

Dr. Koustav Pal

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DOB: 14 January 1997 Nationality: Indian



Professional Profile

Experimental condensed-matter physicist working on CVD/CVT-grown 2D van der Waals quantum materials, heterostructures, twisted bilayers, magnetism, and low-temperature transport. Experienced in materials growth, heterostructure assembly, device fabrication, electrical transport, and magneto-optical Kerr-effect measurements, with characterization expertise in AFM, MFM, Raman spectroscopy, EDS, and TEM. PhD research involved bulk and thin-film synthesis, SQUID/PPMS measurements, structural characterization, and computational modelling of exchange bias and magnetoresistance.

Research and Academic Experience

Postdoctoral Researcher

January 2026–Present

Spin X Institute, South China University of Technology

Panyu District, Guangzhou, Guangdong 511442, China

Focus: CVD/CVT-grown 2D quantum materials, van der Waals heterostructures, and twisted bilayer systems; characterization using AFM, MFM, EDS, TEM, and Raman spectroscopy; device fabrication; electrical transport measurements; and magneto-optical Kerr effect characterization.

Assistant Professor

July 2025–December 2025

Institute of Engineering and Management

Kolkata 700091, India

Courses taught: Engineering Physics (undergraduate); Physics Laboratory.

Post-Ph.D. Research Period

January 2025–June 2025

Saha Institute of Nuclear Physics (SINP)

Kolkata 700064, India

Focus: Completion and dissemination of doctoral research outcomes, including preparation and submission of pending manuscripts, response to peer-review, and finalization of remaining experimental investigations arising from the Ph.D. work.

Academic Qualifications

Doctoral Degree (Ph.D.) in Physics

2019–2024

Institution: Saha Institute of Nuclear Physics (SINP), Kolkata 700064, India

Affiliated to: Homi Bhabha National Institute (HBNI), Mumbai 400094, India

Completed: December 2024 ***Best Thesis Award 2024***

Supervisor: Prof. Indranil Das, Senior Professor & HOD, CMP & SPMS Divisions

Thesis: *Investigation of Exchange Bias and Magnetotransport in Bulk and Thin Films Materials*

Master of Science (M.Sc.) in Physics

2017–2019

Institution: Indian Association for the Cultivation of Science, Jadavpur, West Bengal 700032

Affiliated to: Jadavpur University

Average: 84.6%

Bachelor of Science (B.Sc.) in Physics (Hons.)

2014–2017

Institution: Ramakrishna Mission Residential College, Narendrapur, West Bengal

Affiliated to: University of Calcutta

Average: 79.37%

Distinction: Medal for securing the second-highest marks in B.Sc. Physics Honours

Research Publications

2026

1. **K. Pal***, S. Ghosh, N. N. S. V. Rama Raju, C. Prasad, K. Das, I. Das, “Coexistence of Griffiths phase and superparamagnetic-like behavior in La-doped antiferromagnetic CaMnO_3 ,” *Materials Science and Engineering: B* **335**, 119875 (2026).
2. B. Esmaeilzadeh*, Z. R. Usha, H. Chamkouri, S. Li, **K. Pal**, D. Wu, “Engineering optical coupling strategies for Photo-Enhanced scanning probe microscopy,” *Optics & Laser Technology* **204**, 116592 (2026).
3. H. Zhou*, **K. Pal**, “Stark Effect and Valley Polarization of Interlayer Excitons in 3° Twisted Bilayer WSe_2 ,” *Photonics* **13**, 579 (2026).
4. **K. Pal***, S. Ghosh, I. Das, “Disorder-Induced Griffiths-like Phase and Charge Localization in $\text{Sr}_2\text{FeRuO}_6$,” *The Journal of Physical Chemistry C* **130**, 6416–6423 (2026).
5. A. Karikar, **K. Pal***, K. Das, K. Pradhan, B. Satpati, I. Das, “Advanced protocols for enhancing magnetocaloric effect and relative cooling power: Phenomena important for cooling technology,” *Materials Research Bulletin* **198**, 114021 (2026).

