Sarthak Das, Ph.D.

Assistant Professor Grade - I • Optoelectronic devices with low-dimensional materials

Department of E&ECE, Indian Institute of Technology (IIT) Kharagpur, West Bengal, India

sarthak.das@ece.iitkgp.ac.in • LinkedIn • ResearchGate • Google Scholar • ORCID: 0000-0001-9526-9819

Research Profile

Assistant Professor in the Department of Electronics and Electrical Communication Engineering (E&ECE) at the Indian Institute of Technology (IIT) Kharagpur, with research interests in Quantum Optoelectronics & Cryogenic Spectroscopy. Specializing in low-dimensional quantum materials, van der Waals heterostructures, excitonic physics, valleytronics, and quantum optoelectronic devices. Research focuses on tailoring light-matter interaction, single-photon emission, and electrostatic confinement of quantum state architectures for next-generation quantum technologies.

Professional Experience

Indian Institute of Technology (IIT) Kharagpur **Jul. 2026 – Present**
Assistant Professor *Kharagpur, India*

- Development of an academic laboratory focused on Quantum Optoelectronics & Cryogenic Spectroscopy.
- Research on 2D van der Waals heterostructure optoelectronic devices, excitonic physics, and quantum technologies.

Quantum Innovation Centre (Q.InC SRTT), A*STAR **Jul. 2024 – Jul. 2026**
Scientist *Singapore*

- Led research on on-chip electrically controlled quantum single-photon emitters in 2D heterostructures.
- Principal Investigator for A*STAR Career Development Fund project on electrostatically confined quantum light sources.

Institute of Materials Research and Engineering (IMRE), A*STAR **Jan. 2022 – Jul. 2024**
Scientist *Singapore*

- Investigated valley coherence and dynamics of charged excitons via circular dichroism photoluminescence (CDPL) and Kerr rotation spectroscopy.
- Demonstrated electrical control over valley polarization in monolayer transition metal dichalcogenides (TMDs).
- Engineered solid-state spin-valley qubits and evaluated ultrathin integration dielectrics for 2D electronic platforms.

Education

Indian Institute of Science (IISc) **Sep. 2022**
Ph.D. in Electrical Communication Engineering *Bangalore, India*

- **Thesis:** Tailoring Excitonic Complexes in Layered Materials
- **Advisor:** Prof. Kausik Majumdar | **GPA:** 8.3/10.0

Jadavpur University **Jul. 2016**
M.Tech. in NanoScience and Technology *Kolkata, India*

- **Thesis:** Raman Spectroscopy and Photoluminescence Imaging of Exfoliated 2D Materials
- **Advisor:** Prof. Kalyan Kumar Chattopadhyay | **GPA:** 8.55/10.0

Kalyani Government Engineering College **Jul. 2014**
B.Tech. in Electronics and Communication Engineering *West Bengal, India*

- **GPA:** 8.76/10.0

Berhampore J N Academy **2008 – 2010**
Higher Secondary & Secondary Education *West Bengal, India*

- **Higher Secondary (2010):** 86.0% | **Secondary (2008):** 98.25%

Technical Expertise

Optical Spectroscopy	Circular Dichroic Photoluminescence (CDPL), Micro-reflectance (μ-reflectance), Raman Spectroscopy (Renishaw, Horiba, WiTec), Time-Resolved PL (TRPL), Time-Resolved Kerr Rotation (TRKR), Photoluminescence Excitation (PLE)
Cryogenics & Qubits	Low-temperature optical cryostats (Janis, Montana Instruments, Attocube), Dilution Refrigerators (Bluefors XLD), Pulsed microwave/rf qubit control platforms (Quantum Machines)
Nanofabrication	Class 100 cleanroom operational experience, Electron-Beam Lithography (EBL), Photolithography, Thermal Scanning Probe Lithography (t-SPL), Thermal & E-beam Evaporation

Device Processing	Dry/wet mechanical transfer of van der Waals heterostructures, electrical transport characterization, non-linear optics (SHG)
Computation & Modeling	Python (Data Analysis & Automation), MATLAB, OriginPro, Ansys HFSS, AutoCAD, Blender, LaTeX

