

CV of Rajaram Swaminathan

Name: Dr. Rajaram Swaminathan
Designation: Professor
Department/Institute/University: Department of Biosciences and Bioengineering,
Indian Institute of Technology Guwahati
Guwahati 781 039, Assam, INDIA
Year of Birth: 1968
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Education (degree onwards) & Professional Career

| Institution Place | Degree | Year |
|--|----------------------------------|------|
| A. M. Jain College, Chennai, Madras University | Bachelor of Science, Chemistry | 1988 |
| Indian Institute of Technology, Bombay | Master of Science, Biotechnology | 1990 |
| Tata Institute of Fundamental Research, Mumbai | Ph. D. | 1996 |

| Institution Place | Position | Year |
|--|---------------------|---------|
| University of California, San Francisco, USA | Postdoctoral Fellow | 1995-98 |
| National Centre for Ultrafast Processes, Chennai | Project Associate | 1998-99 |
| Indian Institute of Technology, Guwahati | Faculty | 1999- |

List of journal publications

ORCID ID: 0000 0003 1294 8379

1. **Swaminathan, R.**, N. Periasamy, J. B. Udgaonkar and G. Krishnamoorthy (1994). Molten globule-like conformation of barstar: a study by fluorescence dynamics. *J. Phys. Chem.* 98, 9270-9278.
2. **Swaminathan, R.**, G. Krishnamoorthy and N. Periasamy (1994). Similarity of fluorescence lifetime distributions in single tryptophan proteins in the random coil state. *Biophys. J.* 67, 2013-2023.
3. **Swaminathan, R.** and N. Periasamy (1996). Analysis of fluorescence decay by the maximum entropy method: influence of noise and analysis parameters on the width of the distribution of lifetimes. *Proc. Indian Acad. Sci. (Chem. Sci.)* 108:39-49.
4. **Swaminathan, R.**, U. Nath, J. B. Udgaonkar, N. Periasamy and G. Krishnamoorthy (1996). Motional dynamics of a buried tryptophan reveals the presence of partially structured forms during denaturation of barstar. *Biochemistry* 35, 9150-9157.
5. **Swaminathan, R.**, S. Bicknese, N. Periasamy and A. S. Verkman (1996). Cytoplasmic viscosity near cell plasma membrane: translational diffusion of a small fluorescent solute measured by total internal reflection-fluorescence photobleaching recovery. *Biophys. J.* 71, 1140-1151.
6. **Swaminathan, R.**, C. P. Hoang and A. S. Verkman (1997). Photobleaching recovery and anisotropy decay of green fluorescent protein GFP-S65T in solution and cells: cytoplasmic viscosity probed by GFP translational and rotational diffusion. *Biophys. J.* 72, 1900-1907.
7. Partikian, A., B. P. Olveczky, **R. Swaminathan**, Y. Li, and A. S. Verkman (1998). Rapid diffusion of green fluorescent protein in the mitochondrial matrix. *J. Cell Biol.* 140, 821-829
8. Homchaudhuri, L. and **Swaminathan, R.** (2001) Novel absorption and fluorescence characteristics of L-lysine *Chem. Lett.* 2001, 844-845.
9. Homchaudhuri, L. and **Swaminathan, R.** (2004) Near ultraviolet absorption arising from lysine residues in close proximity: A probe to monitor protein unfolding and aggregation in lysine-rich proteins. *Bull. Chem. Soc. Japan*, 77, 765-769.

