



Rajib Kumar Mitra

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Dr. Rajib Kumar Mitra carried out Ph.D. work at Indian Statistical Institute, Kolkata (Ph.D. degree awarded by Jadavpur University in 2005). He joined S.N. Bose National Centre for Basic Sciences as a Post Doctoral fellow in 2006, selected as a Bose Fellow in 2007. He worked as a BOYSCAST Fellow at Ruhr University, Germany during 2009-2010. He joined the centre as an Assistant Professor in August, 2010 and promoted to Associate Professor in January, 2015.

Supervision of Research / Students

Ph.D. Students

1. Animesh Patra; "Structure Dynamics and Activity of Water in Restricted Environments"; Ph.D. degree awarded in December, 2016
2. Arindam Das; "Structure and Dynamics of Mixed Microemulsions/ Reverse Micellar Systems"; Ph.D. degree awarded in April, 2017
3. Debanjan Polley; "Manipulating THz Radiation Using Nanostructures"; Ph.D. thesis submitted in July, 2016

4. Nirnay Samanta; "Studying the Effects of Different Cosolutes on Protein Conformational Stability, Hydration Dynamics and Activity"; to submit Ph.D. thesis in July, 2017
5. Debasish Das Mahanta; "Investigation of the Collective H-bonded network and Hydration Dynamics around Electrolytes and Bio-molecules"; likely to submit Ph.D. thesis in July, 2018
6. Amit Barh; working since July, 2016 on generation of THz radiation from oxide materials
7. Sk. Imadul Islam; working since July, 2016
8. Saikat Pal; working since January, 2017

Projects of M.Sc./ M.Tech./ B.Tech./ Post B.Sc. students

1. Anupam Gorai, Post B.Sc. student, SNBNCBS, Jan-May, 2017, 4th Semester, "Application of THz Radiation on Materials", project completed.
2. Swarnali Hait, Post B.Sc. student, SNBNCBS, Jan-May, 2017, 4th Semester, "THz Spectroscopy – Generation and Application", project completed.

Post Doctoral Research Scientists

1. Dipak K. Das

Teaching activities at the Centre

1. 3rd Semester (Aug-Dec 2016), PHY 301: Atomic and Molecular Physics (Post B.Sc. course), jointly with Prof. Anjan Barman
2. 4th Semester (Jan-May, 2017), PHY 405: Biological Physics (post B.Sc. course), jointly with Prof. Samir K. Pal

Publications in Journals

1. N. Samanta, D. Das Mahanta, S. Choudhury, A. Barman, and **R. K. Mitra**; *Collective Hydration Dynamics in Some Amino Acid Solutions: A Combined GHz-THz Spectroscopic Study*; J. Chem. Phys.; 2017; **146**; 125101.
2. A. Patra, N. Samanta, D. K. Das, and **R. K. Mitra**; *Enhanced Catalytic Activity of -Chymotrypsin in Cationic Surfactant Solutions: The Component Specificity Revisited*; J. Phys. Chem. B; 2017; **121**; 1457–1465.
3. D. Polley, A. Patra, A. Barman and **R. K. Mitra**; *Terahertz conductivity engineering in surface decorated carbon nanotube films by gold nanoparticles*; Applied Optics; 2017; **56**; 1107-1112.
4. D. Das Mahanta, A. Patra, N. Samanta, T. Q. Luong, B. Mukherjee and **R. K. Mitra**; *Non-monotonic dynamics of water in its binary mixture with 1,2-dimethoxy ethane: A combined THz spectroscopic and MD simulation study*; J. Chem. Phys.; 2016; **145**; 164501.
5. D. Polley, K. Neeraj, A. Barman and **R. K. Mitra**; *Diameter-dependent shielding effectiveness and terahertz conductivity of multiwalled carbon nanotubes*; J. Opt. Soc. Am. B; 2016; **33**; 2430-2436.
6. D. K. Das, A. Patra and **R. K. Mitra**; *Preferential solvation of lysozyme in dimethyl sulfoxide/water binary mixture probed by terahertz spectroscopy*; Biophys. Chem.; 2016; **216**; 31-36.
7. K. Kundu, A. Das, S. Bardhan, G. Chakraborty, D. Ghosh, B. Kar, S. K. Saha, S. Senapati, **R. K. Mitra** and B. K. Paul; *The mixing behaviour of anionic and nonionic surfactant blends in aqueous environment correlates*

in fatty acid ester medium; Colloids and Surfaces A: Physicochemical and Engineering Aspects; 2016; **504**; 331–342.

