Curriculum Vitae

Name Joy Sankar Deb Roy

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Title of Thesis '*Solution Phase Synthesis of Multifunctional Fluorescent Polymers for Sensing and Exclusion of Pollutants*'

Education

June 2018 – till Date

Recently, I have submitted Thesis of my Ph.D. research works from the Department of Polymer Science and Technology, University of Calcutta, Kolkata, West Bengal, India under the joint supervision of Dr. Subhasis Roy, Senior Assistant Professor, Department of Chemical Engineering, University of Calcutta, 92, A.P.C Road, Kolkata -700009, India

2016–2018

Completed Master of Technology (M. Tech.) in Polymer Science and Technology from Department of Polymer Science and Technology, University of Calcutta, Kolkata - 700009, India.

2015

Completed Bachelor of Technology (B. Tech.) in Leather Technology from Department of Leather Technology, Government College of Engineering and Leather Technology (Post-Graduate), Salt Lake, Kolkata - 700106, India

Research summary

Ph.D. work

In recent times, the conventional and non-conventional biocompatible fluorescent multifunctional polymers have been attracting significant attention in the fields of sensing, exclusion, light-emitting diodes, measuring metal ions in an aqueous environment, temperature sensing in living cells, bioimaging, and cancer therapy. In this context, though the

nonconventional luminescent polymers have been reported, intrinsically fluorescent reusable biocompatible polymers have been rarely reported to date. Thus, the structural framework of the thesis entitled “Solution Phase Synthesis of Multifunctional Fluorescent Polymers for Sensing and Exclusion of Contaminants” has been designed to achieve nonconventional multipurpose functional polymers capable of meeting some highly specialized growing demands of the modern civilization.

Initially, the intrinsically fluorescent aliphatic polymers were prepared via C–C and C–N coupled polymerization in the aqueous medium. The as-obtained polymers were characterized through the spectroscopic, thermal, diffractometric, and microscopic methods. In addition, computational studies, i.e., DFT, TDDFT, NTO, and RDG, were carried out to explore the reduction of metal ions, absorption, ratiometric pH sensing, and multi-light emission properties of light-emitting polymers. These smart polymers were noted to be suitable in sensing, removal/ separation, reduction of heavy metal ions, normal-/ cancer-cell imaging, and security applications. The living cells invasion ability and non-cytotoxicity of these biocompatible fluorescent multifunctional polymers have been exploited for sensing of biologically important molecules. The targets of fluorescent polymeric probes can be extended further for detection of chemical species (e.g. anions, organics, and other molecules) at varied physical parameters (e.g. temperature, stress, viscosity etc.).

Other relevant works

In addition to my routine Ph.D. research work, I have been actively involved and played supporting roles in some contemporary and relevant research activities of my co-researchers in our research laboratory. I was involved in design and development of Modified Graphene Oxide-based semi-synthetic polymer supported hybrid materials for electronic device application as well as sensing of heavy metal ions.

Technical proficiency

Instruments handled and associated results analysed

FTIR (Spectrum-2, Singapore, PerkinElmer)
TGA (Pyris6 TGA, The Netherlands, PerkinElmer)
DSC ((Pyris6 DSC, The Netherlands, PerkinElmer)
DLS (Panalytical Zetasizer Pro, Malvern)
UV-vis (Lambda 365, PerkinElmer)
Fluorescence emission studies (Spectrofluorimeter-LS55, Perkin Elmer)
Fluorescence lifetime spectrophotometer (HORIBA Jobin Yvon Fluorocube-01-NL)
Mass Spectrometry (LC-MS/MS Triple Quadrupole Mass Spectrometer)

Results analyzed

^{1}H NMR (Bruker-Advance Digital 300 MHz)

^{13}C NMR (JEOL ECX400)
XPS (ESCA+, Omicron Nanotechnology, Oxford Instruments, Germany)

SEM and EDX (EVO-MA 10, ZEISS equipped with W filament, Sb sources, and 3 nm resolution)
HRTEM (JEOL JEM 2100 HR with EELS having point to point of 0.23 and lattice resolution of 0.14 nm with LaB6 source)
AAS (AAnalyst 100, PerkinElmer)

Software handled

Microsoft office Master Nova for ^{1}H NMR and ^{13}C NMR analyses
Gaussian 16 and GaussSum3.0 for DFT-based structural optimization of the polymer molecules
Chem Draw Ultra 12.0
Origin 9.0

Published Research Articles and Review Paper

(1) **Roy, J. S. D.**; Deb, M.; Sanfui, MD H.; Roy, S.; Dutta, A.; Chattopadhyay, P. K.; Ghosh, N. N.; Roy, S.; Singha, N. R.* Light-Emitting Redox Polymers for Sensing and Removal-Reduction of Cu (II): Roles of Hydrogen Bonding in Nonconventional Fluorescence. *ACS Appl. Polym. Mater.* **2022**, *4*, 1643–1656.

