suburban as well as rural areas. The Indian population, very often, consumes untreated drinking water, which has major reservoirs of E. coli, salmonella, and pseudomonas species responsible for diseases like gastric infections, typhoid and cholera. Therefore, the development of new technology as well as improved antibacterial materials for water treatment and filtration are urgently needed. This concern of microbial contamination can be addressed by developing a polymeric membrane-based water treatment material.

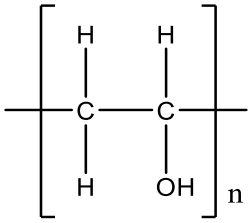

Figure: Chemical structure of Polyvinyl Alcohol

In this study, polyvinyl alcohol nanocomposite membranes were prepared by solvent casting approach. The crosslinking of the membranes with boric acid crosslinker improved the dimensional stability. A series of metallic nanoparticles were used to develop nanocomposite membranes. The structural investigation of these membranes was carried out by using FTIR, XRD, and DSC. The membrane surface hydrophilicity was determined using water contact angle measurements. The antibacterial efficacy of the membranes was studied against E. coli and S. aureus. using the disk diffusion and colony count methods. The most fascinating aspect is that these membranes exhibit a long-term antimicrobial nature. The results demonstrated that the bioactive membrane is appropriate as an antimicrobial material for disinfection of water.

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Development of Bioreceptive Polylactic Acid Films for Biomedical Applications

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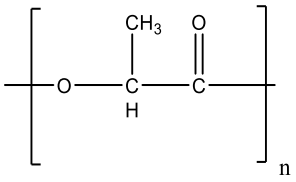
Abstract

Polylactic acid (PLA) is a thermoplastic, compostable, biodegradable and biocompatible polymer derived from renewable resources such as corn and sugar beet. PLA has been the most versatile material in bioengineering domain. Because of its favourable features, PLA is currently used as medical implants, tissue engineering scaffolds, orthopedic devices, and drug delivery systems.



Polylactic Acid

In our study, PLA has been functionalised by alkaline hydrolysis to create carboxyl functional groups on its surface which offer excellent sites for the immobilization of bioactive molecules on it surface. The generation of the functional groups is strongly governed by the hydrolysis conditions, such as reaction time, reaction temperature and the alkaline concentration. The physicochemical properties of the PLA surface were characterized using SEM, AFM, and contact angle. These surfaces were employed to bind bioactive substances, making it antibacterial in nature.

Keywords: Polylactic acid, Functional PLA, Antimicrobial, Biomedical Applications.

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Functionalization of Cotton Fabric via Periodate Oxidation

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Abstract

The healthcare sector is increasingly turning to functional textile materials for a variety of applications, including implants, surgical devices, surgeon's clothing, bandages, dressings, and hygiene textiles. Among these materials, cotton fabric is widely accepted due to its biodegradability and biocompatibility.

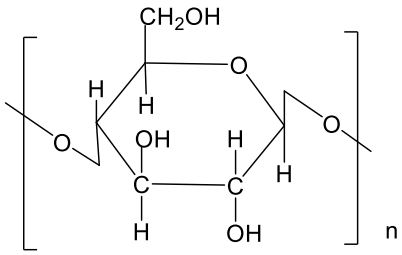

Fig: Chemical Structure of Cotton fabric

In this investigation, periodic acid is utilized to oxidize cotton fabric, resulting in the formation of aldehyde groups at the C-2 and C-3 positions of the glucose moiety within the polymeric chain of cotton. The functionalized cotton fabric was characterized using Fourier Transform Infrared (FT-IR) spectroscopy and Ultraviolet-visible (UV-Vis) spectroscopy using 2,4-dinitrophenylhydrazine (DNPH) assay. The effect of various reaction conditions, including reaction time, temperature, and periodic acid concentration, on the oxidation process was investigated. It was found that an increase in reaction time, temperature, and periodic acid concentration led to a corresponding increase in the amount of aldehyde content in the oxidized cotton fabric.

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Unveiling the Potential of Ruthenium Trichloride Clusters as Novel Therapeutic Agents in Combating Antifungal, Antibacterial, and Ant malarial Activities: A Comprehensive Research Study

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Abstract

Ruthenium trichloride complexes featuring η^2-bound alkyne ligands are suggested as intermediates in the early stages of Ru-catalyzed alkyne reactions. Our research has demonstrated that these electronically unsaturated complexes, with the general formula [RuCl(η^5-Cp)(η^2-RC≡CR')], can be effectively stabilized by using a sterically demanding cyclopentadienyl ligand. Specifically, we have employed the η^5-1-methoxy-2,4-ferrocenyl-3-neopentyl-cyclopentadienyl ligand (abbreviated as Cp). Additionally, we have found that the dimeric complex $[RuCl_2(\eta^5\text{-Cp})]_2$ acts as an effective and regioselective catalyst in the [2+2+2] trimerization of alkynes, demonstrating significant potential for applications in inorganic synthesis. In addition to our studies on the chemical properties and of ruthenium complexes, we have also conducted a thorough investigation of their biological activity. Specifically, we examined their potential as antifungal, antibacterial, and antimalarial agents. This comprehensive analysis aimed to explore the applicability of these complexes in medicinal chemistry, potentially leading to the development of new treatments for various infectious diseases.

Keywords: Ru-clusters, Trinuclear Ruthenium.

Fabrication and Characterization of Bioactive Sodium Alginate-based Membranes

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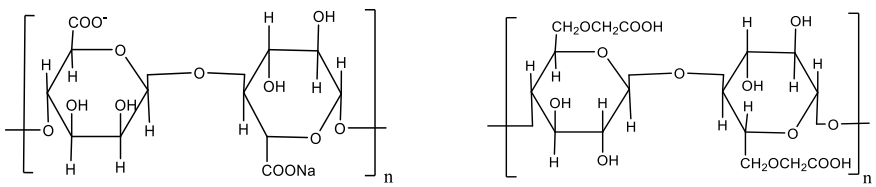
Abstract

Sodium alginate (SA) is an anionic biopolymer with excellent haemostatic and wound healing properties, making it useful for a variety of biomedical applications. The present work focuses on developing SA-CMC blend membranes by varying carboxymethyl cellulose (CMC) content using solution-casting method. CMC is also an anionic biopolymer with high absorption capacity, flexibility, and the ability to promote angiogenesis, making it ideal for biomedical approach.



(a) (b)

Figure: Chemical structure of (a) Sodium Alginate (b) Carboxymethyl Cellulose

The structure and morphology of the membranes were characterized by FTIR, FESEM and AFM analytical techniques. Significant morphological changes take place on the blended membranes by CMC addition to SA matrix. The hydrophilicity of membranes was monitored by contact angle measurements. A proper correlation between the physical properties of the membranes with respect to the CMC content were investigated.

Keywords: Sodium Alginate, Carboxymethyl Cellulose, Membranes, Contact Angle.

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Simulation studies of polyphenol ellagic acid: structural and electronic properties

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Abstract

Ellagic acid (EA), a potent antioxidant found in pomegranate peel, plays a crucial role in neutralizing free radicals and preventing oxidative stress-related diseases. To gain better understanding of the molecular behaviour of EA, density functional theory (DFT) was used to analyse its electronic and structural properties. Frontier molecular orbitals, ionization potential, and electron affinity were obtained using DFT, to understand the antioxidant activity of ellagic acid. Additionally, Natural Bond Orbital (NBO) interactions are analysed to confirm the formation of intra-molecular interactions between functional groups and conjugation present in EA. Solvent effects are modelled using a solvation approach to evaluate its behaviour in various environments, and a pH-dependent study was performed to know its stability under different physiological conditions. The theoretical results were validated against experimental data. The validation of simulated data and experimental results were done by IR and NMR analysis of neutral and deprotonated EA forms. By employing DFT, this study offers a computationally efficient and precise method to investigate the molecular and structural properties of ellagic acid, surpassing traditional experimental methods.

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Electrochemical Synthesis of Carbodiimides and Ureas via Amine–Isocyanide Cross-Coupling

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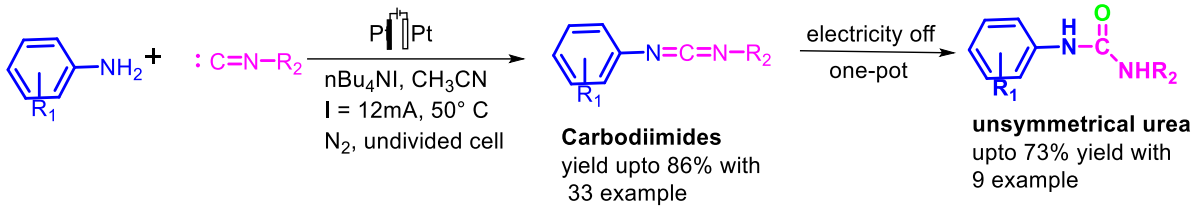
Abstract

This work discloses an electrochemical oxidative cross-coupling of amines with aryl and aliphatic isocyanides. In an undivided cell, the reaction proceeds without involving any transition-metal catalyst, oxidant, or toxic reagents providing carbodiimides in good yields, thereby circumventing stoichiometric chemical oxidants, with H2 as the only byproduct. Moreover, carbodiimides were in situ converted into unsymmetrical ureas in moderate to good yields using an electricity ON−OFF strategy.



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Polymerization-Induced Self-Assembly (PISA) Generated block co-polymer Nano-Objects, via Visible-Light-Driven Photo-catalyzed RAFT-Polymerization

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Abstract

Polymerization-Induced Self-Assembly (PISA) is a powerful technique that combines polymerization and self-assembly in a single, efficient step. Unlike traditional solution-based self-assembly methods, PISA allows the formation of micro- and nano-sized particles with high solid content and well-controlled size and shape. Block copolymers are synthesized using Photoinduced Electron Transfer RAFT (PET-RAFT) polymerization, a method that aligns with the goals of sustainable development in the chemical industry by promoting safe, eco-friendly, and atom-efficient processes. Photo-catalyzed RAFT Polymerization-Induced Self-Assembly (RAFT-PISA) has garnered significant attention due to its ability to produce diverse particle morphologies and its expanding range of applications.

In this work, a family of nano-structured morphologies made of poly(Hydroxypropyl methacrylate)-b-poly(glycidyl Methacrylate) (PHPMA-b-PGMA) copolymers was prepared via photo-catalyzed reversible addition–fragmentation chain transfer (RAFT). The number-averaged degree of polymerization (DPn) of the PGMA segment was targeted to obtain spherical, wormlike, and vesicular nano objects, as evidenced from transmission electron microscopy, supported by dynamic light scattering experiments. In addition, we have successfully incorporated curcumin with block co-polymer. Curcumin, a bioactive compound, shows anti-inflammatory properties, can be incorporated into PISA polymers to enhance their properties and create targeted drug delivery systems.

The shape and size of the nano-architecture directly influence their physicochemical and biological features, such as in vivo biodistribution, photoconductivity, the extent of cell penetration, the profundity of cellular uptake, etc.

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Green Synthesized CuSe@CQDs Nanocomposite for Enhanced Photocatalytic Hydrogen Generation and Dye Degradation

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Abstract

The urgent need for sustainable wastewater treatment and clean energy production has accelerated the search for efficient and eco-friendly photocatalysts. In this study, a novel CuSe@CQDs nanocomposite was synthesized using carbon quantum dots (CQDs) derived from water caltrop (Trapa natans) peels and copper selenide (CuSe) via a green sol-gel method. The composite exhibited outstanding photocatalytic efficiency, degrading 99.4% of thymol blue and 97.8% of Congo red dyes within 60 minutes under visible light. Simultaneously, it enabled hydrogen production rates of 2360 and 1875 mmol g^{-1} h^{-1} approximately 35.7 and 29 times higher than CuSe alone. Enhanced charge separation, increased surface area (38.7 m^2 g^{-1}), and improved visible light absorption were confirmed through XRD, FTIR, XPS, BET, and photoluminescence analyses. This work demonstrates a cost-effective, scalable, and green strategy for environmental remediation and renewable hydrogen fuel generation.

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Synthesis of Mustard Stalk Cellulose Hydrogel for Dye Removal

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Abstract

Cellulose was extracted from mustard stalk by the alkaline method and cellulose-based hydrogel was fabricated using cross-linker epichlorohydrin (ECH) by a chemical crosslinking method. The biopolymer cellulose and hydrogel were characterized by the Fourier transform infrared spectroscopy, scanning electron microscopy, and thermogravimetric analysis. Then, these hydrogels were applied for cationic methylene blue (MB) and anionic methyl orange (MO) adsorption with different initial dye concentrations (5, 10, 15 mg/L), showing more MB adsorption than MO. Pseudo-first-order, pseudo-second-order, and Elovich models were studied to explore the adsorption mechanism and kinetics, exhibiting that pseudo-second-order model was suitable for hydrogel dye adsorption. Freundlich, Langmuir, and Temkin adsorption isotherm models were studied, showing Freundlich adsorption isotherm was the best-fit models. So, adsorption occurs heterogeneously with a multi-layer adsorption process on the surface of hydrogels [1]. The maximum MB and MO adsorption capacity of mustard stalk cellulose hydrogel, were 1.27 and 0.23, respectively. These findings help to fabricate bio-waste-based hydrogels for dye removal [2] and water purification.

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Synthesis of Novel fluorinated Compounds via Metal mediated C-F Bond Activation

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Abstract

Fluorinated compounds are highly demanded in Pharmaceuticals, Polymer chemistry, agrochemicals, and material sciences because of their unique properties.1CF3group into an organic molecule can modify its chemical behavior and lead to changes in its physicochemical and pharmacological properties. The CF3 group is often chosen for its chemical inertness and stability, which are related to the strong C-F bonds.2 The fluorinated compounds are known for their thermal and chemical robustness because they contain strongest covalent single bond that carbon forms with any other element. Functionalization of polyfluorinated compounds into partially fluorinated compound by cleavage of C-F bond is challenge in front of scientific community. Among all order fluorinated compounds selective single bond C-F bond activation in CF3 –group attached to a π-system has drawn signification attention of synthetic chemists and pharmacologists in last few years.

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Turning Agricultural Waste into Microplastic Adsorbents: A Path Toward Sustainable Water Purification

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Abstract

Microplastics (MPs), plastic particles less than 5mm in diameter, have emerged as a pervasive environmental pollutant, posing a far-reaching impact to aquatic ecosystem and human health. Their small size makes them difficult to filter out using conventional methods, and their persistence in the environment poses long-term risks. These particles are omnipresent in marine, freshwater, and terrestrial environments, and their persistence poses severe risk to aquatic life and ecosystems. This critical issue necessitates the emergent development of advanced materials for effective remediation through sustainable routes. Current methods such as mechanical filtration, chemical method, biological methods, and membrane technology for addressing microplastic pollution exhibit several significant limitations including generation of secondary wastes or use of toxic chemicals which further complicate environmental management.

A promising sustainable approach is the use of organic waste based activated bio-charcoal as an adsorbent sourced from bamboo, sugarcane, rice straw and others. As a rapidly renewing resource it may help mitigate the health risks and align with broader environmental goals. The synthesised charcoal is activated using appropriate agents such as zinc chloride ($ZnCl_2$), potassium hydroxide (KOH), Nitric acid (HNO_3), etc. to enhance porosity and surface area. Formation of activated charcoal is confirmed by XRD and FTIR, while surface area determined using BET analyser. Suitable impregnation techniques are used to prepare and incorporate elemental ions into the activated bio-charcoal matrix. Adsorption study of MPs from major demanding polymer materials PET, PS and Polyolefins on modified biochar conducted to evaluate the efficiency of absorbent in removing MPs from water-microplastic sample. Surface charge measurement is done by Zeta-potential analyser which measures changes in surface chemistry that will affect the interaction between MPs and adsorbent. The study highlights the effectiveness of optimised biochar contributing to sustainable and environmentally aligned approach to mitigated aquatic pollution.

Keywords: Microplastics (MPs), Functionalisation, Activated charcoal, Sustainable, Adsorption, Adsorbent.

Fe_3O_4@SiO_2@Taurine Nanocatalyst: A Green and Efficient Approach for the Synthesis of Pyrano[2,3-d]pyrimidinone Derivatives via Multicomponent Reactions

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Abstract

In pursuit of environmentally friendly and sustainable synthetic methods, we report the design, synthesis, and catalytic application of Fe_3O_4@SiO_2@taurine core-shell nanocatalyst for the green synthesis of biologically significant pyrano[2,3-d]pyrimidinone derivatives. The catalyst was prepared via a facile co-precipitation method followed by silica coating and taurine functionalization, and was characterized by FTIR, XRD, TEM, SEM-EDS, TGA, and VSM techniques. The nanocatalyst demonstrated excellent performance in multicomponent reactions involving aromatic aldehydes, malononitrile, and barbituric acid or thiobarbituric acid in aqueous ethanol under mild conditions. This method offers notable advantages, including high yields (up to 94%), short reaction times, catalyst recyclability, and eco-friendly operation. Comparative studies confirmed its superior activity over other reported catalysts. These findings position Fe_3O_4@SiO_2@Taurine as a promising green catalyst for sustainable organic transformations.

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Synthesis and Antimicrobial Evaluation of Tetrazole and Pyrazole Based Polyaniline Composites against Multidrug-Resistant Pathogens

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Abstract

The growing threat of multidrug-resistant microbes has prompted the exploration of novel antimicrobial materials. In this study, we report the synthesis of two novel polyaniline (PANI)-based composites: PANI–tetrazole and PANI–pyrazole, via a chemical oxidative polymerization route using tosic acid as a dopant. The structural characterization was confirmed through FTIR, ^{1}H-NMR, TGA, and GPC analyses, affirming successful integration of heterocyclic moieties and improved molecular weight distributions. Antibacterial and antifungal activities were assessed against gram-positive (Staphylococcus aureus, Streptococcus pyogenus) and gram-negative (E. coli, Pseudomonas aeruginosa) bacteria, and fungal strains (Aspergillus niger, Candida albicans, Aspergillus clavatus). Notably, PANI-pyrazole exhibited the lowest MIC values (25-50 µg/mL), outperforming standard drugs such as chloramphenicol and nystatin in some cases. Additionally, both composites demonstrated significant anti-tuberculosis activity against Mycobacterium tuberculosis H37Rv with MIC values of 0.25 µg/mL, comparable to rifampicin. These results highlight the potential of these PANI composites as multifunctional antimicrobial and anti-TB agents for therapeutic applications.

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Voltage-Controlled Structural Divergence: Electrochemical C-H Acyloxylation and N-Acylation of 2H-Indazoles

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Abstract

Indazoles are important heterocycles known for their broad biological activity, and selective functionalization at the C-3 or N-1 position of 2H-indazoles remains a key synthetic goal. We report a novel voltage-tunable electrochemical approach for the site-selective functionalization of 2H-indazoles. By modulating the cell voltage, we achieved either C-3 acyloxylation or N-1 acylation via a radical-mediated oxidative process under metal-free conditions. This strategy eliminates the need for external oxidants and transition metals, leveraging constant-potential electrolysis in an undivided cell setup. Notably, application of a micro-electro flow reactor (μ-EFR) enabled gram-scale synthesis with high efficiency and reduced reaction time. The method offers broad substrate scope, tolerating both aromatic and heteroaromatic acids, and displays excellent regioselectivity. This electrochemical platform demonstrates practical scalability and sustainable access to structurally diverse indazole derivatives with potential pharmacological relevance.

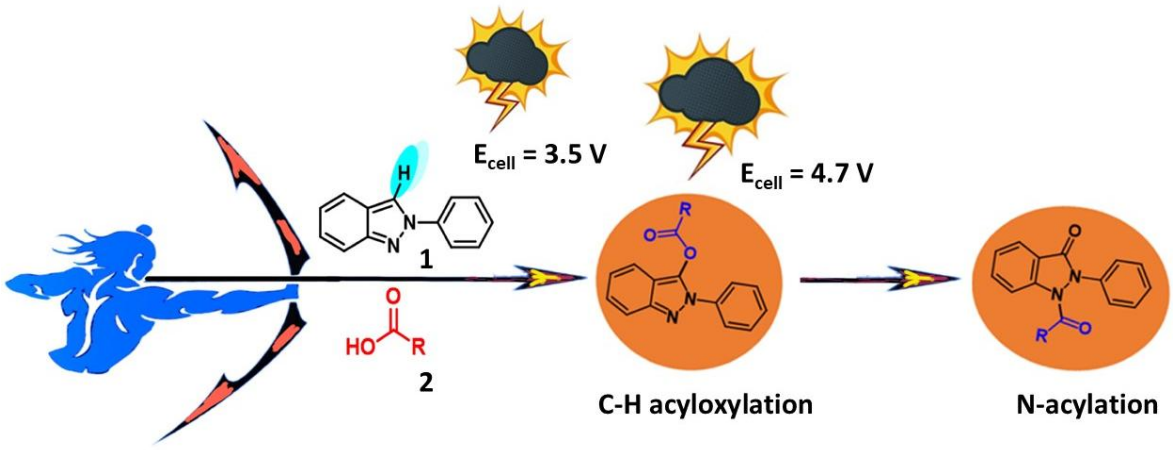

Figure 1. Cell voltage dependent structural dichotomy for electrochemical C-H acyloxylation and N-acylation of 2H-indazoles

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Design and Advancement of High-Performance Flame-Resistant Fibrous Materials

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Abstract

The development of high-performance flame-retardant (FR) fibrous materials is critical for enhancing personal protection in extreme environments, particularly for defense personnel and fighter pilots. This study focuses on the fabrication and characterization of flame-retardant fibers derived from polyetherimide (PEI), a high-performance thermoplastic known for its excellent thermal stability, inherent flame resistance, and mechanical robustness. Electrospinning and melt-spinning techniques were employed to process PEI into fine, uniform fibers suitable for use in advanced protective textiles. The resulting fibers exhibited outstanding flame retardancy, confirmed by high limiting oxygen index (LOI) values, self-extinguishing behavior in vertical flame tests, and superior thermal decomposition profiles as analyzed by thermogravimetric analysis (TGA). Additionally, the fibers maintained desirable mechanical properties such as tensile strength and flexibility, which are crucial for wearer comfort and mobility in high-risk operational scenarios. The fibrous mats also showed good dimensional stability and chemical resistance, supporting their suitability for prolonged use in harsh conditions. These findings position PEI-based fibrous structures as promising candidates for next-generation fighter suits, offering a balance of lightweight protection, durability, and thermal safety. Beyond military applications, these materials can also be adapted for fire service gear, aerospace insulation, and industrial protective clothing, where flame resistance is of paramount importance.

Keywords: flame retardancy, electrospinning, high-performance, defence, protective clothing.

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Durable and Biocompatible Wound Dressing Material Based on Antibacterial Chamomile Oil-Functionalized Graphene Oxide Reinforced Chitosan/Polyvinyl Alcohol Composite

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Abstract

Wound healing is a complex process that unfolds through four interconnected and partially simultaneous phases: hemostasis, inflammation, proliferation, and remodeling. However, this process can be disrupted by factors such as microbial infection, aging, and certain medical conditions (e.g., diabetes, ischemia), often resulting in chronic wounds characterized by prolonged inflammation, cellular dysfunction, and impaired angiogenesis. To address these challenges, we have developed an advanced multifunctional wound dressing composed of a polyvinyl alcohol (PVA) and azelaic acid-modified chitosan (CHAZ) blend, enriched with chamomile oil and graphene oxide (GO), using the solvent casting method. GO provides strong antimicrobial activity due to its ability to generate reactive oxygen species and its sharp nanosheet structure, which can physically disrupt bacterial membranes. Chamomile oil, widely recognized for its antibacterial, anti-inflammatory, and antioxidant properties, promotes re-epithelialization and collagen synthesis. To improve biocompatibility and enhance antibacterial performance, GO was functionalized with chamomile oil, resulting in chamomile oil-functionalized GO (f-GO). Azelaic acid, known for its antimicrobial, antioxidant, and keratolytic effects, further supports wound healing by enhancing the biological activity of chitosan. In this study, f-GO was incorporated at varying weight percentages into the CHAZ/PVA matrix to fabricate PVA/CHAZ/f-GO composite films via solvent casting. The resulting films were thoroughly characterized through FTIR, XRD, SEM, and evaluated for their mechanical and thermal properties. In vitro antibacterial assays have shown notable effectiveness against Staphylococcus aureus and Escherichia coli. The results of the in vitro cellular biocompatibility assay indicated that the developed biocomposite did not significantly affect the viability of HEK293 cells, confirming its biocompatibility as a wound dressing material. Additionally, the in vitro hemolysis assay validated the hemocompatibility of the composite, demonstrating its safety for application in biological systems. In vivo pilot studies have demonstrated a significant enhancement in wound healing compared to the untreated group. A comprehensive in vivo study is being conducted to evaluate the actual wound healing potential of the biocomposite.

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Phytochemical Investigation of Cassia auriculata Twigs and Cytotoxic Evaluation against human prostate cancer cell

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Abstract

Background: Cancer is a vast, multifaceted, and difficult disease class that affects individuals worldwide. Surgery, chemotherapy, and radiation therapy are common cancer therapies. Still, there is a need for new, safe, natural anticancer chemicals and formulations that are less harmful, more effective, and less expensive. Aim & Objectives: Isolation of phytochemical components from the medicinally significant plant Cassia auriculata and spectroscopic characterisation of small molecules to get new potent anti-cancer leads. In traditional medicine, Cassia auriculata is used to cure helminthes infection, eye ailments, diabetes, and skin problems. Methods: Air-dried C. auriculata twigs (powder) was extracted using absolute ethanol further fractionated by hexane, ethyl acetate followed by n-butanol. Ethyl acetate fraction was subjected to column chromatography using silica gel. Further, ten pure compounds were isolated, identified on the bases of modern spectroscopic techniques, including NMR, MS and HRMS and investigated for anticancer activity (in-vitro) using human cancer cell lines. Results & Discussion: From this study, ten compounds were isolated from Cassia auriculata twigs. Further, cytotoxic evaluation of the isolated compounds against a panel of human cancer cell lines using an SRB assay revealed that compound 1 showed significant activity against PC-3 cells, with an IC50 value of 9.61±1.38 µM. Moreover, we have done HPTLC quantification of four marker compound of ethyl acetate fraction. Conclusion: Phytochemical isolation of twigs part of Cassia auriculata lead identification of ten isolates friedelin, 2-ethyl anthraquinone, glutinol, quercetin, rutin, chrysophanal, emodin, kaempferol and stigmasterol. To best of our knowledge this is the first anticancer study of twigs part of C. auriculata. These results could open further paths for the anticancer lead identification.

Keywords: Cassia auriculata, phytochemical constituents, anticancer, HPTLC marker.

Bio-waste Derived Hybrid Fiber Composites: Reinforcement of Chicken Feather and Human Hair in Vegetable Oil Matrix

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Abstract

The increasing environmental burden of synthetic fiber-reinforced composites has accelerated the search for sustainable, biodegradable alternatives using renewable resources. In this context, natural fibers and bio-based polymers offer significant potential for creating eco-friendly composite materials.

The present work is an attempt to develop bio-based hybrid composites by incorporating Human hair (HF) and Chicken feather fibre (CF) in modified soybean oil matrix by compression molding technique. Methacrylic anhydride-modified epoxidized soybean oil (MAESO) was employed as the resin matrix, while chicken feather fiber and human hair fiber served as reinforcing agents. Rosin derivatives acted as eco-friendly crosslinkers, replacing conventional, non-biodegradable petroleum-based compounds such as styrene and divinylbenzene. The fiber-to-resin ratio was maintained at 30:70. In the case of hybrid composites, chicken feather (CF) and human hair (HF) fibers were blended in ratios of 1:1, 2:1, and 1:2. The resulting biocomposites were characterized using Fourier Transform Infrared Spectroscopy (FT-IR). Thermogravimetric Analysis (TGA) was employed to assess the thermal degradation behavior of the composites. Their mechanical properties including tensile strength, flexural strength, and hardness were evaluated, along with chemical resistance and water absorption tests. Among the different formulations, the composite with a chicken feather to human hair fiber ratio of 2:1 exhibited the most significant improvement across all tested properties. These sustainable hybrid composites show potential for use in lightweight interior components, offering an eco-friendly alternative to conventional synthetic materials.

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Glyoxal-Based Bi-Oxazine Benzoxazines: Formaldehyde-Free Biothermosets

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Abstract

Abstract: Natural abundant resources and safe chemicals are attractive feedstocks for achieving circular sustainability. A wide variety of biophenols and greener amines offered interesting avenues in the evolution of the upcoming class of phenolic thermosets, polybenzoxazines (PBZ). High dependence on formalin as a starting material for monomer synthesis has prompted exploration of alternative safe chemicals. In this study, we designed a family of glyoxal-based benzoxazine (BZ) monomers to synthesize formaldehyde-free biothermosets, leveraging a proximity and promiscuity oxazine−oxazine dependent polymerization. The bi-oxazine functionality at the reactive C2 center in the monomers demanded significantly low temperature for ring-opening polymerization with high polymerization enthalpy, favoring an ease in polymer growth, overcoming challenges posed by earlier generation BZ monomers. [1-2]

Current work demonstrates the proof-of-concept for a highly efficient methodology for formaldehyde replacement in benzoxazine chemistry and holds promise for the exploration of a new platform chemical, glyoxal, toward the next generation of benzoxazine with unique reactivities. The innovative design of these newly developed benzoxazines monomers displayed significantly lower polymerization temperatures and followed faster polymerization with extensive mass utilization of to form polymer networks, showcasing the benefits of substituting formaldehyde with relatively benign glyoxal. [3]

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Hydrogel Fabrication by Eco-Friendly Sono-Polymerization of Acrylamide with Dual-Function 2-Acrylamido-2-methyl-1-propane sulfonic acid

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Abstract

This work presents a sustainable and efficient approach for synthesizing ionic hydrogels via the free radical copolymerization of acrylamide (AA) with 2-acrylamido-2-methyl-1-propane sulfonic acid (AMPS) using low-frequency ultrasound (20 ± 3 kHz). Conducted in an aqueous medium, AMPS uniquely serves as both the initiator and co-monomer, facilitating a green, catalyst-free reaction pathway. This strategy eliminates the need for external initiators, offering a cleaner and more sustainable synthesis pathway. The optimized system achieves self-healing functionality through hydrogen bonding within a three-dimensional network, while the degree of crosslinking dictates water uptake capacity, showcasing tunability to specific applications. This sono-polymerization technique offers an environmentally benign alternative to conventional thermal or chemical methods and allows for precise control over the polymer structure and properties. The resulting poly(AA-co-AMPS) hydrogels exhibit a random copolymer structure with high water absorbency, tunable swelling capacity, and enhanced ionic conductivity. The incorporation of AMPS introduces sulfonic acid groups that impart strong acidity, pH sensitivity, and improved ion exchange properties, while acrylamide contributes to polymer flexibility and hydrophilicity. By modulating the AA:AMPS molar ratio and the concentration of the crosslinking agent N,N'-methylenebisacrylamide, the mechanical strength, swelling behavior, and ionic performance of the hydrogels can be tailored to suit specific applications. Potential applications include drug delivery systems, water purification technologies, smart materials for self-healing, and high-performance additives for cement and concrete (e.g., as retarders, plasticizers, and air-entrainers), as well as proton-conducting membranes in fuel cells.1-2 The synthesized copolymers were characterized by Fourier Transform Infrared Spectroscopy (FTIR), Gel Permeation Chromatography (GPC), swelling behavior analysis, and self-healing performance studies.

Keywords: Free radical copolymerization, low-frequency ultrasound, hydrogels, water solvent, no additives.