Lectures Delivered

1. “Collective Dynamics of Water Around Solutes: Terahertz Time Domain Spectroscopic Studies” in Photonics-2016, at IIT Kanpur during 5-8 December, 2016
2. “Application of Terahertz Spectroscopy in Chemistry and Biology” in QIP Short Term Course on ‘Industrial applications of Terahertz Radiation’ at IIT Kharagpur during 27th March-2nd April, 2017

Membership of Committees

Internal Committee

Admission Committee; Technical Cell Advisory Committee; Technical Cell Working Group etc.

Sponsored Projects

1. “Real Time Structure and Solvation Dynamics of Proteins during Folding/Unfolding in Crowded Environment”; SERB (DST); July 2014 - June 2017

Collaborations including publications (Sl. No. of paper/s listed in ‘Publications in Journals’ jointly published with collaborators)

National

1. 01 (Sl. No. 7)

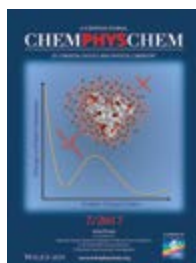
Significant research output / development during last one year

General research areas and problems worked on

Terahertz Spectroscopy, Time resolved fluorescence spectroscopy, Hydration dynamics, Biophysics, Protein folding, Self-assembled systems (micelles, reverse micelles, lamellae, vesicles etc.), Nanomaterials.

Interesting results obtained

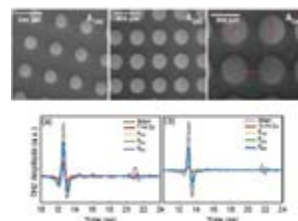
1. Our study shows the unusual concentration induced behavior of alcohols on proteins and we conclude that this behavior is driven by an intricate balance between different counter-interacting interactions.



2. We have made a systematic investigation on the broad notion of hydrophobic hydration using THz time domain spectroscopy. We have found a very systematic

change in the hydration dynamics depending upon the hydrophobic scale of the solute (be it amino acids or alkyl ammonium salts or nonpolar solvents).

3. We have performed two-photon absorption experiment to understand the binding of fluorophores on the surface of a model protein. The study could be found helpful for imaging applications.
4. We have shown that Cu anti dots can be used as efficient anti reflection agent in the THz frequency region.



5. We have investigated the change in the enzyme activity of lysozyme in presence of polyethylene glycol and we conclude that at low concentration region of PEG the protein dehydration phenomenon predominates while at higher concentrations the PEGs directly interact with the proteins.
6. We have investigated the effect of PEGs on DNA-ligand intercalation and found that the quenching of ligand fluorescence, which is due to the intercalation in DNA, is released in presence of PEGs.

Proposed research activities for the coming year

1. Development of a broadband THz facility (~10 THz) using optical rectification (OR) technique. We plan to couple this facility with a optical pump and probe it with THz. That will provide us with the time-resolved optical pump – THz probe measurements of some light sensitive chemicals and proteins.
2. We will investigate in more details hydrophobic hydration. We plan to couple spectroscopic results with thermodynamic outputs (in the form of enthalpy and entropy of the process) which would enable us to obtain the corresponding energetic cost of destruction or formation of water structure around hydrophobic molecules. We would like to include complex molecules like small peptides, self aggregating proteins etc. in order to understand their hydration behavior.
3. We would continue our study to understanding how molecular crowders interact with biomolecules and affect their biological activity. Such molecular crowders often mimic the real cellular environments.
4. We would continue our study on the improvement and fabrication of various THz optical components (e.g. polarizers, band pass filters, anti reflection coatings etc.).
5. We would collaborate with industries regarding application of THz spectroscopy in pharmaceutical and biomedical applications.