

Dr. Pramod P. Pillai

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Education **Ph. D., 2008**
National Institute for Interdisciplinary Science and Technology (NIIST-CSIR),
Trivandrum, India
M.Sc. Chemistry, 2004
Mahatma Gandhi University, Kottayam, India
B. Sc. Industrial Chemistry, 2001
Mahatma Gandhi University, Kottayam, India

Research interests Physical Chemistry; Material Chemistry; Nanomaterials; Light-Matter Interactions at Nanoscale; Photochemistry and Photophysics; Self-assembly

Research Experience/
Employment History **Associate Professor** **2019 - present**
Indian Institute of Science Education and Research Pune, India

- Ligand 'gated' photochemistry and photophysics with hybrid nanomaterials
- Controlling the thermodynamics of self-assembly at nanoscale
- Extracting hot charges and heat from plasmonic materials

Assistant Professor **2014 - 2019**
Indian Institute of Science Education and Research Pune, India

- Investigation of the fundamental as well as applied properties of hybrid nanomaterials
- Controlling interplay of forces to improve and impart functionalities at nanoscale
- Self-assembly, light harvesting and bio-targeting studies with hybrid nanomaterials

Postdoctoral research **2011 - 2014**
Northwestern University, Illinois, U. S. A
Advisor: Prof. Bartosz A. Grzybowski

- Fabricated novel electrically bistable devices based on metal-polymer nanocomposite with controllable dielectric breakdown.
- Developed a general strategy to self-assemble colloids and nanomaterials, by modulating magnetic fields at the micron-scale.
- Designed and developed new family of mixed charge nanomaterials with unique chemical (stability, self-assembly etc.) and biological (antimicrobial, cellular uptake etc.) properties.

Postdoctoral research**2008 - 2010***Technical University, Dortmund, Germany**Advisor: Prof. Christof M. Niemeyer*

- Incorporated semiconductor nanomaterials into colloidal silica nanospheres for cell imaging studies.
- Bio-functionalized luminescent colloidal silica beads for DNA hybridization studies.
- Designed and studied energy transfer process between luminescent silica beads and fluorescent proteins.

Ph. D. research**2004 - 2008***NIIST, Trivandrum, India**Advisor: Prof. K. George Thomas*

- Published first report on the covalent functionalization of ruthenium trisbipyridine chromophores on gold nanoparticles and tuned their optoelectronic properties.
- Improved the electron accepting properties of single-walled carbon nanotubes through covalent functionalization of metal nanoparticles.
- For the first time, experimentally demonstrated the existence of edge effect in gold nanorods.
- Controlled the plasmon coupling in dimers of gold nanorods using aromatic and alkyl dithiols.

Awards

- Awarded the Renewed Research Fellowship under the *Alexander von Humboldt fellowship* Alumni Program in 2019.
- Awarded the prestigious *Alexander von Humboldt fellowship* in November 2008.
- *Best poster award* in February 2008 for the All India Chemistry Symposium conducted by the Chemical Research Society of India (CRSI).
- Qualified the prestigious all India *CSIR-JRF/NET* exam of the Council of Scientific and Industrial Research, Government of India in June 2003.
- Qualified Graduate Aptitude Test in Engineering (*GATE*) in 2006.
- University *second rank* for M.Sc. and *first rank* (Topper) for B.Sc.

Sponsored
R&D
Projects

- SERB/EMR/2015/001561 (2016 – 2018): Interdigitated Metal-Semiconductor Nanowires as a Platform for Plasmon Sensitized Light Harvesting Devices, 41.9 lakhs (INR)
- DST/SR/NM/NS-1014/2017 (2018 – 2020): Charge Transport and Mechanical Motion in One Dimensional Nanomaterials: Towards Ultrasensitive Detection and Mechanochemistry, 79.6 lakhs (INR)
- SERB/CRG/2019/003960 (2021-2023): Surface Ligand Directed Catalysis: Outplaying Ligand Poisoning in Metal and Semiconductor Nanoparticle Catalyzed Reactions, 29.1 lakhs (INR)