Competitive Grants & Funding

Career Development Fund (CDF), A*STAR Singapore **2025 – 2028**
Principal Investigator *Singapore*

- **Project:** Tailoring Quantum Light Emission from 2D Materials Using Electrostatic Confinement
- **Grant Value:** SGD 250,000

Professional Service & Peer Review

Peer Reviewer	**APS** (*Physical Review X*)	Global	2025 – Present
Peer Reviewer	**Nature Portfolio** (*Nature Nanotechnology*, *Nature Communications*)	Global	2024 – Present
Peer Reviewer	**ACS Publications** (*ACS Nano*)	Global	2023 – Present

Selected Key Publications

1. **S. Das**†, D. Huang, I. Verzhbitskiy, *et al.*, "Electrical Control of Valley Polarized Charged Exciton Species in Monolayer WS_2," *ACS Nano*, 18(44), 30805–30815, 2024 [†Corresponding author].
2. C. S. Lau, **S. Das**, I. Verzhbitskiy, D. Huang, *et al.*, "Dielectrics for Two-Dimensional Transition Metal Dichalcogenide Applications," *ACS Nano*, 17(11), 9870–9905, 2023.
3. S. Chatterjee, M. Dandu, P. Dasika, R. Biswas, **S. Das**, *et al.*, "Harmonic to anharmonic tuning of moiré potential leading to unconventional Stark effect and giant dipolar repulsion in WS_2/WSe_2 heterobilayer," *Nature Communications*, 14, 4032, 2023.
4. **S. Das***, G. Gupta*, S. Chatterjee, K. Watanabe, T. Taniguchi, and K. Majumdar, "Highly nonlinear biexcitonic photocurrent from ultrafast inter-layer charge transfer," *ACS Nano*, 16, 9728, 2022 [*Equal contribution].
5. **S. Das**, M. Dandu, G. Gupta, K. Murali, N. Abraham, S. Kallatt, K. Watanabe, T. Taniguchi, and K. Majumdar, "Highly tunable layered exciton in bilayer WS_2: linear quantum confined Stark effect versus electrostatic doping," *ACS Photonics*, 7, 3386–3393, 2020.
6. **S. Das**, S. Kallatt, N. Abraham, and K. Majumdar, "Gate-tunable trion switch for excitonic device applications," *Physical Review B (Rapid Communication)*, 101, 081413(R), 2020.
7. **S. Das***, G. Gupta*, and K. Majumdar, "Layer degree of freedom for excitons in transition metal dichalcogenides," *Physical Review B*, 99, 165411, 2019 [*Equal contribution].
8. S. Kallatt*, **S. Das***, S. Chatterjee, and K. Majumdar, "Inter-layer charge transport controlled by exciton-trion coherent coupling," *npj 2D Materials and Applications*, 3, 15, 2019 [*Equal contribution].

Additional Peer-Reviewed Publications

1. A. Mishra, I. Verzhbitskiy, R. Lee, A. Rodin, Z. Zhang, **S. Das**, *et al.*, "Hopping conduction in quasi-1D titanium trisulfide layered nanoribbons," *Applied Physics Letters*, 127, 11, 2025.
2. I. Verzhbitskiy, A. Mishra, S. Mitra, Z. Zhang, **S. Das**, *et al.*, "Low-Temperature Contacts and the Coulomb Blockade Effect in Layered Nanoribbons with In-Plane Anisotropy," *ACS Nano*, 19(11), 10878–10888, 2025.
3. S. Mukherjee, S. Wang, D. Venkatakrishnarao, Y. Tarn, T. Talha-Dean, R. Lee, I. Verzhbitskiy, D. Huang, A. Mishra, J. W. John, **S. Das**, *et al.*, "Approaching Phonon-Limited Transport in Two-Dimensional Electronics by Oxygen-Free Fabrication," *ACS Nano*, 19(9), 9327–9339, 2025.
4. D. Venkatakrishnarao, A. Mishra, Y. Tarn, M. Bosman, R. Lee, **S. Das**, *et al.*, "Liquid Metal Oxide Assisted Integration of High-K Dielectrics and Metal Contacts for Two-Dimensional Electronics," *ACS Nano*, 18(39), 26911–26919, 2024.
5. T. Talha-Dean, Y. Tarn, S. Mukherjee, J. W. John, D. Huang, I. Verzhbitskiy, D. Venkatakrishnarao, **S. Das**, *et al.*, "Nano-Ironing van der Waals Heterostructures toward Electrically Controlled Quantum Dots," *ACS Applied Materials & Interfaces*, 16(24), 31738–31746, 2024.
6. Y. Zhang, D. Venkatakrishnarao, M. Bosman, W. Fu, **S. Das**, *et al.*, "Liquid-Metal-Printed Ultrathin Oxides for Atomi-

