

Curriculum Vitae

Dr. Arunasish Layek



Mailing Address

Department of Chemistry,
Adamas University, Adamas Knowledge City,
Barasat-Barrackpore Road, Barasat, Kolkata-700126
West Bengal

Contact

Phone: +91-8697991571
E-Mail: arunasish.layek@adamasuniversity.ac.in

Education

PhD, Chemistry 2007-2012
Indian Institute of Technology (IIT) Bombay, Mumbai, India
Thesis title “*Synthesis, carrier dynamics, and spectrally resolved photoluminescence imaging of individual semiconductor nanocrystals*”
Thesis Supervisor: Prof. Arindam Chowdhury

MSc. in Chemistry 2004 - 2006
IIT Bombay, Mumbai, India
MSc Thesis title “*Preparation, characterization and catalytic activity of Vanadium and Uranium based nanostructured materials in mesoporous molecular sieve host*” Thesis Supervisor: Prof. Parasuraman Selvam

BSc in Chemistry (Hons.) (Physics and Mathematics as subsidiary) 2001 - 2004
St. Xavier’s College, University of Calcutta, Kolkata, India

Professional Experience

Postdoctoral Fellow, Department of Chemistry, 11/2012-12/2014
University of Waterloo, Ontario, Canada.

Postdoctoral Fellow, Department of Chemistry, 04/2015-09/2017
KU Leuven, Leuven, Belgium.

Assistant Professor, Department of Chemistry, 11/2017-current
Adamas University, Kolkata

Sponsored Research Project Completed:

1. “*Rational Development of Surface Engineered Perovskite Nanocrystals and Understanding their Photophysical Properties*”, INR 31.24 Lakh, Early Career Research Grant, funded by SERB – Govt. of India, 2019-2022

Research Proposal Submitted:

1. “Upconverting Nanoparticle decorated optical fibre-based sensing device for early detection of cancer cell” submitted to SERB-SURE scheme, Govt. of India, November 2023.

Research Experience:

- Developed a Time Correlated Single Photon Counting Spectrophotometer at Department of Chemistry, Adamas University.
- Developed a multipurpose high-throughput fluorescence microscope capable of single molecule detection, imaging and spectroscopy.
- Designed a new synthetic strategy for preparation of ultra-small ZnO nanocrystals with narrow size distribution, and methodology for rare earth doping in ZnO nanostructures.
- Investigated the role of dopant ions (Mn^{2+}) inside alloyed ZnCdS nanocrystals and their intrinsic optoelectronic behaviours at single particle levels.
- Studied the size and shape dependent luminescent carrier dynamics of semiconductor nanocrystals using Time Correlated Single Photon Counting (TCSPC) spectrometer.
- Performed energy mapped PL imaging spectroscopy of individual localized centres in multiple quantum-well LEDs.
- Surface functionalization of semiconductor nanoparticles to induce multi-functionality.
- Probed lanthanide-doping to transparent conducting oxide (TCO) Ga_2O_3/In_2O_3 nanocrystals toward enhancing functionality and controlling phosphor properties.
- Developing the design and properties of hybrid white-light-emitting nanophosphors by electronic coupling of defect luminescence of colloidal oxide nanocrystals and selected organic dyes.
- Exploring structure-activity and selectivity relationships for heterogeneous catalysts using state-of-the-art single-molecule methods to characterize and understand the properties at nanoscale with single turnover sensitivity.
- Super resolution fluorescence microscopy tool for heterogeneous catalysis study, a novel correlated approach, enabling a direct correlation of insights in molecular dynamics (fluorescence) to local catalyst properties (scanning electron microscopy) *i.e.*, correlated light and electron microscopy (CLEM) approach.