10. Homchaudhuri, L., Kumar, S. and **R. Swaminathan** (2006). Slow aggregation of lysozyme in alkaline pH monitored in real time employing the fluorescence anisotropy of covalently labelled dansyl probe., *FEBS Lett.*, 580, 2097-2101.
11. Homchaudhuri, L., Sarma, N. and **R. Swaminathan** (2006). Effect of crowding by dextrans and Ficolls on the rate of alkaline phosphatase-catalysed hydrolysis: A size dependent investigation, *Biopolymers*, 83, 477-486.
12. Kumar, S. and **R. Swaminathan** (2007) Employing the fluorescence anisotropy and quenching kinetics of tryptophan to hunt for residual structures in denatured proteins. *J. Chem. Sci.*, 119, 141-145.
13. Agrawal, M., S. B. Santra, Rajat Anand and **R. Swaminathan** (2008) Effect of macromolecular crowding on the rate of diffusion-limited enzymatic reaction, *Pramana-J. Phys.* 71, 359-368.
14. Kumar, S., Atul K. Singh, G. Krishnamoorthy and **R. Swaminathan** (2008) Thioflavin T displays enhanced fluorescence selectively inside anionic micelles and mammalian cells, *J. Fluoresc.* 18, 1199-1205.
15. Kumar, S., Vijay K. Ravi and **R. Swaminathan** (2008) How do surfactants and DTT affect the size, dynamics, activity and growth of soluble lysozyme aggregates? *Biochem. J.* 415, 275-288.
16. Dash, N., F. A. S. Chipem, **R. Swaminathan**, and G. Krishnamoorthy (2008) Hydrogen bond induced twisted intramolecular charge transfer in 2-(4'-N,N-dimethylaminophenyl)imidazo [4,5-b]pyridine, *Chem. Phys. Lett.* 460, 119-124.
17. Kumar, S., Vijay K. Ravi and **R. Swaminathan** (2009) Suppression of lysozyme aggregation at alkaline pH by tri-N-acetylchitotriose. *Biochim. Biophys. Acta* 1794, 913-920.
18. Kumar, M. V. S. and **R. Swaminathan** (2010) A novel approach to segregate and identify functional loop regions in protein structures using their Ramachandran maps. *Proteins* 78, 900-916.
19. **Swaminathan, R.**, V. K. Ravi, S. Kumar, M. V. S. Kumar and N. Chandra (2011) Lysozyme: A model protein for amyloid research. *In Adv. Protein Chem. Struct. Biol.* Vol. 84 R. M. Donev (editor), Academic Press, 2011, pp. 63-111. ISBN: 978-0-12-386483-3
20. Prasad, S. and **R. Swaminathan** (2013) Measuring the diffusion of fluorescent dye or protein inside living cells. *Curr. Sci.* 105, 1549-1561.
21. Ravi, V. K., T. Swain, N. Chandra and **R. Swaminathan** (2014) On the characterization of intermediates in the isodesmic aggregation pathway of hen lysozyme at alkaline pH. *PLoS ONE* 9(1): e87256 doi 10.1371/journal.pone.0087256
22. Ravi, V. K., M. Goel, H. C. Kotamarthi, S. R. K. Ainaravapu and **R. Swaminathan** (2014) Preventing Disulfide Bond Formation Weakens Non-covalent Forces Among Lysozyme Aggregates. *PLoS One* 9(2): e87012 doi 10.1371/journal.pone.0087012
23. Iyer, A., A. Chandra and **R. Swaminathan** (2014) Hydrolytic enzymes conjugated to quantum dots mostly retain whole catalytic activity. *Biochim. Biophys. Acta* 1840, 2935–2943
24. Thokchom, A. K., **R. Swaminathan** and A. Singh (2014) Fluid Flow and Particle Dynamics Inside an Evaporating Droplet Containing Live Bacteria Displaying Chemotaxis. *Langmuir* 30,12144-12153
25. Somaiah C, A. Kumar, D. Mawrie, A. Sharma, S. D. Patil, J. Bhattacharyya, **R. Swaminathan**, B. G. Jaganathan (2015) Collagen Promotes Higher Adhesion, Survival and Proliferation of Mesenchymal Stem Cells. *PLoS ONE* 10(12): e0145068. doi:10.1371/journal.pone.0145068
26. Chhabra G, N. Chandra, **R. Swaminathan** (2017) Osmolytes: Key players in regulating protein aggregation in *Cellular Osmolytes: From Chaperoning Protein Folding to Clinical Perspectives*, L. Rajendrakumar Singh and T. A. Das (eds.), pp97—119 Springer Singapore 2017. eBook ISBN 978-981-10-3707-8; Hardcover ISBN 978-981-10-3706-1
27. Prasad, S., I. Mandal, S. Singh, A. Paul, B. Mandal, R. Venkatramani, **R. Swaminathan** (2017) Near UV-Visible electronic absorption originating from charged amino acids in a monomeric protein. *Chem. Sci.*, 8, 5416—5433
28. Ansari, Mohd. Z., A. Kumar, D. Ahari, A. Priyadarshi, L. Padmavathi, R. Bhandari, **R. Swaminathan** (2018) Protein charge transfer absorption spectra: An intrinsic probe to monitor structural and oligomeric transitions in proteins. *Faraday Discuss.*, 207, 91—113. DOI: 10.1039/C7FD00194K
29. R. Anand, M. Agrawal, V. K. S. Mattaparthi, **R. Swaminathan**, S. B. Santra (2019) Consequences of heterogeneous crowding on an enzymatic reaction: A residence time Monte Carlo approach. *ACS Omega*, 4, 727-736. doi: 10.1021/acsomega.8b02863