cally Smooth 2D Material Heterostructures," *ACS Nano*, 17(8), 7929–7939, 2023.

7. S. Chatterjee, G. Gupta, **S. Das**, K. Watanabe, T. Taniguchi, and K. Majumdar, "Trion-trion annihilation in monolayer WS_2," *Physical Review B (Letters)*, 105, L121409, 2022.
8. S. Chatterjee, **S. Das**, G. Gupta, K. Watanabe, T. Taniguchi, and K. Majumdar, "Probing biexciton in monolayer WS_2 through controlled many-body interaction," *2D Materials*, 9, 015023, 2022.
9. R. Roy, **S. Das**, N. Mazumder, D. Roy, and K. K. Chattopadhyay, "Observation of polarization dependent excitonic luminescence in few-layered WS_2 flakes," *Chemical Physics Letters*, 785, 139012, 2021.
10. R. Biswas, M. Dandu, A. Prosad, **S. Das**, S. Menon, J. Deka, K. Majumdar, and V. Raghunathan, "Strong Near Band-edge Excited Second-Harmonic Generation from Multilayer 2H Tin Diselenide," *Scientific Reports*, 11, 15017, 2021.
11. J. R. Gadde, A. Karmakar, T. K. Maji, S. Mukherjee, R. Alexander, A. M. R. Sharma, **S. Das**, A. Mandal, K. Dasgupta, A. Naik, K. Majumdar, R. Hawaldar, K. N. V. D. Adarsh, S. Ray, and D. Karmakar, "Two-dimensional ReS_2: Solution to the Unresolved Queries on Its Structure and Inter-layer Coupling Leading to Potential Optical Applications," *Physical Review Materials*, 5, 054006, 2021.
12. A. Mohapatra, **S. Das**, K. Majumdar, M. S. R. Rao, and M. Jaiswal, "Thermal transport across wrinkles in few-layer graphene stacks," *Nanoscale Advances*, 3, 2252–2259, 2021.
13. T. Maji, A. Rajlakshmi, S. Mukherjee, R. Alexander, A. Mondal, **S. Das**, R. Sharma, N. Chakraborty, K. Dasgupta, M. Anjanashree, R. Hawaldar, M. Pandey, A. Naik, K. Majumdar, S. Pal, K. N. V. D. Adarsh, S. K. Ray, and D. Karmakar, "Combinatorial Large-area MoS_2/Anatase-TiO_2 Interface: A Pathway to Emergent Optical and Opto-electronic Functionalities," *ACS Applied Materials & Interfaces*, 12, 44345, 2020.
14. S. Sarkar, I. Maity, H. L. Pradeepa, G. Nayak, L. Marty, J. Renard, J. Coraux, N. Bendiab, V. Bouchiat, **S. Das**, K. Majumdar, M. Jain, and A. Bid, "Anharmonicity in Raman-active phonon modes in atomically thin MoS_2," *Physical Review B*, 101, 205302, 2020.
15. K. Murali, N. Abraham, **S. Das**, S. Kallatt, and K. Majumdar, "Highly Sensitive, Fast Graphene Photodetector with Responsivity $> 10^6$ A/W Using Floating Quantum Well Gate," *ACS Applied Materials & Interfaces*, 11, 30010, 2019.
16. M. Dandu, R. Biswas, **S. Das**, S. Kallatt, S. Chatterjee, M. Mahajan, V. Raghunathan, and K. Majumdar, "Strong Single- and Two-Photon Luminescence Enhancement by Non-Radiative Energy Transfer across Layered Heterostructure," *ACS Nano*, 13, 4795, 2019.
17. K. Murali*, M. Dandu*, **S. Das**, and K. Majumdar, "Gate tunable WSe_2/$SnSe_2$ backward diode with ultra-high reverse rectification ratio," *ACS Applied Materials & Interfaces*, 10, 5657, 2018 [*Equal contribution].