Techniques

- Spatially and spectrally resolved photoluminescence imaging using multiple laser based wide-field epifluorescence/TIRF microscope capable of single-molecule detection.
- Confocal Laser Scanning Microscopy and Fluorescence Lifetime Imaging Microscopy (FLIM).
- **Super Resolution Fluorescence Microscopy** (NASCA, STORM, SOFI, etc.)
- Micro photoluminescence (micro-PL) and low temperature PL measurements.
- Time-resolved fluorescence lifetime measurements using time-correlated single photon counting (TCSPC) spectrometer, ultrafast laser spectroscopy.
- Atomic Force Microscopy (AFM) (**2 years' experience** as an operator for IIT-B central facility), **more than 2.5 years' operating experience of SEM and EDAX**, Transmission Electron Microscopy (TEM), XRD, ICP-AES.
- Steady-state absorption and fluorescence emission/excitation spectroscopy (PL/PLE).
- Fluorescence resonance energy transfer (FRET)
- FTIR Imaging
- Analyses of data obtained from all of the above-mentioned techniques (using ImageJ, Origin, IBH DAS, Sympho-time, Matlab, Easy Plot, Igor Pro, Adobe Illustrator)

Teaching and Mentoring:

- Involved in Teaching several theory and laboratory courses for undergraduate and post-graduate level the last six years.
- I have mentored more than 20 students at Department of Chemistry, Adamas University.
- I have guided two research project students in a DST-SERB funded project sanctioned to me as Principal Investigator.
- Teaching Assistant (TA) in IIT Bombay, India in one undergraduate chemistry laboratory and one theory courses (basic quantum chemistry, bonding), and molecular spectroscopy course at master's level for 4 years.
- Mentored 3 masters students in different projects based on single molecule imaging, spectroscopy as well as synthesis characterization of semiconductor nanomaterials during Ph.D.
- Guided 2 PhD students: 1 student on solid state lighting and 1 student in single molecule catalysis research during post-doctoral research work.

Awards and Honors

- Early Career Research Grant, SERB- Govt. of India, 2019-2022, ECR/2018/001767; Rs 31.24 L
- Department of Science and Technology Travel Grant for Young Scientists (2012). (*SR/ITS/0314/2012-2013*)
- INSA (CCDST Chennai) Travel Grant for Young Scientists (2012).
- CSIR (Govt. of India) Travel Grant for International Conference (2011). (*Ref. No. TG/5956/11-HRD*)
- Qualified for CSIR NET (2007), Govt. of India.
- Qualified for Graduate Aptitude Test in Engineering (GATE 2006).
- Madhav Pandya Scholarship, Indian Institute of Technology Bombay (2004 -2006)
- National Scholarship 1998 (MHRD, Govt. of India)

List of Publications.

1. "Deciphering broad defect luminescence of semiconductor nanocrystals- a single particle spectroscopic study" Layek, **A.***; Chowdhury, A. [*Under Preparation*]
2. "Monitoring catalytic activity inside the nanocages of rare earth exchanged zeolite Y: Combined super-resolution fluorescence and electron microscopy study" **Layek, A.***; Roeffaers, M. B. J. [*Under Preparation.*]
3. "Insights on Heterogeneous Emissivity of Quantum Dots and the Nature of Traps from Correlative Study amongst Blinking Parameters" Mukherjee, A.; Phadnis, C.; Layek, A.; Chowdhury, A. *The Journal of Physical Chemistry C* (2025) (*Under Review*)
4. "Prospect of Nanotechnology for Sustainable Agriculture" **Layek, A.**; Banerjee, S. *International Journal of Agriworld* (2024), 5(2), 27-34.
5. "Equity and Inclusion: An Effort Adopted by National Education Policy (NEP) 2020" Banerjee, S.; **Layek, A.*** *International Journal of Humanities & Social Science Studies* (2023), 9, 151-154.
6. "Real Time Detection of Neuropeptide Y" **Layek, A.**; Banerjee, S. *International Journal of Humanities & Social Science Studies* (2023), 9, 210-214.
7. "Unraveling The Dual Emission of Single Quantum-Dot by Single Particle Spectroscopy" **Layek, A.***; Arora, V.; Sapra, S.; Chowdhury, A. *Journal of Physics: Conference Series* (2022), 2349, 012026.
8. "Correlated Super-Resolution Fluorescence and Electron Microscopy Reveals the Catalytically Active Nanorods within Individual H-ZSM-22 Zeolite Particles" **Layek, A.**; Loon, J. V.; Roeffaers, M. B. J. Kubarev, A. V *Catalysis Science & Technology* (2019), 9, 4645-4650.