Academic
Activities

- Reviewer for Scientific Journals including JACS, ACS Catal., ACS Nano, Chem. Mater., JPCL, JPC, ACSAMI, ACSANM, Angewandte, Small, ChemPhyschem, Chem. Sci., Nanoscale, PCCP, etc.
- Member of American Chemical Society (ACS)
- Lifetime member of Chemical Research Society of India (CRSI)

Publications

- 1) Electrostatically Directed Long-Range Self-Assembly of Nucleotides with Cationic Nanoparticles To Form Multifunctional Bioplasmonic Networks. Roy, S.; Adury, V. S. S.; Rao, A.; Roy, S.; Mukherjee, A.; **Pillai, P. P.** *Angew. Chem. Int. Ed.* **2022**, *61*, e202203924.
- 2) When Design Meets Function: The Prodigious Role of Surface Ligands in Regulating Nanoparticle Chemistry. Jain, V.; Roy, S.; Roy, P.; **Pillai, P. P.** *Chem. Mater.* **2022**, *34*, 7579-7597.
- 3) Insights into the Utilization and Quantification of Thermoplasmonic Properties in Gold Nanorod Arrays. Kashyap, R. K.; Dwivedi, I.; Roy, S. Roy, S.; Rao, A.; Subramaniam, C. **Pillai, P. P.** *Chem. Mater.* **2022**, *34*, 7369–7378.
- 4) Nanoparticle Self-Assembly: From Design Principles to Complex Matter to Functional Materials. Rao, A.; Roy, S.; Jain, V.; **Pillai, P. P.** *ACS Appl. Mater. Interfaces* **2022**, DOI: 10.1021/acsmi.2c05378.
- 5) Plasmonic Photocatalysis: Activating Chemical Bonds through Light and Plasmon. Jain, V.; Kashyap, R. K.; **Pillai, P. P.** *Adv. Optical Mater.* **2022**, *10*, 2200463.
- 6) Enhancing the Photocatalytic Regeneration of Nicotinamide Cofactors with Surface Engineered Plasmonic Antenna-Reactor System. Dhankhar, A.; Jain, V.; Chakraborty, I. N.; **Pillai, P. P.** *J. Photochem. Photobiol. A: Chem.* **2022**, *437*, 114472.
- 7) Effect of Nanoparticle Size on Plasmonic Heat-Driven Organic Transformation. Kashyap, R. K.; Parammal, M. J.; **Pillai, P. P.** *ChemNanoMat* **2022**, e202200252.
- 8) The Unconventional Role of Surface Ligands in Dictating the Light Harvesting Properties of Quantum Dots. Chakraborty, I. N.; Roy, P.; Rao, A.; Devatha, G.; Roy, S.; **Pillai, P. P.** *J. Mater. Chem. A* **2021**, *9*, 7422-7457.
- 9) Temporal Changes in Interparticle Interactions Drive the Formation of Transiently Stable Nanoparticle Precipitates. Rao, A.; Roy, S.; **Pillai, P. P.** *Langmuir* **2021**, *37*, 1843–1849.
- 10) Electrostatically Driven Multielectron Transfer for the Photocatalytic Regeneration of Nicotinamide Cofactor. Roy, S.; Jain, V.; Kashyap, R. K.; Rao, A.; **Pillai, P. P.** *ACS Catal.* **2020**, *10*, 5522–5528.
- 11) Multicolor Luminescent Patterning via Photoregulation of Electron and Energy Transfer Processes in Quantum Dots. Devatha, G.; Roy, P.; Rao, A.; Roy, S.; **Pillai, P. P.** *J. Phys. Chem. Lett.* **2020**, *11*, 4099–4106.
- 12) Electrostatically Driven Resonance Energy Transfer in an All-Quantum Dot Based Donor–Acceptor System. Roy, P.; Devatha, G.; Roy, S.; Rao, A.; **Pillai, P. P.** *J. Phys. Chem. Lett.* **2020**, *11*, 5354–5360.
- 13) Accelerated Reduction of 4-Nitrophenol: Bridging Interaction Outplays Reducing Power in the Model Nanoparticle-Catalyzed Reaction. Shirin, S.; Roy, S.; Rao, A.; **Pillai, P. P.** *J. Phys. Chem. C* **2020**, *124*, 19157–19165.
- 14) Förster Resonance Energy Transfer Regulated Multicolor Photopatterning from Single Quantum Dot Nanohybrid Films. Devatha, G.; Rao, A.; Roy, S.; **Pillai, P. P.** *ACS Energy Lett.* **2019**, *4*, 1710–1716.
- 15) InP/ZnS Quantum Dots as Efficient Visible-Light Photocatalysts for Redox and Carbon–Carbon Coupling Reactions. Chakraborty, I. N.; Roy, S.; Devatha, G.; Rao, A.;