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Electrospun Polyurethane Nanofibers Embedded with Extractive Deep Eutectic Solvent for Sustainable Rare Earth Element Recovery

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Abstract

Nanofiber-based adsorbents offer high surface area and tunable surface functionalities, making them highly effective for the selective extraction of rare earth elements (REEs) from electronic waste leachates. Their enhanced adsorption capacity and regeneration potential contribute to a sustainable and efficient REE recycling process. Hydrophobic Deep Eutectic solvents have gained significant interest as a sustainable and efficient extraction of the important REEs. The present study explores the application of hydrophobic deep eutectic solvents (HDES) that can be designed to extract and separate REE metals. HDES composed of tri-n-octylphosphineoxide (TOPO) and 2-thenoyltrifluoroacetone (HTTA) (1:2) mole proportion, was successfully immobilized on PU nanofibers by electrospinning. The high amount of HDES (20 wt.%) could be immobilized in PU nanofibers. For extraction experiments, REE leaching experiments were also carried out using Kerala beach sand with 1M NaOH pretreatment and followed by leaching in 6M HNO_3 at 75 °C for 6 h. The pretreatment converts REE into hydroxide form, making it easier to leach the REE. The obtained leach liquor contained all REE with competitive ions, for simulating real conditions. The characterization by Environmental Scanning Electron Microscopy (E-SEM) and Fourier Transform Infrared Spectroscopy (FTIR) confirmed the morphology and successful immobilization of HDES in PU nanofibers, respectively. The inductively coupled plasma mass Spectroscopy (ICP-MS) confirmed the extraction of the REE quantitatively from the leach liquor of Kerala beach sand, having 0.1M HNO_3.

Keywords: Beach Sand, Deep Eutectic Solvent, Nanofibers, Electrospinning, Extraction, Rare Earth Elements.

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Modified Lignocellulosic Material Removes Methylene Blue Dye from Textile Effluents

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Abstract

Lignocellulosic materials are effective adsorbents for the removal of synthetic azo dyes which are considered as the main water pollutant. This study used lignocellulosic agricultural waste sugarcane bagasse and alkali-modified bagasse with 3% and 5%. The particle size of treated and untreated sugarcane bagasse is greater than 5 mm. FTIR, SEM, XRD, and point of zero charges were used to characterize the interactions between sugarcane bagasse (treated and untreated) and methylene blue dye. Methylene blue (cationic dye) was tested for adsorption under different dye solutions of concentrations and different adsorbent doses temperature, pH, adsorption. Dye adsorption increased with time and reached equilibrium in 360 min for pure and processed sugarcane bagasse. The untreated sugarcane bagasse treated removes a 67.40 % per cent of 5 mg L-1 dye at pH 7. Dye adsorption is increased on greater at pH. The sugarcane bagasse treated with 5% sodium hydroxide removes 98.45% of 5 mg L-1 dye at pH 10. For adsorption, pseudo-second-order kinetics fit best. The Freundlich isotherm showed multilayer adsorption. At lower temperatures, methylene blue dye adsorption was more efficient.

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L-Proline Taurinate Mediated One-Pot Knoevenagel-Michael Reaction for the Efficient Synthesis of Pyrido[2,3-d]pyrimidine and Pyrimido[4,5-b]quinoline Derivatives

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Abstract

Greener synthetic methodologies for biologically active scaffolds have been increasingly explored in the quest for eco-friendly and sustainable chemical processes. In this study, a facile, cost-effective, and environmentally benign synthetic protocol has been developed for the preparation of pyrimido[4,5-b]quinoline and pyrido[2,3-d]pyrimidine derivatives via a one-pot Knoevenagel-Michael condensation of aromatic aldehydes with cyclic 1,3-dicarbonyl compounds and 6-aminouracil, respectively. Using L-proline taurinate (LPT) as a homogeneous ionic catalyst, this approach enables the efficient synthesis of products with high yields. The substrate versatility was demonstrated with substituted aromatic and heterocyclic aldehydes, along with 1,3-dicarbonyl compounds like dimedone, 1,3-cyclohexanedione, 5-methyl-1,3-cyclohexanedione, and Meldrum's acid. Fourteen derivatives, including twelve new compounds, were obtained using this method in excellent yields (88-98%) within 10-30 min. The structures of the synthesized products were confirmed through spectral analysis. Advantages of this approach include the use of an environmentally benign catalyst, straightforward product isolation, catalyst recyclability for up to five cycles, gram-scale synthesis capability, and favorable green chemistry metrics.

Keywords: Pyrimido[4,5-b]quinoline; Pyrido[2,3-d]pyrimidine; L-proline taurinate; Knoevenagel-Michael reaction; Recyclability; Green synthesis.

Novel bioactive bioceramics for Orthopedic Applications

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Abstract

Bone regeneration in critical-sized defects remains a persistent challenge in orthopaedic surgery due to the limitations of current graft materials in terms of bioactivity, mechanical integrity, and degradation control. Addressing these issues, this study presents the development and evaluation of a novel biphasic bioceramic system with a tunable hydroxyapatite (HAP) to β-tricalcium phosphate (β-TCP) ratio, designed to enhance osteoconductivity and promote efficient bone regeneration. The unique feature of this bioceramic lies in its ability to maintain a controlled phase composition, modulated through the incorporation of polymer during synthesis. This approach enables precise control over the HAP/β-TCP ratio, allowing for the tailoring of mechanical strength, degradation rate, and ion release kinetics to match the specific requirements of various bone defects. By creating a phase-specific regenerative environment, the material addresses key limitations in existing bioceramics, such as inconsistent particle size, poor bioactivity, and lack of resorption control.

Characterization studies confirmed the bioceramic's favorable microstructural properties, including high porosity, homogeneity, and phase purity. The in vitro analysis demonstrated excellent cytocompatibility, enhanced cellular proliferation, and early markers of osteogenic differentiation. Furthermore, in vivo implantation in a critical-sized bone defect model showed significant new bone formation, improved structural integration, and faster healing compared to commercially available bone grafts. The study highlights the potential of phase-tuned bioceramics to create a biologically responsive environment that supports faster and more effective bone regeneration.[1,2]

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Pro-angiogenic self-assembled peptide gel for wound healing application

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Abstract

Infectious wound healing remains a significant clinical challenge due to multiple pathological barriers, including bacterial colonization, prolonged inflammation, impaired cellular function, and poor angiogenesis, disrupting the natural wound repair process. The excessive use of antibiotics to combat wound infections often results in drug resistance, posing a significant challenge in wound management. To address this, we aim to develop drug-free systems that have the capability to display antibacterial, antioxidant, and pro-angiogenic properties. Herein, we fabricate a self-assembled lauric acid-conjugated peptide gel, incorporating pro-angiogenic selenium nanoparticles through passive entrapment within the fibrous peptide gel (SePG). Morphological characterization of SePG via AFM and HR-TEM confirms the formation of an interconnected nanofibrous network. Rheological analysis reveals the viscoelastic and self-healing behavior of gel, which is essential for maintaining the structural integrity in dynamic wound environments. In addition to strong antioxidant activity of ~91%, it also shows excellent antibacterial activity of ~89% and ~94% against E. coli and S. aureus, respectively. In vitro biocompatibility assessments show enhanced fibroblast viability (109% on L929 cells) and excellent hemocompatibility. Further, the wound scratch assay displays accelerated cell migration and enhanced wound closure in SePG-treated wounds compared to untreated cells. The proangiogenic property of SePG is currently under investigation. These findings suggest that SePG is a promising drug-free system for managing infected wounds, combining antibacterial and antioxidant properties with potential for promoting angiogenesis.

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Evaluation of Hepatoprotective and Antioxidant Properties of Chitrakadi Vati, a Traditional Polyherbal Ayurvedic Medicine

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Abstract

Hepatotoxicity remains a significant global health concern even though hepatology has seen tremendous scientific advancements. The liver is a vital metabolic organ that regulates physiological homeostasis, facilitates detoxification, and is commonly the target of several toxins [1]. As such, it is very susceptible to injury, with oxidative stress serving as a major cause for this damage. Antioxidants prevent free radical-induced tissue damage by preventing the formation of radicals, scavenging them, or promoting their decomposition [2]. Non-toxic, effective antioxidant medicinal plants are gaining more attention in research due to the high toxicity and limited availability of synthetic medications for the treatment of hepatotoxicity [3]. It is established that polyherbal ingredients and their extracts are more effective and safer than single ingredients. In this research work, selected classical Ayurvedic formulations, Chitrakadi Vati extract, were studied for phytochemical and antioxidant properties found through colorimetric methods. The extract was prepared from the formulation in hydro-alcoholic 70:30 v/v. In phytochemical screenings, alkaloids, carbohydrates, tannins, and flavonoids were found to be present; also, in total phenolics (TPC) and flavonoidic (TFC) concentration studies, results found a good amount. TPC was found in Chitrakadi Vati at 9.4306 µg GAE/mg of hydro-alcoholic extract, and TFC was found in Chitrakadi Vati at 3.790µg QUE/mg of hydro-alcoholic extract. Detail An in-vitro antioxidant study was also done where TAC was found in Chitrakadi Vati at 117.4487µg AAE/mg of hydro-alcoholic extract, and also other colorimetric methods were used for the detection of antioxidant properties. In-vivo hepatoprotective activity was also studied with the help of CCl4-induced hepatotoxicity against various dosages of hydro-alcoholic extract after a thorough toxicity study performance. The toxicity study was designed as per OECD guidelines, where an acute toxicity was performed (n=10) in female mice (Wt 25-30 gm) with single-dose administration and parameters checked for 14 consecutive days, followed by a few more days. The highest dosage of 5000 mg/kg BW was given for its morbidity test, for which no significantly major motor activity or any other mortality was observed. Then for chronic toxicity, consecutive 90-day dosing of low dose (10X dilution, 500 mg/kg BW) and high dose (5X dilution, 1000 mg/kg BW) was given to different groups. After the 90th day, the rodents were sacrificed, and blood and major organs were collected for histopathological study. In a therapeutic activity study, Wistar rats were taken (n=6) in each group, weighing 150-200 gm, and for standard positive control, sylimarin (500 mg/kg bw) was administered. Histopathological examinations confirmed hepatocellular protection and reduced hepatotoxicity by the test extract. The observed protective effects are likely attributed to the antioxidant constituents present in the Chitrakadi Vati formulation. These findings provide scientific validation for the use of Chitrakadi Vati as a safe, naturally occurring, and powerful hepatoprotective agent, in addition to its traditional use in digestive diseases.

Keywords: Chitrakadi Vati, Polyherbal formulation, Hepatoprotective activity, Hydro-alcoholic extract.

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Eco-Friendly Chitosan Derivatization via Mechanochemical Method: Computational Validation and waste water remediation

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Abstract

Chitosan is a diverse and multifaceted biopolymer with functional groups such as amino, hydroxyl, and acetamido groups. Derivatization of chitosan enhances the properties and broadens its range of applications. Reported derivatization methods often involve drawbacks such as use of toxic solvents, high temperature, harsh reaction conditions, and lengthy processing time. Therefore, it is imperative to develop a universal, simple, and sustainable synthetic protocol for chitosan derivatization. In this study, we report for the first time use of an environmentally acceptable solvent-free mechanochemical approach for chitosan derivatization. To accomplish this, a solvent-free method was developed that utilizes a mortar and pestle and mechanical force to cross-link chitosan with a variety of linkers, such as acrylic acid, gallic acid, octanoic acid, p-coumaric acid, and ferulic acid. The prepared materials were characterized by FTIR, XRD, elemental analysis, and solid state 13C NMR analysis. Computational studies using Gaussian 16 software were also performed to get an insight into mechanism of derivatization. Out of the five synthesized derivatives, acrylic acid grafted chitosan (AA-g-CTS) shows highest percent grafting (60%), grafting efficiency (123.52%) and degree of substitution (0.42) and was selected for further applications. AA-g-CTS depicted zeta potential of 8.1 mV, point of zero charge as 3.08 and BET surface area 8.147 m^2/g. AA-g-CTS was further investigated for simultaneous removal of heavy metals and pharmaceutical and personal care products (PPCPs). Under optimized conditions (pH 5, adsorbent dose 0.2 g, initial concentration 100 ppm, and contact time 180 minutes), AA-g-CTS demonstrated effective adsorption performance for both heavy metal (dichromate) and PPCP (caffeine).

Enhanced Bio content epoxy resin and hardeners for application of carbon fibre retrofitting applications.

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Abstract

Carbon fibre retrofitting is a new potential area for country like India looking to repair infrastructures, the segment amplifies cost saving vis-a vis new infrastructure and assist in utilization of budgets for new potential cities. In line with climate concerns where in world looks for enhanced and even total bio-based grades we have tried our initiatives in this direction for introducing bio grades both in resin and hardener and tried to match/ surpass stringent application requirements of carbon fibre retrofitting sectors. The resin is based on cardanol chemistry (Bio content theoretical ~34%) while hardeners are based on dimer acids as well as cardanol variants (Bio content theoretical ~ 55%) The other components are chosen in proportion to add the value on the properties. We have seen that there is an improvement of around 15-20% in tensile properties compared to existing pet-chem sources. Similarly, modulus values are at par with pet-chem source.

Essential Oil Components Incorporated Emulsion Hydrogels for Eradicating Dermatophytosis Caused by Pathogenic Fungi

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Abstract

Dermatophytosis is a prevalent fungal skin infection and poses a significant public health challenge, primarily caused by Trichophyton and Microsporum species. Current treatments have several limitations, including drug resistance and adverse side effects, including hepatotoxicity and leucopenia. This research involved the development of emulsion hydrogels (EOCs-EHGs) by incorporating two essential oil components, Eugenol (EU) and Isoeugenol (IU), within a matrix synthesized from Hydroxypropylmethyl cellulose and poly (ethylene glycol) methyl ether methacrylate. The developed EOCs-EHGs exhibited excellent biocompatibility and demonstrated sustained, pH and temperature-responsive release of the encapsulated EOCs. The in vitro studies confirmed potent antifungal activity, effectively inhibiting fungal spore germination and eradicating biofilms of T. mentagrophytes and M. canis at very low EOC concentrations. Furthermore, in vivo studies using a rat model of dermatophytosis demonstrated complete infection eradication and facilitated skin regeneration upon topical application of the EOCs-EHGs. These findings suggest that the combination of sustained drug release and the potent antifungal properties of EOCs within the biocompatible hydrogel platform offers a promising strategy for the effective treatment of dermatophytosis.

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Green Synthesis of Thermoregulating Regenerated Cellulosic Fibers from Textile Waste for Sustainable Polymer Applications

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Abstract

The growing demand for sustainable materials has driven the development of high-performance regenerated fibers from textile waste, supporting green chemistry and circular economy principles. This study explores an innovative method for extracting cellulose from polyester-cotton textile waste using a selective dissolution approach with an environmentally friendly solvent. The process efficiently separates cellulose from synthetic fibers, enabling its recovery and transformation into regenerated fibers through a wet-spinning technique. The solvent is successfully recycled with high purity, minimizing environmental impact. To enhance fiber functionality, thermoregulatory microcapsules were incorporated into the cellulose matrix, imparting energy storage capabilities. The optimized fibers exhibit robust mechanical performance, thermal regulation, and durability, making them suitable for applications in sustainable textiles, composites, and energy-efficient materials. This research promotes resource efficiency by utilizing renewable feedstock, reducing waste, and integrating functional materials for sustainability. The proposed approach offers an eco-friendly solution for textile waste valorization, contributing to advancements in sustainable fashion, smart textiles, and environmental applications.

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Water Swellable Polymeric Gel for the Removal of Heavy Metals

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Abstract

To remove heavy metal ions from aqueous waste, we present here the synthesis of a new ethylenediaminetetraacetic acid (EDTA) similar monomer M1, its homopolymer P1H, and crosslinked polymer P2H. The chelating iminodiacetate moieties are present as pendant groups in the monomer M1, which is structurally like EDTA and is synthesized from o-phenylenediamine in four stages. The water-soluble homopolymer P1H was produced by hydrolysis of the new polymer P1, which was produced via the polymerization of M1. Methylene bisacrylamide (MBA) was used as a crosslinker during the polymerization of M1, resulting in P2, which hydrolyzed to produce the water-swellable polymeric gel P2H. P2H was shown to be an effective sequester for most metal ions, and we show its potential for use in heavy metal ion removal applications. The newly synthesized resin P2H has a high regeneration efficiency, according to the adsorption-desorption experiments, with just a little loss of adsorption capacity after five cycles.

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Development of Starch based Biocomposite Films Reinforced by Rice Husk

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Abstract

The global shift towards sustainable development has led to a growing interest in biodegradable and eco-friendly materials, particularly in replacing petroleum-based products. In this regard, starch-based biocomposites have emerged as promising alternatives due to their renewability, biodegradability, and low cost. However, native starch suffers from inherent drawbacks such as poor mechanical strength, high moisture absorption behaviour, and limited durability. To address these challenges, this study investigates the development of starch-based biocomposite films reinforced with rice husk, an abundant agricultural by-product in the Dalgaon region of Assam. Rice husk, rich in lignocellulosic fibers and silica, has been utilized as the reinforcing filler due to its availability, low cost, and ability to enhance the structural integrity of starch-based films. The biocomposites were prepared by incorporating rice husk at different concentrations (1%, 2%, 3%, and 4% by weight) into a starch matrix plasticized with glycerol and treated with acetic acid to improve compatibility. The physicochemical properties of the composite films were analyzed including environmental resistance, and biodegradability. The interaction between the rice husk powder and starch was confirmed by Fourier Transform Infrared (FTIR) and scanning electron microscope (SEM) study. The nanocomposites exhibited improved mechanical properties, water resistance, and biodegradability. Ultraviolet (UV) and microbial degradation studies revealed enhanced stability upon incorporating higher percentages of rice husk. The results highlight the potential of rice husk as a sustainable reinforcing material in starch-based biocomposites. The developed films offer a promising biodegradable alternative in packaging applications particularly. This approach not only addresses the environmental concerns associated with plastic pollution but also promotes value-added utilization of agricultural waste, contributing to sustainable waste management and rural economic development.

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Assessment of bioengineered polyherbal formulation against Rheumatoid Arthritis – Traditional concept in a modern approach

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Abstract

Abstract: In recent scenario, arthritis is very prevalent bone disorder and rheumatoid arthritis (RA) is the second most common disability of joint. Rheumatoid arthritis is characterized as autoimmune disorder which can affect not only joint; also heart, lung, skin, eye when it is in severe inflammatory condition. Rheumatoid arthritis involves complex cytokine network, with numerous cytokines exhibiting pleiotropic effects and targeting various receptors.To arrest the disease condition, various commercial therapeutic drugs, inhibitor of inflammatory cytokines etc are used which are very expensive, and have many side effects. Hence, herbal products in poly-herbal formulations prepared via herbal bio-engineering process to get synergistic effect and maximum pharmacological action are alternative choice. From the ancient time, guggul (Commiphora weghiitee) was considered as potent medicinal component to treat inflammatory diseases which were used to prepare polyherbal formulation for treatment. This study was focused on the evaluation of anti-arthritic activity of guggul in polyherbal formulation - Triphalaguggul against CFA induced rheumatoid arthritis in rats. Acute toxicity of Guggul upto 2000mg/kg did not show any adverse effect. Regulation of pro-inflammatory cytokines i.e IL-1β, IL-6, TNF-α were studied for controlling RA progression. The data of all heamatological parameters including CRP and RA factor was gradually decreased during the treatment period. The level of CRP is 22.4±1.35 after administration of CFA and this was decreased at 9.08±0.75 after the treatment with drug. TNF-α and IL-6 were elevated by 8-9 fold with administration of CFA which were reduced 75-80% after the treatment with our drug.

This study helps to conclude that triphalaguggul; a traditional polyherbal formulation can be a good option for the treatment of Rheumatoid Arthritis.

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Magnetic nano-bio-composites for efficient photocatalytic degradation of emerging contaminants in water

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Abstract

In recent times, worldwide uncontrolled growth of population, industrialization, pesticide-based agriculture, and modernization of lifestyle have increased the discharge of emerging contaminants (ECs) rapidly into the environment. These ECs are harmful to the environment, aquatic species, and ecosystems and also threats to human health both directly and indirectly. Here, we synthesized an efficient, cost-effective, magnetic nano-bio-composite by integrating an efficient semiconductor photocatalyst (TiO_2) and iron oxide (Fe_3O_4) in a sodium alginate backbone to achieve enhanced photocatalytic activity along with magnetic recoverability. Detailed characterization of nanocomposites was performed using instrumental techniques such as UV-Vis, XRD, TEM, SEM, DLS, and Zeta potential to confirm the successful synthesis and favourable physicochemical properties of the hybrid nanocomposite. The photocatalytic performance of the magnetic nano-bio-composite was performed under simulated solar irradiation against model ECs. The result evidenced significantly better degradation rates compared to individual photocatalysts alone, attributed to improved charge transfer dynamics and increased active site availability. The magnetic nano-bio-composite offers a significant advancement over conventional photocatalysts and supports the development of next-generation sustainable water purification technologies.

Keywords: Nano-bio-composite, emerging contaminants, photocatalyst, wastewater treatment.

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Stimuli-responsive Copolymer Mediated Fabrication Gold Nanoparticles for Nanozyme-based Colorimetric Sensing of Mercury (II) ions

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Abstract

Mercury ion (Hg2+) is an extremely hazardous pollutant to humans, soil, and aquatic life. The enzyme-based sensing approaches are promising for detecting toxic heavy metal ions. In this work, gold nanoparticles (AuNPs), were directly prepared in aqueous media using a stimuli-responsive, poly(ethylene glycol methyl ether methacrylate)-b-poly(dimethylaminoethyl methacrylate (p(PEGEMA)-b-p(DMAEMA)) block copolymer, synthesized through RAFTpolymerization. In the following, an AuNPs-based colorimetric sensor was fabricated for the trace detection of Hg2+ by capitalizing the inherent peroxidase-mimetic features of AuNPs for oxidizing the colorimetric indicator 3,3,5,5-tetramethylbenzidine (TMB) in the presence of hydrogen peroxide (H2O2). Using TMB, H2O2, and the AuNP colorimetric system, the concentration of Hg2+ in aqueous media was quantitatively and selectively detected over other common interfering metal ions. The Hg2+ was linearly measured between 10 nM and 3.5 µM and achieved a detection limit of 0.4 nM. Subsequently, a naked-eye sensing strategy was also developed by integrating the colorimetric sensor on a paper device with a detection limit of 3.5 nM. The efficient colorimetric sensing platform is promising for detecting mercury from water and different biological samples.

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Compensatory effects of the Disordered Region of Human Parathyroid Hormone on amyloid aggregation in macromolecular crowded conditions

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Abstract

Human parathyroid hormone (PTH), comprising 84 amino acids, is secreted by the parathyroid glands and plays a pivotal role in regulating blood serum phosphate and calcium levels. PTH is also characterized as a functional amyloid due to its ability to store itself in the form of amyloid prior to its release. The N-terminal residues (S1-Q29) have a helical propensity, while residues (R25-L37) play a significant role in fibril formation[1]. PTH is largely disordered, as its C-terminus(D30-Q84) constitutes the intrinsically disordered section of PTH.

In this study, we investigated the role of the intrinsically disordered C-terminal region on pre-fibrillar aggregates by comparing sizes and structures of oligomers of the truncated variant and the full length protein using spectroscopic techniques as Fluorescence Correlation Spectroscopy (FCS) and Infrared(IR)spectroscopy.

In the conclusion, we found that the absence of the C-terminal region lead to smaller oligomer and nuclei sizes as well as to accelerated fibrillation[2]. Moreover, using macromolecular crowding conditions, we could assign the differences in fibrillation kinetics, sizes, and structural changes to the compensatory effect of the intrinsically disordered region.

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Drying Evolution and Skin Formation in Aqueous Dextran Solution Droplets

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Abstract

The evaporation of a sessile droplet of polymer solution is an interesting phenomenon that leads to the formation of complex deposited patterns after drying[1]. This drying process of polymer solutions has many technological applications, such as coating, film making, inkjet printing, biomedicine, and biotechnology. Controlling the final shape and size of the dried droplet is essential in these processes. The drying mechanism is quite complex and involves different physical phenomena such as solvent diffusion, fluid convection, mass transfer at the air/medium interface, and glass transition[2].For example on glass substrate, Dextran, a non-toxic polysaccharide biopolymer in aqueous solution, in dilute regime typically forms a characteristic "coffee-ring" pattern upon drying, whereas at higher concentrations, a soft elastic or viscoelastic skin layer forms near the air/medium interface, and the final shape (e.g., “Mexican hat” etc.) depends on various conditions such as concentration, contact angle with substrate and humidity[3]. However, not all aspects of the drying process are fully understood, and several mechanisms remain to be explored.

In this preliminary study, the drying mechanism of aqueous- Dextran (Mw :70,000) solution droplet of volume 2-5 µl deposited at various concentrations (5 wt% – 40 wt%) was investigated on gold-coated quartz substrate, using the half-angle method with a contact angle meter. It was observed that at low concentrations (eg., 10 wt%), the final deposited pattern resembles a “coffee ring”, whereas at high concentrations (e.g., 40 wt%), it took the form of a “Mexican hat” structure. Further, optical microscopic studies of droplet and rheological properties will also be discussed. Evaporation dynamics of polymer solution will be explained through gravimetric and optical techniques using quartz crystal microbalance and ellipsometry, respectively. These experiments aim to deepen the understanding of drying dynamics across various polymer concentrations and to relate evaporation behaviour with hydrophobicity/hydrophilicity of substrate, confined environment, curvature of the droplet, humidity etc.

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A Sustainable Approach for Valorizing Kinnow Peel: Extraction of Functional Dietary Fibers

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Abstract

Kinnow, one of the most abundant crops of Punjab, is processed not only to obtain juice, but also in the canning industry to produce marmalade and by the chemical industry to extract flavonoids and essential oils [1]. However, massive industrial waste is produced in the industries resulting in severe environmental problems. Kinnow by-products are mainly composed of dietary fibers and pectin and contain a variety of other bioactive ingredients including protein, pigment, flavonoids, and essential oils. Previous studies have shown that the citrus fibers (CF) are more valuable than the cereal fibers for its higher total dietary fibers (TDF) content, with better functional properties (i.e. water holding and water swelling capacities) [2]. Kinnow peels, a primary residue of Kinnow processing industry, are rich in polysaccharides, such as soluble dietary fibers (SDF) and insoluble dietary fibers (IDF) which can be isolated and used as a functional ingredient in fortified beverages. Commonly used processing methods include chemical, physical methods like homogenization or a combination of these methods, however, result in a low content of SDF and thus can limit the functional properties and usage of dietary fibers derived. The transition from discarding horticulture byproducts to exploiting them for their bioactive potential has encouraged research on non-conventional extraction modification techniques such as extraction using microwave, ultrasound, high-pressure etc, which helps in modifying IDF to SDF. In the present work, ultrasound-assisted extraction (UAE) and enzymatic extraction (EE) have been used to maximize SDF yield from Kinnow peel. The present investigation would provide convenient and sustainable method to improve the functional properties of DF's and broaden its application in food industry.

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Computational Screening of Parthenium hysterophorus Phytochemicals for Antifungal Activity Against Aspergillus and Fusarium

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Abstract

Fungal phytopathogens, particularly species of Aspergillus and Fusarium, represent significant threats to agriculture and human health due to their growing resistance to conventional fungicides (Naqvi et al 2025). Secondary metabolites from Parthenium hysterophorus, including volatile compounds, phenolics, flavonoids, alkaloids, and organic acids, have been previously reported to possess in vitro antifungal activity. Building on this evidence, the present study focuses on evaluating the antifungal potential of these metabolites through an in silico molecular docking approach. Approximately 60–70 metabolites identified from the literature were screened against key fungal protein targets (6K3H, 5FRB, 6U14, and 1ULW) to assess their binding affinities and potential inhibitory mechanisms. Molecular docking simulations were conducted using AutoDock, with commercial fungicides—prochloraz and pyraclostrobin—serving as positive controls for benchmarking (Naimuzzaman et al 2025). Several Parthenium-derived compounds, particularly specific phenolics and alkaloids, demonstrated strong binding interactions, in some cases exceeding the affinities observed with the commercial fungicides. These findings suggest that the antifungal activity of Parthenium metabolites may involve interference with essential fungal proteins, similar to known fungicidal modes of action. The work offers a scientific foundation for the creation of plant-based fungicides and emphasizes P. hysterophorus' potential as a source of environmentally benign antifungal drugs. To confirm these in silico results and promote the use of these drugs in integrated fungal disease treatment methods, more in vivo research is advised.

Keywords:
Parthenium hysterophorus, antifungal activity, secondary metabolites, molecular docking, Aspergillus, Fusarium.

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Role of PBDMS in tailoring the mechanical and thermal performance of the natural rubber blends

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Abstract

This study presents the development of high-performance natural rubber elastomer blends through the incorporation of PBDMS gels, with the objective of simultaneously enhancing mechanical strength and thermal stability. The resulting elastomers exhibit a unique combination of flexibility, improved thermal resistance, and enhanced mechanical integrity, positioning them as potential candidates for demanding applications such as thermal interface materials, impact-resistant structures, high-voltage insulation systems, automotive vibration dampers, protective coatings, and wearable electronic devices. To achieve this, a viscoelastic PBDMS gel was synthesized by modifying hydroxy-terminated polydimethylsiloxane with boric acid, forming dynamic Si–O–B covalent bonds. This PBDMS gel was subsequently incorporated into the natural matrix at varying loading levels using a two-roll milling process, followed by sulphur-based vulcanization at 150 °C. FTIR spectroscopy confirmed molecular interactions between natural and PBDMS, evidenced by the broadening of characteristic peaks at 833 cm^{-1} (Si–O bending) and 1310 cm^{-1} (B–O stretching). An increase in the intensity of peaks at 1087 cm^{-1} and 1257 cm^{-1}, corresponding to Si–O–Si asymmetric stretching and Si–CH_3 groups, respectively, further validated successful incorporation and interaction of PBDMS in the rubber matrix. Mechanical testing revealed that the incorporation of PBDMS significantly improved the tensile strength of the natural blends, with optimal performance observed at 0.5 Phr loading. Beyond this concentration, a gradual decline in tensile strength was noted, likely due to the plasticizing effect of excess flexible PBDMS, which compromises the matrix rigidity. However, elongation at break continued to increase with higher PBDMS content, reflecting enhanced flexibility. The improved mechanical behavior at optimal loading is attributed to effective crosslinking and strong interfacial interactions facilitated by the dynamic covalent bonding, which restricts polymer chain mobility and reinforces the elastomer network. Thermal analysis further confirmed that PBDMS incorporation enhances thermal stability, with modified blends exhibiting higher degradation temperatures and reduced char residue compared to neat natural rubber. Overall, this work demonstrates that strategic incorporation of PBDMS gels into natural rubber matrices offers a promising route to engineer elastomers with tunable mechanical and thermal performance suitable for multifunctional advanced applications.

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Selective Single C-F Bond Activation in Trifluoromethylated Dienes

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Abstract

Fluorinated organic compounds are valuable components in pharmaceuticals, agrochemicals and materials. The significant strength of the C-F bond leads to chemical inertness that depending on the context, is beneficial, problematic or simply formidable synthesis challenge. In recent years, selective C–F bond activation in trifluoromethyl (-CF_3) groups has emerged as a powerful strategy for accessing difluorinated compounds which are difficult to obtain by other synthetic pathways. Our group had reported lanthanide-mediated selective C–F activation in trifluoromethylated dienes. Expanding on this work, ongoing research focuses on alkaline earth metal-mediated strategies to activate C–F bond under milder conditions.

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Synthesis and characterization of lignin derived triphenols and their use for development of biobased polyurethane films

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Abstract

Petroleum derived raw materials have been extensively exploited after industrial revolution for the development of various polymeric materials in general and in polyurethane in particular. This has led to depletion in the petroleum resources along with the production of toxic by-products during utilization. To address this burgeoning issue, the approach has recently shifted to the development of biobased polyurethane. In this context, we have synthesized lignin-derived tri-phenolic monomer using vanillin and guaiacol as the greener substrates. As- synthesized molecule was confirmed through ATR-FTIR, NMR, and GC-MS measurements. Further, this monomeric unit has been used as polyol with isocyanate to develop the triphenol based polyurethane films. The biobased PU films have been characterized through multiple techniques. The ATR-FTIR study confirmed the formation of polyurethane film, FESEM and XRD revealed their amorphous nature. Furthermore, the DSC, DMA and TGA measurements proved that the synthesized PU films exhibited a significant improvement in their thermal and mechanical properties. Also, the incorporation of tri-phenolic monomer led to an enhanced hydrophobic character along with high chemical resistance within the film, making it a viable coating material for packaging applications.

Keywords: Lignin, Lignin-derived Triphenol, Biobased-polyurethane.