30. Ansari, Mohd. Z., **R. Swaminathan** (2020) Structure and dynamics at N- and C-terminal regions of intrinsically disordered human c-Myc PEST degron reveal a pH-induced transition. *Proteins* 88, 889-909. doi:10.1002/prot.25880
31. Kumar, Amrendra, D. Ahari, A. Priyadarshi, Mohd. Z. Ansari and **R. Swaminathan** (2020) Weak Intrinsic Luminescence in Monomeric Proteins Arising from Charge Recombination. *J. Phys. Chem. B* 124, 2731-2746. Doi: 10.1021/acs.jpcc.9b10071
32. Ansari, Mohd. Z., Shah Ekramul Alom, **R. Swaminathan** (2021) Ordered Structure Induced in Human c-Myc PEST region upon forming a Disulphide bonded Dimer. *J. Chem. Sci.* 133(26). DOI: 10.1007/s12039-021-01889-3
33. Singh, Anuma, G. Bhatt, N. Gujre, S. Mitra, **R. Swaminathan**, A. M. Limaye, L. Rangan (2021) Karanjin. *Phytochemistry*. 183:112641. doi: 10.1016/j.phytochem.2020.112641.
34. Singh, Anuma, M. Z. Ansari, S. Senthilkumar, L. Rangan, **R. Swaminathan**, (2021) Enhanced solubility, electronic absorption and fluorescence observed for Karanjin in aqueous SDS micelles compared to water. *J. Photochem. Photobiol. A: Chemistry*, 414:113289. doi: 10.1016/j.jphotochem.2021.113289
35. Kumar, Amrendra, Shah E. Alom, D. Ahari, A. Priyadarshi, Mohd. Z. Ansari and **R. Swaminathan** (2022) Role of Charged Amino Acids in Sullyng the Fluorescence of Tryptophan or Conjugated Dansyl probe in Monomeric Proteins. *Biochemistry* 61, 339-353. DOI 10.1021/acs.biochem.1c00753
36. Rakesh Ruchel Khanikar, Parismita Kalita, Monika Narzary, Deepjyoti Basumatarya, Ashim Jyoti Bharati, Anurag Priyadarshi, **R. Swaminathan**, Heremba Bailunga and Kamatchi Sankaranarayanan (2022). Cold atmospheric plasma driven self-assembly in serum proteins: insights into the protein aggregation to biomaterials. *RSC Adv.*, 12, 26211-26219. DOI: 10.1039/D2RA04318A
37. Chalapathi, D.; Kumar, A.; Behera, P.; Sathi, S.N.; **Swaminathan, R.**; Narayana, C (2022). Insights on Aggregation of Hen Egg-White Lysozyme from Raman Spectroscopy and MD Simulations. *Molecules* 27, 7122. DOI: 10.3390/molecules27207122
38. Priyadarshi, Anurag, Himanshi Maniram Devi and **R. Swaminathan** (2023), Disruption of Spatial Proximities among Charged Groups in Equilibrium-Denatured States of Proteins Tracked Using Protein Charge Transfer Spectra. *Biochemistry*, 62, 1643-1658. doi: 10.1021/acs.biochem.3c00006
39. Alom, Shah Ekramul and **R. Swaminathan** (2023). Protein Charge Transfer Spectra in a Monomeric Protein with No Lysine. *Phys. Chem. Chem. Phys.* 25, 16626-16642. Doi: 10.1039/D2CP05836G
40. Senthilkumar, Sanjana, Rashmi Singh, Latha Rangan and **R. Swaminathan** (2023), Enhanced electronic absorption and solubility of Mammeigin in aqueous micelles and protein aggregate solutions compared to water. *Journal of Molecular Liquids* 386, 122510.
41. Kulkarni, Alark Shripad, Harshal B. Nemade, **R. Swaminathan** (2023), Replacement of conventional reference electrode with platinum electrode for electronic tongue based analysis of dairy products. *Results in Chemistry* 6, 101185.
42. Alom, Shah Ekramul, Sourav Kalita, Altaf Hussain Kawa, Bhubaneswar Mandal and **R. Swaminathan** (2024), Early Events during the Aggregation of A β 16-22-derived Switch-peptides Tracked using Protein Charge Transfer Spectra. *Analytica Chimica Acta* 1297, 342374. DOI: 10.1016/j.aca.2024.342374
43. Alom, Shah Ekramul, Karthik Swaminathan, V. Nuzelu, Alka Singh, Hugues de Rocquigny and **R. Swaminathan** (2024), Label-free tracking of Hepatitis B Virus Core Protein Capsid assembly in real-time using Protein Charge Transfer Spectra. *Biomacromolecules* (in press) DOI: 10.1021/acs.biomac.4c00521