Pillai, P. P. *Chem. Mater.* **2019**, *31*, 2258–2262.

- 16) Turn-On Selectivity in Inherently Nonselective Gold Nanoparticles for Pb²⁺ Detection by Preferential Breaking of Interparticle Interactions. Rao, A.; Kumar, G. S.; Roy, S.; Rajesh, A. T.; Devatha, G.; **Pillai, P. P.** *ACS Appl. Nano Mater.* **2019**, *2*, 5625–5633.
- 17) Photoluminescence Quenching in Self-Assembled CsPbBr₃ Quantum Dots on Few-Layer Black Phosphorus Sheets. Muduli, S.; Pandey, P.; Devatha, G.; Babar, R.; Kothari, D. C.; Kabir, M.;* **Pillai, P. P.**;* Ogale, S.* *Angew. Chem. Int. Ed.* **2018**, *57*, 7682–7686.
- 18) Precise Nanoparticle–Reactant Interaction Outplays Ligand Poisoning in Visible–Light Photocatalysis. Roy, S.; Roy, S.; Rao, A.; Devatha, G.; **Pillai, P. P.** *Chem. Mater.* **2018**, *30*, 8415–8419.
- 19) Electrostatically Regulated Photoinduced Electron Transfer in “Cationic” Eco-friendly CuInS₂/ZnS Quantum Dots in Water. Xavier, J. A. M.; Devatha, G.; Roy, S.; Rao, A.; **Pillai, P. P.** *J. Mater. Chem. A.* **2018**, *6*, 22248–22254.
- 20) Revealing the Role of Electrostatics in Gold Nanoparticle Catalyzed Reduction of Charged Substrates. Roy, S.; Rao, A.; Devatha, G.; **Pillai, P. P.** *ACS Catal.* **2017**, *8*, 3879–3884.
- 21) Electrostatically Driven Resonance Energy Transfer in “Cationic” Biocompatible Indium Phosphide Quantum Dots. Devatha, G.; Roy, S.; Rao, A.; Mallick, A.; Basu, S.; **Pillai, P. P.** *Chem. Sci.* **2017**, *7*, 7141–7145.
- 22) Trapping, Manipulation, and Crystallization of Live Cells using Magnetofluidic Tweezers. Timonen, J. V. I.; Raimondo, C.; Pilans, D.; **Pillai, P. P.**; Grzybowski, B. A. *Nanoscale Horiz.* **2017**, *2*, 50–54.
- 23) Regulation of Interparticle Forces Reveals Controlled Aggregation in Charged Nanoparticles. Rao, A.; Roy, S.; Unnikrishnan, M.; Bhosale, S. S.; Devatha, G.; **Pillai, P. P.** *Chem. Mater.* **2016**, *28*, 2348–2355.
- 24) Engineering Gram Selectivity of Mixed-Charge Gold Nanoparticles by Tuning the Balance of Surface Charges. **Pillai, P. P.**; Kowalczyk, B.; Kandere-Grzybowska, K.; Borkowska, M.; Grzybowski, B. A. *Angew. Chem. Int. Ed.* **2016**, *55*, 8610–8614.
- 25) Electrostatic Titrations Reveal Surface Compositions of Mixed, On-Nanoparticle Monolayers Comprising Positively and Negatively Charged Ligands. **Pillai, P. P.**; Kowalczyk, B.; Pudlo, W. J.; Grzybowski, B. A. *J. Phys. Chem. C* **2016**, *120*, 4139–4144.
- 26) Self-assembly of Like-Charged Nanoparticles into Microscopic Crystals. **Pillai, P. P.**; Kowalczyk, B.; Grzybowski, B. A. *Nanoscale* **2016**, *8*, 157–161.
- 27) Synthesis of Toroidal Gold Nanoparticles Assisted by Soft Template. Yan, Y.; **Pillai, P. P.**; Timonen, J. V. I.; Emami, F. S.; Vahid, A.; Grzybowski, B. A. *Langmuir* **2014**, *30*, 9886–9890.
- 28) Mechanical Control of Surface Adsorption by Nanoscale Cracking. Zhuang, Q.; Warren, S. C.; Baytekin, B.; Demirörs, A. F.; **Pillai, P. P.**; Kowalczyk, B.; Grzybowski, B. A. *Adv. Mater.* **2014**, *26*, 3667–3672.