2025

6. A. Ahmed, **K. Pal***, I. Das, “Alteration and enhancement in magnetocaloric effect through ionic engineering,” *Inorganic Chemistry Communications* **179**, 114760 (2025).
7. **K. Pal***, S. Mandal, S. Dey, K. Pradhan, I. Das, “Unraveling the origins of exchange bias and magnetic anomalies in $\text{Sr}_2\text{FeRuO}_6$: Experimental and theoretical insights,” *Materials Today Communications* **46**, 112814 (2025).

2024

8. **K. Pal***, S. Dey, A. Alam, I. Das, “Revealing exchange bias in spin-compensated systems for spintronics applications,” *Scientific Reports* **14**, 30678 (2024).
9. **K. Pal***, S. Dey, I. Das, “Unraveling extraordinary magnetoresistance in $\text{GdFe}_2\text{Al}_{10}$: A comprehensive exploration of transport and magnetism for technological applications,” *Journal of Materials Chemistry C* **12**, 14936–14943 (2024).
10. **K. Pal***, S. Mandal, I. Das, “The investigation of the influence of B-site disorder on giant exchange bias: Experimental observations and theoretical insights,” *Acta Materialia* **278**, 120276 (2024).
11. **K. Pal***, I. Das, “Exploring the origin of exchange bias and spin glass behavior in 6H hexagonal perovskite structure: Structural and magnetic analysis,” *Applied Materials Today* **39**, 102316 (2024).

12. **K. Pal***, S. Dey, I. Das, “Giant Magnetoresistance Resulting from Superzone Gap in Spin-Frustrated Rare-Earth-Based Aluminide: DyFe₂Al₁₀,” *Journal of Physics: Condensed Matter* **36**, 215802 (2024).
13. **K. Pal***, I. Das, “Exploring the exchange bias of Gd and MnPt: A combined structural and magnetic investigation,” *Thin Solid Films* **790**, 140211 (2024).

2023

14. **K. Pal***, I. Das, “The impact of oxygen deficiency on giant exchange bias in perovskite oxide: SrFe_{0.5}Co_{0.5}O_{3- δ} ($\delta = 0.37$),” *Journal of Alloys and Compounds* **960**, 170794 (2023).

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Ph.D. Research Summary

My doctoral research focused on **exchange bias** and **magnetoresistance** in a diverse range of material systems — perovskite oxides, rare-earth intermetallic compounds, and sputtered thin-film multilayers — motivated by their relevance to magnetic-memory and spintronic device technologies. I synthesized all oxide and intermetallic samples via high-temperature solid-state reactions and arc melting, and deposited thin-film multilayers by AC/DC magnetron sputtering. Structural characterization using XRD, XRR, and TEM was combined with low-temperature SQUID magnetometry and PPMS transport measurements down to 1.5 K. Monte Carlo simulations calculations provided theoretical support for the experimental observations.

Technical Expertise

2D Materials	CVD (Chemical Vapour Deposition) and CVT (Chemical Vapour Transport) Single-Crystal Growth; Mechanical Exfoliation; Optical Flake Identification and Transfer; van der Waals Heterostructure Stacking; Twisted Bilayers; Moiré Physics.
Microscopy & Spectroscopy	Optical Microscopy; Atomic Force Microscopy (AFM); Magnetic Force Microscopy (MFM); Scanning Electron Microscopy (SEM); Transmission Electron Microscopy (TEM); High-Resolution TEM (HRTEM) Image Analysis; Energy-Dispersive X-ray Spectroscopy (EDS/EDX); Raman Spectroscopy; X-ray Photoelectron Spectroscopy (XPS); Fourier-Transform Infrared Spectroscopy (FTIR).
Device Fabrication	Nanolithography; Device Patterning and Fabrication; Probe-Station Electrical Transport; Magneto-Optical Kerr Effect Measurements.
Magnetism & Spintronics	Exchange Bias; Spintronics; Magnetoresistance; Magnetotransport; Magnetocaloric Effect; Spin-Frustrated and Correlated Electron Systems.
Material Synthesis	High-Temperature Solid-State Synthesis (Box and Tube Furnaces); Crystal Growth by Zone Furnace; Arc Melting; AC/DC Magnetron Sputtering; Pulsed Laser Deposition.
Structural Methods	X-Ray Diffraction; X-Ray Reflectivity; Neutron Diffraction; Rietveld Refinement; Crystal-Structure Characterization; Thin-Film Structural Analysis.

