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Festschrift issue of *Nanoscale* in honour of Santanu Bhattacharya

Asish Pal,*[a] Praveen Kumar Vemula[b] and Shyni Varghese[c]

This themed collection of *Nanoscale* honors the incomparable contributions of Professor Santanu Bhattacharya to the scientific community. As an acclaimed scientist, Professor Bhattacharya has played a crucial role in enhancing the research culture at the interface of chemistry, biology, and materials science in India and has been instrumental in promoting research at the cross sections of these fields. Professor Bhattacharya's research group has achieved considerable advancements across several key areas, discovering new phenomena, *e.g.*, phase-selective gelation,[1] surfactants with multiple headgroups,[2] nanomaterials for the modulation of the rheology of physical gels,[3] delineation of the role of DNA topology in lipofection,[4] control of fruit pests by nano-gel-mediated sustained release of pheromones to plants,[5] small-peptide-mediated vesicle formation and drug delivery,[6] and charge-transfer-induced heat-set hydrogels,[7] and also contributed to important and comprehensive reviews in interfacial fields.[8–10] His exceptional contributions have greatly enriched our understanding of these diversified domains and have facilitated the exploration of significant biomedical applications.

[a]*Chemical Biology Unit, Institute of Nano Science and Technology (INST), Knowledge City, Sector 81, Mohali, Punjab 140306, India. E-mail: apal@inst.ac.in*
[b]*Institute for Stem Cell Science and Regenerative Medicine (InStem), UAS-GKVK Post, Bellary Road, Bangalore, Karnataka 560065, India*
[c]*Department of Biomedical Engineering, Duke University, 203 Research Drive, MSRB1 Room No. 381, Durham, NC, 27710, USA*

Professor Bhattacharya is a distinguished leader in Chemistry with a remarkable career spanning over three and a half decades. He served as a prominent faculty member at the Indian Institute of Science (IISc) in Bangalore from 1991 to 2023, where he contributed greatly to countless students and researchers. As the Director of the Indian Association for the Cultivation of Science (IACS) in Kolkata from 2015 to 2021 and the founding Vice Chancellor of the IACS-deemed-to-be university, he demonstrated exceptional leadership, driving the advancement of science education in India. Currently, he leads as the Director of the Indian Institute of Science Education and Research (IISER) in Tirupati, where he continues to kindle innovation and excellence in scientific research and teaching. His extensive experience in scientific research across prestigious institutions in India and internationally has solidified his reputation in the global academic community. His roles as an honorary professor of Chemical Biology at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) in Bangalore, a JSPS invited professor at RIKEN, Japan, and visiting professor at IITs in India, and in renowned universities in France and the United States, reflect his influential global presence and collaborative approach. Professor Bhattacharya's contributions are shaping the future of science and education with unwavering commitment and expertise.

Professor Bhattacharya stands out as a prominent figure in the scientific community, co-authoring approximately 340 publications in reputable international peer-reviewed journals and holding several patents. His scholarly impact is reflected in an *h*-index exceeding 80 and citations nearing 20 000. Professor Bhattacharya has demonstrated a steadfast obligation to mentoring, having guided over 50 Ph.D. students; at least 30 of his former students are now recognized independent researchers at esteemed universities, academic institutions, and industries in the United States and India. These talented individuals contribute vitally to advancing biomimetic materials through diverse and innovative approaches. In recognition of his significant contributions to the field, Professor Bhattacharya was awarded the Shanti Swarup Bhatnagar Prize for Science and Technology, one of the foremost honors in Indian science. This esteemed award acknowledges and promotes exceptional talent and excellence in pioneering contributions to scientific research within the country. He also received the TWAS Prize in Trieste, Italy. Additionally, he has taken an active role on the editorial boards of prominent journals, including *Bioconjugate Chemistry*, *Langmuir*, and *Chemical & Biomedical Imaging*, published by the American Chemical Society. This year marks a milestone in celebrating his contributions, with a special thematic collection in the journal *Nanoscale* that is dedicated to recognizing Professor Bhattacharya's lifelong dedication to the advancement of science. This themed collection not only celebrates his illustrious career but also underscores the pro-

found impact of his ground-breaking work on the broader scientific community, inspiring generations of researchers.