- 29) Colloidal Assembly Directed by Virtual Magnetic Moulds Demirörs. A. F.; **Pillai, P. P.**; Kowalczyk, B.; Grzybowski, B. A. *Nature* **2013**, *503*, 99-103.
- 30) Controlled pH Stability and Adjustable Cellular Uptake of Mixed-Charge Nanoparticles. **Pillai, P. P.**; Huda, S.; Kowalczyk, B.; Grzybowski, B. A. *J. Am. Chem. Soc.* **2013**, *135*, 6392-6395.
- 31) Nanostructural Anisotropy Underlies Anisotropic Electrical Bistability. **Pillai, P. P.**; Paclawski, K.; Kim, J.; Grzybowski, B. A. *Adv. Mater.* **2013**, *25*, 1623-1628.
- 32) Gold Nanoparticle-Functionalized Carbon Nanotubes for Light-Induced Electron Transfer Process. **Pramod, P.**; Soumya, C. C.; Thomas, K. G. *J. Phys. Chem. Lett.* **2011**, *2*, 775-781.
- 33) Quantum Dot-Encoded Silica Nanospheres for Nucleic Acid Hybridization. **Pillai, P. P.**; Reisewitz, S.; Schroeder, H.; Niemeyer, C. M. *Small* **2010**, *6*, 2130-2134.
- 34) Organic Nanomaterials: Morphological Control for Charge Stabilization and Charge Transport. **Pramod, P.**; Thomas, K. G.; George, M. V. *Chem. Asian J.* **2009**, *4*, 806- 823.
- 35) Plasmon Coupling in Dimers of Au Nanorods. **Pramod, P.**; Thomas, K. G. *Adv. Mater.* **2008**, *20*, 4300-4305.
- 36) Preferential Functionalization of Au nanorods Through Electrostatic Interactions. **Pramod, P.**; Joseph, S. T. S.; Thomas, K. G. *J. Am. Chem. Soc.* **2007**, *129*, 6712-6713.
- 37) Interaction of thiol derivative of Ru(II)trisbipyridyl complex with gold nanorods. Morphological changes and excited state interactions. Jebb, M.; Sudeep, P. K.; **Pramod, P.**; Thomas, K. G.; Kamat, P. V. *J. Phys. Chem. B* **2007**, *111*, 6839-6844.
- 38) Photochemistry of Ruthenium Trisbipyridine Functionalized on Gold Nanoparticles. **Pramod, P.**; Sudeep, P. K.; Thomas, K. G.; Kamat, P. V. *J. Phys. Chem. B* **2006**, *110*, 20737-20741.
- 39) Gold Nanorods to Nanochains: Mechanistic Investigations on their Longitudinal Assembly Using α,ω -Alkanedithiols and Interplasmon Coupling. Joseph, S. T. S.; Ipe, B. I.; **Pramod, P.**; Thomas, K. G. *J. Phys. Chem. B* **2006**, *110*, 150-157.