Development of Chemically Modified Hollow Nanospheres for Targeted Delivery of Anti-Cancer Agents

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Abstract

Hollow nanomaterials have gained significant attention in nanomedicine due to their exceptional drug-loading capacities, potential for sequential drug release, and amenability to multifunctional surface modifications. In this study, we report the synthesis and characterization of hollow zinc oxide (ZnO) nanospheres designed for the targeted delivery of an anticancer agent.The ZnO nanospheres were synthesized via a template-assisted method and subsequently loaded with a model chemotherapeutic drug. To achieve controlled and sustained release, the drug-loaded nanospheres were coated with a natural polysaccharide-based biopolymer and further functionalized with a cancer-specific targeting ligand. Morphological and structural analyses were conducted using Transmission Electron Microscopy (TEM) and Field Emission Scanning Electron Microscopy (FESEM). The nanospheres exhibited a well-defined spherical morphology with an average diameter of ~400 nm, composed of assembled ZnO nanoparticles approximately 50–60 nm in size. Owing to their hollow and porous architecture, the nanospheres achieved an exceptionally high drug loading efficiency of 98%. Drug release kinetics were evaluated in phosphate-buffered saline (PBS) at physiological pH (7.4) for both coated and uncoated formulations. Results revealed that the uncoated nanospheres released approximately 84% of the drug within 18 hours, whereas the polysaccharide-coated nanospheres exhibited a more controlled release profile, with 60% of the drug released over the same period. These findings highlight the potential of hollow ZnO nanospheres as an efficient and tunable drug delivery platform. Their high loading capacity, customizable surface, and sustained release profile make them promising candidates for targeted cancer therapy.

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Agro-waste to wealth: Fabrication of mechanically surface fibrillated pineapple leaf fibre reinforced polypropylene composite for protective applications

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Abstract

This work investigated the potential utilization of the agro-waste pineapple leaf fibre (PALF) as green reinforcement in polypropylene (PP) composites. A study of the Food and Agriculture Organization Corporate Statistical Database (2018) indicated that an average of 852,000 metric tons of potential PALF were generated annually [1]. The raw PALF is extracted by mechanical or physical scratching from the leaves and sun-dried for preservation. Then, the sticky fibres are degummed with chemicals to eliminate the non-cellulosic constituents. Generally, the effluents of those chemicals are discharged into nature, which pollutes the environment. Instead of using any chemical treatment, we used a new mechanical approach (carding) to remove the remaining extraneous substances from the scratched and sun-dried PALF. Our earlier research found that the carding technique is a better, eco-friendly way to remove unwanted materials from PALF compared to using traditional chemical treatments [2]. Then the surface fibrillated PALF and PP fibres were subsequently combined consistently at a 50% weight percentage via the carding process. The carding procedure yielded an excellent dispersion of PALF within the fibre-structured PP matrix for overcoming the penetration problem of thermoplastic matrix for higher viscosity in conventional techniques. The blended fibres were next treated by a gill-drawing machine to yield oriented PALF-PP slivers, which were then consolidated in a compression molding machine at 180°C for 15 minutes under 20 bar pressure to manufacture the unidirectional composites. A uniform fibre-matrix distribution was attained with longer PALF and finer PP fibres, resulting in maximum tensile strength, tensile modulus, bending strength, bending modulus, and impact strength of 124.6 MPa, 6.2 GPa, 103.3 MPa, 6.2 GPa, and 104.3 kJ/m² for the fabricated composites, respectively. Therefore, agro-waste PALF-reinforced PP composites can be used for the development of various value-added products for several protective applications, including decking, window and door edges, heat sinks, packaging, sports equipment, construction, and automotive materials.

Keywords: Agro-waste, PALF, thermoplastic composites, protective applications.

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Synthesis and Characterization of Disulfide-Containing Poly(urethane-urea) for Self-Healing Applications

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Abstract

Self-healing polymeric materials have gained significant interest due to their autonomously repair damages, preventing catastrophic failures and prolonging the lifespan of the material. The incorporation of disulfide linkages into a polymer backbone imparts reversible bond exchange under stimuli like heat, light exposure, or moisture. While most recent studies use disulfide bonds as crosslinkers or chain extenders, a novel disulfide-containing poly(urethane-urea) (PUU) was synthesized where the disulfide bond is integrated into the polymer backbone to increase self-healing properties, and urethane-urea linkages can form strong hydrogen bonds to enhance the mechanical properties. The synergistic effect of both hydrogen bond and disulfide-bond exchange leads to faster and efficient self-healing. The PUU polymer was synthesized using a disulfide-based polymer with methylene diphenyl diisocyanate (MDI) and 4,4'-diaminodiphenylmethane (MDA) in a molar ratio of 1:1.1:1. The resulting film exhibited excellent mechanical properties before and after self-healing, with a self-healing efficiency of 44%. After scratching, the film was healed at 100 °C within 7 min, which was observed by atomic force microscopy and optical microscopy. A complete recovery of the storage modulus was observed up to the fifth cycle in the presence of strain 0.1% to 100% at 100 °C, as evidenced by rheological tests. The facile synthesis method and good self-healing as well as self-recovery properties demonstrate that this polymer can be used for self-healing applications.

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Eco-Friendly Synthesis of CQDs from Kigelia pinnata Flowers: A Sustainable Catalyst for 1,2,4-Triazolidine Derivatives

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Abstract

In this study, carbon quantum dots (CQDs) were successfully synthesized using Kigelia pinnata flowers as a novel carbon precursor. The obtained KP-CQDs were thoroughly characterized by HRTEM (300 kV), UV-Visible spectroscopy, fluorescence spectroscopy, Zeta potential, EDS, FT-IR, and XRD analysis. The study showed the average particle size of 3.78 nm for the KP-CQD. The synthesized KP-CQDs exhibited excellent catalytic activity in the green synthesis of 1,2,4-triazolidine derivatives. The reactions proceeded efficiently at room temperature in an ethanol: water (1:4) medium, affording the desired products in high yields (82-97%) within 5-20 minutes. All the synthesized derivatives were characterized by NMR (1H, 13C, and 19F), as well as mass spectrometry. The developed protocol offers significant advantages such as mild reaction conditions, broad substrate scope, reusability of the catalyst up to six cycles, gram-scale applicability, and favorable green chemistry metrics, demonstrating the potential of KP-CQDs as an efficient and eco-friendly catalyst for the synthesis of biologically active heterocycles.

Keywords: Carbon quantum dots, Kigelia pinnata, green synthesis, 1,2,4-triazolidines.

Multifunctional Hydrogels: Pioneering Soft, Conductive Materials for Wearable Electronics

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Abstract

The rapid advancement of wearable electronic devices is driving a paradigm shift toward the development of materials that seamlessly integrate mechanical flexibility, electrical conductivity, biocompatibility, and environmental sustainability. At the forefront of this evolution are multifunctional hydrogels ingeniously synthesized materials combining soft, tunable polymeric matrices bearing functional additives. In this study, a novel multifunctional hydrogel system was synthesized by integrating a biocompatible polymer to ensure cyto-safety, a self-healing polymer to impart resilience under mechanical stress, and an adhesive polymer to enhance conformal contact with skin or flexible substrates. The incorporation of conductive nanoparticles enabled highly sensitive detection capabilities, positioning the multifunctional hydrogel as a powerful interface for next-generation electronics. Remarkably, the multifunctional hydrogel demonstrated exceptional swelling behavior with absorption rates reaching up to 3900%, facilitating enhanced interaction with biological environments and improving sensory responsiveness. Additionally, high gel content and superior moisture retention properties were observed, ensuring dimensional stability and prolonged operational performance under ambient and physiological conditions. Fourier-transform infrared (FTIR) spectroscopy confirmed the presence of desired functional groups indicative of robust crosslinking and multifunctionality within the hydrogel network. These structural features not only support efficient electron transport but also preserve mechanical integrity over extended use. Collectively, this multifunctional hydrogel represents a significant stride in the design of intelligent, skin-friendly materials with profound implications for wearable biosensors, soft robotics, and health-monitoring platforms. This innovation aligns with the growing demand for seamless integration of electronics into daily life, fostering a future where smart, sustainable, and adaptive materials redefine the boundaries of human-device interaction.

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Ultrasound assisted synthesis of Ag-PEG-chitosan nanobiocide film using Origanum majorana flower extract

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Abstract

This work aims to prepare green synthesized Ag-PEG-Ch nanobiocide film using the aqueous flower extract of Origanum majorana under the influence of ultrasound and access its biocidal proficiency. This nanocomposite thin film that is formulated utilizing the Origanum majorana flower extract and ultrasound as a green energy source have emerged as nontoxic and ecofriendly in nature. In this investigation, silver acetate was used as Ag precursor and PEG and chitosan were used as the polymeric stabilizer and solid support, while Origanum majorana flower extract acts as a green reducing agent to produce Ag nanoparticles. This metal polymer film was characterized by UV-Vis, FT-IR, TEM, TGA, DSC and biocidal activities. Characterization data clearly reveals that Ag nanoparticles embedded in a crosslinked polymer matrix. Very fine Ag nanoparticles (4-6 nm) have been synthesized using ultrasound as a green energy source has been proven by TEM images and TGA-DSC results show that this nanocomposite film is thermally stable. This nanocomposite film possesses synergistic biocidal activities too and can be used for wound healing applications.

Keywords: Ultrasound, Biosynthesis, crosslinking, nanocomposite film, biocidal activity.

Efficient Dye Removal from Wastewater Using metal free Based Photocatalysts Under Visible Light Irradiation

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Abstract

In recent years, nitrogen-rich graphitic carbon nitride (g-C_3N_5) has emerged as an advanced photocatalyst, offering improved performance over conventional g-C_3N_4 due to its higher nitrogen content and optimized electronic structure. In this work, g-C_3N_5 was synthesized via a 3-amino-1,2,4 triazole and characterized using X-ray diffraction (XRD), confirming its graphite-like polymeric structure. The synthesized material was applied as a metal-free, visible-light-responsive photocatalyst for the degradation of organic dye, azure A —common industrial pollutants associated with the textile, plastic, and leather industries. The catalyst demonstrated efficient photodegradation activity under visible light, highlighting its potential for sustainable wastewater treatment and solar energy conversion. This study reinforces the significance of g-C_3N_5 as a low-cost, environmentally friendly photocatalyst for addressing organic pollution in aquatic environments.

Synthesis, Characterization and Biological Importance of Zinc Nanoparticles Using Thermosetting resins

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Abstract

In this study, Phenol-Formaldehyde nanoparticles doped with Zinc were prepared through chemical process. FT-IR and NMR spectroscopy have verified that the Zinc polymer metal complex has formed successfully. X-ray diffraction technique revealed the average size of Zinc nanoparticles which was 26.10 nm. Energy dispersive X-ray (EDX) and Scanning electron microscopy (SEM) were used to measure the elemental composition of these nanoparticles and surface morphology of the prepared sample. Zinc salts and thermosetting polymer were used as precursors to create Zn NPs. After 30 minutes of calcination at 800 °C, Zn NPs were produced. Synthesized nanoparticles have spherical and cluster shapes of various size, according to a SEM investigation. The Zn NPs that are generated are crystalline, according to XRD examination. The antibacterial activity was studied against pathogenic bacteria by using the spread plate method. To test the anti-microbial activity of the created Zn NPs and compare them to the common antibiotic Ciprofloxacin, experimental strains of E. coli, S. marcescens and P. aeruginosa (Gramme -ve) were utilized as human pathogens.

Keywords: Zn NPs, FT-IR, XRD, EDX, SEM and Antibacterial activity.

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Metal organic frameworks of pyromellitic diimides: syntheses, properties and applications

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Abstract

The research in the field of metal organic frameworks (MOFs) of pyromellitic diimides (PMDIs) has gained much attention of researchers due to their uses in the field of optical materials, cation and anion sensors, gas adsorption, solvents separation, electrocatalysis, photosensitization, and biomedical related applications. Such applications of PMDIs are attributed to the presence of several non-covalent interactions such as H-bonding, cation-π, anion-π, π-π stacking and some other weak interactions within the frameworks that lead the MOFs to create various 1D, 2D and 3D architectures. These MOFs can be prepared via various type of reactions between the metal salts and substituted-PMDI ligands such as solvothermal reactions, microwave assisted synthesis, electrochemical method and many others. For the preparation of these MOFs, various substituted-PMDI ligands are synthesized first by simple condensation reaction between pyromellitic dianhydride and primary amines. The literature survey provides an insight into the formation and applications of these MOFs in the fields mentioned above.

Keywords: Pyromellitic diimide (PMDI), non-covalent interactions, Metal organic frameworks (MOFs).

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Hydrophobic Modification of Carboxymethyl Cellulose for Textile Applications

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Abstract

Driven by growing sustainability concerns and the rapid advancement of green technologies, the development of renewable, biodegradable materials has become a pivotal focus in the emerging field of sustainable materials science. Carboxymethyl cellulose (CMC), a cellulose-derived biopolymer, stands out as a promising candidate due to its abundance, biodegradability, and functional adaptability. This study investigates the hydrophobic modification of CMC using amine to enhance its water repellency, thermal stability, and biocompatibility, unlocking its potential for diverse applications in textiles, coatings, and environmental technologies.

This work presents the hydrophobization of carboxymethyl cellulose (CMC), a widely available, biodegradable cellulose derivative, via functionalization with hexadecylamine, a long-chain amine. The modification is facilitated through N-hydroxysuccinimide (NHS) as a carboxyl activator and dicyclocarbodiimide (DCC) as a crosslinker, yielding a hydrophobically modified CMC (H-CMC) that exhibits improved water repellency, stain resistance, and durability.

The structural and chemical modifications were confirmed using FTIR and 13C-NMR, while Dynamic Light Scattering (DLS) measured particle size distribution. Enhanced thermal stability of H-CMC was validated through Differential Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA). The modified CMC was incorporated into a polyurethane dispersion (PUD), with the effect of Zinc Oxide (ZnO) nanoparticles and applied to cotton textiles via surface coating. The optimal hydrophobic performance was achieved at 7.5% H-CMC in PUD containing 0.5% ZnO nanoparticles on a cotton textile. These results demonstrate the potential of hydrophobically modified CMC as a functional, sustainable component in the development of advanced bio-based materials.

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High-Performance EMI Shielding and Electrothermal Behavior of Flexible PVDF/CNT Conducting Composites

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Abstract

In this study, flexible and electrically conductive polyvinylidene fluoride (PVDF)/carbon nanotube (CNT) composites were fabricated via a solution mixing method followed by compression molding. The influence of CNT loading (ranging from 1 to 15 wt%) on the electromagnetic interference (EMI) shielding and Joule heating characteristics was systematically investigated. The EMI shielding effectiveness increased significantly with CNT content, reaching a maximum of 34.43 dB for the PVDF/CNT15 composite, indicating its strong potential for EMI shielding applications. The composite films also demonstrated excellent mechanical flexibility, retaining functionality under various deformed states, as evidenced by their ability to light an LED even when bent or twisted.

Joule heating behavior of the composites revealed rapid and controllable thermal responses, with the PVDF/CNT15 sample achieving surface temperatures of 46 °C, 103.4 °C, 167.6 °C, and 245.2 °C under applied voltages of 2.5 V, 5 V, 7.5 V, and 10 V, respectively. Infrared thermography confirmed a uniform heat distribution across the surface, indicating good dispersion and conductive network formation. Rheological characterization further supported the enhanced interfacial interaction and percolated structure within the composite. These findings highlight the multifunctionality of PVDF/CNT composites, making them promising candidates for next-generation flexible electronic devices and thermal management systems.

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Influence of Etchant Concentration on MXene Synthesis and Energy Storage Efficiency

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Abstract

MXenes, a group of two-dimensional compounds composed of transition metal carbides and nitrides, have gained attention as potential candidates for energy storage systems owing to their excellent electrical conductivity, adjustable surface functionalities, and layered architecture. This research explores the effect of varying the concentration of hydrofluoric acid (HF) impacts the synthesis process of MXenes, particularly in terms of their electrochemical behaviour and morphology. To isolate the role of the etchant, all syntheses were carried out under some controlled variables, avoiding the influence of ultrasonication or change in temperature during the synthesis. Among the different HF concentrations synthesized, the sample produced using 30% HF showed the highest electrochemical efficiency at slower scan rates, delivering 204 F/g at 2 mV/s—indicative of effective etching, better ion transport and a robust layered structure with the comparable interlayer spacing. Nonetheless, its capacity significantly decreased under higher scan rates, pointing to challenges with ion transport and electrical conductivity during rapid cycling. Techniques such as cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and galvanostatic charge-discharge (GCD) confirmed these results, highlighting a dependence of synthesis concentration and a balance between maintaining structural integrity and sustaining high-rate performance. These findings shed light on how careful adjustment of HF concentration during synthesis can optimize MXene-based materials for specific electrochemical storage applications.

Keywords: etchant, ultrasonication, CV, EIS, GCD.

Palladium-catalyzed electrochemical ortho-C–H monoarylation of arenes using benzenediazonium salt

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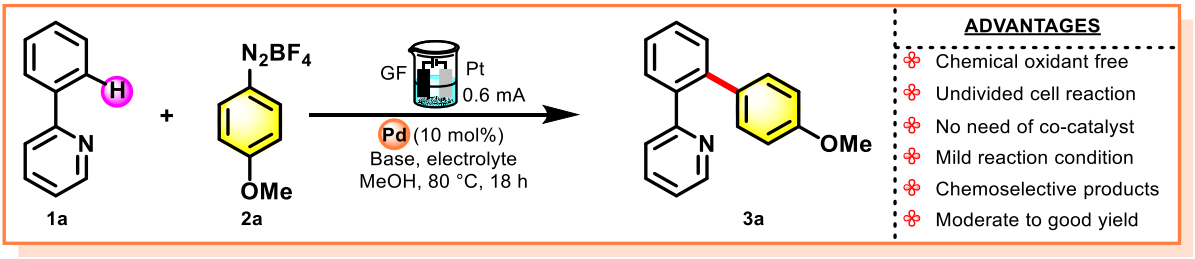
Abstract

Over the past few decades, transition metal-catalyzed electrochemical C–H activation has emerged as a viable option to create more environmentally friendly, economical, and resilient synthetic methods.1-4 To contribute more in this field, we have developed a practical and efficient palladium-electrocatalyzed method for the ortho-C–H arylation of arenes using arenediazonium salts. This technique effectively produced the ortho-arylated product of 2-phenylpyridine derivatives without using stoichiometric chemical oxidants and harsh reaction conditions under electrochemical circumstances. The reaction occurs in a methanol solvent, and palladium salt is employed as a catalyst, offering a wide range of substrate scope, including both electron-donating and electron-withdrawing groups on aryl and pyridine rings in good to moderate yield. To investigate the mechanism, cyclic voltammetry was used in a comprehensive mechanistic investigation. TEMPO was used to understand the involvement of the radical mechanism. Apart from this, the reaction was also performed in a divided cell, which provided evidence for both cathodic reduction of diazonium salt and anodic oxidation of palladium.5



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Utilization of Natural Extracts in Taro Starch Films for Sustainable Food Packaging

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Abstract

Impact on environment waste problem caused by plastic used packaging materials and for the consumer's demand for high quality food products has caused increasing interest in developing biodegradable food packaging as sustainable food packaging. In this research work, starch was extracted from taro using the wet extraction method and incorporated with natural plant extracts. The synthesized films were characterized by SEM, XRD and TGA. The incorporation of natural plant extracts led to improvement of mechanical properties and thermal stability. The experimental results when applied to grapes, the films effectively increased the product's shelf life. It was found that taro starch was found to be suitable for developing transparent edible films

Fabrication and Evaluation of Biodegradable Packaging Films Incorporating Corn Starch and Natural Agri-Waste Extracts

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Abstract

Fruit and vegetable peel extracts were utilized in preparing the corn starch based film to study the improvement in shelf life of the tomatoes. Corn starch and glycerol were used as base and plasticizer respectively along with water. Results demonstrated that the extract incorporated induced the antimicrobial property against the gram-positive (S.aureus) and gram-negative (E.coli) bacteria. FESEM indicated porous structure of the film. The XRD results indicated that the extracts did not affect the semi – crystalline structure of the film. Peel extract impregnated film showed a positive result to the shelf life of the tomatoes.

Synthesis And Characterization of Azo Linkage Incorporated Four-ring Bent-core Liquid Crystalline molecules

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Abstract

Large optical anisotropy and quick response to an electric field of Liquid crystals (LCs) accounts for the significant role of LCs during the development of photonics. Using photosensitive reactions to control the optical anisotropy of LC molecules is a very attractive way to control the molecules for application in optical devices. Introducing azobenzene moiety into the LC system can be one way to do. Liquid crystals doped with organic photochromic molecules such as azobenzenes are of great interest in photonics. To modify the physical properties of LCs, many azobenzene derivatives have been used as dopants since 1980 in conventional LCs. Azobenzene LC systems can be developed into functional materials viz. nematic liquid crystals (NLCs) thereby introducing both a photosensitive and rigid linking group within the LC molecules. The direct introduction of the photochromic moiety into the LC molecule provides the LC phases with flexibility of molecular design. Liquid crystals in which the azobenzene is either chemically attached to the molecule or used as dopant in a liquid crystal host material is found to exhibit photoinduced effects. So, a four ring system was designed incorporating an azo linkage (-N=N-) into the molecular framework accompanied by an ester (-COO-), and imine (-C=N-). The imine linkage confers stability to the molecule due to the hydrogen bond with the ortho hydroxyl (-OH) group in addition to augmenting the transverse dipole due to a chloro (-Cl) substituent at the bay position of the central core. The transverse dipole is believed to stabilise a biaxial nematic phase if molecular interactions are strong. Introduction of an azo linkage introduces a new field of photochromism into the molecule which otherwise is not possible with any other linkage. The design also envisages different alkyl chain length at the two end of the system.

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Amine functionalized f-SiO_2@GO incorporated thin-film nanocomposite membranes for efficient separation of CO_2

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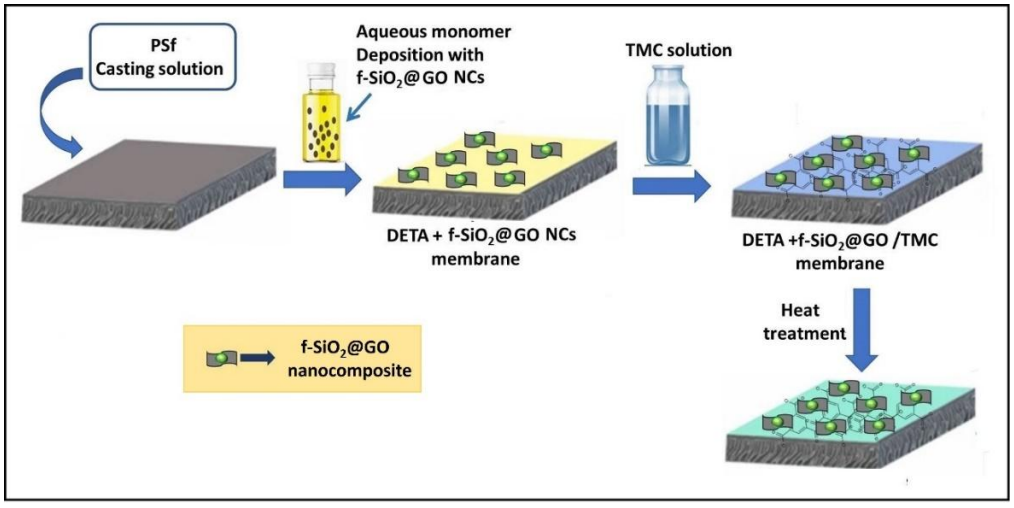
Abstract

In recent years, anthropogenic carbon dioxide (CO_2) emissions have emerged as one of the most significant environmental challenges facing industrialized countries, largely due to the rapid expansion of industries.[1] However, polymeric membranes incorporating various nanofillers have proven to significantly enhance CO_2 separation performance.1-3 This study demonstrated the development of a novel thin-film nanocomposite (TFN) nanofiltration membrane incorporating aminosilanized SiO_2 (f-SiO_2) nanoparticles embedded with graphene oxide (GO) (f-SiO_2@GO) nanocomposite via interfacial polymerization. A polysulfone (PSf) barrier coating was employed as the substrate layer. The synthesized nanoparticles were well characterized using different spectroscopic and microscopic techniques such as FT-IR, XRD, TEM, SEM, etc. Surface properties of the fabricated composite membranes were also investigated using SEM, EDX, and XRD. The addition of nanofillers enhanced the gas separation performance of the TFN membranes. Amine functionalized f-SiO_2@GO enhanced the CO_2/N2 selectivity by strengthening the contact between the polymer phase and the embedded nanofiller. The fabricated TFN membranes showed excellent results for the separation and selectivity of CO_2 gas. The CO_2/N2 separation improved as the concentration of nanofiller increased, such that the highest CO_2 permeance of 3309.6 GPU and CO_2/N2 selectivity of 25.1 was achieved for TFN membranes containing 1.0 wt% f-SiO_2@GO at a feed pressure of 0.2 bar.



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Development of Radiopaque, Biocompatible Microspheres for Embolization Applications

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Abstract

Embolization is a minimally invasive interventional procedure used to deliberately occlude blood vessels for therapeutic purposes, including the treatment of tumors, vascular malformations, and hemorrhages. Various embolic agents present in the market include coils, beads/particles, plugs, detachable balloons, glue, sponge, liquid embolic, sclerosants, precipitating agents, and others. Among these, microspheres have emerged as a superior option due to their ability to provide precise, controlled, and uniform occlusion with minimal inflammatory response. In this study, a radiopaque copolymer was synthesized using iodinated monomers. The resultant polymer was thoroughly characterized through various techniques, such as NMR, FTIR, and GPC, to confirm its structure and molecular properties. This radiopaque copolymer was subsequently converted into microspheres using an oil-in-water emulsion technique. The fabrication process was optimized by varying parameters such as polymer concentration, time, amount of surfactant, and stirring speed, to obtain uniform and stable microspheres. The resulting microspheres had a uniform size and spherical morphology. Radiography analysis proved that the synthesized microspheres were radiopaque and could be visualized using low-cost imaging techniques, such as plain X-ray or fluoroscopy, supporting their application in resource-limited clinical settings. Furthermore, in vitro cell culture cytotoxicity evaluation of microspheres was carried out by the direct contact method using a monolayer of L929 mouse fibroblast cells, and the microspheres demonstrated above 80% cell viability, indicating that the microspheres are non-toxic in nature. All the above tests suggest that the developed microspheres are highly suitable for safe and effective use in image-guided embolization therapies.

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Engineering and development of polymer-based thin film nanocomposite membrane for the removal of emerging contaminants from wastewater

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Abstract

The global issue of water scarcity is increasingly intensified by industrial contamination and rapid population growth, restricting the availability of clean and safe drinking water1. One of the major challenges is the presence of emerging contaminants such as heavy metals, fluoride, and various salts in wastewater. This highlights the pressing demand for advanced membrane technologies capable of efficiently removing these pollutants on an industrial scale to produce clean and drinkable water2-3. TFN membranes were fabricated using the Schotten–Baumann reaction between an amine and acid chloride in this work. The manganese oxide nanoparticles were also incorporated into the active polyamide layer, and the effect on the membrane performance was examined. The prepared membranes were characterized using various physicochemical characterization techniques. The resulting TFN membranes exhibited high rejection rates up to 94 ± 3% salts with 14 ± 2 $Lm^{-2}h^{-1}$ permeance and up to 70% fluoride rejection. These findings demonstrate the potential of such membranes for effective water purification, with the combined influence of nanofillers and polymerization conditions offering key insights into developing next-generation materials for selective ion separation and sustainable water treatment.

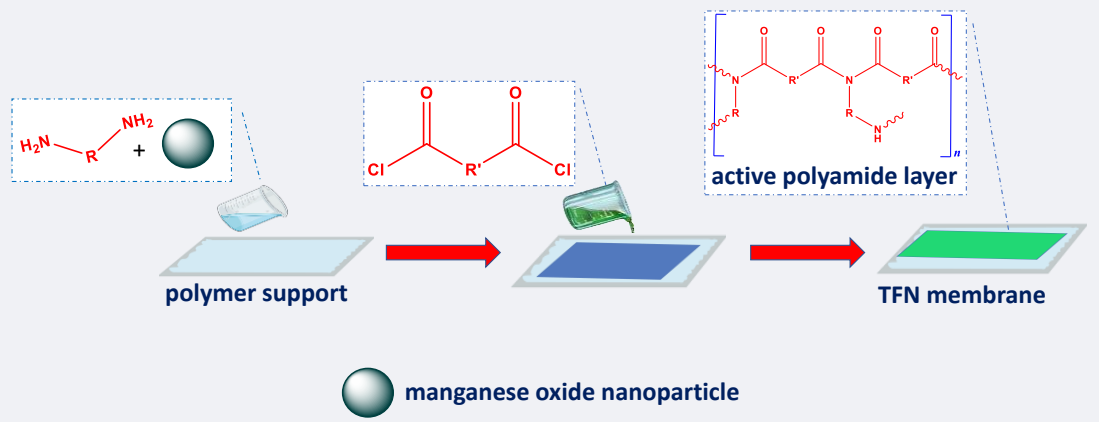

Figure: Fabrication of an active polyamide layer on a polymer support.

Keywords:Thin-film nanocomposite (TFN) membranes, Interfacial polymerization, Water purification, Heavy metal and salt removal

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A sustainable approach towards the synthesis of Poly(urethanes-urea)s via CO_2-derived Oligourea

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Abstract

Poly(urethane-urea)s (PUUs) are an important category of polymers that are widely used in coatings, adhesives, and foams due to their high mechanical strength, flexibility, and customizable properties. However, their traditional synthesis largely relies on petrochemical feedstocks, raising concerns about environmental sustainability. Given the urgent need for greener alternatives, carbon dioxide (CO_2) an abundant, inexpensive, and renewable feedstock has emerged as a promising building block for polymer synthesis. In this study, we present a sustainable method for synthesizing PUUs using a CO_2-derived oligourea diamine as a chain extender. The oligourea was synthesized by reacting 4,7,10-trioxa-1,13-tridecanediamine with CO_2 under mild, solvent-free, and catalyst-free conditions. This oligourea was then incorporated into the PUUs alongside poly(tetramethylene glycol) and 4,4'-methylenedi(cyclohexyl isocyanate). Structural analysis using FTIR and NMR confirmed the successful formation of PUUs. Additionally, thermal and mechanical characterization showed improved thermal stability and enhanced mechanical properties in the resulting materials. This study highlights the advantage of utilizing CO_2 in conjunction with functional polymer design, paving the way for sustainable approach for the synthesis of PUUs in advanced material applications.

Keywords: Polyurethane-urea, CO_2-based diamine, Oligourea, Renewable feedstock, Sustainable polymers

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Harnessing the Quinoline Scaffold: Strategic Syntheses and Emerging Roles in Anticancer Drug Development

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Abstract

Quinoline heterocycles are regarded as significant structural motifs due to their wide-ranging applications in organic synthesis, coordination chemistry, and particularly in drug design and improvement. Quinoline derivatives have demonstrated significant anticancer potential across various cancer cell lines, including those of breast, colon, lung, colorectal, and renal cancers. The quinoline scaffold is a key component in anticancer drug development, as its derivatives have exhibited remarkable efficacy through various mechanisms of action, including cell cycle arrest, induction of apoptosis, inhibition of angiogenesis, interference with cell migration, and modulation of nuclear receptor activity. Several established methods have been reported for the synthesis of quinoline-based anticancer drugs, including the Skraup, Doebner-Miller, Friedländer, Combes, and Conrad-Limpach reactions, among others. Here, we discuss a comprehensive overview of both green and traditional synthetic approaches for the preparation of quinoline and its derivatives. It covers multicomponent one-pot reactions, solvent-free conditions, and synthesis methods promoted by ultraviolet and microwave irradiation using eco-friendly, reusable catalysts. Additionally, the article explores the anticancer potential, cytotoxicity, and clinical development stages of quinoline derivatives, offering a valuable foundation for future research into more effective therapeutic agents.

Keywords: Quinoline, Heterocyclic, Anticancer, Synthesis, Activity, Multicomponent reaction.