(2) **Roy, J. S. D.**; Chowdhury, D.; Sanfui, MD H.; Hassan, N.; Mahapatra, M.; Ghosh, N. N.; Majumdar, S.; Chattopadhyay, P. K.; Roy, S.; Singha, N. R.* Ratiometric pH Sensing, Photophysics, and Cell Imaging of Nonaromatic Light-Emitting Polymers. *ACS Appl. Bio Mater.* **2022**, *5*, 2990–3005.

(3) **Roy, J. S. D.**; Deb, M.; Sanfui, MD H.; Hassan, N.; Roy, S.; Chowdhury, D.; Das, B.; Rahaman, M.; Ghosh, N. N.; Mondal, S.; Chang, M.; Majumdar, S.; Chattopadhyay, P. K.; Singha, N. R.* Light Emissions of Ratiometric Aliphatic Redox Polymer from Canonical, Anion, and Anion-Aggregate: Reduction-Associated Naked Eye Detections of Hg(II), Fe(III), and Cu(II). *Eur. Polym. J.* 206, **2024**, 112754.

(4) Deb, M.; Roy, S.; Hassan, N.; **Roy, J. S. D.**; Ghosh, N. N.; Chattopadhyay, P. K.; Maiti, D. K.; Singha, N. R.* Chromo-Fluorogenic Sensing of Fe(III), Cu(II), and Hg(II) using a Redox-Mediated Macromolecular Ratiometric Sensor. *ACS Appl. Polym. Mater.* **2023**, *5*, 4820–4837.

(5) Roy, C.; Chowdhury, D.; Sanfui, MD H.; **Roy, J. S. D.**; Mitra, M.; Dutta, A.; Chattopadhyay, P. K.; Singha, N. R.* Solid Waste Collagen-Associated Fabrication of Magnetic Hematite Nanoparticle@Collagen Nanobiocomposite for Emission-Adsorption of Dyes. *Int. J. Biol. Macromol.* **2023**, *242*, 124774.

(6) Mahapatra, M.; Dutta, A.; **Roy, J. S. D.**; Deb, M.; Das, U.; Banerjee, S.; Dey, S.; Chattopadhyay, P. K.; Maiti, D. K.; Singha, N. R.* Synthesis of Biocompatible Aliphatic Terpolymers via In Situ Fluorescent Monomers for Three-in-One Applications: Polymerization of Hydrophobic Monomers in Water. *Langmuir* **2020**, *36*, 6178–6187.

(7) Mahapatra, M.; Dutta, A.; **Roy, J. S. D.**; Das, U.; Banerjee, S.; Dey, S.; Chattopadhyay, P. K.; Maiti, D. K.; Singha, N. R.* Multi C–C/ C–N Coupled Light-Emitting Aliphatic Terpolymers: N–H Functionalized Fluorophore-Monomers and High-Performance Applications. *Chem.-Eur. J.* **2020**, 26, 502–516.

(8) Mahapatra, M.; Dutta, A.; **Roy, J. S. D.**; Mitra, M.; Mahalanobish, S.; Sanfui, MD H.; Banerjee, S.; Chattopadhyay, P. K.; Sil, P. C.; Singha, N. R.* Fluorescent-Terpolymers via In Situ Allocation of Aliphatic Fluorophore-Monomers: Fe(III)-Sensor, High-Performance Removals, and Bio-Imaging. *Adv. Healthc. Mater.* **2019**, *8*, 1900980.

(9) Mitra, M.; Mahapatra, M.; Dutta, A.; Chattopadhyay, P. K.; Deb, M.; **Roy, J. S. D.**; Roy, C.; Banerjee, S.; Singha, N. R.* Light-Emitting Multifunctional Maleic Acid-*co*-2-(N-(hydroxymethyl)acrylamido)succinicAcid-*co*-*N*-(hydroxymethyl)acrylamide for Fe(III) Sensing, Removal, and Cell Imaging. *ACS Omega* **2020**, *5*, 3333–3345.

(10) Mitra, M.; Mahapatra, M.; Dutta, A.; **Roy, J. S. D.**; Karmakar, M.; Mondal, H.; Deb, M.; Roy, C.; Chattopadhyay, P. K.* Bandyopadhyay, A.; Singha, N. R.* Carbohydrate and Collagen-Based Doubly-Grafted Interpenetrating Terpolymer Hydrogel via N–H Activated In Situ Allocation of Monomer for Superadsorption of Pb(II), Hg(II), Dyes, Vitamin-C, and p-Nitrophenol. J*. Hazard. Mater.* **2019**, *369*, 746–762.

(11) Roy, C.; Dutta, A.; Mahapatra, M.; Karmakar, M.; **Roy, J. S. D.**; Mitra, M.; Chattopadhyay, P. K.; Singha, N. R.* Collagenic Waste and Rubber Based Resin-Cured Biocomposite Adsorbent for High-Performance Removal(s) of Hg(II), Safranine, and Brilliant Cresyl Blue: A Cost-Friendly Waste Management Approach. *J. Hazard. Mater*. **2019**, *369*, 199–213.