Measurement Systems	SQUID Magnetometry; Physical Property Measurement System (PPMS); Cryogenic He-Cooled Resistivity Measurements down to 1.5 K; LabVIEW-Based Instrument Interfacing.
Computation & Simulation	Python; Fortran; Custom Data-Analysis Algorithms; Monte Carlo Simulations.
Analysis Software	FullProf and Profex (Rietveld Refinement); Parratt32 (XRR); CASA and KolXPD (XPS); Gatan Microscopy Suite (HRTEM); VESTA and ChemDoodle 3D (Crystal Visualization); Origin (Scientific Plotting); L ^A T _E X (Manuscript Preparation).

Awards & Achievements

- **Best Thesis Award 2024**, Saha Institute of Nuclear Physics, Kolkata.
- **J.B. Joshi Endowment Innovation Award 2025**, Homi Bhabha National Institute, Mumbai.
- Qualified **CSIR–UGC NET** for Junior Research Fellowship and Assistant Professor eligibility, June 2019.
- Qualified **JEST (Ph.D.)** and **GATE**, 2019; **WB-SET**, 2018; and **JEST (Integrated Ph.D.)**, 2017.
- Received a medal for securing the **second-highest marks in B.Sc. Physics Honours**, University of Calcutta, 2017.
- Received a **Certificate of Merit** for placement in the **National Top 1% merit list**, Indian Association of Physics Teachers, 2017.

Fellowships & Scholarships

- **Senior Research Fellowship (SRF)**, Department of Atomic Energy, 2021–2024.
- **Junior Research Fellowship (JRF)**, Department of Atomic Energy, 2019–2021.
- **DST Fellowship**, Department of Science and Technology, 2017–2019.
- **INSPIRE Scholarship (SHE)**, Department of Science and Technology, Government of India, 2014–2017.

Conference Poster Presentations

- First DAE Conclave 2024, NISER Bhubaneswar, India
- Symposium on Magnetism and Spintronics 2024, IIT Bombay, India
- Annual Conference on Quantum Condensed Matter 2023, NISER Bhubaneswar, India
- 67th DAE Solid State Physics Symposium 2023, Visakhapatnam, India
- Condensed Matter, Materials Science & Statistical Physics Symposium 2023, Kolkata, India
- School on Fundamental Crystallography & Workshop on Rietveld Refinement 2023, Rourkela, India
- HBNI Interaction Meeting on Condensed Matter Physics 2022, Kolkata, India
- 66th DAE Solid State Physics Symposium 2022, Ranchi, India

Research Mentoring & Supervision

Research Supervision — Saha Institute of Nuclear Physics, Kolkata

Mentored postgraduate (M.Sc./M.Tech.) project students and Junior Research Fellows in experimental condensed-matter physics, providing hands-on training in AC/DC magnetron sputtering, X-ray diffraction and reflectivity analysis, SQUID magnetometry, and PPMS transport measurements.

Teaching — IEM, Kolkata

July–Dec. 2025

Taught undergraduate Engineering Physics (theory) and supervised Physics Laboratory sessions during my appointment as Assistant Professor. Responsible for course planning, student assessment, and laboratory demonstration for first-year B.Tech. students.