Radiation-induced GMA grafting and cinnamaldehyde (CAL) conjugation through chemical means to develop antifouling properties of EVA

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Abstract

Ethylene-vinyl acetate (EVA) is a versatile polymer widely used in biomedical and consumer applications due to its flexibility, biocompatibility and ease of processing. In the medical field, it finds application in intravitreal drug delivery systems, urethral catheters, artificial organs, and more. [1] Its low cost and favorable mechanical properties make it a promising alternative to silicones in healthcare devices. However, its use in bacteria-prone environments raises concerns regarding biofouling and infection risk. Radiation-induced grafting of hydrophilic monomers offers a promising strategy to enhance antifouling properties and mitigate these issues. In this study, EVA containing 18% vinyl acetate was compression-molded into 1 mm thick sheets, cleaned with ethanol, and oven-dried prior to surface functionalization. Glycidyl methacrylate (GMA) was grafted onto the EVA surface using Co-60 gamma radiation via the mutual irradiation technique. Under optimized conditions, a grafting yield of approximately 36% was achieved at 10 kGy using a 20% (v/v) GMA solution in acetone. Further, an antimicrobial agent, cinnamaldehyde, was covalently linked to the grafted GMA moieties.[2] Cinnamaldehyde (CAL) is a naturally occurring α, β-unsaturated aromatic aldehyde, known for its broad-spectrum antimicrobial activity. The epoxy groups on the GMA-grafted EVA surface were hydrolysed and reacted with a CAL-based hydrazone derivative prepared using hydrazine sulfate under basic conditions. The modified sheets, i.e., GMA-g-EVA and CAL/GMA-g-EVA, were characterized using ATR-FTIR, TGA and surface wettability analysis, confirming successful surface modification. This dual strategy of hydrophilic grafting and CAL conjugation is expected to significantly improve the antifouling performance of EVA-based materials.

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Chitosan Electrospun Nanofiber Coated 3D-Printed PLA Scaffolds for Biomimetic Crystallization of Hydroxyapatite

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Abstract

Bone defects resulting from osteoporosis, osteoarthritis, surgical interventions, and traumatic injuries often result in critical-sized bone defects. To tackle this clinical challenge, scaffold-based tissue engineering has emerged as a promising approach. However, 3D printing enables the fabrication of patient-specific scaffolds with customized macroporous structures, but it fails to provide nanoscale surface features that are vital for optimal tissue integration.

In this research, we developed a composite scaffold by integrating 3D-printed polylactic acid (PLA) with a surface layer of chitosan nanofibers (CH), using electrospinning. This hybrid fabrication method leverages the structural benefits of 3D printing and the surface-enhancing properties of electrospun fibers. The efficiency of the developed scaffolds for the deposition of hydroxyapatite (HAp) crystals has been investigated through acellular biomineralization in DMEM, resulting in the deposition of HAp crystals with distinct flower-like morphologies on the CH-coated PLA surface. X-ray diffraction (XRD) analysis confirmed preferential crystal growth along the (121) plane, characteristic of natural bone mineralization. Additionally, it also exhibited excellent antibacterial activity against E. coli and S. aureus, respectively. This study highlights the role of scaffold surface chemistry in directing in vitro biomimetic mineral formation. It is anticipated that the fabricated biomaterial will promote cell adhesion and proliferation. In conclusion, our material is expected to be a promising option for bone regeneration.

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Development of ethylene propylene diene elastomers (EPDM)/pistachio shell biocomposite: structure-property relationship and thermal stability

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Abstract

EPDM is widely used in many applications. In order to improve the physio-mechanical properties and reduce cost of EPDM in many fields, it is compounded with many fillers, which make their use more profitable in many applications. Compared to inorganic fillers, organic fillers have many advantages such as renewable resources, biodegradable, etc. In order to get benefits from both cellulose and lignin molecules in prepared biocomposites lignocellulose-based fillers are used. Pistachio shell (PS) contains approximately 26 % lignin, 50 % cellulose and 24 % hemicellulose [1]. Therefore, EPDM/pistachio shell powder (PSP) biocomposite with 10-40 wt% PSP filler content are prepared successfully. Properties of prepared bio-composites are studied thoroughly. The effect of PSP-reinforcement on mechanical properties of EPDM is investigated in details. With continuous increase in filler loading in EPDM, Young's modulus and yield strength keep on increasing continuously due to high stiffness of PSP and increase in filler-filler interactions in filled system [2]. Incorporation of 10 wt%, 20 wt% 30 wt% 40 wt% and 50 wt% PSP in EPDM results in enhancement of Young's modulus by 200 %, 251 %, 439 %, 553 % and 647 %, respectively with respect to pure EPDM. Biocomposites with 10 wt%, 20 wt%, 30 wt%, 40 wt% and 50 wt% PSP in EPDM show increase in yield strength by 241 %, 266 %, 295 %, 306 % and 310 %, respectively with respect to pure EPDM. Elongation at break (EAB) decreases with the increase in PSP reinforcement in EPDM matrix due to different surface wettability of PSP and EPDM. However, biocomposite with 40 wt% PSP in EPDM shows optimum mechanical performance, EAB being around 200 %, beyond which, the elongation is decreased drastically (less than 50 % EAB for biocomposites with 50 wt% PSP in EPDM). Dynamic mechanical analysis reveals that both storage and loss modulus keep on increasing with continuous increase in PSP content in EPDM matrix. For 40 wt% PSP reinforcement in EPDM, the storage modulus and loss modulus are increased by around 414 % and 492 %, respectively with respect to those of pure EPDM at 30 0C. TGA study reveals that there is no degradation of any component during high temperature processing and composites are prepared successfully. SEM study reveals that PSP particles are uniformly distributed in EPDM matrix during melt mixing without any degradation of filler and matrix, which is the reason for observed good mechanical properties of the composites. As per the requirement, varying the composition, EPDM based biocomposites can be prepared.

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Layer by layer solution cast bipolar membranes with 3-D interface design for electrochemical energy systems

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Abstract

Bipolar membranes (BPMs) are emerging as potential polymer electrolyte material for energy conversion technologies like fuel cells, redox-flow batteries, and CO2 electrolyzers. Water formation at the interface of forward bias BPM facilitates self-humidification in fuel cell and presence of different pH conditions (acidic-anode and alkaline-cathode) in this assembly promotes faster electrode half reactions. Amount of interface catalyst and design of interface in BPM play crucial role in kinetics of water formation. Layer by layer solution cast method was used to prepare bipolar membranes which is having three layers as cation exchange layer, interfacial catalyst layer, and anion exchange layer. TiO2 nanoparticles (interface catalyst) of varying loading 0, 1, 2, 3, and 4 mg cm−2 were used to fabricate BPMs, and their electrochemical performance under forward bias were compared with that of commercial FBM fumasep® membrane. The BPM with 3 mg cm−2 (BPM-3) of TiO2 loading showed lowest potential drop, 0.20 V at applied current density of 50 mA cm−2 compared to BPM-0 (0.375 V) and FBM (0.24 V). The smooth interface of BPM was subsequently modified introducing square and cylindrical shape (3-D corrugations over anion exchange layer), which was coated with 3 mg cm−2 (optimized) catalyst to obtain BPMs with modified interface geometry. BPMs with square corrugation (BPM-3-S) showed potential drop of 0.17 V at 50 mA cm−2 followed by BPM with cylindrical shape (BPM-3-C), 0.195 V under identical conditions. EIS study of bipolar membranes with modified interface showed reduced resistance for water formation reaction. These findings elucidate catalyst loading and interface geometry strongly influence the performance of BPM under forward bias conditions

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Exploration of metal salt modified Deep Eutectic Solvent as a potential green route for model jet fuel desulfurization

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Abstract

The major portion of the crude oil being processed in refineries contain high amount of sulphur impurities (sour crude) which inevitably end up in the final products including fuel fractions. Untreated jet fuel fractions are no exception containing as high as 10000ppm of organic sulphur impurities which on combustion generate SOx thereby causing adverse effects on the environment; therefore it is desirable to reduce the sulphur content below a certain threshold value which is conventionally achieved by the hydrodesulfurization (HDS) process. However HDS has certain drawbacks including extreme processing conditions, requirement of costly catalysts and inability to remove heterocyclic sulphur compounds effectively which necessitates the exploration of alternative low energy process, effective in removing sulphur compounds from a fuel fraction. One such desulfurization approach is via solvent extraction utilizing deep eutectic solvents (DESs). In this investigation, a choline chloride based DES has been modified with a metal chloride (CuCl2) to enhance its efficiency. This DES has been characterized by FTIR, TGA, HNMR and viscosity along with structural geometry optimization. Desulfurization performance of this metal chloride modified DES (MCDES) has been conducted by utilizing a model jet fuel and the results have indicated that the synthesized DES has a desulfurization efficiency of 98% when used in 1:5 solvent:feed ratio. A further evaluation of solvent recyclability has indicated that there is minimal deterioration in its desulfurization efficiency even after three cycles.

Keywords: Deep eutectic solvent, solvent extraction, desulfurization.

Castor oil-based porous polyurethane composite foams using PDMS/MWCNT for oil-absorption application

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Abstract

Currently, vegetable oils, especially non-edible such as castor oil, have become promising bioresources for the development of polyurethane (PU) foams. The aim of the present work is to synthesize castor oil-based polyurethane foams (PUFs) incorporating two different fillers, PDMS and MWCNT, for effective applications in the removal of various oils from oil-contaminated water. The synthesized PUFs were characterized using ATR-FTIR, SEM, XRD, and POM techniques and confirmed the presence, homogeneous distribution of fillers, and modified porosity of the PU foam matrix. TGA, DSC, and tensile strength measurements showed that the PDMS enhances hydrophobicity, thermal stability, and flexibility, whereas MWCNTs improved the mechanical reinforcement and surface area. As it is an essential requirement to develop a selective and reusable material for the removal of oil from oil-polluted water, the synthesized castor oil-based PUFs have been investigated for oil-absorption experiments. The integrated effect of PDMD/MWCNT in the castor oil-based PUFs found enhanced oil absorption efficiency, high water resistance, better structural stability, and more reusability. The developed PU composite foams in this work may be an excellent material for the separation of various oils from micro- to bulk-level applications in environmental problems.

Keywords: Castor oil, Polyurethane Foam, PDMS, MWCNT, Oil-Absorption.

VOC-Free Anionic Polyurethane waterborne Dispersion for Coatings: Innovation & IPR Protection Strategies

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Abstract

The growing point up on high-performance and environmentally compliant coating materials has led to the continuous refinement of waterborne polyurethane (WPU) systems. This study focuses on the synthesis and characterization of aqueous anionic polyurethane dispersions (PUDs) using conventional petroleum-based polyols, providing benchmark data for performance comparison with emerging bio-based alternatives.

Petroleum-derived polyols, known for their consistent quality, hydroxyl functionality, and established use in polyurethane chemistry, were reacted with isophorone diisocyanate (IPDI) and dimethylolpropionic acid (DMPA) as an internal emulsifier to synthesize prepolymers. These prepolymers were neutralized and subsequently dispersed in water to form stable anionic PUDs. Process parameters such as NCO/OH ratio, neutralization degree, and emulsification conditions were carefully optimized to enhance dispersion quality and film properties.

The resulting polyurethane dispersions displayed nanoscale particle sizes (40–90 nm), low viscosity, and excellent storage stability without incorporating volatile organic solvents, thus aligning with current environmental regulations on VOC emissions. Differential scanning calorimetry (DSC) and revealed a microphase-separated structure, with well-defined hard and soft segment domains that provided a balance of toughness, elasticity, and thermal resistance. The films prepared from these dispersions exhibited outstanding flexibility, adhesion to substrates, and water resistance, making them suitable for applications in coatings, sealants, and packaging materials.

This investigation demonstrates the effectiveness of petroleum-based polyols in producing waterborne polyurethane systems with excellent performance characteristics. The results provide a reference framework for comparing traditional fossil-based chemistries with sustainable bio-based alternatives, supporting the future development of tailored WPU systems that meet industrial performance and regulatory demands. This research emphasizes the development of VOC-free anionic polyurethane waterborne dispersions for sustainable coatings while exploring possibility of safeguarding innovations through Intellectual Property Rights (IPR). The study highlights the importance of protection of Intellectual Property through applying for patent and IP management to promote commercialization and prevent technology infringement in the coatings industry.

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Synthesis of Zero Valent Iron Nanoparticles and it's Application in Soil Remediation

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Abstract

Nano zero valent iron (nZVI) is an excellent adsorbent/reductant with wide applicability in remediation of persistent contaminants in soil. There are concerns about its environmental fate, agglomeration, toxicity and stability in the air. The synthesis of a novel green nZVI (gNZVI) with Eucalyptus globulus leaf extracts was successfully executed. Production of gNZVI involved the simultaneous addition of an optimum amount of the NaBH4 and Eucalyptus globulus extract to FeCl3 in an inert environment (Nitrogen). The solution was stirred for 30 min, washed with dilute ethanol (50%) and freeze dried. This procedure offered the best option for the synthesis of gNZVI in terms of nontoxic and inexpensive choice of stabiliser/reductant. Systematic characterisations using TGA, TEM, SEM, XRD, FT-IR confirmed the synthesis of crystalline, stable, reactive, well dispersed and predominantly 50 nm diameter sized gNZVI compared to the conventionally synthesised nZVI which is 65 nm. Nano Zero Valent Iron (nZVI) is emerging as a new option for the treatment of contaminated soil. Due to the small size, the particles are more reactive than granular iron which is conventionally applied in reactive barriers and can be used for in situ treatment.

Keywords: Nano zero valent iron, Remediation, Nontoxic, TEM, In-situ.

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Development of a 3D Neural Tissue Model for In Vitro Brain Aging Studies

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Abstract

Brain aging is a complex process characterized by progressive cognitive decline, neurodegeneration, and impaired neural plasticity. Traditional two-dimensional (2D) cultures and animal models have limitations in replicating the intricate cellular microenvironment of the human brain. To address this issue, we developed a novel three-dimensional (3D) neural tissue model using a tissue engineering approach involving Wharton's jelly-derived mesenchymal stem cells (WJ-MSCs) and electrospun polycaprolactone/gelatin (PCL/gelatin) scaffolds that mimic the brain extracellular matrix. The electrospun PCL/gelatin scaffolds exhibited high porosity, mechanical stability, and cytocompatibility, supporting neuronal growth and maturation. Next, WJ-MSCs were isolated, characterized, and induced to differentiate into neuronal cells over 20 days on the PCL/gelatin scaffolds. Further, neuronal differentiation was confirmed by the expression of key neural markers, including Nestin, Synapsin-1, neural nuclei (NeuN), Postsynaptic density protein 95 (PSD95), and neurofilament-light chain (NF-L). Brain aging in the engineered neural tissue was simulated by D-galactose (300 mM) treatment, which induced oxidative stress and cellular senescence. The 3D aged neural tissue demonstrated elevation in oxidative stress and apoptotic markers, along with enhanced autophagic activity. Increased expression of LC3B, Beclin1, ULK1, and neuronal markers confirmed the relevance of the model. Furthermore, the system was validated using neuroprotective agents, which showed significant reversal of aging markers. Thus, the engineered 3D brain aging model offers a physiologically relevant, scalable, and reproducible platform for studying neuronal aging and high-throughput screening of anti-aging therapeutics.

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Palladium catalyzed cross electrophile coupling reactions

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Abstract

Palladium catalyzed cross-electrophile coupling (XEC) has become an important tool for building biaryls. The development of sustainable and efficient methods for the formation of C(sp2)-C(sp2) bonds has long been a compelling area of research for organic chemists.1-2 These reactions have remained as simple strategies for rapid construction of C–C, C–N, C–O and other C-heteroatom bonds from readily available substrates. Traditional transition metal catalyzed XEC often relies on chemical reductants, which limit their potential applications. Nowadays, electrochemical transition metal catalyzed, reductant free XEC has emerged as a powerful approach for constructing C(sp2)-C(sp2) bonds.3 Our work focuses on the integration of transition metal catalysis with electrochemical methods. Specifically, we proposed a transition metal-catalyzed electrocatalytic XEC between two electrophilic partners. The reaction was conducted in an undivided cell, and iodobenzene and diazonium salt's derivatives were selected as the electrophilic substrates. The reaction conditions were optimized by changing the reaction parameters like current, time, temperature, and solvent etc. The method was successfully applied to the various derivatives of both the substrates.

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Development of photoluminescent hydrogen-bonded frameworks based on pyromellitic diimide-tethered carboxylic acid hosts and multi-bonding solvent guests

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Abstract

The significance of hydrogen-bonding interactions in improving the chemical and physical properties of functional materials related to sustainable energy, gas absorption, catalysis, and pharmaceuticals has gained considerable research attention. In this report, some unprecedented hydrogen bond motifs between the –COOH group and the solvents capable of forming multiple hydrogen bonds with –COOH are studied. The effects of such diverse motifs on the construction of 3D supramolecular architectures of hydrogen-bonded host–guest frameworks and their optical properties are elucidated. For this purpose, structural studies on seven solvates, namely, 1a (1:2DMF), 1b (1:2pyridine), 1c (1:2quinoline), 2a (1:2DMF), 2b (1:2pyridine), 2c (1:2quinoline), and 2d (1:1quinoline:2piperidine), of two isomeric pyromellitic diimide hosts 1 and 2 were carried out. Single crystal X-ray diffraction (SCXRD) analyses revealed that solvates 1a, 2a, and 2b show 3D non-porous supramolecular host–guest networks, whereas solvates 1b, 1c, 2c, and 2d show 3D supramolecular host–guest channelled architectures accommodating guest solvent molecules within the cavities of different dimensions. Formation of different hydrogen bond motifs, either cyclic/ring (R) or discrete (D) or a combination of both, between the –COOH groups of isomeric hosts and identical guest molecules is analysed through density functional theory (DFT) calculations. Minor differences in the interaction energies of different motifs of isomeric hosts with the same guest suggest that the formation of either motif depends on the steric orientations of hosts and other weak host–guest interactions in the crystal lattices. Solid state fluorescence emission properties of solvates 1a, 2a, and 2b are found to be similar to their respective hosts, whereas those of solvates 1b, 1c, 2c, and 2d are different from their hosts. Along with the diversity of supramolecular synthons, frontier molecular orbital (FMO) analysis of hydrogen-bonded model structures explained well the different emission behaviours of solvates. Thermal analyses for the solvates are in good agreement for the association of the numbers of guest solvent molecules with both the isomeric hosts. Overall, this research is focused on establishing the phenomena for the formation of distinct hydrogen bond patterns between the two similar host–guest binding groups together with the effect of supramolecular states on the photophysical properties of such hydrogen-bonded complexes.

Keywords: pyromellitic diimide, supramolecular architectures, fluorescence, hydrogen-bonding.

Development of Angiogenic and Osteoinductive Multivesicular Liposomes Loaded Bioink for Bone Regeneration

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Abstract

Critical-size bone defects resulting from severe trauma, tumor resection, or degenerative diseases present a significant clinical challenge for effective regeneration. Surgical interventions such as autografting and allografting are commonly used to treat these defects. However, these approaches have several limitations, including infection risk, donor site morbidity, limited tissue availability, and geometric mismatch at the defect site. In recent studies, composite scaffolds have been developed incorporating various biochemicals that not only enhance the biological activity of bioinert materials but also promote stem cell recruitment and osteogenesis at the defect site. However, these scaffolds still fail to effectively induce angiogenesis, a critical process for sustained tissue regeneration. The goal of this research is to develop a scaffold that simultaneously induces angiogenesis and osteogenesis to enable the regeneration of critical-size bone defects. Multivesicular liposomes (MVLs) have nonconcentric internal vesicles which facilitates sequential drug release over time and enhance therapeutic efficacy. Sodium nitroprusside (SNP) which is nitric oxide (NO) donor known to stimulate angiogenesis via the NO–sGC–cGMP pathway. To counteract CN induced toxicity and enhance osteogenic potential, hydroxocobalamin is used. Alginate and demineralized bone matrix (DBM) will be used as the scaffold matrix, into which two types of MVLs will be incorporated: one loaded with SNP and the other with hydroxocobalamin. Alginate offers easy crosslinking, printability, and structural integrity suitable for 3D bioprinting, while DBM provides essential adhesion sites to support cell attachment and differentiation. Together, this system is designed to create a pro-regenerative microenvironment for effective healing of critical-size bone defects.

This study focuses on the development of a biomimetic scaffold using coaxial 3D bioprinting to replicate the structural and functional architecture of native bone. The scaffold comprises a dual-layered design: the inner core is loaded with SNP-encapsulated MVLs to enable sustained NO release, thereby promoting endothelial cell differentiation and angiogenesis; the outer layer contains hydroxocobalamin-loaded MVLs, which serve a dual function—neutralizing the toxic cyanide byproducts of SNP and supporting osteogenic differentiation. By spatially organizing angiogenic and osteogenic cues, this scaffold aims to mimic the natural bone environment, where vascularization predominates in the inner regions and osteogenesis in the outer cortical regions.

MVLs were prepared using double emulsion method. This technique enabled efficient encapsulation of both sodium nitroprusside and hydroxocobalamin, with high entrapment efficiency (~72%). Zeta potential analysis revealed that the prepared MVLs were negatively charged, with an average zeta potential of −59.4 ± 5.08 mV, indicating good colloidal stability. Morphological analysis using light, scanning electron and transmission electron microscopy confirmed their multivesicular architecture with an average size was 25µm. This bioink used for coaxial 3D bioprinting, enables the fabrication of functionally graded scaffolds that support site-specific tissue regeneration. Its application is expected to advance current strategies in bone tissue engineering, particularly for the repair of critical-size defects via both vascularization and osteogenesis.

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Synthesis And Characterization Of Zein Based Biodegradable Radiopaque Microbeads For Trans Arterial Chemoembolization

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Abstract

Hepatocellular carcinoma (HCC) is a common type of liver cancer and the fourth leading cause of cancer-related deaths worldwide. Trans arterial chemoembolization (TACE) is a vital treatment option for both early and advanced stages of HCC, especially when other treatment methods are not viable for various reasons. In TACE, HCC nodules are embolized by delivering either radiopaque or non-radiopaque embolic agents directly into the hepatic artery. These embolic agents contain small molecule anticancer drugs that enhance treatment outcomes by combining chemotherapy with ischemic effects. Chemoembolization with drug-eluting microbeads (DEB-TACE) can induce permanent embolization and maintain sustained local concentrations of anticancer drugs. However, the repeated use of DEB-TACE can lead to permanent embolization, resulting in decreased liver function. Current study aims to develop 2,3,5-triiodobenzoic acid (TIBA) conjugated Zein based microbeads for TACE. As a first step, TIBA was conjugated to Zein via carbodiimide chemistry using carboxyl group of 2,3,5-triiodobenzoic acid (TIBA) and amine group of the glutamine residue of zein. Microbeads were fabricated using TIBA conjugated zein via precipitation method. Fourier Transform Infrared Spectroscopy confirmed the Zein-TIBA conjugate. The stretching frequency of OH peak was shown around 3500 cm-1. The amide band in the spectra of Zein ~1600 cm-1 is slightly shifted to 1545 cm-1 after conjugation. The particle size and particle size distribution of Zein-TIBA microbeads were evaluated using Zetasizer Nano ZS. The average size of bare zein microparticles was found to be 562.73 ± 3.633 nm. Whereas the average size range of zein- TIBA microparticles was found to be 450.43 ± 6.634 nm. The reduction size after conjugation was attributed to the hydrophobic nature of Zein-TIBA microbeads. The zeta potential of bare zein microparticle was found to be +14.5 ± 0.1630 mV. Whereas the zeta potential value was decreased while using zein conjugated TIBA; + 9.28 ± 0.1865 mV. The study also confirmed the X-ray visibility of Zein-TIBA microbeads.

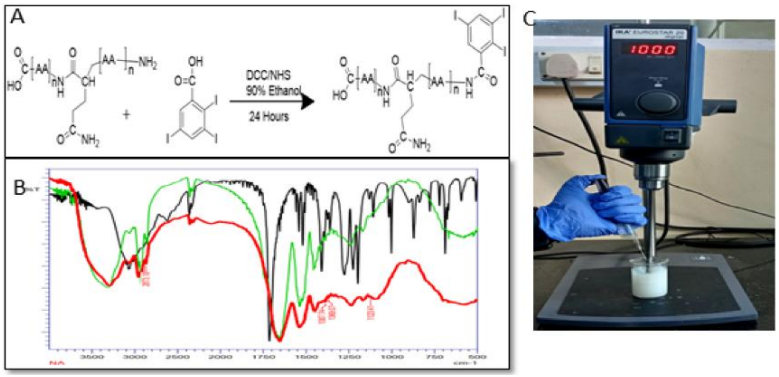

Fig: A. Schematic representation for the synthesis of Zein-TIBA conjugate; B. FTIR of Zein (green), TIBA (black) and Zein-TIBA conjugate (Red); C. Preparation of Zein- TIBA microparticles by precipitation method

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4D Bioprinted pH-responsive Hydrogel Scaffold with Tannic Acid and Sr– Se Co-doped Bioglass for Targeted Osteosarcoma Treatment

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Abstract

Osteosarcoma (OS) is a primary malignant bone tumour largely prevalent among growing children, characterised by a significant propensity to pulmonary metastases. Conventional therapeutic approaches, namely chemotherapy and radiotherapy, have a profound impact on patients due to detrimental effects on localised tissues and have a high recurrence rate, necessitating advanced biomaterials that can simultaneously promote bone regeneration and control tumour growth. This study focuses on the design and physicochemical optimisation of Strontium-Selenium (Sr-Se) co-doped Bio glass as a key therapeutic component designed for integration into a pH-responsive 4D bio-printed scaffold aimed at osteosarcoma treatment. The optimised bio glass will be incorporated into a 4D hydrogel system comprising Glycidyl methyl acrylated alginate, tannic acid, and a riboflavin-triethanolamine photo initiator, forming a composite that undergoes shape transformation in response to acidic osteosarcoma microenvironment, targeting systematic site-specific pH-activated release of therapeutic ions. Strontium offers osteogenic differentiation, and Selenium imparts anticancer properties by inducing oxidative stress and apoptosis selectively in tumour cells, offering a synergistic approach for Osteosarcoma treatment.

The co-doped bio glass was synthesised via a sol-gel method and calcined at 650 °C for 6 hours to preserve its amorphous structure and maximise therapeutic ion release. SEM images revealed rhombus-shaped morphology of (Sr-Se) co-doped bio glass compared to the crystal-shaped growth of bio glass, which corresponds to diffraction signature from planes (111),(001) and (004) in XRD analysis. These crystallographic planes suggest the presence of localised short-range ordering and anisotropic growth induced by ionic doping during sol-gel processing. The unique geometry may enhance surface reactivity, ion exchange, and interaction with the osteosarcoma microenvironment. EDS demonstrated homogeneous incorporation of Sr^{2+} and Se^{4+}, ensuring consistent and bioavailable ion delivery. FTIR analysis confirmed successful chemical integration of dopants, with characteristic peaks at 1026 cm^{-1} and 554 cm^{-1} corresponding to Se–O–Si and Sr–O–P bonds, respectively. These bonds reflect stable incorporation into the silicate-phosphate matrix, supporting enhanced structural bioactivity and controlled therapeutic ion release for osteosarcoma intervention The combination of optimised therapeutic filler with a standard dynamic pH-responsive hydrogel matrix comprising of methyl acrylate alginate will be bio-printed using MG63 osteosarcoma cell lines and osteoblast cell line for selective assessment of anticancer activity alongside bone regenerative capacity, aiming for a clinically translatable bio-printable system for next-generation osteosarcoma treatment.

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Cissus quadrangularis incorporated osteoinductive bioink for bone regeneration

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Abstract

Bone defects exceeding twice the diameter of the bone diaphysis are termed as critical size bone defects (CSD) and they cannot heal by itself. The available treatment includes bone grafts and metal implants along with drug therapy. However, these approaches have notable limitations such as donor site morbidity, anatomical mismatch, bone-shielding effect and risk of infection [1]. Cissus quadrangularis (CQ) commonly known as "Hadjod" has been used in Ayurvedic medicine to treat bone defects and is rich in terpenoids, flavonoids, and phytosterols. Previous studies have explored the osteogenic properties of CQ extract by studying its effect on MAPK, Runx2, BMP-2 and other bone related genes [2]. Considering the challenges faced in CSD there is a need to assimilate CQ in bone tissue engineering (BTE) to achieve its full potential. Materials used in BTE should possess cell adhesion sites and facilitate cell proliferation and differentiation. Alginate is a polysaccharide material intensively used for scaffold printing due to its mechanical strength and fast crosslinking ability but it lacks bioactivity required for cell adhesion and differentiation. Gelatin is polymeric, denatured and hydrolysed form of collagen protein, which facilitate cell adhesion through RGD (Arg-Gly-Asp) sequences. 3D bioprinting involves fabricating scaffolds with live cells and biomolecules, tailored to the patient's anatomy and demonstrate controlled release of bioactive compounds. In this study, we aim to develop a novel 3D-bioprinted gelatin-alginate based scaffold incorporated with CQ powder.

Molecular docking demonstrated the stable incorporation of CQ particles in the alginate-gelatin matrix. AutoDock simulation showed greater binding affinity of Quercetin (-4.5 kcal/mol), Resveratol (-3.9 kcal/mol), Taxifolin (-4.5 kcal/mol) and other phytochemicals of CQ towards gelatin. In contrary, they showed enhanced hydrogen bonding with alginate (H bond= 2) as compared to gelatin (H bond= 1) which revealed its hydrophilic tendencies. In accord with this data, we followed up with using CQ powder over its non polar solvent extract which would help in attaining better sustained release of phytochemical compounds from the matrix system. Next, we performed physicochemical analysis (FTIR, SEM, XRD and XPS) of CQ particles. FTIR spectra revealed the presence of Acyl C-O (1316cm-1), C-C stretch (1602 cm-1), C-H vibrations (2922 cm-1) and O-H stretch (3286 cm-1) which are characteristic peaks of CQ. SEM micrographs revealed the granular particle like morphology of CQ particles. Furthermore, XRD plot showed characteristic peaks of CQ at 15°, 20° and 36° (2θ) indicating the presence of cellulose type I and lignin respectively in CQ. Presence of elemental calcium and phosphorous, which supports bone growth, was confirmed by XPS analysis. Bioink formulations (A15GCQ, A20GCQ, and A25GCQ) were tested for their physicochemical and rheological properties. FTIR study revealed a very intense broad peak at 3400cm-1 in all bioink corroborating with the in silico studies along with COO- vibration (1608, 1408 cm-1), C-O-C stretch (1022 cm-1) of Alginate and Amide I (1628 cm-1), Amide II (1546 cm-1) of Gelatin. All bioink compositions exhibited shear-thinning property as indicated by the viscosity-shear rate study and were further used to fabricate composite scaffolds with CELLINK BIO X6 bioprinter. The optimal shape fidelity was found in A20GCQ whose printability value was closest to 1 (Pr: 0.98±0.06). Composite scaffolds will be assessed for their in vitro osteogenic, and immunomodulatory properties.

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Environmentally Friendly Waterborne Polyurethane-Urea Films with Improved Performance through 1,8-Diaminooctane-Induced Crosslinking

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Abstract

The main goal of this study is to develop new waterborne polyurethane-urea polymers (WPUUs) using castor oil as a polyol and 1,8-diamino octane (OA) as a chain extender. We explored different weight percentages of OA during the synthesis of WPUU polymers. The WPUU dispersions were well-defined and had nanoparticle sizes ranging from 130.9 to 109.6 nm. The characteristic peak observed at 1636 cm-1 corresponds to the urea C=O stretching. After adding OA to the PU-prepolymer, the appearance of the peak at 1636 cm-1 in the ATR-FTIR spectrum confirmed the successful incorporation of OA into the polymeric chain of WPUU. The WPUU films showed excellent chemical resistance. The young's modulus and tensile strength increase from 98.40 to 155.14 N/mm2 and 0.533 to 0.689 MPa. The thermal stability of the WPUU films was investigated through TGA and DSC analyses. The Tg values were 36.8°C, 39.4°C, 52°C, and 57.4°C for WPUU films, indicating that a higher content of OA enhances the Tg. The films were also found to be highly stable up to 200°C. The activation energy (Ea) values were 76.47 kJ mol-1 (Tp1), 84.88 kJ mol-1 (Tp2), 93.13 kJ mol-1 (Tp3), and 107.67 kJ mol-1 (Tp4), while the WPUU3 film with a higher OA content showed Ea values of 123.98 kJ mol-1 (Tp1), 126.32 kJ mol-1 (Tp2), 137.04 kJ mol-1 (Tp3), and 168.65 kJ mol-1 (Tp4). High activation energy is required for the degradation of WPUU with a high content of OA due to the cross-linking network structure in the polymer. These WPUU films exhibited superior properties in chemical resistance, thermal stability, and mechanical strength, suggesting promising applications for these environmentally friendly WPUU materials, particularly in the area of decorative and protective coatings.