9. "Insights on heterogeneity in blinking mechanism and non-ergodicity using sub-ensemble statistical analysis of single quantum dots" Mukherjee, A.; Roy, K. K.; Phadnis, C.; **Layek, A.**; Bera, S.; Chowdhury, A. *The Journal of Chemical Physics* (2019), 151, 084701 (1-11).
10. "Solvent effect changes pore preference of ZSM-5 acid catalysis as revealed by fluorescence microscopy" Kubarev, A. V.; Breyneart, E.; Loon, J. V.; **Layek, A.**; Fleury, G.; Radhakrishnan, S.; Martens, J. A.; Roeffaers, M. B. J. *ACS Catalysis* (2017), 7, 4248-4252.
11. "Heterogeneity in optical properties of a near white-light emitting Eu(III) chelate as revealed by spectroscopy at the sub-ensemble level" Irfanullah, M.; Sharma, D.; Ramya, C.; **Layek, A.**; De, S.; Chowdhury, A. *Chemical Physics Letters* (2017), 667, 247-253.
12. "Synthesis of rare-earth doped ZnO nanorods and their defect-dopant correlated enhanced visible-orange luminescence" **Layek, A.***; Banerjee, S.; Manna, B.; Chowdhury, A. *RSC Advances* (2016), 6 (42), 35892-35900.
13. "Native defects determine phase dependent photoluminescence behaviour of Eu²⁺ and Eu³⁺ in In₂O₃ Nanocrystals" Ghodsi, V.; **Layek, A.**; Hegde, M.; Yildirim, B.; Radovanovic, P. *Chemical Communications* (2016), 52, 4353-4356.
14. "Manifestations of Varying Grading Level in CdSe/ZnSe Core Shell Nanocrystals" Sonawane, K. G.; Agarwal, K. S.; Phadnis, C.; Sharma, D. K.; **Layek, A.**; Chowdhury, A.; Mahamuni, S. *The Journal of Physical Chemistry C* (2016) 120 (9), 5257-5264.
15. "Dual Europium Luminescence Centers in Colloidal Ga₂O₃ Nanocrystals: Controlled In Situ Reduction of Eu(III) and Stabilization of Eu(II)" **Layek, A.**; Yildirim, B.; Ghodsi, V.; Hutflus, L. N.; Hegde, M.; Wang, T.; Radovanovic, P. *Chemistry of Materials* (2015), 27, 6030-6037.
16. "Distance-Dependent Energy Transfer between Ga₂O₃ Nanocrystal Defect States and Conjugated Organic Fluorophores in Hybrid White Light-Emitting Nanophosphors" Chirmanov, V.; Stanish, P.; **Layek, A.**; Radovanovic, P. V. *The Journal of Physical Chemistry C* (2015) 119, 5687-5696.
17. "Hybrid ZnO-Based Nanoconjugate for Green and Sustainable White Light Generation" **Layek, A.**; Stanish, P., Chirmanov, V., Radovanovic, P. V. *Chemistry of Materials* (2015), 27, 1021-1030.
18. "Correlation between native defects and dopants in colloidal lanthanide-doped Ga₂O₃ nanocrystals: A path to enhancing functionality and controlling optical properties" Wang, T.; **Layek, A.**; Hosein, I. D.; Chirmanov, V.; Radovanovic, P. V. *Journal of Materials Chemistry C* (2014), 2, 3212-3222.
19. "Ultranarrow and widely tunable Mn²⁺ - induced photoluminescence from single Mn-doped nanocrystals of ZnS-CdS alloys" Hazarika, A.; **Layek, A.**; De, S.; Nag, A.; Debnath, S.; Mahadevan, P.; Chowdhury, A.; Sarma, D.D. *Physical Review Letters* (2013), 110, 267401 (1-5). [Selected as **Focus: A Quantum Dot Shows Its True Colors, Physics** 6, 73 (2013)]
20. "A generalized three-stage mechanism of ZnO nanoparticle formation in homogeneous liquid medium" **Layek, A.**; Mishra, G.; Sharma, A.; Spasova, M.; Dhar, S.; Chowdhury, A.; Bandopadhyaya, R., *The Journal of Physical Chemistry C* (2012), 116, 24757-24769.
21. "Strong quantum-confined Stark effect in Individual Localization Centres within InGaN quantum well based light emitting diodes" De, S.; **Layek, A.**; Bhattacharya, S.; Das, D.; Kadir, A.; Bhattacharya, A.; Dhar, S.; Chowdhury, A. *Applied Physics Letter* (2012), 101, 129919.
22. "Carrier Recombination Dynamics through Defect States of ZnO Nanocrystals: From Nanoparticles to Nanorods" **Layek, A.**; Manna, B.; Chowdhury, A. *Chemical Physics Letters* (2012), 539-540, 133-138.
23. "Optoelectronic behaviors and carrier dynamics of individual localized luminescent centers in InGaN quantum-well light emitting diodes" De, S.; Das, D.; **Layek, A.**; Raja, A.; Singh, M. K.; Bhattacharya, A.; Dhar, S.; Chowdhury, A. *Applied Physics Letter* (2011), 99, 251911(1-4). [Selected as January 9, 2012 issue of *Virtual Journal of Nanoscale Science & Technology*]
24. "Two Distinct Origins of Highly Localized Luminescent Centers within InGaN/GaN Quantum-Well Light-Emitting Diodes" De, S.; **Layek, A.**; Raja, A.; Kadir, A.; Gokhale, M. R.; Bhattacharya, A.; Dhar, S.; Chowdhury, A. *Advanced Functional Materials* (2011), 21, 3828-3835. [Selected as [frontispiece "highlight article"](#) for Oct 23 Issue]
25. "ZnO nanocrystals in strong confinement regimes: Insight on relaxation dynamics of defect states responsible for the visible luminescence" **Layek, A.***; Chowdhury, A. *International Journal of Nanoscience* (2011), 10 (4,5), 681-685. [* corresponding author]