Professor Bhattacharya's research area encompasses a diverse range of topics, from the fundamental science of designing lipids, peptides, and DNA-binding small molecules, to studying their self-assembly toward various applications including smart hydrogels, novel nanocomposites, gene therapy, antimicrobial therapy, and drug delivery. A major thrust has been selecting review articles to make this Festschrift issue an excellent collection. They cover the relevant areas of supramolecular biomaterials (**https://doi.org/10.1039/D4NR02088J**), nanogels and vesicles for diagnostics and therapeutic applications (**https://doi.org/10.1039/D4NR01423E**, **https://doi.org/10.1039/D4NR00207E**) and gene therapy (**https://doi.org/10.1039/D4NR01300J**) outlining the major advances in recent times. Designing self-assembled nanostructures based on biomolecules and their nanocomposites, toward deciphering their tunable spectroscopic and material properties, is among the core research areas of Prof. Bhattacharya. Thus, we included some interesting articles focusing on self-assembled polymers for photodynamic therapy and altered circularly-polarized luminescence, crystallization-driven self-assembly, peptide-templated nanoparticles for biocatalysis, hydrogels hosting the Fenton reaction and molecular saddles for proton conductivity. Srivastava *et al.* showed an interesting design and self-assembly of an aza-crown-type macrocycle to form a molecular saddle that ramps up solid-state proton conduction

Asish Pal

Prof. Asish Pal is Dean–Administration and Professor (Scientist-F) of Chemical Biology at the Institute of Nano Science and Technology (INST), Mohali, India. He earned his Ph.D. in Organic Chemistry from the IISc, Bangalore, under the mentorship of Prof. Santanu Bhattacharya. He then pursued postdoctoral research with Prof. Rint P. Sijbesma at the Eindhoven University of Technology and with Prof. Sijbren Otto at the University of Groningen, The Netherlands. In 2015, Prof. Pal began his independent research career as Scientist-E in the Chemical Biology Unit at the INST, Mohali. His research focuses on supramolecular chemistry, peptide self-assembly, polymeric nanostructures, chiroptical polymers, and ECM-mimetic hydrogel scaffolds.

Praveen Kumar Vemula

Prof. Praveen Kumar Vemula is Dean of Research, Professor (Scientist G) at the Institute for Stem Cell Science and Regenerative Medicine (inStem) in Bangalore, and a pioneering researcher in drug discovery, drug delivery, and translational science. After completing his Ph.D. in Organic Chemistry at the IISc, Bangalore, Dr Vemula pursued postdoctoral work at the City College of New York and the Harvard-MIT Division of Health Sciences and Technology at Harvard Medical School. He was later awarded the prestigious Kauffman Foundation Postdoctoral Entrepreneur Fellowship. This experience paved the way for his successful work in commercializing biomedical technologies. Dr Vemula's lab has developed numerous technologies that have seeded the creation of seven startup companies, including Sepio Health and Alivio Therapeutics. His current research focuses on developing biomaterials to address critical medical needs, including organ transplant protection, new treatments for inflammatory and infectious diseases, and methods to prevent pesticide toxicity.

Shyni Varghese

Prof. Shyni Varghese is the Laszlo Ormandy Distinguished Professor of Orthopaedic Surgery at Duke University, with a unique triple appointment in Biomedical Engineering, Mechanical Engineering & Materials Science, and Orthopaedic Surgery. An affiliate of the Duke Regeneration Center, Prof. Varghese earned her Ph.D. from the National Chemical Laboratory in India. She has since become a renowned leader in biomaterials and stem cell research. She is Duke's first MEDx Investigator, with an interdisciplinary role bridging medicine and engineering. Prof. Varghese's research covers wide-ranging topics, including aging, stem cells, biomaterials, and microphysiological systems, each aiming to drive advances in regenerative medicine and therapeutic development.

(https://doi.org/10.1039/D4NR00456F). Haldar *et al.* reported antimicrobial nanocomposite paints to mitigate catheter-associated urinary tract infections, which pose significant challenges (https://doi.org/10.1039/D4NR00653D).

Other areas of Prof. Bhattacharya's research interests include innovative design strategies and applications for nano-micelles, vesicles, lipid nanoparticles, and covalent-organic frameworks. We are pleased to present a collection of outstanding articles demonstrating numerous biomedical applications. These include dual drug delivery, gene therapy, tumor suppression, targeted cancer cell therapies, and peptides aimed at mitigating amyloidogenesis. For instance, Ganguli *et al.* have explored gene therapy utilizing sugar alcohol-modified poly (β-amino esters) to facilitate selective caveolae-mediated endocytosis (https://doi.org/10.1039/D3NR05300H). Furthermore, Maji *et al.* have contributed significant insights into small-molecule-based degradation of nucleic-acid interactome proteins through PROteolysis TArgeting Chimeras, targeting anti-cancer activity (https://doi.org/10.1039/D4NR01006J).

We are excited to showcase this collection, as it highlights recent advancements and challenges at the intersection of chemistry, biology, and nanoscience. The overwhelming response from researchers worldwide—including those from Professor Bhattacharya's former students, associates, friends, and colleagues—attests to his profound impact on biomaterials research. We are grateful for the support of the editorial team of '*Nanoscale*' in bringing this thematic issue to fruition. Lastly, we congratulate Professor Santanu Bhattacharya on his remarkable scientific journey, which has propelled significant cross-disciplinary research in India, particularly in soft nano-bio materials, self-assembled biomolecules, and their biomedical applications. We extend our best wishes to him, celebrating a legacy that inspires future innovations!

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