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Synthesis of titanium dioxide (TiO_2) nanoparticles and its antimicrobial properties

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Abstract

In this study, green synthesis of TiO_2 nanoparticles using leaf extract. Leaf extract act as a reducing agent and titanium tetraisopropoxide is used as a precursor. Synthesized TiO_2 nanoparticles were identified by using fourier transform infrared spectroscopy, X-ray diffraction, SEM and TEM. The X-ray diffraction showed a characteristic peak at 31.50º containing 121 plane. SEM images showed that TiO_2 nanoparticles are spherical in shape and the average size of nanoparticles is in the range of 25-65 nm. We described the antimicrobial activity of the as-sythesized TiO_2 nanoparticles. These nanoparticles showed interesting antimicrobial activity against the selected bacterium.

Structural Modulation of Oxynitrides for Improved Photocatalytic Water Splitting: Recent Developments and Outlook

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Abstract

The application of solar energy for chemical conversion represents a highly promising strategy in the pursuit of a carbon-neutral energy landscape. Among the most environmentally sustainable methods supporting this transition is particle-based photocatalytic water splitting. In this context, oxynitride materials have emerged as leading substance, owing to their strong absorption within the visible spectrum of sunlight and their favourable band structures for facilitating water-splitting reactions. Their intrinsic properties—namely a narrow band gap and suitably aligned conduction and valence band edges—enable theoretical solar-to-hydrogen (STH) conversion efficiencies exceeding 10%, positioning oxynitrides as viable contenders for large-scale hydrogen fuel production. To further improve. With the help of various material engineering strategies like introduction of co-catalysts, elemental doping, morphological tuning at the nanoscale, construction of heterojunction interfaces, and the development of solid solutions, their photocatalytic activity has been improved. Such structural modifications contribute not only to enhanced light harvesting but also to more efficient separation and transport of charge carriers. This review discusses the classification of metal oxynitrides, recent advancements in their synthesis, and structural engineering techniques that contribute to improved hydrogen evolution performance. In addition, it explores mechanisms underlying charge separation and highlights the role of computational modelling in enabling accelerated, data-driven optimization of photocatalyst design for future applications.

Impact of enzymatic extraction on biopolymer recovery from leguminous waste for packaging materials

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Abstract

Proteins are increasingly being used in food packaging due to their biodegradability, film-forming capabilities, and potential to create sustainable alternatives to traditional plastics. Food packaging utilizes a variety of proteins, both plant-based and animal-derived. Soy proteins, zein, gluten, lentil and fish protein concentrates, whey protein, casein, gelatin, and collagen are all potential candidates for biodegradable packaging. A large volume of waste (up to 25% of production) is generated at different stages, such as harvesting, sorting, milling, processing, and storage in legume processing. This side stream of the legume processing sector is a potential source of biopolymers (protein). This article aims to explore the effect of enzymatic extraction methods on biopolymer (protein) extraction from legume waste followed by its physicochemical characterization using laser particle-size analyzer, field emission scanning electron microscopy (FESEM), X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, and differential scanning calorimetry (DSC). The extraction was performed by using protease enzymes and a multi-enzymatic complex (a wide range of carbohydrase enzymes) at varying pH and concentration and incubating for a time with controlled temperature. The powder of waste legume was dispersed in distilled water (1:10 w/v) and incubated with enzymes at different pH, time, and concentrations at specific temperatures. Then enzymes were deactivated by keeping them at boiling temperature for 5 min, and biopolymers were extracted by alkali extraction. The biopolymers were obtained by centrifugation and freeze-dried for further analysis. The biopolymers obtained by protease enzymes were significantly ($p \leq 0.05$) higher than those obtained by carbohydrase enzymes. However, all of the independent parameters (pH, concentration, and time) had significant effects on biopolymer extraction as well as its physicochemical properties. Enzyme concentration has a significant ($p \leq 0.05$) positive effect on biopolymer yield, microstructure, and particle size, whereas incubation time revealed a non-significant change. The study concluded that the enzyme type, pH, concentration, and incubation time significantly affect the recovery of biopolymers from legume waste. Proteins, including plant-based and animal-derived proteins, are being used in food packaging due to their biodegradability, film-forming capabilities, and potential as sustainable alternatives to traditional plastics. These proteins can be processed into films, offering gas barrier properties, improved mechanical properties, edible packaging, and active packaging. However, critics have pointed out that plastic packaging takes a long time to degrade and has the potential to lower food quality.

Keywords: Biopolymers; green extraction; enzyme assisted extraction; packaging materials.

Waste to wealth: Productive use of agricultural waste for microwave absorption and achieving circular economy

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Abstract

Recycling of agricultural waste and its use in the production of sustainable materials is an alternative way to address the waste management issues globally. The present work describes the effective use of rice husk ash (RHA), a valuable by-product obtained from agricultural waste as filler in an epoxy (EP) matrix for the development of microwave absorbing material (MAM). The composites with varying RHA content were fabricated. The study primarily focused on the thermal, dielectric and microwave absorption properties of the developed composites. The density of composites was found in the range of 1.18 to 1.34 g/cm^3. The thermal conductivity of EP/RHA composites slightly increased with increasing RHA content. The heat deflection temperature (HDT) and Vicat softening temperature (VST) of the composites were influenced by the addition of RHA in epoxy matrix. The dielectric breakdown strength and volume electrical resistivity of the epoxy/RHA composites are affected slightly with RHA content. The incorporation of RHA significantly improved the microwave absorption properties. The composite with 30 wt.% RHA showed excellent reflection loss (RL) with maximum RL (RLmax) of -22.57 dB at 8.45 GHz. This suggests that EP/RHA composites are suitable for defense applications where efficient microwave absorption along with good thermal properties is needed. Overall, the composites present a promising balance of performance, sustainability, and versatility.

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Multifunctional waste resource-based superabsorbent polymers for biomedical applications

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Abstract

The petrochemical origin and hazardous synthesis process makes it difficult for conventional superabsorbent polymers (SAPs) to fit in the criteria for biodegradability and as an environmentally friendly material. On the other hand, the increasing accumulation of underutilized agricultural biomass waste also presents a substantial ecological issue. The proposed work suggests the utilization of agricultural waste-derived and plant-based materials for the development of multifunctional SAPs, an environmentally benign method that combines sustainability and usefulness in a single system. The study aims to design bio-based SAPs using cellulose-based polymer blended with biochar and Moringa oleifera fibers offering a sustainable and cost-effective alternative for biomedical and healthcare applications.

The proposed study focuses on the development of multifunctional SAPs by using the method of cryogelation. The cellulose-based polymer was blended with biochar and with Moringa olifera fibers with the aim to enhance the functionality in terms of biological and physical properties. Therefore, to monitor the performance of developed SAPs, the material was subjected to swelling tests, degradation studies, and biocompatibility studies. The proposed approach resulted in the successful development of biodegradable SAPs from cellulose-based polymer mixed with waste derived moringa fibers and biochar. Addition of both functional additives to the cellulose based polymer showed an increase in the swelling properties, biocompatibility, and biodegradability of the developed SAP, followed by a decrease in the mechanical strength with respect to enhanced porosity and biocompatability. Therefore, these plant and waste derived SAPs are expected to form an eco-friendly substitutes for synthetic polymers used in biomedical applications such as drug delivery, hygiene products, and wound dressings.

Keywords: Superabsorbent Polymer, Biodegradability, Sustainability, Plant based materials , Biocompatibility

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Synthesis and Characterization of bioactive monoflavonoxy alkane derivative

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Abstract

The synthesis of monoflavonoxy alkane derivatives typically involves the functionalization of flavonoid compounds by introducing alkoxy groups (-O-alkyl) at certain positions. Flavonoids are a diverse group of secondary metabolites found in plants, and their functionalization can lead to the formation of novel derivatives with potential biological activities. Monoflavonoxy alkane derivatives are synthesized by modifying the flavonoid structure to introduce an alkoxy group at one of the hydroxyl sites of the flavonoid. Structural elucidation was carried out using spectroscopic techniques including FTIR, ^{1}H and ^{13}C NMR, and mass spectrometry, confirming the successful formation of the monoflavonoxy linkage. Preliminary biological screening revealed significant antioxidant and antimicrobial activities, attributed to the synergistic effect of the flavonoid core and the alkyl substituent. The findings suggest that monoflavonoxy alkane derivatives hold potential as lead compounds in the development of therapeutic agents targeting oxidative stress and microbial infections.

From Weed to Wonder: Jungle Rice Mediated Gold Nanoparticles for Analyzing Antibacterial, Antioxidant and Antidiabetic Potential

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Abstract

Phytogenic nanoparticles fulfill a significant role across various global sectors, including agriculture and healthcare, on an extensive scale. The environmentally sustainable production of metallic nanoparticles derived from botanical sources addresses the growing demand for these materials (Lakshman et al 2016). This synthesis can be effectively integrated with strategies for efficient weed management, thereby contributing to sustainable development. Jungle rice, recognized as a traditional medicinal plant, possesses documented historical properties, including anti-cancerous, anti-oxidant, anti-diabetic, and anti-microbial effects (Paul et al 2024). It is classified as a high-fiber and low-gluten herb, providing a viable and health-conscious dietary alternative for individuals affected by celiac disease (Rekha et al 2018). The study employs a strategy to encapsulate the beneficial compounds of jungle rice within a specially designed and characterized gold nanoformulation. This is achieved through the utilization of an optimized concentration of gold salt in conjunction with a reactive extract derived from the seeds of the plant. The formulation is subsequently evaluated for its antioxidant, antidiabetic, and antimicrobial properties. In alignment with these objectives, the research thoroughly examines toxic concentration levels using both in vitro and in silico methodologies, complemented by effective pathway analyses that can significantly enhance drug design processes.

Keywords: Jungle rice, Nanotechnology, Medicinal properties, phytogenic synthesis, Environmental sustainability.

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Biogenic Synthesis and Antibacterial Activity of Zinc oxide Nanoparticles (ZnONPs) from Litsea glutinosa Leaf Extract

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Abstract

The green synthesis of ZnO nanoparticles by using aqueous leaf extract of Litsea glutinosa has reported in present article. This aqueous synthesis method can be used to obtain a self-assembled ZnO nanoparticle with ease, cost-effectiveness, stability, and reproducibility. The XRD, TEM, and SEM-EDS techniques used to characterize ZnO nanoparticles resulted in their size and shape being identified. By analysing UVeVis spectrophotometer, the formation and stability of the nanoparticles in the colloidal solution were observed. ZnO nanoparticles had their mean particle diameter determined by TEM and SEM, and their size was measured between 25nm. The particle spherical shape was revealed by TEM analysis. The crystallographic nature of the nanoparticles in the face-centered cubic structure is confirmed by the peaks in the XRD pattern corresponding to (100), (002), (101), (102) (110), (200), and (201) planes. This study proved that it is biogenic, eco-friendly, and cost-effective. Synthesis and characterization of the ZnO nanoparticles.

Keywords: nanoparticles, Crystalline, diameter, colloidal, antibacterial.

Ultrasonic-Assisted Fabrication, Photocatalyst Performance and Biological Evaluation of Fe3O4-Supported SGO/PTh Nanocomposites

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Abstract

We synthesized a multifunctional Fe@SGO/PTh nanocomposite via in situ polymerization using ultrasonic irradiation. The material's structure and surface morphology were characterized through X RD, FT IR, TGA, FE SEM, E DX, ^{1}H NMR, TEM, and UV–Vis diffuse reflectance spectroscopy. Magnetic properties were then assessed using a vibrating sample magnetometer (VSM). The nanocomposites exhibited superparamagnetic behavior, with a saturation magnetization (Ms) of 0.036 emu g^{-1}, and were observed to rapidly cluster near a permanent magnet.

We next evaluated photocatalytic activity by degrading methylene blue at nanocomposite loadings of 10, 20, and 30 mg. The 30 mg loading delivered the best performance, achieving an 84 % degradation rate in 90 minutes, corresponding to a reaction rate constant of 0.0202 min^{-1}. Moreover, the material retained excellent reusability over four consecutive cycles in dye removal trials.

Finally, the antibacterial efficacy of Fe@SGO/PTh was tested, demonstrating strong inhibition even at low minimum inhibitory concentration (MIC) and significant zones of inhibition (ZOI). These results highlight the material's multifunctionality, indicating its potential for applications in enhanced magnetic performance, efficient photocatalytic dye degradation, and antimicrobial therapy.

Keywards Polythiophene, Magnetic sulfonated graphene oxide, Photocatalytic performance, Antibacterial activity.

Synthesis and characterization of polymeric flocculants for protein flocculation

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Abstract

Processing of Seafood generates by-products in the form of bones, skin, head and viscera and also the suspended proteins. In the fish processing industry, washing and cutting fish releases proteins into the water, constituting 1–2% of the total weight. These proteins if discharged into natural water bodies adversely affect the environment, causing pollution due to the high Biochemical Oxygen Demand (BOD) of the water. The suspended proteins are valuable if extracted and used as fish meal. For recovering these valuable proteins, flocculants play extremely important role in separating and recovering them from water. Since many of these proteins carry a negative charge, cationic flocculants are required for effective flocculation and recovery . In view of this, there are major efforts in designing and synthesizing efficient flocculants for the best performance in protein flocculation and recovery.

In our laboratory, we have synthesized a cationic flocculant copolymer of acrylamide and (3-acrylamidopropyl)trimethylammonium chloride by inverse emulsion polymerization. The chemical structure of the copolymer was determined by NMR and FTIR spectroscopy. The molecular weight and charge on the polymer were determined by gel permeation chromatography and zeta potential analysis, respectively. The flocculation efficiency was estimated by measuring the time of flocculation of fish meal industry wastewater by visually measuring the clarity of the water with time. Generally the fish meal industry waste water contain suspended proteins such as myofibrillar, sarcoplasmic, and stromal fish proteins. These suspended proteins were from various sea fishes such as Lizard fish, Ribbon fish, Itoyori fish, and Sardine fishes was collected for our study. The synthesized cationic flocculant showed a very good flocculation efficiency. Further details will be discussed in the poster.

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Unravelling Pre-Gelation Dynamics in Biopolymer Derived Polyelectrolyte Complexes: A Rheo-DLS Study

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Abstract

Polyelectrolyte complexes (PECs), formed via electrostatic interactions between oppositely charged polymers, present opportunities for designing responsive soft materials. Among bio-derived PECs, complexes of chitosan (a cationic biopolymer) and carboxymethyl cellulose (CMC), an anionic cellulose derivative, are notable for their biocompatibility, sustainability, and tunable properties. This study focuses on the pre-gelation regime—a critical phase where the polymer chains form transient, dynamic networks without achieving macroscopic gelation. Understanding this stage is key to tuning material properties such as viscosity, relaxation dynamics, and aggregation behaviour, which influence final gel structure and function.

We investigate dilute-stage chitosan–CMC PECs at varying weight ratios using oscillatory rheology and dynamic light scattering (DLS). Rheology reveals a non-monotonic viscosity trend: an initial drop due to charge neutralization and strong interpolymer attraction, followed by a modest rise and then a decline at higher CMC content. This is attributed to a transition from network-like structures to compact, coil-like complexes. DLS supports these observations, showing reduced hydrodynamic diameter with increasing CMC, indicating tighter, stabilized complexes. Ongoing experiments assess how added salts modulate electrostatic screening and complex architecture. These findings aid the rational design of salt-tunable PECs for applications in drug delivery, food structuring, personal care, and sustainable coatings.

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MOFs Featuring NDI Units for Photochemical Applications

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Abstract

Naphthalene diimide-based metal-organic frameworks (NDI-MOFs) represent a versatile class of materials with diverse structural topologies, porosities, and functionalities, enabling multifunctional applications. A key feature of NDI-MOFs is their photochromism, attributed to the electron-accepting nature of the NDI cores, electron-donating properties of interacting species, and the generation of NDI radical anions via photoinduced electron transfer. The reversible one-electron reduction of NDI units leads to the formation of these radical anions, driving the photochromic behavior. Investigations into the photophysical and photochemical properties of NDI-MOFs have demonstrated their potential in optoelectronics, molecular switches, and smart sensing applications. The integration of light-responsive properties, tunable porosity, and high stability positions NDI-MOFs as advanced materials for innovative energy-efficient and responsive technologies.

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Thermothickening Behavior of Chemically Modified Alginate: Insights from Scattering and Rheological Studies

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Abstract

Thermothickening polymers, characterized by the presence of thermodynamic lower critical solution temperature (LCST), show an increase in solution viscosity with rising temperature. This study investigates the thermothickening behavior of a chemically modified Alginate, focusing on its potential applications in injectable formulations. We employed Dynamic Light Scattering (DLS) to determine the hydrodynamic radius, diffusion coefficient, and particle size in dilute solutions, which provide insights into their conformational changes and underlying molecular mechanisms responsible for thermothickening. Our findings indicate that above the LCST, the enhanced hydrophobic interactions between polymer chains lead to the formation of a transient, dynamic network. This network restricts polymer chain movement, resulting in a significant increase in the viscosity or even gelation. The unique thermothickening properties of these chemically modified Alginate hold substantial promise for biomedical applications, including their development as smart injectables for controlled drug release technologies and as rheology modifiers in cosmetic and pharmaceutical formulations, ultimately impacting patient compliance, product efficacy, and consumer experience.

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Resorcinol based moisture-activated oxygen scavenger for active packaging of fresh bread and their effect on shelf-life extension

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Abstract

Recent years have seen a significant increase in consumer interest for active packaging strategies like oxygen scavengers. Sustainable and biodegradable materials present a potential alternative to metal-based scavengers. The current study verifies the applicability of an oxygen-scavenging sachet comprising resorcinol (RC) and potassium carbonate (PC) for active packaging and shelf-life extension of bread. The effect of applied oxygen scavenger on headspace oxygen concentration (%), fungal decay, and microbiological analysis was investigated over a storage period of 6 days at 25 °C. Other tests include pH analysis, titratable acidity, and sensory analysis. The results demonstrated that scavenger application was highly efficient in scavenging oxygen from the headspace. 0.2% oxygen levels were achieved within 144 hours of storage time. Low oxygen levels further helped in sustaining an appreciably low microbial load under 5 log colony forming unit /gram (cfu/g) up to 5 days. It was also successful in delaying changes in pH, titratable acidity and subsequently maintaining an acceptable sensory profile over an extended period of 2 days. Overall, it is suggested that resorcinol can proficiently be utilized for its oxygen-scavenging properties for packaging in the food industry.

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Bio-based polyurethane composite foam reinforced with graphene oxide for enhanced antibacterial and dye removal applications

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Abstract

The development of polyurethane foam-based materials has become a key area of research due to their potential to advance technology, improve sustainability, and expand their applications in areas such as advanced composites, aerospace materials, and energy absorption systems. Current studies focus on creating environmentally friendly polyurethane foams by utilizing bio-based materials and enhancing recyclability. This research aims to fabricate polyurethane composite foams derived from non-edible oils as a sustainable source of polyols, with graphene oxide (GO) incorporated as a nano filler. The impact of varying GO content on the adsorption capacity and stability of the resulting polyurethane foam was systematically evaluated. All the fabricated nanocomposite foams have been characterized through FE-SEM, ATR-FTIR, DSC, and TGA analysis. The synthesized graphene oxide polyurethane foam (GOPUF) demonstrated significant enhancements in mechanical strength, thermal stability, and antibacterial properties. The antibacterial activity of GOPUF was evaluated against Escherichia coli (E. coli) and Staphylococcus aureus (S. aureus), revealing a notable reduction in bacterial growth on the cultured samples. This broad-spectrum antibacterial effect highlights the potential of GO-based polyurethane foams for various applications. Additionally, the GOPUFs exhibited a dye removal efficiency ranging from 68.9% to 89.3% for the removal of Brilliant Blue Ponceau (BPB) dye, underscoring their effectiveness in wastewater treatment applications.

Keywords: Polyurethane foam, Graphene oxide, Antibacterial activity, Dye removal application.

Development of Crosslinked Anionic Polyelectrolytes for Metal Removal from Contaminated Water

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Abstract

Water treatment plays a crucial role in addressing the broad challenges of pollution and is considered one of the most vital areas of environmental research today. Among the various pollutants, metal contamination poses a significant threat to water quality. Metal ions can enter aquatic systems through industrial discharges, mining activities, agricultural runoff, and other anthropogenic sources. Additionally, the improper disposal of electronic waste and batteries contributes notably to the presence of toxic metals in water bodies. Regulatory agencies have established permissible limits for metal concentrations in drinking water. Elevated levels of metals such as lithium, mercury, cadmium, lead, aluminium etc. are associated with specific health risks, including kidney and thyroid dysfunction, neurological disorders, bone and kidney damage, gastrointestinal disturbances, and cardiovascular diseases etc.

In response to this critical challenge, we have developed a polyelectrolyte polymer synthesized from acrylamide and 2-Acrylamido-2-methylpropane sulfonic acid, crosslinked with N, N'-methylene bisacrylamide. Different copolymers were synthesized by carefully adjusting the monomer ratios, anionic content, crosslinking density and method of polymerization. These polyelectrolytes have the potential to bind positively charged metal ions paving the way for efficient removal of hazardous metal ions from water. The efficiency of metal ion binding will be examined using NMR and XPS techniques. This material could offer an effective solution for mitigating metal contamination, supporting both environmental sustainability and public health safety.

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Electrode-supported palladium electrocatalyst for Suzuki-Miyaura cross-coupling reaction

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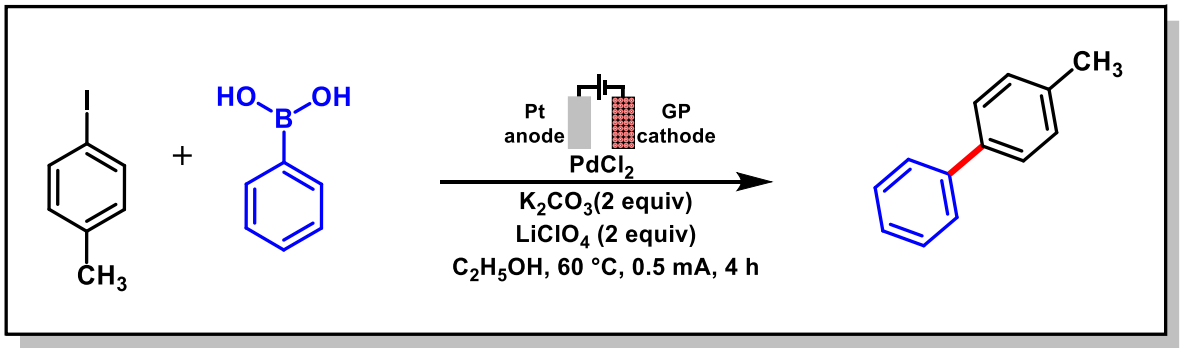
Abstract

Solid support catalysts are heterogenous catalytic systems which offer 3-R approach (Recoverable, Robust and Recyclable) for transition metal catalyzed chemical transformations.(1) Further, electrochemical reactions are environmentally safe and offers sustainable and cost-effective protocols without using chemical based redox reagents. Merger electrocatalysis and solid supported catalysis can be potential methods due to promising outcomes in terms of high recyclability particularly for C-C cross-coupling reactions without appreciable loss of its activity with high TON and TOF.

Herein, we have developed a supported palladium nanoparticles electrocatalyst system by electro-reductive deposition of palladium nanoparticles onto electrode surface and successfully employed for solid-supported palladium electro-catalyzed Suzuki-Miyura cross-coupling reaction.(2) This method provides a heterogeneous catalyst system with the advantage of easy separation from the reaction systems and high recyclability.(3,4) In this system, palladium nanoparticles remain anchored onto the surface of electrocatalyst without significant loss of its catalytic activity. Thus, the development of high-performance sustainable electrocatalysts can paves a way to future chemical industries.



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Sustainable Valorization of Invasive Echinochloa colona for Multifunctional Gold Nanoparticle Synthesis: Pharmacological Potential in-vitro and in-silico Profiling

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Abstract

Phytogenic synthesis presents an environmentally sustainable approach for the production of functional nanomaterials while effectively utilizing invasive plant biomass. This study investigates the seeds of the medicinal herb Echinochloa colona (commonly known as jungle rice), which are abundant in bioactive compounds. These phytochemicals have been analyzed through gas chromatography-mass spectrometry (GC-MS) to identify their antioxidant, antidiabetic, and antimicrobial properties, thereby facilitating the development of high-value gold nanoparticles (AuNPs). The optimized biosynthesis procedure employed 1 mM $HAuCl_4$ in combination with aqueous seed extract of variable concentrations leading to a best optimized concentration analysis verified through UV- Spectrophotometer with sharp peaks within the range of 520-540nm, resulting in the formation of stable AuNPs. These nanoparticles were characterized using transmissive and scanning electron microscopy (TEM and SEM), allowing for the assessment of their structural size and morphology. X-ray diffraction (XRD) analysis confirmed the face-centered cubic crystallinity and purity of the metal, in conjunction with the characteristics of the seed extract. Additionally, Fourier-transform infrared spectroscopy (FTIR) elucidated the precise chemical composition of the synthesized nanoparticles in comparison to the seed constituents, thereby identifying the changes in the properties of the produced nanoparticles. The E. colona-AuNPs exhibited substantial bioactivities, demonstrating considerable antioxidant capacity validated by DPPH and ABTS assays. Furthermore, their potential for anti-diabetic activity was evaluated through α-amylase and β-glucosidase inhibition assays. The AuNPs also displayed broad-spectrum antimicrobial effectiveness against several fungal, Gram-positive, and Gram-negative pathogens, assessed via minimum inhibitory concentration (MIC) and confirmed using the disc-diffusion method. A comprehensive in-silico toxicology analysis was conducted to mitigate risks associated with therapeutic applications. Molecular docking studies revealed that key phytoconstituents exhibit a strong affinity for binding, correlating with their antioxidant, anti-diabetic, and antimicrobial efficacy. Furthermore, Molecular Dynamic (MD) simulation confirmed the structure stability by showing conservative energy flow during the interaction. This integrative research approach positions E. colona-AuNPs as a benign and multifunctional nanotherapeutic platform derived from an invasive agro-ecological resource, which holds significant promise for applications in the management of metabolic diseases and antimicrobial therapies.

Keywords: Jungle rice, Nanotechnology, Medicinal properties, phytogenic synthesis, Environmental sustainability.

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An eco-friendly nanocomposite of modified cellulose, TiO_2, and cinnamon bark for the spectrophotometric reduction of toxic organic pollutants

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Abstract

In the present study, a bio-nanocomposite catalyst was developed using sulfated carboxymethyl cellulose (S-CMC) and TiO_2 nanoparticles, incorporated with cinnamon bark extract (CIN), resulting in the CIN/S-CMC/TiO_2 composite. This bio-nanocomposite served as a support material for synthesizing highly active zero-valent metal nanoparticles (M^o). Mono-metallic (Co, Cu) and bimetallic (Co-Cu) ions were loaded onto the CIN/S-CMC/TiO_2 composite and subsequently reduced using an aqueous solution of sodium borohydride to form their respective zero-valent metal nanoparticles. The resulting M^o/CIN/S-CMC/TiO_2 composites were characterized using FTIR, XRD, EDX, and FE-SEM, confirming the successful formation of M^o nanoparticles on the surface of the bio-nanocomposite. These catalysts were then employed for the efficient reduction of 4-nitrophenol (4-NP) and azo dyes, including Congo Red (CR), Methyl Orange (MO), and Acid Red (AR). Among the various catalysts synthesized, the Co-Cu/CIN/S-CMC/TiO_2 composite exhibited the highest catalytic activity for reducing 4-NP and the azo dyes in the presence of sodium borohydride, with apparent rate constants of 0.99 min^{-1} for 4-NP, 0.747 min^{-1} for CR, 0.621 min^{-1} for MO, and 0.342 min^{-1} for AR. In addition to its superior catalytic performance, the bio-nanocomposite catalyst demonstrated good recyclability, as it could be easily separated from the reaction mixture and reused multiple times for the reduction of new pollutant samples.

Keywords: Bio-nanocomposite catalyst, Zero-valent metal nanoparticles (M^o), Azo dyes reduction, Sodium borohydride.

Preliminary phytochemical screening and antioxidant activity of Cucumis maderaspatanus

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Abstract

Cucumis maderaspatanus (syn. Mukia maderaspatana), commonly known as Madras pea pumpkin, a monoecious climbing herb belonging to the family Cucurbitaceae, is widely distributed throughout tropical and subtropical parts of Asia. This plant has long been valued in traditional medicinal systems, particularly in Ayurveda, where it is used to treat a wide range of health issues, including cardiac disorders, urinary tract infections, and other systemic conditions. Furthermore, this plant's ethnomedicinal value is demonstrated by the fact that indigenous communities in different regions have utilized different parts of this plant for treating both human and livestock ailments. In the present study, both fruits and leaves of M. maderaspatana were subjected to successive solvent extraction using different organic solvents of increasing polarity. This approach was employed to ensure the broad-spectrum isolation of phytoconstituents. The qualitative phytochemical screening revealed the presence of numerous bioactive secondary metabolites, including alkaloids, saponins, flavonoids, phenolic compounds, tannins, anthraquinones, cardiac glycosides, and terpenoids. The detection of flavonoids, alkaloids, phenolic compounds, tannins, and terpenoids further supports the plant's potential as a source of pharmacologically significant compounds. To evaluate antioxidant capacity, the extracts were subjected to the DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical scavenging assay. The methanolic extract demonstrated significant free radical scavenging activity, indicating the potential of the plant as a natural antioxidant. These findings not only affirm the traditional uses of M. maderaspatana but also point to its potential for use in the development of therapeutic agents derived from natural sources.

Keywords: Cucumis maderaspatanus, phytochemical screening, antioxidant activity.

Sustainable Knitted Aerogel Liners for High-Performance Insulation in Cold Weather Clothing

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Abstract

Traditional cold weather clothing, typically made from down or synthetic fibers, often suffers from excessive bulk and limited insulation efficiency. This underscores the need for thermal liners that are both lightweight and highly effective. This study presents, for the first time, the development of washable, sustainable thermal liners based on wool knit fabrics infused with a silica/alginate hybrid aerogel. The aerogel coating significantly enhanced insulation, doubling the Clo value compared to the uncoated fabric and achieving 4.65 Clo/inch at a minimal thickness of 2.6 mm. Effusivity was reduced by 66%, contributing to a noticeably warmer tactile feel without added bulk. Compared to conventional insulation materials, the coated fabric demonstrated a 133% improvement in Clo/inch while being 92% thinner. The aerogel-coated knitted liners also exhibited excellent durability, retaining thermal performance even after 10 home laundering cycles. Thermal conductivity measurements across a temperature range from +25°C to -25°C confirmed effectiveness in cold environments. Biocompatibility evaluations, including cytotoxicity and skin sensitization tests, confirmed the liners are non-toxic and safe for skin contact. This straightforward fabrication method offers a scalable, lightweight, durable, and sustainable solution for thermal insulation, with potential applications ranging from outdoor clothing to advanced technological fields.

Keywords: Hybrid aerogel, sustainable coating, knitted aerogel liners, washable insulation, cold weather clothing.

Plant-extract Mediated Biogenic TiO2 Nanoparticles for Photocatalytic Degradation of Dye Pollutants

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Abstract

The green method of metal oxide synthesis is an alternative to the more time consuming and difficult to use traditional procedures, as the invention achieves a significant yield with minimal effort. The present study is aimed at using Mangifera Indica (Mango) seed aqueous extract for the bio-inspired fabrication of Titanium oxide nanoparticles. The detailed characterization of as synthesized nanoparticles was carried out using X-ray diffraction (XRD), Scanning electron microscope (SEM), Transmission electron microscope (TEM), Ultra violet-visible (UV-Vis), Fourier transform infrared (FTIR) and Photoluminescence (PL) spectroscopic techniques. The appearance of characteristic XRD peaks and FTIR band at 665 cm-1 confirms the formation of TiO2 nanoparticles. The intense XRD peaks suggest the construction of Titanium oxide nanoparticles with high purity and crystallinity. The average crystallite size of 57.34 nm was obtained using Debye Scherrer's equation. Morphological characterization of the synthesized nanoparticles using FE-SEM with EDX and HR-TEM with SAED analysis demonstrate spherical like crystallites having sizes in nano ranges. The bio-inspired semiconducting nano metal oxides were tested for their photocatalytic potential against Brilliant Cresyl Blue (BCB) dye in aqueous medium. With the optimum condition of dye concentration, photocatalyst dose, pH and time, the photocatalyst was found very effective for elimination of the dye under visible light illumination. Kinetic study of the dye photo-mineralization over the biogenic nanoparticles approved pseudo first order kinetic model. The reusability experiment proved high photo stability and recyclability of the photocatalyst for potential practical use.