Selected
Talks &
Presentations

- 1) 'Hot Carriers' and 'Hot Surfaces': The Two Faces of Plasmons in Chemical Transformations; In Conference on Advances in Catalysis for Energy and Environment (CACEE -2022), TIFR Mumbai, 31 October – 04 November 2022.
- 2) Surface Ligand Directed Light Harvesting with Nanomaterials; In National Conference on Recent Trends in Materials Science (NCMST 2021), Organized by INST Trivandrum, 29-31 December 2021.
- 3) Photochemistry and Photophysics with Surface Engineered Nanomaterials; In Workshop in Chemistry for PG Students & Teachers, Organized by Calicut Chemistry Collective, Kerala, Online Conference, 19 November 2021.
- 4) Multicolour Luminescent Patterning via Photoregulation of Electron and Energy Transfer Processes in Quantum Dots; In 11th Asian Photochemistry Conference (APC 2021), 01-04 November 2022.
- 5) Photochemistry and Photophysics with Surface Engineered Quantum Dots; In nanoGe:

- NCFun21. Fundamental Processes in Nanocrystals and 2D Materials, 21-22 October 2021.
- 6) Photochemistry and Photophysics with Surface Engineered Quantum Dots; In Covid-19 Lecture Series-Spring 2021, University of Miami, 27 February 2021.
 - 7) Photophysics and Photopatterning with Surface Engineered Quantum Dots; In ChemSci2020, Leaders in the Field Symposium (RSC Sponsored Chemical Science Virtual Symposium) IISER Kolkata, 07 – 10 December 2020.
 - 8) Surface Ligand Directed Catalysis by Nanomaterials; In Emerging Frontiers in Chemical Sciences (EFCS 2020), Farook College, Calicut, Kerala, 04 – 05 December 2020.
 - 9) Ligand Directed Light Harvesting by Nanomaterials; In Departmental Talk in Chemical Sciences, TIFR Mumbai; 19 October 2020.
 - 10) Ligand Directed Catalysis by Nanomaterials; In Virtual National Seminar on Catalysis and Photocatalysis for Clean Energy (CPCE 2020), NIT Jamshedpur, 09 – 10 October 2020.
 - 11) Catalysis and Light Harvesting by Nanomaterials; In National Seminar on Frontiers in Materials and Chemical Sciences (NSFMC 20), Jain (deemed to be University), Bangalore, Aug 31-04 Sept 2020.
 - 12) Career in nanoscience: How BIG is Small; In Sree Narayana College, Kerala, 17 August 2020.
 - 13) Ligand as a ‘Gatekeeper’ in Nanoparticle Catalyzed Reactions; In International Conference on Recent Trends in Catalysis 2020 (RTC 2020)” held at NIT Calicut, Kerala (India) February 26-29, 2020.
 - 14) Surface Ligand Directed Light Harvesting by Nanoparticles; In International Conference on Ultrafast Spectroscopy (ICUS 2020)” held at IISER Thiruvananthapuram, Kerala (India) February 21-22, 2020.
 - 15) Surface Ligand Directed Catalysis and Light Harvesting by Nanoparticles; In International Conference on Energy and Environment (ICEE 2k19)” held at T.K.M. College of Arts & Science, Kollam Kerala (India) December 12-14, 2019.
 - 16) Surface Ligand Directed Catalysis and Light Harvesting by Nanoparticles; In Institut Charles Sadron (ICS) – CNRS at University of Strasbourg, Strasbourg, (France) June 18, 2019.
 - 17) Crafting Advanced Nanoparticle Functions through Interplay of Forces and Interactions; In Institut de Science et d'Ingénierie Supramoléculaires (ISIS) at University of Strasbourg, Strasbourg, (France) June 17, 2019.
 - 18) Regulation of Interparticle Interactions: In Search of Advanced Nanoparticle Functions; In Donostia International Physics Center (DIPC), San Sebastian, (Spain) June 13, 2019.
 - 19) Transformations on the Surface of Nanoparticles: Not all Ligands are ‘Poisonous’ for Catalysis; In *Students Seminar Organized by SFB 838* at Westfälische Wilhelms-Universität (WWU, SFB 858), Muenster, (Germany) June 05, 2019.
 - 20) Regulation of Interparticle Interactions: In Search of Advanced Nanoparticle Functions; In Westfälische Wilhelms-Universität (WWU), Muenster, (Germany) June 04, 2019.
 - 21) Regulation of Interparticle Forces for Advanced Nanoparticle Functions: In Institute for Biological Interfaces 1 (IBG-1) at Karlsruhe Institute of Technology (KIT), (Germany) May 15, 2019.
 - 22) Regulation of Interparticle Forces for Advanced Nanoparticle Functions; In 1st Indian