26. "Spectrally resolved photoluminescence imaging of ZnO nanocrystals at single-particle levels" **Layek, A.***; De,S.; Thorat, R.; Chowdhury, A.* *The Journal of Physical Chemistry Letters* (2011), 2(11), 1241-1247. [* corresponding author]
27. "Synthesis of Vanadium Oxide Nanoclusters in Confined Environment via a Template-Exchange Method" Selvam, P.; Krishna, V.; **Layek, A.** *Nanoporous Materials* (2008), 8, 179-186.

Professional Activities.

Refereeing Journals.

Analytical Methods, Journal of Materials Chemistry C, Plasmonics, RSC Advances, Advanced Powder Technology, New Journal of Chemistry.

(I) Conferences/Invited Talks (India)

1. S. Banerjee, **A. Layek*** "A review on the detection and quantification of Neuropeptide Y (NPY) molecule - a cause of mental depression disorder (MDD)" Global Summit on Sustainable Science and Technology 2022 (**GS3T 2022**) (Oral)
2. **A. Layek**, V. Arora, Sameer Sapra, Arindam Chowdhury, "Unraveling the Dual Emission Of Single Quantum-Dot By Single Particle Spectroscopy" National Conference on Frontiers in Modern Physics 2021 (**NCFMP 2021**) (Oral)
3. **A. Layek**, "Single Molecule Fluorescence Microscopic Aspect of Broad Defect Luminescence in Semiconductor Nanocrystals", National E-Conference on Advanced Research in Materials Science 2021 (**NCARMS 2021**). (Oral)
4. **A. Layek**, Direct correlation of structure-activity relation of nanosized zeolites using correlated super-resolution fluorescence and electron microscopy, Department of Chemistry, Indian Institute of Technology Bombay, (27/03/2017: Mumbai, India). (*Invited Talk*)
5. **A. Layek**, Fluorescence Microscopy as a tool to monitor chemical reactions inside solid catalysts at the single molecule level, (10/04/2017: St. Xavier's College, Kolkata). (*Invited Talk*)
6. Indo-US Workshop on Frontiers of Excellence in Photovoltaic Science and Technologies, January 15-17, 2012, IIT Bombay, India.
7. **A. Layek**, A. Chowdhury, "Photoluminescence Imaging and Spectroscopy of Single Nanoparticle: Insight on ZnO Defects", **International Conference on Chemistry and Complexity, December 6-8, 2011**, Indian Association for the Cultivation of Science, Jadavpur, Kolkata, India
8. **A. Layek**, A. Hazarika, D. D. Sarma, A. Chowdhury, "Photoluminescence Spectroscopy of CdSe-ZnS-CdSe-ZnS Quantum Dot/ Quantum-Well Systems at Single Particle Level" National Symposium on **New Horizons in Chemistry**, October 3-4, 2011, IIT Bombay, India
9. **A. Layek**, A. Chowdhury, "Synthesis of Size Quantized ZnO Nanocrystals and their Characterization: A Detailed Study" International Conference on Nanoscience and Technology (**ICONSAT 2010**), February 17-20, 2010, IIT Bombay, Mumbai, India.