Keywords: Titanium oxide, Mango seed, Photocatalytic degradation, Brilliant crystal blue.

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Cracking the Resistance Code: Evaluating Cephalosporin Effectiveness in UTI Isolates

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Abstract

Urinary tract infections (UTIs) are among the most prevalent bacterial infections encountered in both community and hospital settings, often requiring empirical treatment with broad-spectrum antibiotics. Cephalosporins are frequently prescribed due to their efficacy and safety; however, increasing antimicrobial resistance poses a significant challenge to their continued effectiveness. This study was undertaken to evaluate and compare the susceptibility patterns of six cephalosporin antibiotics—Cefalotin, Cefoxitin, Cefixime, Cefotaxime, Ceftazidime, and Ceftriaxone—in patients diagnosed with UTIs.

Urine samples from one hundred fifty patients were processed using standard microbiological techniques. The most common uropathogens isolated included Escherichia coli, Klebsiella spp., Citrobacter spp., Pseudomonas spp., Enterobacter spp., and Staphylococcus spp. Antibiotic susceptibility testing was performed using the antibiotic susceptibility card (VITEK®-2 AST-N235), and the comparative resistance trends among the selected cephalosporins were analysed.

The study revealed variable resistance across the tested antibiotics, with older-generation cephalosporins generally showing higher resistance, while certain third-generation agents exhibited relatively better sensitivity. Nonetheless, reduced susceptibility was observed even among widely used newer cephalosporins, highlighting the ongoing threat of resistance. These findings emphasize the need for continued antimicrobial stewardship, local resistance surveillance, and judicious antibiotic use to ensure effective treatment outcomes in UTI management.

Keywords: Urinary Tract Infection (UTI), Cephalosporins, Antibiotic Resistance, Uropathogens.

Ultra-Low Particulate Air Filters from Porous PLA and Porous TiO2-PLA Nanofibres with Excellent Antibacterial Properties

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Abstract

Porous nanofibrous membranes are redefining the standards of air filtration by offering an optimal balance between high particle capture efficiency and breathable flow resistance. In this study, I developed biodegradable and composite antibacterial nanofiber membranes using electrospun polylactic acid (PLA) and TiO_2-loaded PLA, aiming to create sustainable alternatives to conventional synthetic filters. The membranes were engineered to maintain controlled fibre diameters (623 ± 195 nm for PLA and 445 ± 156 nm for TiO_2–PLA) and uniform pore sizes (85 ± 20 nm and 65 ± 20 nm, respectively). These structural parameters enabled the membranes to achieve ultra-high particle filtration efficiencies ranging from 99.992% to 99.998% for submicron PMs at a face velocity of 5 cm/s, with a low pressure drop between 40 and 78 Pa, ensuring comfort without compromising protection. The integration of TiO_2 not only enhanced the filtration performance but also imparted strong antibacterial functionality. Notably, the porous architecture significantly increased the available surface area for interception and diffusion-based capture, promoting extended residence time for submicron particles within the membrane. This work underscores the potential of eco-friendly, nanostructured fibrous membranes for next-generation air filtration and personal protective applications. The findings pave the way for scalable, sustainable, and high-efficiency filters that align with global environmental and health priorities.

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Comparative Impact of NiO Nanowires and Nanoparticles on Electrospun PAN-Based TENGs for Innovative Applications

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Abstract

The growing use of wearable electronic devices has created a need for sustainable alternatives to rechargeable batteries, which can be harmful to the environment and difficult to dispose of. Triboelectric nanogenerators (TENGs) offer a promising solution by converting mechanical energy from human motion into electrical energy [1]. The performance of TENGs largely depends on the choice of dielectric materials. Electrospun nanofibers are especially suitable due to their high surface area and flexibility. In this study, polyacrylonitrile (PAN) was used as the tribo-negative material and Nylon 6,6 as the tribo-positive material [2]. To improve the dielectric properties of PAN, nickel oxide (NiO) nanostructures—both nanoparticles and nanowires—were added to the PAN nanofibers in different concentrations ranging from 1 wt.% to 9 wt.%. A comparative analysis showed that NiO nanowires perform better than nanoparticles in enhancing the output of the TENG. The optimal performance was achieved with 5 wt.% NiO nanowire loading, delivering an open-circuit voltage (VOC) of 208 V and a short-circuit current (ISC) of 21 µA under a 10 N applied force over a 4 cm^2 active area The developed TENG was able to light up 53 LEDs and charge a capacitor, showing its potential for practical energy harvesting applications. Additionally, the device was used to power a smart glove for disabled users, where a machine learning model was used for gesture recognition and showed good results. Overall, this work highlights that adding NiO, especially in nanowire form, to electrospun PAN nanofibers significantly improves TENG performance, making it a suitable approach for developing efficient and eco-friendly energy harvesting systems.

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Dose-Dependent Effects of Zinc Oxide Nanoparticles on Growth and Antioxidant Response in Ashwagandha (Withania somnifera

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Abstract

Withania somnifera (L.) Dunal, commonly referred to as Ashwagandha, serves as a fundamental herb within Ayurvedic medicine, renowned for its significant adaptogenic, antioxidant, and anti-inflammatory properties. These attributes contribute to its extensive application in stress management and immune support. This study explores the physiological and biochemical responses of Ashwagandha plants to exposure to zinc oxide nanoparticles (ZnO NPs), which are increasingly employed across a range of agricultural and industrial domains. The research involved the synthesis of ZnO nanoparticles, followed by a rigorous characterization of their physicochemical properties, including crystallinity, size, and morphology, using techniques such as X-ray Diffraction (XRD) and Scanning Electron Microscopy (SEM). Ashwagandha plants were treated with varying concentrations of ZnO NPs in the soil, specifically at levels of 0 (control), 150, 300, 600, and 1200 mg/kg. The analysis revealed a significant dose-dependent inhibitory effect on essential morphological growth parameters. Notably, both root length and shoot length experienced considerable declines, with the highest concentration of 1200 mg/kg resulting in the most substantial reduction in overall plant growth and biomass accumulation. Additionally, comprehensive phytochemical profiling indicated that increased levels of ZnO NPs adversely affected the biosynthesis of critical secondary metabolites that are vital for the herb's medicinal efficacy, leading to a marked decrease in alkaloid and flavonoid content. Simultaneously, the activity of key antioxidant enzymes, including superoxide dismutase and catalase, exhibited significant alterations, suggesting the induction of oxidative stress within the plant tissues. These collective findings illustrate that while lower concentrations of ZnO NPs may be tolerable, elevated levels present a significant risk to the growth, development, and phytochemical integrity of Ashwagandha. This highlights the imperative need for thorough assessment and careful regulation of nanoparticle dosage in agricultural practices to ensure the preservation of medicinal plant quality and ecosystem health.

Keywords: Oxidative stress, Withania somnifera, Nanotoxicology, Antioxidant enzymes.

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Band Gap Engineering and Structural Tuning of Ferrite-ZnO@Polymer Nanocomposites for Photocatalytic Applications

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Abstract

An extensive study was carried out to examine the photocatalytic and optical behaviour of ZnO nanoparticles and ferrite-ZnO@polymer nanocomposites aiming to explore their potential in future technological applications. The synthesis of both ferrite and ZnO nanoparticles was achieved using co-precipitation technique. Structural analysis conducted via X-ray diffraction (XRD) and transmission electron microscopy (TEM) confirmed that ZnO- ferrite@polymer sample possess a cubic spinel crystal structure. Fourier-transform infrared (FTIR) spectroscopy identified absorption peaks within the 390–561 cm^{-1} range which are typical of spinel-type ferrites. The particle sizes across all synthesized samples were found to range between 25 and 35 µm. Optical studies using UV–Visible and photoluminescence spectroscopy indicated a modification in the band gap of the composites, improving their effectiveness in photocatalytic applications. This enhancement is largely due to the development of a favorable interfacial structure between the ZnO and ferrite phases. The photocatalytic capability was assessed through the degradation of Congo red dye under visible light. The degradation efficiencies observed were approximately 29% for ZnO, 52% for ferrite/ZnO and 86% for the ferrite/ZnO@polymer nanocomposite in 180 mintues, demonstrating the significant impact of polymer integration.

Keywords: Photocatalysis, ferrite nanocomposite, organic dye degradation.

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Biogenic Construction of Nickel nanoparticle and their use in thin film Formation

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Abstract

The biogenic synthesis of nickel nanoparticles (Ni NPs) has emerged as a sustainable and eco-friendly alternative to traditional chemical methods, offering a pathway to produce nanoparticles without the use of toxic chemicals and high-energy processes. Our approach involves converting metal ions into nanoparticles using natural plant extracts or biological systems, resulting in materials with specific properties suitable for various applications. These nanoparticles can be integrated into thin films through various deposition techniques, such as spin coating, dip coating, and spray pyrolysis, to create films with desired characteristics for applications in sensors, solar cells, and environmental remediation. In the synthesis process involves the reduction of nickel ions by bioactive compounds present in plant extracts, leading to the formation of Ni NPs. Using various characterization techniques, including UV-Visible spectroscopy, X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR), we determined that the nickel oxide (NiO) nanoparticles are spherical in shape, crystalline in nature. We endeavor to utilize nickel oxide (NiO) nanoparticles for thin film formation applications.

Keywords: Biogenic synthesis, Ni NPs, Thin film formation, Green chemistry, Plant-mediated synthesis, thin film formation.

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Eco-Friendly Synthesis and Bioactivity Evaluation of 2-Amino-3-cyano-4H-chromene Derivatives Using Fe_3O_4@SGO Nanocatalyst

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Abstract

Recent attention has surged around the extensive application of biologically active compounds. In this study, a series of 2-amino-3-cyano-4H-chromene derivatives were synthesized and screened for their antimicrobial and antioxidant properties, employing Fe_3O_4@SGO a green, magnetically recoverable nanocatalyst. The derivatives were synthesized through a one-pot, three-component domino Knoevenagel–Michael condensation reaction involving aldehydes, malononitrile, and α-naphthol, resorcinol, or β-naphthol. This reaction was facilitated under ultrasonication using a water-ethanol (1:1) solvent system. The antimicrobial efficacy of the synthesized compounds was assessed using the agar well diffusion method against a range of microorganisms, including gram-positive bacteria (S. aureus), gram-negative bacteria (E. coli), and fungi (C. albicans, F. oxysporum). Among the synthesized molecules, compounds 4n and 4p demonstrated significant antibacterial activity, while compounds 4a, 4c, 4i, and 4l exhibited strong antifungal effects when compared to standard drugs. Antioxidant potential was determined via the DPPH radical scavenging assay, with compounds 4k and 4n showing remarkable activity.

Keywords: Bilogically active compounds, Antimicrobial activity, Antioxidants, Magnetic catalysts.

Computational Screening of Microalgae Metabolites for NADPH Oxidase Inhibition

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Abstract

Excessive reactive oxygen species (ROS) production by NADPH oxidase 5 (NOX5) is implicated in pathologies like hypertension and cancer, driving the search for specific inhibitors. Natural products, particularly phytochemicals from microalgae like Chlorella pyrenoidosa, represent promising sources of bioactive compounds. This study employed computational molecular docking using the CB-Dock 2 server (version 1.0) to screen 32 documented C. pyrenoidosa phytochemicals against the crystallized catalytic domain of human NOX5 (PDB ID: 8WEJ), specifically targeting its FAD-binding active site. Blind docking simulations identified 14 compounds with predicted binding affinities ≤ -7.0 kcal/mol. The top three ligands and their specific docking results were: Luteolin exhibiting the highest affinity at -9.2 kcal/mol, forming 3 hydrogen bonds with key catalytic residues Glu429, Arg482, and His404, plus significant hydrophobic contacts with Phe390, Leu413, and Val467; Chlorogenic acid with an affinity of -8.7 kcal/mol, establishing 2 hydrogen bonds (Glu429, Arg482), π-π stacking with His404, and hydrophobic interactions with Leu413 and Val467; Kaempferol showing an affinity of -8.5 kcal/mol, generating 2 hydrogen bonds (Glu429, Arg482) and hydrophobic contacts with Leu413 and Val467. All top compounds were predicted to bind deep within the NOX5 catalytic cavity near the FAD cofactor. Analysis of the top 10 complexes revealed Glu429 and Arg482 participated in ligand binding interactions in 100% of cases, while His404 was involved in 80%. Control docking with the known NOX inhibitor apocynin yielded a significantly lower predicted affinity (-6.8 kcal/mol) compared to the leading phytochemical hits. These CB-Dock 2 results computationally identify luteolin, chlorogenic acid, and kaempferol from C. pyrenoidosa as high-affinity potential inhibitors of NOX5, warranting experimental validation as ROS-modulating therapeutic candidates.

Keywords : ROS, NADPH oxidase, Chlorella Pyrenoidosa, Microalgae.

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Biodegradable chitosan films incorporated with taro peel carbon dots for active food packaging

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Abstract

The world population is growing rapidly, and according to the United Nations, it is projected to reach 9.7 billion by 2050. An estimated 1.3 billion tons of food is wasted before consumption, as quantified by the Food and Agriculture Organization (FAO). The issue of food spoilage is primarily attributed to improper packaging materials such as plastic-based materials, which contribute to environmental pollution and municipal solid waste. They are also incapable of providing sufficient protection against harmful UV light, oxidation, and contamination from microorganisms present in the environment. In this regard, active packaging alternatives can help to improve the environment of packaged food and extend its shelf life. Currently, there is a high demand for developing biodegradable active packaging materials in a sustainable manner.

In this study, we fabricated chitosan (CH)-based film incorporated with taro peel carbon dots (TCDs) via solvent casting method. The films of CH incorporated with different amounts of TCDs are prepared through the solvent casting method. The CHT film, incorporated with 0.08% TCDs, exhibits approximately 81% enhancement in water vapor barrier characteristics and a substantial 87% increase in tensile strength. The film also shows good antioxidant and antimicrobial properties, thus presenting their enormous potential as an active packaging material to prolong the shelf life of fruits, such as banana and pomegranate arils.

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Investigation of Flow Dynamics and Mixing Efficiency in Multi-Cell Micro Tesla Valves

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Abstract

Microfluidic systems have become indispensable in a variety of scientific and industrial fields, particularly in biotechnology, chemical analysis, and diagnostics, due to their ability to manipulate and mix extremely small fluid volumes with high precision. Effective mixing at the microscale is critical for processes such as biochemical reactions, point-of-care testing, and drug development, where even slight improvements in mixing can significantly enhance performance and reliability. Passive micromixers, which rely solely on geometry-induced flow patterns rather than external energy sources, offer several advantages, including simplicity, low power consumption, and ease of integration into lab-on-chip devices.

This study investigates the mixing performance and flow characteristics of micro Tesla valve-based micromixers composed of one, two, three, and four sequential valve cells. The objective is to assess how increasing the number of Tesla valve units influences key flow and mixing parameters, such as flow velocity distribution, turbulence intensity, vorticity, pressure drop, mixing efficiency, and mixing time. Special attention is given to the occurrence of chaotic advection, which can significantly enhance mixing, potentially induced by the asymmetric geometry of the Tesla valves.

All simulations were conducted with a fixed inlet velocity of 0.01 m/s to ensure consistent comparison across all designs. The micromixer geometries were modeled using SOLIDWORKS 2020, and computational fluid dynamics (CFD) simulations were performed using ANSYS software. Fabrication of the microchannels was carried out through laser micromachining on PMMA substrates, chosen for their optical clarity, biocompatibility, and suitability for precision microfabrication.

Neural Network Based Generative Method for Potential Polymer Lead Generation Targeting Oligonucleotide Polymer Conjugates

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Abstract

Oligonucleotide therapeutics represent a transformative class of drugs with the unique ability to precisely modulate gene expression and target previously "undruggable" biological pathways. Despite their inherent molecular specificity, unmodified oligonucleotides face significant limitations in vivo, including rapid enzymatic degradation, poor cellular uptake, limited biodistribution, and potential off-target effects. Polymer-oligonucleotide conjugation has emerged as a crucial strategy to overcome these challenges. Oligonucleotides can be functionalized at their ends for polymer conjugation, but current polymer options are limited, often requiring complex bottlebrush architectures for extended half-life. Manual development is inefficient given the vast number of chemical possibilities. To accelerate this, we employed a neural network-based generative model using an LSTM architecture and PSMILES representation to design novel polymers. We fixed potential conjugation points as alkyne, amine, carboxylic acid, hydroxyl, and thiol. Generated polymers were validated with RDKit. Our model achieved over 95% validity and a mean uniqueness ratio 9.9, demonstrating its strong capability in generating diverse and chemically sound polymer candidates for oligonucleotide conjugation.

Keywords: Neural Networks, Polymers, Generative Modeling, Oligonucleotide-Polymer Conjugation.

Soy protein supported PPO/PEO nanocomposite hydrogels as a vehicle for safe release of ciprofloxacin

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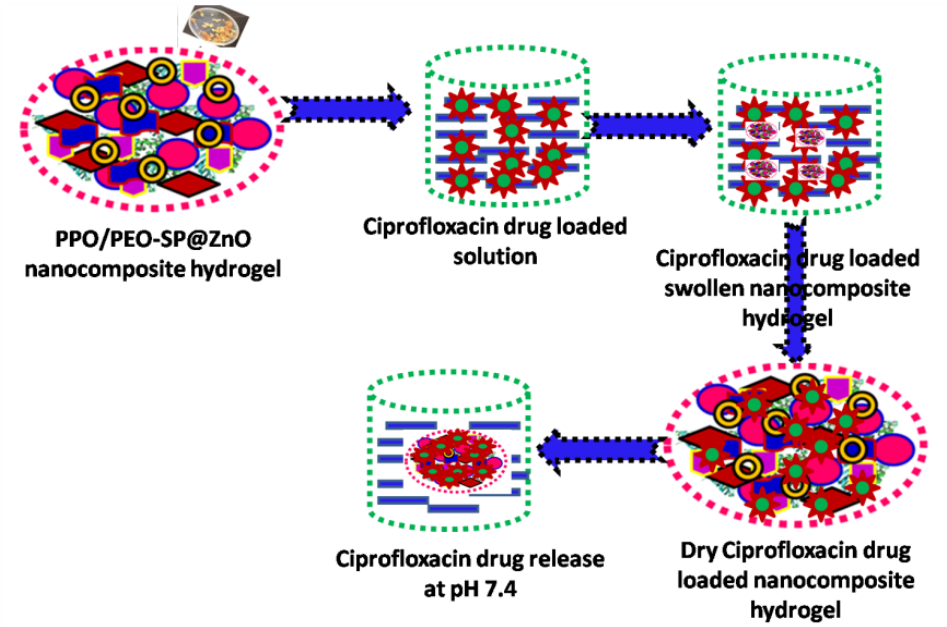
Abstract

In this study, we present the synthesis of nanocomposite hydrogels (PPO/PEO-SP@ZnO) incorporating soy protein (SP) with propylene oxide (PO)/polyethylene oxide (PEO) and polyethylene glycol methacrylate as a cross linker, achieved through in situ polymerization. The impact of soy protein and nano ZnO on the structural and morphological properties of the nanocomposite hydrogels is analyzed. The resulting nanocomposite hydrogels polymers are characterized using techniques such as FTIR, XRD, FESEM, EDX mapping, AFM, and TGA. Zeta potential measurements are employed to assess the particle distribution within the hydrogels. Key properties of the hydrogels, including their structure, morphology, thermal sensitivity, swelling behavior, and water retention, are systematically examined. Rheological analysis shows that incorporating evenly distributed nano ZnO into the matrix greatly improves the stiffness and viscoelasticity of the hydrogel. The antibacterial effectiveness of the biodegradable ZnO nanohybrid composite hydrogels is assessed using inhibition zone assays, which focus on both gram-positive and gram-negative bacteria. Drug delivery properties of the nanocomposite hydrogels are assessed using ciprofloxacin as the model antibiotic. A maximum drug release of 95.2% is observed after 5 hours in a basic medium. Cytotoxicity testing on mouse fibroblast cells (L-929, ATCC CCL-1) shows that the nanocomposite hydrogels are non-toxic and exhibit greater biocompatibility than poly propylene oxide/poly ethylene oxide-soy protein, since evidenced by Cytotoxicity testing. These results indicate that PPO/PEO-SP@ZnO nanocomposite hybrid hydrogels exhibit effective biodegradable carriers and pH sensitivity for in vitro model drug ciprofloxacin liberate. These findings suggest new possibilities for oral drug delivery, offering an alternative to the current practice of transdermal drug release, which can be inconvenient in modern lifestyles.

Keywords: Soy protein; ZnO; AFM; in vitro; ciprofloxacin; Drug delivery.



Developing an inter-relationship between surgical suture size (USP/EP) and textile numbering system (tex)

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Abstract

This paper presents the development of a novel inter-relationship between suture size, as defined by the United States Pharmacopeia (USP) and European Pharmacopeia (EP), and the textile numbering system, particularly linear density (tex), for surgical suture materials. Sutures, mainly used to stitch for holding together edges of a wound or surgical incision, are traditionally characterized by their diameter, which influences their tensile strength and application suitability. However, existing standards of sutures do not account for the varying densities and material compositions of modern synthetic and natural fibers used in sutures. This leads to potential inconsistencies in suture performance despite identical USP or EP size classifications. This study introduces a generalized equation derived through regression analysis to correlate USP/EP suture sizes with the tex value, offering a more comprehensive understanding of suture characteristics. The research utilizes eight commercially available sutures, representing a range of materials and configurations, to validate the proposed equation. This enhanced correlation is expected to aid both manufacturers in producing more consistent suture products and surgeons in selecting the most appropriate suture material for specific medical applications. The findings promise to bridge the gap between textile manufacturing practices and medical device standards, ensuring better surgical outcomes.

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Bio-Inspired NiO Nanoparticles: Structural Analysis and Dual Application in Antibacterial and Photocatalytic Performance

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Abstract

The current work aims to synthesize nickel oxide nanoparticles (NiO NPs) from the medicinal leaf extract of Nyctanthes arbor-tristis and investigate their antibacterial and photocatalytic properties for the degradation of color. The synthesised NPs were studied using UV-visible spectroscopy, which revealed a colour change pattern and validated their highest absorption peak at 280 nm, which is unique to NiO NPs. The FTIR analysis revealed the presence of numerous functional groups both in the leaf extract and on the NiO NPs. XRD analysis indicated the highly crystalline form of NiO NPs with an average size of 9.6 nm. The TEM micrograph displays the 13 nm-sized, non-agglomerated NPs in a hexagonal configuration. Through EDX analyses, the elements' compositions of nickel and oxygen were verified. The antibacterial activity of NiO NPs was evaluated against gram-positive and gram-negative strains of Escherichia coli and Staphylococcus aureus using the well diffusion technique. Furthermore, NiO NPs were used to perform photocatalytic degradation of Fast Green (FG) and Rose Bengal (RB) dye molecules. We verified that NiO NPs degrade FG by 89% and RB by 77% when exposed to sunlight, based on the findings we got.

Recycling Reinvented: Converting PET Bottle Waste into 3D printable PCR Polypropylene Vitrimers for a Sustainable Future

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Abstract

Global plastics pollution has a triad impact on the environment, energy, and climate. Numerous innovative closed- and open-loop plastics recycling or upcycling methods have been created or suggested, addressing a range of concerns related to the realization of a circular economy. In the pursuit of sustainable polymeric materials, this study explores the use of depolymerized polyethylene terephthalate (PET), derived from waste, as a dynamic crosslinker to enhance the properties of functionalized post-consumer recycled polypropylene (PCR PP). Following glycolysis, waste PET was converted to BHET (bis(2-hydroxyethyl) terephthalate) with very high yield, which was subsequently employed to introduce dynamic covalent bonding in maleated PCR PP through transesterification reactions with the maleic anhydride groups following industrially viable melt extrusion approach. The resulting crosslinked PCR PP, exhibits vitrimer-like properties, allowing for reprocess ability, high dimensional stability and enhanced mechanical strength (14% improvement in yield strength as compared to PCR PP) and rheological performance. Characterization of the crosslinked polymer network confirmed the formation of reversible ester linkages, contributing to improved material durability and recyclability without any significant phase separation. This approach not only adds value to PET waste by converting it into a functional additive but also enhances the properties of polyolefins, offering a sustainable and circular solution for advanced polymer applications with controlled flow characteristics. Finally, a 3D printed product is successfully fabricated from this vitrimer using Fused Granulate Fabrication (FGF), an extrusion-based 3D printing process, which is not feasible with unmodified PCR PP due to its high MFI (melt flow index) resulting from chain-scission during processing. This study demonstrates the potential of using depolymerized polymers as dynamic crosslinkers to create high-performance, reprocessable materials, promoting both environmental and economic benefits.

Keywords: Upcycling, PCR PP, waste PET, Dynamic crosslinking, Vitrimer, 3D printing, Circular economy.

Green Synthesis, Characterization and Antimicrobial Activity of Gold Nanoparticles Using Leafless Milk Hedge Extract

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Abstract

Leafless Milk Hedge has exhibited antimicrobial potential since ancient times, traditionally used to treat various infections. The current research assesses the antibacterial capacity of gold nanoparticles (AuNPs), which were prepared using a cost effective, non-toxic in addition to environmentally sustainable green method via the use of aqueous extracts of Leafless Milk Hedge. After reducing and stabilizing, 1 mM AuNPs took on a colour change, which is in agreement with surface plasmon resonance (SPR) and spectroscopically established through the absorption peak (ranging between 520-540 nm). Additional structure determination was done by Fourier transform infrared spectroscopy (FTIR) that determined the functional groups directing reduction and stabilization of the AuNPs; X-ray diffraction (XRD) to determine a crystalline lattice and scanning electron microscope (SEM) and transmission electron Microscope (TEM) in order to establish a narrow range of particles in the nanometre range. Biosynthesized AuNPs evinced significant antimicrobial potential against a panel of Gram-positive and Gram-negative bacterial strains and fungal pathogens of choice. Evaluation of anti-microbial activity in the form of zone of inhibition assays along with a determination of minimum inhibitory concentration (MIC) revealed that the AuNPs showed an increased activity than the original plant extract and conventional antibiotics. These findings warrant a synergistic effect between bioactive phytochemicals in the plant and the AuNPs, and thus, holds potential as new antimicrobial agents. The research confirms the validity of conventional folk medicine of the plant and proves the effectiveness of nanotechnological treatment of the plant against microbial infections.

Keywords: Leafless Milk Hedge, Nanoparticles, Minimum Inhibitory Concentration, Green synthesis.

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Tribology of Additive Manufactured High Performance Polymer Composites

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Abstract

Poly(ether-ketone-ketone) (PEKK), a high performance semi-crystalline engineering polymer, based composites reinforced with short carbon fiber (SCF) have been manufactured using twin screw extruder followed by high temperature 3D printer via fused deposition modeling (FDM). The effect of 3D printing parameters such as nozzle temperature, layer thickness, and raster angle (0^o) were studied to minimize the presence of porosity in the final 3D printed parts. The tribological performance of the neat PEKK and its composites was investigated using a pin-on-disc tribometer in parallel (P) and normal (N) orientation of the SCF. It was found that fiber orientation plays a vital role in PEKK/SCF composite's wear performance. It was found that the specific wear rate of the P-oriented SCF composite was significantly lower than those of N-oriented SCF composite, compared to neat PEKK. These findings demonstrated that interior flaws could have a negative effect on wear performance, depending on fiber orientation. The findings of this work help to improve understanding of the manufacturing of neat PEKK and its composites for tribological applications via 3D printing.

Keywords: Additive manufacturing, fused deposition modeling, tribological testing, wear rate, coefficient of friction, and fiber orientation.

Upcycling acrylonitrile-butadiene-styrene into vitrimers by reactive extrusion with a commercial polyepoxide crosslinker

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Abstract

With an increase in plastic production in the previous decade, the management of plastic waste has become an increasingly important topic for researchers to deal with. Plastic recycling, although a very prominent option has its drawbacks. Mechanical recycling, a preferred method for plastic recycling has limitations of poor mechanical integrity of recycled plastic compared to virgin plastic, which limits the applications of this recycled plastic [1]. Closed-loop recycling, which refers to the use of recycled plastic for the same application as that of virgin plastic demands that the mechanical integrity of the plastic should not be compromised during recycling [2]. To achieve this, scientists have increasingly turned to dynamic covalent bonds (DCB's) as a potential solution. Incorporating DCB's into thermoplastics to convert them into vitrimers improves the mechanical integrity of the plastics and preserves them during recycling which can enable the closed-loop recycling of various commercial thermoplastics [3]. In this study, we converted acrylonitrile-butadiene-styrene (ABS) into vitrimers via reactive extrusion which is a scalable and eco-friendly method widely employed in the polymer industry. The vitrimerization was carried out by crosslinking ABS with a commercial polyepoxide resin 4,4' methylenebis-(N,N-diglycidylaniline) (TGDDM). The ABS vitrimers showed significant improvement in ultimate tensile strength (approximately 44%) and high retention of mechanical properties after three reprocessing runs. This strategy can potentially facilitate the closed-loop recycling of ABS and pave the way for a circular economy.

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Tuning of electromagnetic interference shielding properties by oxidant variation in polyaniline

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Abstract

Polyaniline is among the category of intrinsically conducting polymer known for its good conducting behavior which can be modified by varying synthesis process. The three oxidation states of polyaniline make it useful in worldwide applications of polymers such as optoelectronic devices, sensors, batteries, anticorrosion coating, and electromagnetic shielding devices. The polymers existing in emeraldine salt form can be used as electromagnetic shield because of its conductive nature. The addition of dopant makes the polymer conductive and oxidant initiates the formation of polymer. The impact of different oxidants during in-situ oxidative polymerization process has been investigated. 1M of FeCl3 and 1 M of (NH4)2S2O8 (APS) have been used as oxidizing agents. The formation of polyaniline has been confirmed using Fourier transform infrared spectroscopy. The current voltage characteristics of polyaniline concludes the conducting behavior of polymers. APS containing polymer shows good value of conductivity i.e., 0.07S/cm than FeCl3 i.e., 0.02S/cm. The electromagnetic interference study performed using vector network analyzer gives the value of shielding effectiveness in X-band frequency regime. The highest value of total shielding effectiveness (SET) is ~21dB for APS whereas FeCl3 is having ~ 15dB. The achieved value of shielding using APS as oxidant makes polyaniline more suitable to be used as microwave shield.

Keywords: Conducting Polymer, Shielding effectiveness, microwave absorbers, oxidative polymerization.

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Tailoring of PVDF based CoFe2O4 incorporated thick films for superior dielectric and magnetic performance

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Abstract

Polyvinylidene fluoride (PVDF) is a highly non-reactive and semi-crystalline thermoplastic fluoropolymer known for its excellent chemical resistance, mechanical strength, and thermal stability. PVDF is soluble in common polar solvents and can be easily processed into films via solution casting, electrospinning, or tape casting techniques. Its versatility and compatibility with various fillers make PVDF a popular matrix in the development of nanocomposites for sensors, actuators, energy storage devices, magnetoelectric and microwave components. Among various ceramic nanofillers, cobalt ferrite (CoFe2O4) is a magnetic spinel ferrite material known for its high coercivity, high saturation magnetization, chemical stability, and mechanical hardness.

Polyvinylidene fluoride-cobalt ferrite (PVDF-CoFe2O4) nanocomposite thick films are successfully fabricated using the solution casting method. The structural and morphological characteristics of the nanocomposites are systematically investigated using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and field emission scanning electron microscopy (FESEM). The influence of CoFe2O4 incorporation into the PVDF matrix is examined with particular focus on the magnetic and dielectric properties of the resulting films. Nanocomposites are synthesized with a high loading of CoFe2O4 (100 wt.%) nanoparticles, and two distinct film thicknesses, 50 µm and 150 µm, are prepared to study the effect of thickness variation. The results demonstrate that dispersion of CoFe2O4 into PVDF matrix not only enhances the magnetic properties but also plays a crucial role in improving the dielectric response of the nanocomposites due to the strong interfacial interactions. Along with it, film thickness plays a significant role in determining the functional properties of the nanocomposites.