(12) Singha, N. R.* Karmakar, M.; Chattopadhyay, P. K.; Roy, S.; Deb, M.; Mondal, H.; Mahapatra, M.; Dutta, A.; Mitra, M.; **Roy, J. S. D.** Structures, Properties, and Performances Relationships of Polymeric Membranes for Pervaporative Desalination. *Membranes*, **2019**, *9*, 58.

(13) Singha, N. R*.; Dutta, A.; Mahapatra, M.; **Roy, J. S. D.**; Mitra, M.; Deb, M.; Chattopadhyay, P. K. In Situ Attachment of Acrylamido Sulfonic Acid-Based Monomer in Terpolymer Hydrogel Optimized by Response Surface Methodology for Individual and/or Simultaneous Removal(s) of M(III) and Cationic Dyes. *ACS Omega* **2019**, *4*, 1763−1780.

(14) Singha, N. R.; * Roy, C.; Mahapatra, M.; Dutta, A.; **Roy, J. S. D.**; Mitra, M.; Chattopadhyay, P. K.* Scalable Synthesis of Collagenic-Waste and Natural Rubber-Based Biocomposite for Removals of Hg(II) and Dyes: Approach for Cost-Friendly Waste Management. *ACS Omega* **2019**, *4*, 421–436.

(15) Mondal, H.; Karmakar, M.; Dutta, A.; Mahapatra, M.; Deb, M.; Mitra, M.; **Roy, J. S. D.**; Roy, C.; Chattopadhyay, P. K.; Singha, N. R.* Tetrapolymer Network Hydrogels via Gum Ghatti-Grafted and N–H/ C–H-Activated Allocation of Monomers for Composition-Dependent Superadsorption of Metal Ions. *ACS Omega* **2018**, *3*, 10692–10708.

(16) Mahapatra, M.; Karmakar, M.; Dutta, A.; Mondal, H.; **Roy, J. S. D.**; Chattopadhyay, P. K.; Singha, N. R.* Microstructural Analyses of Loaded and/ or Unloaded Semisynthetic Porous Material for Understanding of Superadsorption and Optimization by Response Surface Methodology. *J. Environ. Chem. Eng*. **2018**, *6*, 289–310.

Manuscripts Submitted for Publication

(17) Deb, M.; Roy, S.; Mitra, M.; **Roy, J. S. D.**; Chowdhury, D.; Ghosh, N. N.; Mondal, S.; Maiti, D. K.; Chattopadhyay, P. K.; Singha, N. R.* Unravelling Unusual Photoluminescence, Conductivity, and Sensing

of Triple-Color Emitting Redox ESICT-ESIPT Polymers and ICT-/ PET-Mediated Fe(III)/ Hg(II) Reduction and Cd(II) Oxidation (Submitted, September, **2023**).

Full Papers in Conference Proceedings

(18) Patra, S. K.; Mitra, M.; **Roy, J. S. D.**; Mahapatra, M.; Roy, C.; Chattopadhyay, P. K.; Singha, N. R.* Comparative Efficiencies of Different Dye Fixing Agents in Leather Dyeing. International Conference on Emerging Technologies for Sustainable Development (ICETSD'19) ©**2019** GCELT, ISBN No: 978-81-8211-146-2, pp 108–112.

(19) Mitra, M.; Mahapatra, M.; Dutta, A.; Deb, M.; Roy, C.; **Roy, J. S. D.**; Chattopadhyay, P. K.; Singha, N. R.* C–C/ N–C/ O–C Coupled Scalable Synthesis of Intrinsically-Fluorescent Multifunctional Ter-/ Tetra-polymers Using *Two* (2) Non-Emissive Monomers: Structures, Properties, and Applications. International Conference on Chemistry for Human Development. (ICCHD-2020) in collaboration with 'University of Calcutta' and "Heritage Institute of Technology" during January 9-11, **2020** in Calcutta.

(20) Mahapatra, M.; Dutta, A.; Mitra, M.; **Roy, J. S. D.**; Deb, M.; Chattopadhyay, P. K.; Singha, N. R.* Fluorescent Terpolymer Hydrogels for "Turn-off" Hg(II)-Sensor and Bio Imaging of Living Cell. International Conference on Emerging Technologies for Sustainable Development (ICETSD'19) ©**2019** GCELT, ISBN No: 978-81-8211-146-2, pp 11–17.

(21) Dutta, A.; Mahapatra, M.; **Roy, J. S. D.**; Mitra, M.; Deb, M.; Banerjee, S.; Chattopadhyay, P. K.; Taraphdar, A.; Singha, N. R.* 3-D Terpolymer Hydrogel Composed of Acrylamido-Sulphonic Acid Moiety for Removal of Sb(III). International Conference on Emerging Technologies for Sustainable Development (ICETSD'19) ©**2019** GCELT, ISBN No: 978-81-8211-146-2, pp 247–253.

Declaration: I hereby declare that the particulars furnished herein by me are true to the best of my knowledge and belief.

Date: 13thFeb, 2024

Place: Kolkata, India

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(Joy Sankar Deb Roy)