10. **A. Layek**, A. Chowdhury, "Photoluminescence Imaging and Spectroscopy of Single CdSe Quantum Dots" 3rd Asia Pacific Symposium on Radiation Chemistry and Trombay Symposium on Radiation & Photochemistry (**APSRC-TSRP 2010**), September 14-17, 2010, Lonavala, India.
11. **A. Layek**, A. Chowdhury, "ZnO Quantum Dots and their Spectroscopic Investigation by Electronic and Optical Microscopy" **Fluorescence 2009**, March 16-19, 2009, TIFR, Mumbai, India.
12. Orientation Programme for Research Scholars in Catalysis, November 17- December 7, 2006, National Center for Catalysis Research, Department of Chemistry, IIT Madras, India

(II) Conferences/Invited Talks (Abroad)

1. **A. Layek**, M. Roeffaers, “Correlated light and electron microscopy tool for direct structure-activity mapping of zeolite catalysts”, **Catalysis Science & Technology 10th Anniversary Symposium 2021**.
2. **A. Layek**, M. Roeffaers, “Correlated super-resolution fluorescence and electron microscopy tools to probe structure-function relation of solid acid catalysts”, 15th **International Conference on Methods and Applications of Fluorescence (MAF 2017)**, September 10-13, 2017, Bruges, Belgium.
3. Defect Network Materials Science and Engineering (**DEFNET 2015**) Workshop, December 1-4, 2015, KU Leuven, Leuven, Belgium
4. The Workshop on Nonlinear Imaging and Microscopy in Biology and Materials Science (**ECONOS 2015**), April 12-15, 2015, KU Leuven, Leuven, Belgium
5. **A. Layek**, "Heterogeneity of Defect Energy Levels in Semiconductors: Looking at them through Single Quantum Dot PL Microscopy and Spectroscopy" May 12, 2012, Institut für Physikalische und Theoretische Chemie, University of Tübingen, Tübingen, Germany. [**Invited Talk**]
6. **A. Layek**, "Carrier Recombination Dynamics in Single Quantum Dot/ Quantum Well Structures" May 9, 2012, Institute of Physical Chemistry, Johannes Gutenberg University Mainz, Mainz, Germany. [**Invited Talk**]
7. **A. Layek**, A. Hazarika, D.D. Sarma, A. Chowdhury, Photoluminescence Imaging and Spectroscopy of Single Quantum Dots: Insight on doping the undoped, **E-MRS 2012** Spring Meeting, May 14-18, 2012, Strasbourg Congress Centre, Strasbourg, France. [**Oral**]
8. **A. Layek**, V, Arora, U. Soni, S. Sapra, A. Chowdhury, Photoluminescence Imaging and Spectroscopy of Single CdSe/ZnS/CdSe/ZnS Quantum-Dot Quantum-Well System, 16th International Conference on Luminescence (**ICL' 11**), June 26-July 1, 2011, University of Michigan, USA.