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Green Nanocomposites for Multi-Metal Removal and Recovery

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Abstract

Heavy metal contamination is a persistent environmental challenge requiring efficient and sustainable remediation strategy, especially for ensuring food safety. In this study, initially, multiple microorganisms were screened for their biosorptive capabilities, leading to the selection of a high-performing microalgal species. The selected biosorbent was optimized for metal uptake using Response Surface Methodology, and its adsorption behaviour was modelled using kinetic and isotherm analyses along with testing performance in single and multi-metal conditions. The raw microalgal biosorbent demonstrated a high removal efficiency of up to 99.99% within 1 hour for individual metals, and over 80% efficiency in multi-metal systems. To enhance the commercial applicability and material recovery, the microalgal biosorbent was immobilized into bead form along with the incorporation of green iron nanoparticles (FeNPs). These FeNPs were synthesized via a green route using waste biomass, eliminating the need for harsh chemicals. The FeNPs were thoroughly characterized using SEM, EDX, FTIR, and XRD, confirming successful integration and functional integrity. Texture analysis revealed strong mechanical stability of beads, with confirmed magnetism for easy separation. Desorption tests confirmed effective metal recovery, indicating the potential for multiple reuse cycles without significant loss in efficiency. Therefore, the nano-composite beads demonstrated excellent reusability with minimal leaching and retained high adsorption performance across multiple cycles. Importantly, the system utilized minimal raw biosorbent and maintained eco-compatibility throughout.

Keywords: Heavy metals; Biosorbent; Optimization; Beads; Green iron nanoparticles; Re-usability; Nanocomposites.

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Development of Temperature-Responsive Biodegradable Materials for Transdermal Drug Delivery

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Abstract

This study focuses on developing biodegradable, temperature-responsive hydrogels for advanced drug and cell delivery via transdermal patches. The hydrogels will be synthesized through photopolymerization (UV-365nm for 20 minutes), utilizing hyaluronic acid methacrylate (HAMA) as the polymer and N-Vinylcaprolactam (NVC) as the temperature-responsive monomer. N,N'-Bis(acryloyl)cystamine (BAC) will serve as the cross-linker, aiming to create a HAMA-NVC hydrogel. The synthesis parameters will be systematically optimized to achieve the desired material properties. The structural characteristics of the hydrogel and its intermediates will be thoroughly investigated using UV-Vis, FT-IR, and NMR spectroscopy, alongside thermal analysis techniques (DSC, TGA). Furthermore, the in vitro swelling and degradation behavior of the hydrogels will be meticulously evaluated across varying pH and temperature conditions over several days to ascertain their water absorption capacity and biodegradability. This research seeks to advance the development of highly effective and biocompatible transdermal delivery systems.

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Phytochemical-Assisted Synthesis of Nanoparticles from Pongamia pinnata Pods and Their Role in Polymer Composites

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Abstract

The increasing demand for sustainable nanomaterials has driven the development of green synthesis methods utilizing plant-based resources for eco-friendly nanoparticle production. In this study, nanoparticles were synthesized using phytochemical-rich extracts from Pongamia pinnata pods, which served as natural reducing and stabilizing agents. The biosynthesized nanoparticles were incorporated into a polyvinyl alcohol (PVA) matrix to fabricate polymer nanocomposites with enhanced functional properties. Structural and morphological characterization of the nanoparticles and nanocomposites was performed using X-ray diffraction (XRD) and scanning electron microscopy (SEM). XRD analysis confirmed the crystalline nature of the synthesized nanoparticles, with characteristic diffraction peaks indicating successful formation and integration within the PVA matrix. SEM images revealed uniform dispersion of nanoparticles within the polymer network, suggesting strong interfacial compatibility and minimal agglomeration. The incorporation of P. pinnata-derived nanoparticles improved the homogeneity and potential reinforcing effect of the PVA films. This study highlights the dual benefits of utilizing agricultural bio-waste for green nanoparticle synthesis and enhancing polymer properties for potential applications in sustainable packaging, biomedical materials, and environmental remediation. The findings support the feasibility of using phytochemically active plant parts like Pongamia pinnata pods for the fabrication of eco-friendly, value-added polymer nanocomposites.

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Evaluating Tear Propagation in Combat Fabrics Under Impact: Practical Insights for Durable Uniform Design

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Abstract

Protective textiles used in defence applications are exposed to high risk environments during the battles where the fabric integrity is crucial for soldier's safety and operational effectiveness. Sudden tearing caused by the sharp objects or high-energy impact can lead to catastrophic garment failure. Traditional test such as such as tongue tear specimen performed in Elmendorf tear tester often evaluates the initial tear strength but do not capture the how tear initiates and propagates from slits or punctures encountered in real field conditions. This study investigates the tear propagation behaviour of ripstop woven fabric using a tensile crack test method under controlled dynamic loading in fabric impact tensile testing machine. The tensile crack test replicates real-world tearing, enabling evaluation of a fabric's ability to resist crack propagation a key indicator of durability in protective textiles. In order to identify the performance threshold and optimize material selection for different risk levels, the fabric specimens were tested under three impact loads (3 Kgf, 3.25 Kgf, and 3.5 Kgf) in both warp-wise and weft-wise orientations. Results showed that fabrics tested in the weft-wise direction demonstrated higher energy absorption and delayed tearing, while the tear propagated more easily with lower energy dissipation in the warp-wise direction.

Industrial Waste-Based Epoxy Composites: A Lightweight Microwave Absorbing Material

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Abstract

The present work demonstrates the microwave absorption properties of industrial waste reinforced epoxy composites in the X-band. The composites with 0 - 50 wt. % waste were fabricated and their thermal, electrical and microwave absorption properties were investigates. The results highlight that the density of the composites increased from 1.19 (neat epoxy) to 1.76 g/cm3 (50 wt.%). A significant improvement in dimensional stability was observed with increasing waste content. The addition of filler improved the microwave absorption properties and the best reflection loss (RL) was obtained for the composite filled with 50 % waste filler. The maximum RL (RLmax) in the X-band obtained is -37.68 dB at 8.58 GHz with effective absorption bandwidth (less than -10 dB) of 0.46 GHz. The obtained results show the practical applicability of the developed composites where lightweight, dimensionally stable and good microwave absorption is essential.

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Utilization of Corn Protein Meal for Sustainable Plant Based Protein Source

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Abstract

Corn Protein Meal (CPM), a major byproduct of the corn wet milling industry, holds considerable potential as a plant-based protein source for food and feed applications. However, its widespread use is constrained by several intrinsic limitations, including an imbalanced amino acid profile (notably deficient in lysine and tryptophan), low solubility and digestibility, and a pronounced off-odour that adversely affects palatability. This study aimed at improving the qualities of CPM. Fermentation, chemical and enzymatic method were used to enhance the nutritional and sensory attributes of CPM. Fermentation with Agaricus bisporus enhanced the crude protein content approximately about 15-20% whereas chemical and enzymatic method did not show any significant results. Based on sensory evaluation at a hedonic scale of 10 fermentation was found most effective rated 8, followed by chemical method rated 7 in eliminating the off odour and improving the sensory properties of CPM. Enzymatic treatment was found ineffective in improving the sensory properties of CPM. These findings suggests that fermentation with Agaricus bisporus is promising approach to overcome key limitations of CPM. By enhancing its functional attributes, these treatments support the valorization of CPM as a sustainable protein supplement, contributing to the development of value-added products within a circular bioeconomy framework.

Keywords: Corn Protein Meal, Fermentation, Enzyme, De-odouring, Plant protein.

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Lanthanide-mediated Synthesis of Functionalized Difluoroalkenes and Mechanistic Insights

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Abstract

The area of C-F bond activation remains very attractive for the synthetic chemists as well as pharmaceuticals because of the wide applications of fluorinated compounds in the field of agrochemicals, pharmaceuticals, polymer chemistry, and material sciences.1 Globally several research groups are actively involved in C-F activation reactions of fluorinated compounds.2 The C-F activation process is mainly studied in three types of carbon-fluorine bond viz.(i) C(SP3)-F bond activation: studied on CF3-group attached to a π–system, (ii) C(SP2)-F bond activation: studied in alkenyl fluorides and (iii) C(SP2)-F bond activation: studied in aromatic fluorides.2 Selective single C-F bond activation of polyfluorinated compounds remains a major challenge as most of the previously developed methods leads to complete defluorination.2 The present work is associated with C-F activation of C(SP3)-F bond in CF3-group attached to a π–system (diene),3 viz. CF3-dienes using lanthanides as electron donors. The reactivity of various electrophiles for the process has been studies under two different catalytic systems and the further organic transformations of the products will be discussed.

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Advancing Polyurethane Acrylate Coatings with Silane Termination: Influence on Structural and Functional Performance

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Abstract

The exceptional synergistic effects and intrinsic stability of hybrid polyurethane resins make them a preferred choice for coating applications. We synthesized a range of in-situ silane-terminated polyurethane acrylate (SPUA) resins by modifying the proportions of Vinyltrimethoxy silane (VTMS) and 2-hydroxyethyl methyl acrylate (HEMA) during solution polymerization. Subsequently, the wood and mild steel panels were coated with SPUA hydride resin and cured using UV radiation. UV-curing triggered the initiation of free-radical polymerization, evidenced by the disappearance of C=C absorption bands in FT-IR, resulting in the formation of a crosslinked network with the substrate. This resultant coating possesses transparency, a gloss value of 84-90 GU at 60°, high crosslinking (gel fraction > 97%), optimal viscosity (20-40 Pa.s), lowered glass transition temperature (71-55°C), and thermal stability (over 400°C). The hybrid coating exhibited enhanced water absorption resistance, evidenced by an increased water contact angle (75-95°C), attributed to a reduction in the surface free energy of the polar component. The strong bonding between the cross-linked silane-terminated polyurethane-acrylate network, and the substrate is the reason behind the significantly improved mechanical properties, including pencil hardness (3H–4H), impact strength (25–35 cm), flexibility (0.2–0.1), solvent rub resistance (>450) and adhesion strength on wood substrate (4.9–7 MPa). This study shows that organosilane modification of polyurethane-acrylate resin enhances coating properties, providing a viable alternative to conventional emulsion polymerization systems.

Keywords: Hybrid coatings; UV curing; Silane-terminated PU, Coating properties.

Synthesis and Evaluation of Hypoxia-targeted Metal-Organic Frameworks (MOFs) for Oral Tumour Therapy

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Abstract

Oral cancer is the sixth most common cancer worldwide, and its global incidence increased by approximately 6.44% from 2018 to 2020. Oral Squamous Cell Carcinoma (OSCC) is the most common type of oral cancer, accounting for more than 90%. Conventional therapies such as surgery, radiotherapy, and chemotherapy are limited by severe systemic toxicity, drug resistance, and the absence of tumour-specific targeting, leading to low survival rates and significant adverse effects. Metal-organic frameworks (MOFs) are a potential multifunctional nanocarrier due to their large surface area, adjustable porosity, and ability to respond to stimuli.

Our study is focused on a dual strategy, synthesis of a hypoxia-responsive MOF using Titanium, which has minimal cytotoxicity and nitroimidazole linkers that degrade selectively in a hypoxic tumour environment.MOFs were synthesised by the solvothermal process & characterised by FTIR, XRD, SEM, TGA, & BET. These frameworks showed strong crystallinity, mesoporosity (BET surface area ~104.58 m^2/g), for drug delivery. This study aims to minimise off-target effects and shows potential for site-specific oral Tumour therapy.

Keywords: Oral Tumour Therapy, Metal organic framework (MOFs), Targeted Drug Delivery.

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Design and development of ex-vivo vascular bioreactor for cardiovascular tissue engineering

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Abstract

Advances in cardiovascular tissue engineering have driven the development of ex-vivo systems to reduce animal sacrifice and reliance on in-vivo studies of medical devices by simulating physiological environments. The current work introduces a compact, automated vascular bioreactor designed for ex-vivo culture of large blood vessels under physiological conditions. The system replicates native vascular environments by generating pulsatile flow, cyclical systolic/diastolic pressure and wall shear stress using a peristaltic pump and a pressure conditioning unit controlled by electric actuators. The vessel culture chamber is housed in a Falcon tube, enabling precise control and continuous monitoring of flow, pressure, temperature, and pH. Feedback control systems maintain physiological parameters in real time, improving reproducibility. This closed-loop, user-friendly system supports advanced studies of vascular function, tissue remodeling, and cardiovascular device testing, offering a promising alternative to in-vivo experiments in real time with enhanced ethical and translational benefits.

Keywords: Bioreactor, Ex-vivo, Cardiovascular, Devices, Blood vessels, and Hemodynamics.

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Scalable Roll-to-Roll manufacturing of Proton Exchange Membrane for High-temperature Proton Exchange Membrane Fuel Cell (HT-PEM) with high Power Density

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Abstract

The global transition toward sustainable, low-carbon energy systems has intensified interest in hydrogen-based technologies due to their potential for zero-emission operation. While significant research has focused on efficient hydrogen production, the efficient conversion of hydrogen into usable energy is equally critical. In this context, high-temperature proton exchange membrane fuel cells (HT-PEMFCs) offer a direct and efficient method for chemical-to-electrical energy conversion. Ensuring both high performance and durability of these systems is essential to maximize hydrogen utilization and enable practical deployment. Fuel cell performance depends heavily on the optimization of key components: high-conductivity catalysts to accelerate electrochemical reactions, gas diffusion layers (GDLs) designed for efficient gas and water transport, and proton exchange membranes that maintain high proton conductivity at elevated temperatures. Here, we developed a scalable fabrication strategy for HT-PEMFC membrane, focusing on the roll-to-roll fabrication and in-situ acid-doping of the membranes during the fabrication process. A roll-to-roll casting process, based on scalable non-solvent induced phase separation (NIPS), enabled the production of meter-scale (length: 2 m; width: 0.3 m) free-standing membranes.

Key membrane parameters, including acid doping, thickness, and water content, were systematically optimized. The membranes, with an active area of 45 cm^2, were integrated into fuel cell assemblies and tested using commercially available catalysts. The optimized HT-PEMFCs achieved a current density of 0.45 A cm^{-2} and maintained stable performance over 100 hours. Importantly, the fuel cells demonstrated a power density values exceeding 530 mW cm^{-2} at 0.4 V, highlighting the potential of this scalable approach for efficient hydrogen utilization. This work addresses key challenges in membrane fabrication and component integration, advancing HT-PEMFC technology as a viable solution for hydrogen-powered, low-carbon energy systems.

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Direct Upcycling of Waste Polycarbonates into High-Value Polysulfones for Water Treatment Membrane Applications

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Abstract

Polycarbonates (PCs) are among the most widely used engineering polymers, with the annual global bisphenol A polycarbonate (BPA–PC) production capacity exceeding six million tons and continuing to rise steadily. However, recycling of PC remains a significant challenge. Classified under category seven ("Others") of the Resin Identification Code (RIC), polycarbonate lacks a defined recycling method, leading to its disposal through incineration or landfilling. These methods not only contribute to greenhouse gas emissions but also risk releasing bisphenol A (BPA), a potentially carcinogenic compound, into the environment, raising concerns related to food chain contamination and public health risks. Although various chemical depolymerization methods—such as alcoholysis, phenolysis, ammonolysis, and hydrogenolysis, have been developed to recover BPA monomers from polycarbonate, these processes often lead to side reactions and require an additional handling and isolation step to purify BPA for further utilization. In this study, we demonstrate a one-step chemical upcycling strategy that converts polycarbonate waste directly into polysulfone (PSU), a high-value polymer, using a single-step polycondensation reaction via mild alkaline hydrolysis. This method eliminates the need for BPA isolation, enabling direct upcycling of polycarbonate into high-value functional materials.

The purity of synthesized PSU was structurally confirmed using 1H NMR and FT-IR spectroscopy, with molecular weight distribution analyzed via gel permeation chromatography (GPC). Thermal stability and polymer purity were also assessed through TGA and DSC analyses. The upcycled PSU was subsequently utilized to fabricate ultrafiltration membranes using the scalable non-solvent induced phase separation (NIPS) method. Membrane morphology and structure were characterized using scanning electron microscopy (SEM). These membranes were evaluated for surface water treatment, and their fouling resistance was assessed. Additionally, membranes fabricated from upcycled PSU were used as support layers for polyamide thin-film composite membranes intended for reverse osmosis (RO) applications. This work presents a sustainable, scalable approach for one-step chemical upcycling of polycarbonate waste into high-performance polysulfone membranes, addressing both environmental hazards and adding functional value. The developed process offers a dual benefit: mitigating PC disposal challenges while producing membrane materials for molecular separation applications, contributing to a more circular and sustainable polymer economy.

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Large-area Freestanding Membranes for Forward Osmosis with No Internal Concentration Polarization

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Abstract

With increasing global water scarcity, developing energy-efficient desalination technologies is critical. Forward osmosis (FO), which relies on osmotic pressure gradients rather than hydraulic pressure, offers a theoretical energy advantage, requiring only 0.11 kWh m-3(at 50% water recovery) for desalination, compared to 2.7 kWh m-3for reverse osmosis (RO) under similar conditions. Yet, RO remains the industrial standard for seawater desalination. The large-scale adoption of FO is hindered primarily by two challenges: (i) internal concentration polarization (ICP), which reduces the effective osmotic driving force due to solute build-up within the membrane's porous support, and (ii) the substantial energy required for draw solution separation to recover purified water.

Fabrication of free-standing membranes is identified as a key strategy for mitigating ICP by removing the porous support layer, remains largely undeveloped at the industrial scale, which is essential for practical large-scale implementation of FO. In this work, we address this bottleneck by developing a scalable, roll-to-roll process for producing meter-scale (length: 3 m; width: 0.3 m) free-standing membranes. The measured water flux ranged from 2–7.4 L m^{-2} h^{-1} bar^{-1} for osmotic pressure differences of 24–98 bar between feed and draw sides, while reverse solute flux was 1–50 g m^{-2} h^{-1} under identical conditions. Indigenously developed roll-to-roll free-standing membranes for FO effectively overcome Reverse Solute Flux (RSF) and eliminate ICP. These membranes, fabricated using scalable Non-Solvent Induced Phase Separation (NIPS) method, offer mechanical stability and good performance, showing promise for cost-effective, large-scale water purification. Future work will focus on further optimizing these properties and exploring commercial applications in various fields.

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Development of Chitosan-azo-vanillin Schiff bases for photochromic and antimicrobial applications

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Abstract

The promise of functional biomaterials with responsive qualities in antimicrobial applications is making them more and more desirable. In this work, we used condensation reactions between chitosan and three distinct azobenzene derivatives to create photochromic chitosan-based Schiff bases. The resulting biopolymers were characterized by FT-IR spectroscopy, thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), scanning electron microscopy (SEM), and X-ray diffraction (XRD). These analyses revealed that the materials exhibited good thermal stability, an amorphous structure, and a distinctive belt-like morphology. The optical properties were investigated through UV-Vis absorption spectroscopy, which confirmed photoresponsive behavior under UV irradiation. Among the three Schiff bases, ChS-Azo-P exhibited characteristic π-π* and n-π* transitions without reversible changes, while ChS-Azo-O and ChS-Azo-S demonstrated enhanced absorbance upon irradiation—showing increases of 87% at 404 nm and 93.2% at 364 nm, respectively.

Antimicrobial efficacy was assessed against various human pathogens, including fungi (Candida albicans, C. glabrata, Cryptococcus neoformans) and bacteria (Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Acinetobacter baumannii). The materials exhibited potent antimicrobial activity, with MIC_{90} values ranging from 0.5–128 µg/mL—outperforming several standard drugs. Importantly, all Schiff bases demonstrated excellent hemocompatibility with hemolysis rates below 5%. These findings highlight the potential of chitosan-azobenzene Schiff bases as biodegradable, photoresponsive biomaterials for antimicrobial and bio-interface applications.

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Valorization of Expanded Polystyrene Waste via Sulfonation for Thermally Stable Composite Fabrication

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Abstract

Expanded polystyrene (EPS), widely used in packaging and insulation, contributes significantly to plastic waste due to its low recyclability and bulky nature. Its persistence in the environment poses a serious threat to ecosystems and waste management. In this study, EPS waste has been chemically modified through sulfonation to introduce functional groups that enhance its compatibility and reactivity, paving the way for the development of value-added material. The sulfonated polystyrene (SPS) obtained was further used as a polymer matrix to develop conductive composites by incorporating various fillers—including carbon-based and inorganic materials—at different loading percentages. The resulting composites were characterized using Fourier-transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), and AC electrical conductivity measurements. FTIR confirmed successful sulfonation and interaction between SPS and fillers. The composites exhibited improved thermal stability and enhanced AC conductivity, indicating their potential in electronic and thermal stable materials for energy storage applications. This study demonstrates a sustainable approach to convert EPS waste into functional materials, contributing toward waste valorization and circular economy.

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Alizarin-Embedded Electrospun Fibrous Films for Real-Time pH monitoring in Food Packaging

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Abstract

Food packaging is crucial as it preserves food quality and safety from production to consumption. The current demand from the consumer market led to next-generation intelligent packaging for real-time food quality monitoring.[1] The recent advance in nanotechnology, electrospinning, enables fibrous materials to encapsulate active/intelligent agents owing to their high surface area, encapsulation efficiency, and sustained release. These electrospun fibers can respond to minor changes such as temperature, pH, and gas released, thus giving a timely response upon spoilage in the food packaging systems.[2]

The current study aimed to develop biopolymer ethyl cellulose and polyethylene oxide (PEO) based fibrous films as intelligent packaging to effectively monitor food's freshness. The morphological features of fibers were analysed using FE-SEM analysis. In addition, alizarin as a pH indicator with different weight percentages (0.5,1,1.5 and 2% w/w) was incorporated into fibrous films using blend electrospinning. The effect of alizarin on the fibrous film's water absorption, stability, hydrophobicity, water vapor permeability, and mechanical and thermal properties have also been investigated. Furthermore, fibrous film color response was evaluated at different pH environments (3 to 11). The fibrous film displayed a distinct color change from yellow to violet in the selected pH range of 3−11. The color response of fibrous films was studied using ammonia solutions of varying concentrations, and the duration of color change was recorded. Therefore, the current work provides a promising sustainable strategy for preparing intelligent food packaging films to monitor food items.

Keywords: Intelligent packaging, Electrospinning, Alizarin, pH indicator.

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Enzymatic Surface Functionalization of Lignocellulosic Fibers for the Preparation of Biocomposites

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Abstract

Lignocellulosic fibers are primary raw materials in food packaging, composites, and textile industries, but usually display poor microbial and moisture resistance. Surface functionalization of lignocellulosic fibers using green methods may surpass conventional chemical processes for effective industrial applications. Therefore, efforts should be focused on the green surface functionalization of lignocellulosic fibers rather than using chemical methods. Enzymatic surface functionalization is a green approach that provides innovative solutions to enhance the performance of lignocellulosic fibers with new properties, including strength & stiffness, as well as resistance to moisture & microbial attack. Enzymatic surface functionalization of antibacterial and other natural molecules on lignocellulosic fibers is an environmentally friendly and best approach to incorporate desired functionalities for successful industrial applications. Laccase, lipases, and peroxidases are among the enzymes being investigated for functionalizing organic molecules onto lignin to enhance the properties of lignocellulosic fibers.

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Fabrication of Polymeric Thin Film-Leaflets for Transcatheter Aortic Valve

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Abstract

Aortic valve diseases, including aortic stenosis and regurgitation, affect approximately 2–4% of the elderly population and contribute to a high mortality rate—nearly 25% of untreated patients die annually. With rising life expectancy, the burden of calcific aortic valve disease is expected to increase globally, necessitating effective valve replacement strategies. Current prosthetic aortic valves—mechanical and bioprosthetic—are associated with significant limitations such as the requirement of lifelong anticoagulation or limited structural durability. To overcome these challenges, polymeric aortic valves are being investigated as a promising class of next-generation prostheses.

This study focuses on the fabrication and characterization of polymeric thin films for use as transcatheter aortic valve leaflets. Thermoplastic polyurethane (TPU) and its blends with PLA and PDMS were synthesized. These films were evaluated for mechanical properties (tensile strength, fatigue resistance), physico-chemical stability (FTIR, GC-MS), and biological performance (cytocompatibility, hemolysis, platelet adhesion, and cell proliferation). Preliminary results demonstrate excellent flexibility and favorable hemocompatibility, supporting the feasibility of polymer-based aortic valve leaflets as a viable alternative to current options.

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Synthesis and Characterization of a promising Metal free Polymer Carbon Dot for Dissolved Oxygen Sensing

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Abstract

The accurate and sensitive determination of dissolved oxygen (DO) in water is important for environmental monitoring, wastewater treatment, aquatic system monitoring, and numerous industrial processes. Different methods such as iodometric, Colorimetric, Galvanic, Polarographic, and Optical methods are used for DO sensing. Among all these methods, optical DO sensors are more attractive because they have a fast response time, do not consume oxygen, do not require flow, have less signal drift, and require less maintenance. Optical DO sensors require oxygen sensitive membranes or thin films that are made up of luminescent transition metal complexes such as ruthenium (II), iridium (III), osmium (II), and metal oxides such as tin dioxide (SnO2), titanium dioxide (TiO2), and zinc oxide (ZnO). However, these membranes or thin films are sensitive to environmental conditions, have slow response time, and are expensive to synthesize. To overcome this, a new class of photoluminescent carbon dots was introduced. They possess unique properties such as being highly fluorescent, more tuneable, less toxic, being more stable in harsh environmental conditions, metal free, and being easy to synthesize at a low cost. We synthesized polymer carbon dots (PCD) hydrothermally by condensation reaction between citric acid and ethylenediamine. we characterized its optical properties like Absorption, PL, and decay lifetime. synthesized photoluminescent carbon dots showed an absorption at 355 nm, emission at 445 nm, and decay lifetime of 18 µs showed good sensitivity to the dissolved oxygen. Polymer carbon dot is a promising material for DO sensing applications.

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Optimisation of Pt-X Hybrid Electrocatalyst for Cost-Effective Hydrogen Production in Alkaline Media

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Abstract

The world is moving towards zero carbon emissions by replacing traditional fossil fuels-based energy production with green and renewable energy alternatives. Hydrogen is an emerging and promising energy carrier and fuel of the future. It can be produced through water electrolysis integrated with renewable energy sources. Overall, the water-splitting reaction is very sluggish and needs catalysts to improve electrode kinetics. Currently, PGM's materials are widely used as a catalyst for water-splitting reactions due to their activity and long-term stability. The overall cost of this technology increases due to the expensive PGM. To make this technology cost-effective and boost overall hydrogen production, a hybrid catalyst with excellent activity and long-term stability is need of the hour. We have developed newly engineered hybrid catalyst materials from the cost-effective metal family for the HER and OER reactions. These catalysts are coated on GDLs with the help of CVD and PVD methods at different coating thicknesses. These electrodes are tested with different membranes at different operating conditions to maximize hydrogen production cost-effectively. Maximum efficient hydrogen production is observed when combining catalyst loading, membrane type, MEA thickness, temperature, electrolyte concentration, and pressure. We have used JRC standard protocols and operating conditions for optimization.

Keywords: Hybrid catalyst, CVD, PVD, Hydrogen Production, Hydrogen evaluation Optimization.

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Silver-based catalysts used in the selective catalytic reduction (SCR) of NOx with hydrogen: Water tolerance and efficient NOx conversion

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Abstract

Rapid industrialization has led to serious air pollution problems, especially from gases like SOx, NOx, hydrocarbons (HC), and carbon monoxide (CO), which are primarily produced by combustion in industries and transportation engines (such as cars, trains, and airplanes) [1]. As a result, air quality has deteriorated over time, prompting the implementation of stricter air pollution control regulations. Consequently, new technologies must be developed to reduce these pollutants and comply with regulatory limits. Numerous studies have investigated Selective Catalytic Reduction (SCR) of NOx using various reducing agents such as ammonia (NH_3), urea, hydrocarbons (HC), and hydrogen (H_2), with H_2-SCR emerging as a promising de-NOx technology. However, NH_3-SCR faces several challenges, including vanadium emissions, ammonia slip, air heater fouling, and high operating costs. Although HC-SCR has also been widely studied, the use of hydrogen for SCR (H_2-SCR) has recently gained significant attention [2]. When hydrogen is used as the reducing agent, NOx can be effectively reduced at low temperatures (T < 200 °C). Furthermore, the combustion of hydrogen in air produces only water, without any CO_2 emissions, making it an environmentally friendly option. Additional advantages of H_2-SCR include high selectivity, low-temperature operation, compatibility with a variety of catalysts, abundant hydrogen availability, reduced reliance on precious metals, and overall environmental sustainability. However, low water tolerance remains a key challenge for H_2-SCR catalysts. Platinum (Pt) and Palladium (Pd)-based catalysts are highly effective but expensive, with limited water tolerance (5–10%) and susceptibility to sulphur poisoning, which pose difficulties in the exhaust pre-treatment of hydrogen internal combustion engines [3]. In this study, we explore a novel silver-based catalyst that offers lower cost, high NOx conversion efficiency, greater water tolerance, and effective operation at low temperatures.

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Engineering Next-Generation Cellulose Acetate Electrospun Fiber Mats: A Sustainable Solution for Absorbent Cores in Female Hygiene Applications

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Abstract

The growing concern for environmental impact and women's health has driven a strong demand for bio-based alternatives to conventional petrochemical-derived absorbent core materials in feminine hygiene products. This study focuses on the sustainable development of electrospun cellulose acetate fiber mats designed for use as absorbent cores, particularly in sanitary napkins. To enhance the functional properties of the mats, aloe vera gel was incorporated into cellulose acetate in varying concentrations. To improve fiber flow, facilitate Taylor cone formation, and ensure uniform deposition during electrospinning, glycolic and ether-based compounds were introduced as processing aids while maintaining structural integrity.

The resulting fiber mats were thoroughly characterized using scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), and contact angle measurements to evaluate their morphology, chemical composition, and wettability. Absorption performance was tested using three liquid media: distilled water, 0.9 wt.% saline, and defibrinated sheep blood, along with absorbency under load in saline solution. The composite mats exhibited excellent absorption capacity, mechanical strength, and biodegradability in soil burial tests. Additionally, they showed notable antibacterial activity against Escherichia coli (E. coli) and Staphylococcus aureus (S. aureus), two common vaginal pathogens.

Overall, these aloe vera-loaded cellulose acetate fiber mats exhibit promising potential as next-generation absorbent cores, offering a sustainable and high-performing alternative to conventional petrochemical-based materials for feminine hygiene applications.

Keywords: Cellulose acetate, Aloe vera gel, Absorbent core, Electrospinning, Female hygiene applications.

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Optimisation of The Electrolyte Conductivity for Efficient Hydrogen Production in Alkaline Media.

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Abstract

After the historic Paris agreement, the world is currently going through a major energy transition to achieve the net-zero emission target. The hydrogen is emerging as a new alternative energy source. Hydrogen can be produced from water electrolysers with integrated renewable energy sources, but currently, only 4% of the world's hydrogen production comes from water electrolysers due to the high cost. A tremendous amount of research is currently going on in developing cost-effective catalysts, membranes, ionomers, etc. As the hydrogen production depends on inputting various operating conditions and choice of materials, the optimisation of the electrolyser cell for high throughput is needed at the hour to produce efficient hydrogen from water electrolysers. In the present study to optimise the effect of electrolyte conductivity on the overall water electrolysis in alkaline media, we have studied the hydrogen evolution at variable molar conductivity of potassium hydroxide (KOH) solution ranging from 0.5 M to 12 M. The electrolyser testing was carried out in 13 cm2 standard electrolyzer single cell with globally accepted benchmark catalyst Pt/C as HER and RuO2 as an OER, and Sustainion® X37-50 Grade RT membrane. The cell was operated with the JRC standard testing protocols.

Keywords: Electrolyte conductivity, Potassium Hydroxide, Electrolyzer Optimisation, Hydrogen Production.

