AISHIK CHAKRABORTY

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Keywords: 3D bioprinting, *In situ* gelation, Biomaterials, Nanotechnology, Cell-derived therapeutics, Stem cell therapy, Stem cell freezing, Controlled drug delivery, Regenerative medicine, Microfluidics

RESEARCH SUMMARY

I am a chemical engineer with a post-Ph.D. experience in developing polymeric hydrogel-based healthcare solutions for tissue engineering and drug delivery. My work focuses on bone and cartilage regeneration, diabetic wound healing, blood coagulation, and cancer therapy. Operating at the intersection of chemical engineering, biomanufacturing, materials science, nanotechnology, and pharmaceutical science, my work is highly interdisciplinary.

My expertise encompasses advanced hydrogel scaffold manufacturing strategies, including 3D bioprinting, *in situ* gelation, and cryogelation, using bio-derived and synthetic polymers. The fabrication and characterization of these scaffolds rely heavily on chemical engineering principles. For example, this knowledge is essential in modulating material and printing properties to produce optimal scaffolds.

The application of these scaffolds, on the other hand, relies heavily on my knowledge of bioengineering. One of my latest studies (*Advanced Healthcare Materials*, 2025) has demonstrated the feasibility of *in vitro* mammalian cell culture-extracted extracellular matrix as a potent therapeutic agent. Another recent work (*Advanced Healthcare Materials*, 2024) established the potential of engineered microfluidic chips in freezing stem cells for long-term storage.

I have also developed several multifunctional nanomaterials that exhibit unique material properties, including antimicrobial activity and responsiveness to light. Antimicrobial behavior is extremely important, especially because of the rise of drug-resistant “superbugs”. Light-responsiveness, on the other hand, can be useful for treating cancer, where light-to-heat conversion can reduce tumor volume. Lastly, I have also controlled the release of pharmaceutical small molecules using nanoparticles (*ACS Molecular Pharmaceutics*, 2022), which can be effective in treating diabetic wounds. Overall, these nanomaterials can be used to enhance the properties of hydrogels, and the resulting nanoparticle-integrated hydrogels can be used in various biomedical applications.

CORE COMPETENCIES

Biomaterials Research and Development || Critical Scientific Thinking || Junior Researcher Training and Mentorship || Science Communication || Scholarly Work and Grant Writing || Instrument Procurement, Set-up, and Maintenance || Biomedical Facility Management || Project Management || Interdisciplinary Collaboration || Leadership || Teamwork || Adaptability || Time Management and Organization || Interpersonal Skills

TECHNICAL EXPERTISE

Biofabrication: 3D Bioprinting, *in situ* gelation, cryogelation, spray gelation

Mechanical Assays: Rheological testing, mechanical testing

Analytical Techniques: FTIR, UV/Vis spectroscopy, Raman spectroscopy, XRD, EDX, NMR

Cell Culture Proficiency: Stem cells, endothelial cells, osteoblast cells, chondrocyte cells, liver cancer cells, breast cancer cells

Bioassays: H&E staining, Masson’s trichrome staining, Immunohistochemistry, ELISA, qPCR, scratch assay, MTS assay, calcein staining, Flow Cytometry

Imaging Technologies: Optical microscopy (fluorescence, brightfield, phase contrast), SEM, TEM, AFM

Miscellaneous: Langmuir-Blodgett technology, Liquid Phase exfoliation, Quartz crystal microbalance with dissipation

SOFTWARE SKILLS

MATLAB, COMSOL, ImageJ, OriginLab, GraphPad, Adobe Illustrator, ImageJ, Microsoft Office Suit

RESEARCH EXPERIENCE

Postdoctoral Associate 2019-present
Department of Chemical and Biochemical Engineering
The University of Western Ontario, Canada

- Conduct biomaterials research
- Publish high-impact scientific articles
- Present scholarly work at international conferences
- Assist in writing grants (e.g., CFI, RTI, H&S Foundation, NFRF)
- Procure lab equipment (e.g., Inverted fluorescence microscope, Ultracentrifuge, Flow Cytometer, Multimode microplate reader, 3D bioprinter, lyophilizer, etc.)
- Mentored and trained 25 graduate, undergraduate, and high school students
- Manage and maintain a biomedical facility
- Assist in peer-reviewing high-impact scientific journal articles
- Served as a reviewer for the Catalyst Grant ($130,000 CAD) at the University of Western Ontario

Graduate Student 2013-2019
Department of Chemical & Petroleum Engineering
The University of Kansas, USA

- Investigate interactions between self-assembling biological molecules and nanoparticles at interfaces
- Examined the role of peptides and sterols in modulating the behavior of lipids at interfaces
- Evaluated the *in vitro* toxicity of nanoparticles
- Assessed the role of surface tension in aggregation of monoclonal antibodies
- Taught and trained 4 undergraduate students to conduct research related to final year thesis
- Taught core chemical engineering courses as a Graduate Teaching Assistant for 8 semesters

SELECTED PUBLICATIONS

1. Developing Bioactive Hydrogels Containing Cell-derived Extracellular Matrix: Implications in Drug and Cell-free Bone and Cartilage Repair. *Advanced Healthcare Materials.* 2025 https://doi.org/10.1002/adhm.202402701

2. Nanoparticle-reinforced Tough Hydrogel as a Versatile Platform for Pharmaceutical Drug Delivery: Preparation and *In Vitro* characterization. *ACS Molecular Pharmaceutics.* 2022 https://doi.org/10.1021/acs.molpharmaceut.2c00564

SELECTED AWARDS & HONORS

1. Transdisciplinary Award ($15,000 CAD), Bone and Joint Institute at the University of Western Ontario 2023
2. **Carlin Graduate Teaching Assistant Award** in recognition of exceptional teaching by graduate students **across all faculties**, The University of Kansas 2018
3. Outstanding Master of Science Research Award from the Department of Chemical & Petroleum Engineering, The University of Kansas 2015-2016
4. Accepted into the Ph.D. program in the Department of Energy, Environmental, and Chemical Engineering at **Washington University in St. Louis (USA)** with a **full research assistantship** 2013
5. Accepted into the M.S., Ph.D. program in the Department of Chemical & Petroleum Engineering at the **University of Kansas (USA)** with **full scholarship** 2013

ACADEMIC CREDENTIALS

Ph.D., Chemical Engineering, The University of Kansas, KS, USA**,** GPA: 4.0 2015-2019
M.S., Chemical Engineering, The University of Kansas, KS, USA, GPA: 4.0 2013-2015
M. Tech., First-year in Chemical Engineering, Jadavpur University, India, GPA: 8.28 2012-2013
B. Tech., Chemical Engineering, West Bengal University of Technology, India, GPA: 8.84 2008-2012