Materials Conclave and 30th Annual General Meeting of MRSI” held at IISc Bangalore, (India) February 12-15, 2019.

- 23) Regulation of Interparticle Forces for Advanced Nanoparticle Functions; In Humboldt Kolleg 2019” held at Kashid, Maharashtra, (India) 31st January – 02nd February 2019.
- 24) Regulation of Interparticle Forces for Advanced Nanoparticle Functions; In International Conference on Chemistry and Physics of Advanced Materials - III held at IISER Pune, (India) October 08-09, 2018.
- 25) Regulation of Interparticle Forces for Advanced Nanoparticle Functions; In Gordon Research Conference on Noble Metal Nanoparticles held at South Hadley, Boston, (U. S.A.) June 17-23, 2018.
- 26) Controlling the Interparticle Interactions for Advanced Nanoparticle Functions; In *International Conference on Advanced Nanostructures (ICAN 2018)* held at Catholicate College, Kerala, (India) March 12-14, 2018.
- 27) Controlling the Interparticle Interactions for Advanced Nanoparticle Functions; In IISER-Weizmann Institute of Science scientific workshop held at IISER Pune, (India) January 18-19, 2018.
- 28) Exploring Nanoscience - How BIG is Small; As a resource person in Inspire Internship Camp held at Sacred Heart College, Kochi, Kerala, (India) January 09-13, 2018.
- 29) Crafting Advanced Nanoparticle Functions through Interplay of Forces; In Inter IISER & NISER Chemistry Meet (IINCM-2017) held at NIISER Bhubaneswar, Orissa, (India) December 22-24, 2017
- 30) Crafting Advanced Nanoparticle Functions by Controlling Interparticle Interactions; In Humboldt Colloquium held at Bengaluru, (India) November 23–25, 2017
- 31) Crafting Advanced Nanoparticle Functions by Controlling Interparticle Interactions; In International Conference of Young Researchers in Advanced Materials (IUMRS-ICYRAM 2016) held at IISc Bangalore, (India) December 11-15, 2016
- 32) Coding Nanoparticle Functionalities by Tuning the Nanoscale Forces; In Gordon Research Conference on Noble Metal Nanoparticles held at South Hadley, Boston, (U. S.A.) June 19-25, 2016.
- 33) Regulation of Interparticle Interactions: In Search of Advanced Nanoparticle Functions; In Department of Chemistry, University of North Carolina at Chapel Hill, North Carolina, USA on June 17, 2016.
- 34) Regulation of Interparticle Interactions: In Search of Advanced Nanoparticle Functions: In Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana, USA on June 14, 2016.