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The Salinity effect on decay lifetime of Ru-Si complex: a prospective study for dissolved oxygen monitoring

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Abstract

Monitoring dissolved oxygen (DO) concentration is crucial in water treatment, sewage treatment, aquaculture, and biological research. Luminescent materials are widely used in monitoring DO concentration for sensing, optimization, calibration, and validation. Therefore, we aim to prepare and characterize the luminescent material having DO sensing optical properties. In this work, we synthesize the Ruthenium-Silica (Ru-Si) complex by hydrothermal reaction and their photoluminescent (PL) properties were investigated. In this work, we concentrate on the salinity effect on the decay lifetime of the complex were observed which therefore demonstrates its feasibility as an indicator complex for dissolved oxygen sensors. In our study, we synthesized the Ru-Si complex using the hydrothermal method. The optical DO sensor adopts the fluorescent quenching mechanism to detect the DO content and solve the problem, whereas traditional chemical methods are easily influenced by the environment. Consequently, the determination of oxygen concentrations is highly important in the aquaculture industry and daily life. However, monitoring the DO content with all its external influencing factors, which alters the sensors output value, such as temperature, pressure, and salinity is difficult. To obtain accurate DO content, the detection method should be implemented. This study aims to provide the salinity effect on the decay lifetime of the synthesized complex.

Keywords: Salinity effect, Decay lifetime, Optical DO sensor.

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Microcontroller Based PPG Sensor for Real-time Monitoring of Body Hemodynamic Parameters

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Abstract

Patients admitted to intensive care units (ICUs) are often critically ill, experiencing organ failure or facing a high risk of developing it. Continuous and real-time monitoring of hemodynamic parameters is essential for improving patient outcomes in terms of both mortality and morbidity. While existing optical and non-optical monitoring techniques are widely used, they are often limited in functionality typically measuring only a few parameters and can be expensive, complex, or unsuitable for continuous real-time use. In this context, photoplethysmography (PPG) offers a promising alternative due to its non-invasive, cost-effective, simple, and reliable nature. It operates using an emitter-receiver pair to detect changes in blood volume within peripheral circulation. In this study, we present the development and validation of a PPG-based sensor designed to continuously monitor multiple hemodynamic parameters in critically ill patients. The sensor enables the estimation of heart rate, oxygen saturation (SpO_2), respiration rate, blood pressure (including MAP, SBP, and DBP), perfusion index, stiffness index, and body temperature by analysing both temporal and morphological features of the PPG signal. These parameters were evaluated across different sex and age groups. The results obtained from the PPG device closely aligned with those from standard clinical instruments, with standard deviation values falling within the acceptable range defined by the Association for the Advancement of Medical Instrumentation (AAMI). Thus, this study may help in real-time monitoring of body hemodynamic parameters in critically ill patients.

Keywords: Microcontroller, Body hemodynamic parameters, PPG, real-time monitoring.

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Electrospun Core–Shell PAN/Cellulose Acetate Nanofiber Membranes as High-Performance Separators for Lithium-Ion Batteries

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Abstract

The development of next-generation lithium-ion batteries (LIBs) demands advanced separators with enhanced thermal stability, ionic conductivity, and electrolyte wettability. In this study, electrospun nanofibrous membranes based on cellulose acetate (CA) and polyacrylonitrile (PAN) were fabricated and evaluated as alternative separators to commercial Celgard. Three configurations were studied such as CA membrane, PAN membrane and core–shell structured PAN (core) / CA (shell) fibres fabricated via co-axial electrospinning. Morphological analysis revealed that the core–shell structure offered a uniform fibrous network with high porosity and interconnected pathways. Electrochemical tests demonstrated that the PAN@CA core–shell separator exhibited superior electrolyte uptake, higher ionic conductivity, and lower interfacial resistance compared to pristine CA, PAN membranes and Celgard. The PAN core provided robust mechanical integrity and dimensional stability, while the CA shell enhanced electrolyte affinity and thermal resistance. The findings suggest that the combination of renewable CA and electrochemically stable PAN in core–shell architecture can deliver a sustainable, high-performance in LIBs, which surpasses the limitations of conventional polyolefin-based materials. The detailed methodology and the outcomes will be presented at the conference.

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Evaluating the Role of Polymeric Binders in Enhancing Durability and Performance in Supercapacitor Applications

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Abstract

Polymeric binders play a crucial role in the construction of supercapacitor electrodes, contributing not only to the mechanical integrity of the electrode but also to the overall device stability, flexibility, and environmental compatibility [1]. These binders act as a glue that holds the active materials and conductive additives together while ensuring strong adhesion to the current collector. The nature and properties of the binder can significantly influence the electrochemical behavior and long-term performance of the device. In this study, we investigate and compare the performance of supercapacitor electrodes fabricated using two different binders: the widely used polyvinylidene fluoride (PVDF) [2], which requires NMP as solvent, and polytetrafluoroethylene (PTFE) emulsion, a water-based alternative known for its greener processing. The electrodes were prepared following identical protocols to isolate the effect of the binder type. A comprehensive evaluation of their physical structure, adhesion, surface morphology, and electrochemical properties was conducted. Through cyclic voltammetry (CV), galvanostatic charge–discharge (GCD), and electrochemical impedance spectroscopy (EIS), we analyze how these binders influence key performance parameters such as specific capacitance, rate capability, and resistance behavior. The comparative analysis provides valuable insights into the role of binder chemistry in optimising electrode fabrication for supercapacitors.

Keywords: PTFE, PVDF, Supercapacitor, Polymeric binder.

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Development of Mosquito-repellent cum multifunctional Polyester using Novel Colorants

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Abstract

Multifunctional textiles have been dominating the world of research and development since more than a decade. Various methods and finishing formulations have been reported to provide multi-functional properties have been already reported. However, the modern textile industry necessitates the need of sustainable approaches towards development of multifunctional textiles.

The current study reports novel disperse dyes for simultaneous dyeing and multifunctional finishing of polyester. The dye and dyed polyesters were characterized using various techniques. The functional properties were evaluated using standard methods. The dyed polyester demonstrated superior functionalities like mosquito repellency (>90%), antibacterial activity against E. coli (>90%) and S. aureus (>85%). Additionally, the dyed polyester displayed excellent wash durability and retained their functional properties without any significant deterioration. The fabrics dyed using these dyes showed overall good fastness ratings in terms of laundering, rubbing and light.

Eco- Engineered Zeolite Composites infused with Carotenoids Extracts for Water purification

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Abstract

This study presents the synthesis and application of an eco-engineered zeolite composite infused with carotenoid-based for efficient water purification. Zeolites, known for their high surface area, ion exchange capacity, and stability, were modified with naturally derived carotenoids to enhance adsorption properties and introduce antioxidant functionality. The carotenoids, sourced from agricultural waste such as carrot wastes, were integrated into the zeolite matrix using a green synthesis route, ensuring environmental sustainability and cost-effectiveness. Comprehensive characterization using XRD, and SEM surface analysis confirmed the structural integrity and functionalization of the composite. Adsorption studies demonstrated significant improvement in the removal of heavy metals (Pb^{2+}, Cd^{2+}) and organic contaminants (dyes and phenolic compounds), attributed to synergistic effects between the zeolite's porous structure and carotenoid active sites. Additionally, the composite exhibited antimicrobial activity, further contributing to water safety. These findings highlight the potential of carotenoid-influenced zeolite composites as a multifunctional, sustainable solution for water treatment in both urban and rural settings.

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Enhanced Toughness of PLA-Based Biodegradable Films for Sustainable Food Packaging Applications

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Abstract

The escalating environmental concerns stemming from conventional plastic waste have intensified the pursuit of biodegradable materials, especially for use in food packaging. Polylactic acid (PLA), a biopolymer derived from renewable resources, has gained considerable attention due to its biodegradability and high transparency. Despite these advantages, PLA's application in flexible packaging is limited by its intrinsic brittleness, low impact resistance, and restricted elongation at break. To broaden its practical utility, PLA must undergo modification to enhance its mechanical performance while preserving its environmental benefits.

A widely adopted strategy to address this limitation involves blending PLA with other biodegradable polymers like polybutylene succinate (PBS), which can significantly improve its toughness and flexibility. In the present study, a highly toughened biodegradable film was fabricated by incorporating PBS and suitable additives into PLA through melt extrusion followed by film casting. The optimized PLA/PBS blend demonstrated notable improvements in mechanical properties, including tensile strength, elongation at break, and impact resistance, effectively mitigating the brittleness of PLA.

Surface morphology analyses using SEM and AFM revealed a well-dispersed PBS phase within the PLA matrix, which played a crucial role in enhancing mechanical performance. These advancements position the developed PLA/PBS films as a sustainable and efficient option for flexible food packaging, offering a viable solution to plastic pollution while ensuring necessary mechanical integrity.

Keywords: PLA, PBS, biodegradable film, toughening, sustainable food packaging.

Development of Contact-Drawn Xanthan Gum/Polyethylene Oxide microfibers: preparation and characterization for Potential Biomedical Applications

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Abstract

Xanthan gum (XG), a naturally derived polysaccharide, offers excellent biocompatibility, hydrophilicity, and film-forming properties, making it attractive for biomedical applications. Polyethylene oxide (PEO), a synthetic, biocompatible polymer, can enhance processability and mechanical stability when blended with XG. Microfiber-based biomaterials fabricated from such blends can be tailored for wound dressings, tissue engineering scaffolds, drug delivery systems, and hemostatic materials. This study aims to develop stable XG/PEO nanofibers using a simple, solvent-free contact-drying method, followed by crosslinking to enhance aqueous stability, and to assess their potential as multifunctional biomedical platforms.

XG/PEO nanofiber mats were fabricated via contact-drawing and subsequently crosslinked. Stability was evaluated in water and phosphate-buffered saline (PBS, pH 7.4) at room temperature and 37 °C. Morphological characterization will be carried out using scanning electron microscopy (SEM) and transmission electron microscopy (TEM), while Fourier-transform infrared spectroscopy (FTIR) will assess chemical interactions. Additional analyses, including mechanical testing, thermal behavior (DSC/TGA), and swelling/porosity measurements, are planned to determine suitability for biomedical use. Data collection is in progress. Preliminary observations indicate the successful formation of uniform XG/PEO nanofibers with retained morphology after crosslinking. Full structural, physicochemical, and stability data will be presented. The contact-drawn XG/PEO nanofibers under development are anticipated to exhibit tunable stability, mechanical strength, and biocompatibility, enabling their application in diverse biomedical areas such as wound care, tissue scaffolding, and controlled therapeutic delivery. This work highlights a facile approach for fabricating polysaccharide-based nanofibers with translational potential.

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Bioactive Compound-Assisted Green Synthesis of Copper Nanoparticles from Copper Dust for Enhanced Antimicrobial and Drug Delivery Systems

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Abstract

This study explores the green synthesis of Copper Nanoparticles (CuNPs) from copper dust, utilizing plant extract rich in bioactive compounds as natural reducing and capping agents. This eco-friendly approach overcomes limitations of conventional synthesis methods, offering cost-effective and sustainable production. The synthesized CuNPs, characterized using techniques like UV-Vis, FTIR, XRD, SEM, TEM and DLS display enhanced functionality due to the attached bioactive molecules.

These biogenic CuNPs show promising applications in biomedicine and environmental remediation. They exhibit potent antimicrobial activity against various pathogens, including antibiotic-resistant strains, and possess antioxidant potential for mitigating oxidative stress.

Furthermore, they are investigated for targeted drug delivery and environmental pollutant degradation. While promising, challenges such as cytotoxicity and large – scale synthesis need to be addressing. Further research should focus on optimizing synthesis, exploring novel bioactive agents, and evaluating safety and efficacy for practical applications.

Keywords:
Green Synthesis, Copper Nanoparticles (CuNPs), Bioactive Compounds, Plant Extract, Antimicrobial Activity, Antioxidant Potential, Drug Delivery, Characterization, Cytotoxicity, Environmental Remediation.

Energy harvesting by self-powered Pulse sensor based on triboelectric nanogenerator

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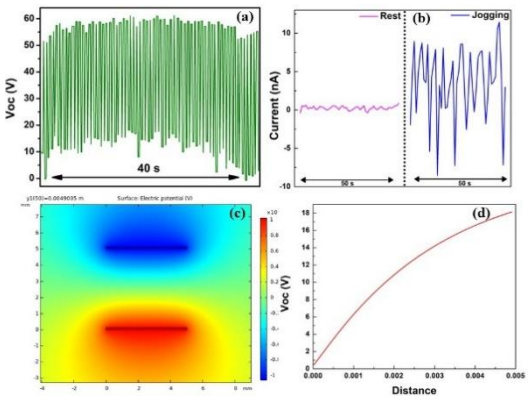
Abstract

With rapid increase in wearable devices and the increasing demand of continuous health monitoring, there has been a requirement of continuous power supply. Triboelectric Nanogenerators(TENG) has been a solution to this problem as they can convert very low frequency biomechanical motion into electric signal; thus can be self-powered. It converts mechanical energy into electrical energy using the combined effect of contact electrification and electrical induction. When two triboelectric materials with different electron affinity comes in contact, one material looses electron while the other gains it and this process creates a potential difference between them, this results in flow of electron between the electrodes; thus an alternating current output gets generated. With each contact-separation cycle this process gets repeated by providing a continuous current.

Based on triboelectric nanogenerator (TENG) concept, we have developed a pulse sensor for cardiovascular energy harvesting. First, the TENG design is simulated using COMSOL Multiphysics. Cellulose-PEDOT: PSS-based aerogel composite and PDMS sheets were considered for the tribopositive and tribonegative layers of the TENG device respectively. The fabricated device has provided optimal output performance, with an open circuit voltage (Voc) of 50 V, a short circuit current (Isc) of 200 nA, and a short circuit transferred charge (Qsc) of 50 nC. Based on a similar concept and materials, a wearable pulse sensor is fabricated and provides significant output for cardiovascular signal monitoring during the rest and physical activity phase. Upto 3 V (Voc), 10 nA (Isc), and 2 nC (Qsc) were recorded in pulse sensor during physical activity phase. This technology would revolutionize the health monitoring device sector and other cutting-edge applications based on energy harvesting from regular physiological activity.



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Synthesis and Study of Conjugated Polymers via Metal Free Aldol Condensation Polymerization Strategy

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Abstract

The development of donor-acceptor conjugated polymers is a challenge due to the involvement of costly transition-metal catalysts and hazardous reagents during the synthesis of such materials, which may potentially cause serious environmental problems. Aldol polycondensation is a promising, metal-free polymerization method to synthesize such donor-acceptor conjugated polymers. Herein, we report the synthesis of three new symmetrical diformyl functionalized thiophene-capped carbazole, fluorene and indolocarbazole moieties. The polymers, were synthesized by Aldol condensation reaction between the diformyl compounds and bis(indolinone). Photophysical, electrochemical, thermogravimetric analysis, gel permeation chromatography, DFT calculations and SCLC hole mobility measurements were performed for these polymers. The photophysical and electrochemical studies of these polymers revealed high visible light absorptivity with a HOMO energy level close to -5.5 eV and a low-lying LUMO energy level close to -3.35 eV. The SCLC hole mobilities of polymers were determined to be in the range of 1.7 – 6.7 □ 10-3 cm2V-1 S-1.

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Electrospun nanofiber derived from X-ray film functionalized with ZnO nanoparticle and crystalline nano cellulose: converting biomedical waste into high performance antibacterial membrane

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Abstract

The current study explores the process of value addition of discarded X-ray film-derived polyethylene terephthalate (PET) into electrospun nanofiber membranes functionalized with zinc oxide nanoparticles and crystalline nano cellulose to produce high-performance antibacterial membrane. PET recovered from x-ray film waste through a thermo-solvolysis method was electro spun into nanofibrous membranes reinforced with ZnO nanoparticle and crystalline nano cellulose. Physicochemical characterizations including Fourier transform infrared spectroscopy, Xray diffraction, filed emission scanning electron micrscopy, and Energy dispersive xray confirmed the successful incorporation of ZnO nanoparticle and crystalline nano cellulose without disrupting PET's molecular or crystalline structure. Mechanical testing revealed that hybrid membrane combining both 1 wt% ZnO nanoparticle and 1 wt% of CNC yielded optimal performance with enhanced tensile strength (2.63 MPa) and elongation (80%). Antibacterial activity evaluated against E. coli and S. aureus revealed a strong ZnO nanoparticle concentration dependent response, with the combining effect 1wt% ZnO and 1 wt% crystalline nano cellulose embedded membrane achieving overal 92% reduction in bacterial viability for both strains. These multifunctional hybrid membranes demonstrate promising potential for sustainable applications in biomedical filtration and infection control.

Green Development of PLA-Based Composite Films with Natural Fillers for Agricultural Sustainability

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Abstract

The excessive use of petroleum-based plastics in agriculture has raised severe environmental concerns due to their persistence in soil and ecosystems. Biodegradable polymers such as polylactic acid (PLA) have emerged as promising alternatives; however, their inherent brittleness, low thermal stability, and limited moisture regulation hinder large-scale adoption. In this study, PLA-based films were developed by incorporating natural fillers as eco-friendly reinforcements to tailor their functionality for agricultural applications. The addition of fillers not only improved the water vapor transmission rate (WVTR) and moisture retention but also enhanced the biodegradation rate and nutrient release, which are highly beneficial for soil–plant interactions. Structural (FTIR), thermal (DSC), and mechanical characterizations confirmed strong interfacial interactions between PLA and the natural fillers, leading to modified crystallinity, improved flexibility, and controlled hydrophilicity. Soil burial tests further demonstrated that the films degraded at an accelerated rate compared to neat PLA, validating their environmental compatibility. These findings highlight the potential of PLA-natural filler composites as sustainable candidates for seedling bags, mulching films, and related agricultural applications, offering a green solution that combines performance, biodegradability, and resource efficiency.

Smartly passivated Nanocarbon-Enforced Poly(N-isopropylacrylamide) Hydrogel for Effective Healing of Damaged Skeletal Muscle

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Abstract

Injuries to the skeletal muscle during trauma-inducing events and pathophysiological conditions significantly affect the voluntary physical activities of the patients. Therefore, to effectively treat such injuries, several treatment strategies have been reported. Examples of such strategies include the application of drug molecules like nonsteroidal anti-inflammatory drugs (NSAIDs), surgical implantation of tissue engineering scaffolds, etc., in the case of trauma-inducing mechanical damage. Alternatively, nutritional support, protein supplementation, etc., are provided to prevent the loss of muscle mass during pathophysiological conditions like cancer. However, these treatment procedures are limited owing to incomplete functional recovery of the damaged myofibers, the chances of developing drug-associated side effects, and tissue fibrosis. Therefore, to circumvent the limitations of the conventional treatment approaches, a musculoresponsive polymer−carbon composite for assisting myotubular regeneration (MusCAMLR) has been developed using a unique combination of smartly passivated nanosized carbon particles (smapCNP) and poly(N-isopropylacrylamide) (PNIPAM). It has been experimentally demonstrated that MusCAMLR could promote the differentiation of myoblasts to form multinucleated myotubes via mechanically compatible interaction in vitro. Thereafter, its application through intramuscular injection in an in vivo mechanically damaged skeletal muscle animal model could repair the damaged muscle microstructure within 72 hours. Further investigations into MusCAMLR have revealed that the incorporated smapCNPs could increase the interaction between polymer chains, which resulted in the formation of anisotropic phase-separated meshwork (PhasedMesh). Intriguingly, this smapCNP-induced PhasedMesh of PNIPAM was morphologically alternative to the meshwork induced by extracellularly relevant salts like NaCl and KCl. Further exploration of the PhasedMesh of MusCAMLR has established its myo-regenerative ability by facilitating recruitment, attachment, and promoting the proliferation of muscle cells. Furthermore, taking advantage of the PhasedMesh formation and muscle regenerating ability, MusCAMLR has been used for the treatment of cancer cachexia, which is a severe muscle-wasting condition that develops as a co-morbid condition during cancer and exposure to chemotherapeutic drugs. It has been experimentally demonstrated that interfering with the phospho-STAT3 (pSTAT3) signaling via engineered therapeutic delivery through MusCAMLR could enhance the proliferation and differentiation of myoblasts in an experimental animal model of cancer cachexia. Thus, the versatile myo-regenerative potential of MusCAMLR has been established for effective repair of skeletal muscle damage.

References:

1 *Chatterjee, N., & Misra, S. K., ACS Applied Materials & Interfaces, 2023, 15(23), 27533-27547.*
2 *Granted Indian Patent No. 533077,15/04/2024; Santosh Kumar Misra, Niranjan Chatterjee,*
3 *Title: A MUSCULO-RESPONSIVE POLYMER CARBON COMPOSITE FOR ASSISTING MYOTUBULAR*
4 *REGENERATION (MusCAMLR) AND PROCESS FOR PREPARING THEREOF.*
5 *Indian Patent Application No. 202511059823, Santosh Kumar Misra, Niranjan Chatterjee, Adheeti Agarwal,*
6 *Title: A VEHICULAR COMPOSITION FOR THE NANO-DELIVERY OF NICLOSAMIDE WITH ANTI-CANCER DRUG, AND*
7 *ITS METHOD OF PREPARATION*

Publication in Special Issue

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P137	412	Large-area Freestanding Membranes for Forward Osmosis with No Internal Concentration Polarization	Vinay Kumar Jaiprakash Barai	CSIR-NCL	Pune
P138	417	Development of Chitosan-azo-vanillin Schiff bases for photochromic and antimicrobial applications	Akash Siotey	NSUT New Delhi	New Delhi
P139	418	Valorization of Expanded Polystyrene Waste via Sulfonation for Thermally Stable Composite Fabrication	Diwakar Chauhan	NSUT New Delhi	New Delhi
P140	419	pH-Sensitive Electrospun Fibrous Films for Food Spoilage Monitoring	Km Mansi Aditya	IIT Jammu	Jammu
P141	420	Enzymatic surface functionalization of lignocellulosic fibers for the preparation of biocomposites	Susheel Kalia	IMA Dehradun	Dehradun

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P142	421	Fabrication of Polymeric Thin Film-Leaflets for Transcatheter Aortic Valve	Garima Gulati	CBME, IIT Delhi	New Delhi
P143	423	Synthesis and Characterization of a promising Metal free Polymer Carbon Dot for Dissolved Oxygen Sensing	Rutuja Kundalik Kadam	CSIR-NCL	Pune
P144	424	Optimisation of Pt-X Hybrid Electrocatalyst for CostEffective Hydrogen Production in Alkaline Media	Revati Avinash Dokhe	CSIR-NCL	Pune
P145	425	Silver-based catalysts used in the selective catalytic reduction (SCR) of NOx with hydrogen: Water tolerance and efficient NOx conversion	Vinod Akaram Lohar	CSIR-NCL	Pune
P146	426	Engineering Next-Generation Cellulose Acetate Electrospun Fiber Mats: A Sustainable Solution for Absorbent Cores in Female Hygiene Applications	Roshni Pattanayak	CIPET:SA RP-LARPM	Bhubaneswar
P147	427	Optimisation of The Electrolyte Conductivity for Efficient Hydrogen Production in Alkaline Media	Atul Ugale	CSIR-NCL	Wakad
P148	428	The Salinity effect on decay lifetime of Ru-Si complex: a prospective study for dissolved oxygen monitoring	Gangadhar Mallikarjun Hattale	Fergusson College	Pune
P149	429	Microcontroller Based PPG Sensor for Real-time Monitoring of Body Hemodynamic Parameters	Vaibhav Varpe	CSIR-NCL	Pune
P150	430	Electrospun Coreâ€“Shell PAN/Cellulose Acetate Nanofiber Membranes as High-Performance Separators for Lithium-Ion Batteries	Arya Chandran	CIPET:SA RP-LARPM	Bhubaneswar
P151	431	Evaluating the role of polymeric binders in enhancing durability and performance in supercapacitor applications	Dibyasha Panda	CIPET:SA RP-LARPM	Bhubaneswar
P152	436	Eco- Engineered Zeolite Composites infused with Carotenoids Extracts for Water purification	Smruti Rathwa	ITMVU, Waghodia	Vadodara
P153	438	Enhanced Toughness of PLA-Based Biodegradable Films for Sustainable Food Packaging Applications	Chinmaya Acharya	CIPET:SA RP-LARPM	Bhubaneswar
P154	447	Development of Contact-Drawn Xanthan Gum/Polyethylene Oxide microfibers: preparation and characterization for Potential Biomedical Applications	Vikas Shukla	AIIMS, New Delhi	New Delhi
P155	448	Bioactive Compound-Assisted Green Synthesis of Copper Nanoparticles from Copper dust for Enhanced Antimicrobial and Drug Delivery Systems	Avinash Kumar Pathak	MU Aligarh	Aligarh
P156	452	Energy harvesting by self-powered Pulse sensor based on triboelectric nanogenerator	Sashwata Sahoo	CIPET SARP LARPM	Bhubaneswar

S. No.	ABS No.	Title	Presenting Author	Institution	City
P157	435	Development of Mosquito-repellent cum multifunctional Polyester using Novel Colorants	Nikhil Shaiwale	IIT Delhi	New Delhi
P158	454	Synthesis and Study of Conjugated Polymers via Metal Free Aldol Condensation Polymerization Strategy	Sneh Kamleshbhai Patel	MS University	Vadodara
P159	460	Electrospun nanofiber derived from X-ray film functionalized with ZnO nanoparticle and crystalline nano cellulose: converting biomedical waste into high performance antibacterial membrane	Satyabrata Sahoo	Ravenshaw University	Odisha
P160	463	Green Development of PLA-Based Composite Films with Natural Fillers for Agricultural Sustainability	Anupam Kumar Gupta	Ravenshaw University	Odisha
P161	465	Smartly passivated Nanocarbon-Enforced Poly(Nisopropylacrylamide) Hydrogel for Effective Healing of Damaged Skeletal Muscle	Niranjan Chatterjee	IIT Kanpur	Kanpur
P162	472	Waste-Derived Carbon Materials for High-Performance Supercapacitor Electrodes	Shama Parveen	IIT Delhi	New Delhi

List of Delegates

S. No.	Name	Institution	City	Country
1	Akanksha Gupta	Dwarka, New Delhi	New Delhi	India
2	Anup Ghosh	IIP, Delhi	New Delhi	India
3	Anupam Gupta	Smartbio Innovations	New Delhi	India
4	Anurag Kulshreshtha	Indian Institute of Technology	Roorkee	India
5	Arun Torris	CSIR-National Chemical Laboratory	Pune	India
6	Ashwini K. Nangia	UPES	Dehradun	India
7	Ayushi Taver	Mohanlal Sukhadia University	Udaipur	India
8	Bhuvanesh Gupta	UPES	Dehradun	India
9	Deepak Sharma	Gujarat Fluorochemicals Limited	Noida	India
10	Devesh Avasthi	UPES	Dehradun	India
11	Durgesh Verma	Gujarat Fluorochemicals Limited	Noida	India
12	Guenther G. Scherer	PSI	Switzerland	Switzerland
13	Hemlata Bagla	HSNC University	Mumbai	India
14	Jolly Nangia	UPES	Dehradun	India
15	Jyoti Chaudhary	Mohanlal Sukhadia University	Udaipur	India
16	Jyoti Kiraula	CSIR-National Chemical Laboratory	Pune	India
17	Manohar V Badiger	CSIR-National Chemical Laboratory	Pune	India
18	Mitul Nai	Mohanlal Sukhadia University	Udaipur	India
19	Munish Jagadish Hinduja	Gokaldas Images Pvt Ltd	Bangalore	India
20	Neha Sharma	Nature Safety Solutions Pvt. Ltd.		India
21	Nilakshi Sadavarte	CSIR-National Chemical Laboratory	Pune	India
22	Nirmala Verma	Nature Safety Solutions Pvt. Ltd.		
23	Onkar Dube	CSIR-National Chemical Laboratory	Pune	India
24	Padma Venkat	UPES	Dehradun	India
25	Pankaj Kumar	UPES	Dehradun	India
26	Prabhat Kumar Baroliya	Mohanlal Sukhadia University	Udaipur	India
27	Prasad Madamana	ADEKA India Pvt Ltd	Mumbai	India
28	Prem Sukh Verma		Mandi, HP	India
29	Priyanka Singh	Mohanlal Sukhadia University	Udaipur	India
29	Rahul Sherkhane	BHU	Varanasi	India
31	Rahul Shevate	CSIR-National Chemical Laboratory	Pune	India
32	Rajesh Kanawade	CSIR-National Chemical Laboratory	Pune	India
33	Ram Sharma	UPES	Dehradun	India
34	Ravi Kant Pathak		Sweden	
35	Rituparna Duarah	CSIR Northeast Institute of Science and Technology	Jorhat	India
36	Robin Kumar Patel	CSIR-National Chemical Laboratory	Pune	India
37	Rohan More	Adeka India Pvt Ltd.	Mumbai	India
38	Sangeeta Badiger		Pune	India

S. No.	Name	Institution	City	Country
39	Sanjay Nayak	Ravenshaw University	Cuttack	India
40	Satyajit Karandikar	Karandikars Orgochem Private Limited	Navi Mumbai	India
41	Shahab Ali Asghar	Aligarh Muslim University	Aligarh	India
42	Shiv Upadhyay	Indian Institute of Technology Delhi	New Delhi	India
43	Srikanth Billa	ACG Capsules	Mumbai	India
44	Sudip Kumar Maji	GIRDA	Vadodara	India
45	Suresh Bhat	CSIR-National Chemical Laboratory	Pune	India
46	Suresha P. R.	CSIR-National Chemical Laboratory	Pune	India
47	Syed Mohammad Tauseef	UPES	Dehradun	India
48	Tanmoy Ghosh	MSRUAS	Bengaluru	India
49	Tatsuhito Nakamura	Adeka India Pvt Ltd.	Mumbai	India
50	Virendra Gupta	RIL	Mumbai	India
51	Vishal Malhotra	Presto, Fbd		India
52	VK Soni	Gujarat Fluorochemicals Limited	Noida	India
53	Yash Paul	Nature Safety Solutions Pvt. Ltd.		India
54	Yash Gupta	Gujarat Fluorochemicals Limited	Noida	India
55	Priyanka Singh	HMEL	Noida	India
56	Tamalika Das	HMEL	Noida	India
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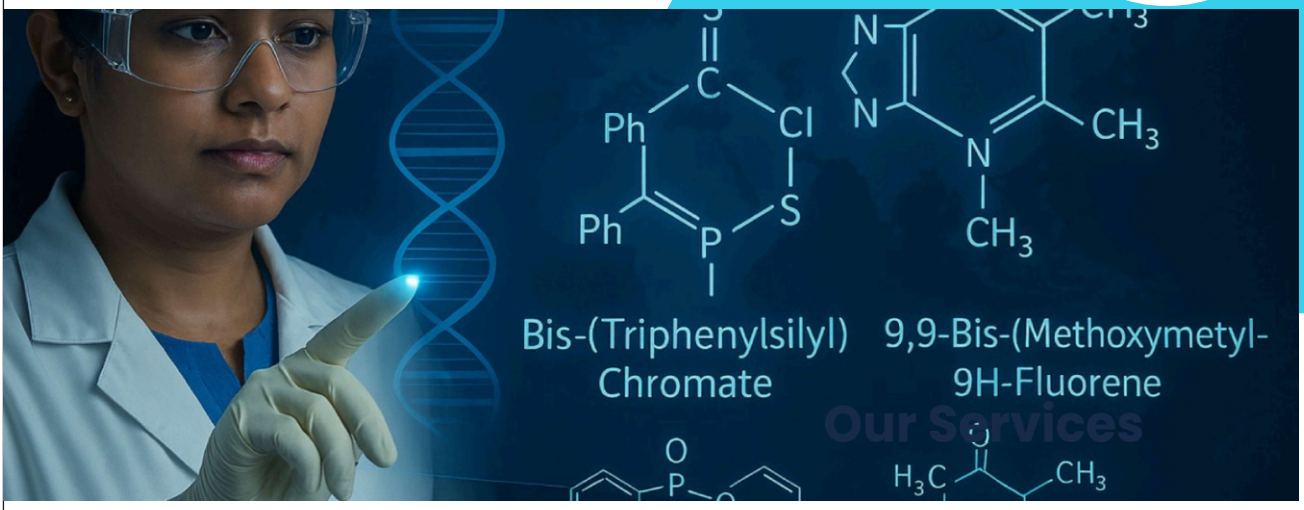

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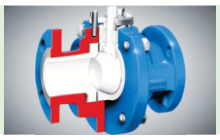

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