Patents Granted

Title: COST EFFECTIVE, PORTABLE OPTOELECTRONIC INSTRUMENT TO MEASURE STEADY STATE FLUORESCENCE AND ITS SET UP METHOD

Inventors: Kulkarni Alark Shripad, Harshal B. Nemade and Rajaram Swaminathan

Patent Application No.1136/KOL/2015

Patent Number: 310875, The Patent Office, Government of India.

Title: TRANSFORMING PROTEIN INTO A PRIME NUMBER SEQUENCE: ASSIGNING UNIQUE PRIME INTEGER TO EACH AMINO ACID

Inventors: Saumya Prasad and Rajaram Swaminathan
Patent Application No.: 201831038890
Patent Number: 396261, The Patent Office, Government of India.

Current Research Interests:

Protein Charge Transfer Spectroscopy and its application to investigate protein structure and function; Influence of Macromolecular Crowding on enzymatic reaction rates & equilibria; Intrinsically Disordered Proteins; Big Data analysis of the Proteomes;

Professional Activities

Member, Biophysical Society, USA
Member of the Royal Society of Chemistry, UK
Life Member, Indian Biophysical Society
Reviewer: *Journal of Fluorescence*, *Biotechnology Progress*, *Biochemistry (USA)*,
Biopolymers, *Biochimica et Biophysica Acta*, *Analytical Chemistry*

List of sponsored projects completed/ongoing

- 1) **Title:** Effect of macromolecular obstacles on the kinetics of a chemiluminescent reaction.
Funding source: Department of Science and Technology, New Delhi.
Amount: INR 5 lakhs
Start: July 2000
Status: Completed
- 2) **Title:** Protein Folding: Looking for residual structures in denatured proteins
Funding source: Ministry of Human Resources and Development under the Research and Development scheme
Start Date: 1 May 2003 Duration: 3.5 years
Amount; INR 14,00,000
REF: F 26.—4/2002 TS V
Status: Completed
- 3) **Title:** Tracking the growth of soluble protein aggregates in real time using fluorescence and subsequent manoeuvres to inhibit their growth.
Funding source: Council for Scientific and Industrial Research, New Delhi.
Start Date: 29 May 2006
Amount: INR 10,00,000
Ref: 37(1247)/06/EMR II
Status: Completed
- 4) **Title:** Conjugating luminescent quantum dots to proteins: Consequences on protein function and development of sensitive assays.
Funding source: Council for Scientific and Industrial Research, New Delhi.

Start date: 8 Dec 2009 **Duration:** 3 years

Ref: 37/1373/09 EMR II

Amount: INR 13,68,752

Status: Completed

- 5) **Title:** Protein aggregation: Early molecular events, mechanisms and inhibition
Funding source: Department of Science and Technology, New Delhi.
Start date: 1 Dec 2010 **Duration:** 3 years
Amount: INR 53,00,000
REF: SR/SO/BB-48/2009
Status: Completed
- 6) **Title:** Single molecule fluorescence investigations on the mechanism of lysozyme aggregation and RNA helicase activity
Funding source: Department of Biotechnology, New Delhi.
Status: Completed
Start Date: March 2011 **Duration:** 3 years
Amount: INR 94,75,000
REF: BT/53/NE/TBP/2010
- 7) **Title:** Investigating the role of protein dynamics on the function of few disordered proteins
Funding source: Department of Biotechnology, New Delhi.
Start date: 7 August 2014 **Duration:** 3 years
Amount: INR 98,20,000
REF: BT/409/NE/U-Excel/2013
Status: Completed
- 8) **Title:** Investigating enzymatic reactions in crowded physiological spaces AND structural changes in SARS-CoV-2-S protein in response to drug
Funding source: National Supercomputing Mission, IISc Bengaluru.
Start date: 6 April 2021 **Duration:** 2 years
Amount: INR 15,00,000
REF: DST/NSM/R&D_HPC_Applications/2021/03.27
Status: Completed.