Book Chapters

1. F. Bussolotti, **S. Das**, W. Tong, and K. E. J. Goh, "Valley Addressability and Controllability," in *Valleytronics in 2D Materials*, World Scientific Publishing Company, 2023.

Conferences & Symposia

1. **S. Das**, "Quantum Engineering of Valley States in Monolayer WS_2 Using External Bias," *International Conference on Materials for Advanced Technologies (ICMAT)*, 2025. [**Oral Presentation**]
2. **S. Das**, K. E. J. Goh, "Coherent coupling between neutral and charged exciton," *Bulletin of the American Physical Society (APS March Meeting)*, 2025. [**Oral Presentation**]
3. **S. Das**, H. Ding, I. Verzhbitskiy, C. S. Lau, K. E. J. Goh, "Valleytronics with Charged Excitons: Electrical Control and Polarization Switching," *Institute of Physics Singapore (IPS)*, 2024. [**Oral Presentation**]
4. **S. Das**, H. Ding, I. Verzhbitskiy, K. Watanabe, T. Taniguchi, C. S. Lau, K. E. J. Goh, "Electrical control over valley polarization for charge excitonic species," *Recent Progress in Graphene and 2D Materials Research (RPGR)*, 2023. [**Oral Presentation**]
5. **S. Das**, I. Verzhbitskiy, H. Ding, Z.-E. Ooi, F. Bussolotti, C. S. Lau, K. E. J. Goh, "Investigating the Compatibility of MoO_3 as Alternative Dielectric: A Spectroscopic Approach," *ICMAT*, 2023.
6. **S. Das**, S. Chatterjee, G. Gupta, K. Majumdar, "Nonlinear, Ultra-fast photocurrent generation using charged biexciton," *APS March Meeting*, 2022. [**Oral Presentation**]
7. **S. Das**, K. Majumdar, "Excitons in flatland," *EECS Research Students Symposium*, IISc, 2021. [**Oral Presentation**]
8. **S. Das***, G. Gupta*, K. Majumdar, "Layer distribution of excitons in few-layer TMDC," *Graphene Conference*, Rome, 2019.

Awards & Honors

Best Poster Award	International Conference on Materials for Advanced Technologies (ICMAT)	Singapore	2023
Best Presentation in Session Award	EECS Research Students Symposium, IISc Bangalore	Bangalore, India	2021
Student Travel Grant Award	Graphene 2019	Rome, Italy	2019
MHRD Central Sector Scheme Scholarship	Government of India	India	2010 – 2014
Amul Vidya Bhushan Award	Amul Educational Excellence	India	2011
Selected Participant	CSIR Programme on Youth for Leadership in Science (CPYLS)	India	2008

Academic & Professional References

Dr. Kausik Majumdar — **kausikm@iisc.ac.in**
Associate Professor — *IISc Bangalore*

- Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore, India.

Prof. Kuan Eng Johnson Goh — **kejgoh@yahoo.com**
Senior Principal Scientist, Adjunct Professor — *A*STAR, DSO & CQT*

- Director, Quantum Engineering Programme (QEP) | Quantum Sensing Centre, DSO National Laboratories, Singapore.

Dr. Varun Raghunathan — **varunr@iisc.ac.in**
Associate Professor — *IISc Bangalore*

- Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore, India.

Dr. Ivan A. Verzhbitskiy — **ivan_verzhbitskiy@a-star.edu.sg**
Senior Scientist — *A*STAR Singapore*

- Quantum Innovation Centre (Q.InC SRTT), A*STAR, Singapore.