

Dr. Jeevesh Kumar

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Education

Course	Specialization	University/ Institution	Year
PhD & MTech Res.	2D Materials & Devices	Indian Institute of Science, Bangalore, India	2022
BTech	ECE	National Institute of Technology, Trichy, India	2013

Key Contributions

Jeevesh's key contributions include atomic-level investigations of 2D materials, especially graphene, phosphorene, and transition metal dichalcogenides (TMDs), to address their technological roadblocks and reliability challenges. In computational investigations, he used QuantumATK tools for the density functional theory (DFT) and molecular dynamic (MD) simulations to explore the materials' fundamental properties and contact interfaces. Based on the theoretical finding, he further explored and engineered different materials and their devices using an integrated electrical and optical characterization system. Jeevesh's key findings consist proposal of direct bandgap opening in graphene by creating hydrogenated or fluorinated vacancy patterns [10], and defect-assistance contact resistance engineering of graphene's [2], [4], [29] and TMDs' [1], [16], [17], [18], [26], FETs. He further explored phosphorene's ambient degradation dynamics and degradation stakeholders of the material [5], [15], [27] and devices [6], [24]. He also investigated the thermal evolution of different Raman characteristics of phosphorene [7]. Besides, Jeevesh worked on the various reliability issues of the graphene [11], [12], [25] and TMDs [3], [13], [20], [21], [22], [28] along with their device performance improvement for electronic applications. [8], [9], [23]

Research Publications (Journals & Conferences)

1. **Jeevesh Kumar**, and Mayank Shrivastava. "Role of Chalcogen Defect Introducing Metal-Induced Gap States and Its Implications on Metal-TMDs' Interface Chemistry", ACS Omega, 2023. DOI: [10.1021/acsomega.2c07489](https://doi.org/10.1021/acsomega.2c07489)
2. Adil Meersha*, **Jeevesh Kumar***, Abhishek Mishra, Harsha B. Variar, and Mayank Shrivastava. "Vacancy Assisted Bilayer Graphene Contact for Monolayer Graphene Channel Devices" IEEE Electron Device Letters 44, no. 4 (2023): 666-669. (*Equal contribution). DOI: [10.1109/LED.2023.3250329](https://doi.org/10.1109/LED.2023.3250329)
3. Ansh, Utpreksh Patbhaje, **Jeevesh Kumar**, Adil Meersha, and Mayank Shrivastava. "Origin of electrically induced defects in monolayer MoS2 grown by chemical vapor deposition." Communications Materials 4, no. 1 (2023): 8. DOI: [10.1038/s43246-023-00333-y](https://doi.org/10.1038/s43246-023-00333-y)
4. **Jeevesh Kumar**, Adil Meersha, Harsha B. Variar, Abhishek Mishra, and Mayank Shrivastava. "Carbon Vacancy Assisted Contact Resistance Engineering in Graphene FETs.", IEEE Transactions on Electron Devices 69, no. 4 (2022): 2066-2073. DOI: [10.1109/TED.2022.3151033](https://doi.org/10.1109/TED.2022.3151033)
5. **Jeevesh Kumar**, and Mayank Shrivastava. "First-Principles Molecular Dynamics Insight into the Atomic Level Degradation Pathway of Phosphorene." ACS omega (2022). DOI: [10.1021/acsomega.1c05353](https://doi.org/10.1021/acsomega.1c05353)
6. **Jeevesh Kumar**, Utpreksh Patbhaje, and Mayank Shrivastava. "Role of Channel Inversion in Ambient Degradation of Phosphorene FETs", IEEE Transactions on Electron Devices 69, no. 6 (2022): 3353-3358. DOI: [10.1109/TED.2022.3171504](https://doi.org/10.1109/TED.2022.3171504)
7. **Jeevesh Kumar**, Utpreksh Patbhaje, and Mayank Shrivastava. "Breathing Mode's Temperature Coefficient Estimation and Interlayer Phonon Scattering Model of Few-layer Phosphorene", ACS omega 7, no. 48 (2022): 43462-43467. DOI: [10.1021/acsomega.2c03759](https://doi.org/10.1021/acsomega.2c03759)
8. Hemanjaneyulu, Kuruva, **Jeevesh Kumar**, and Mayank Shrivastava. "Gaps in the Y-Function Method For Contact Resistance Extraction in 2D Few-Layer Transition Metal Dichalcogenide Back-Gated FETs." IEEE Electron Device Letters 43, no. 4 (2022): 635-638. DOI: [10.1109/LED.2022.3149410](https://doi.org/10.1109/LED.2022.3149410)
9. Hemanjaneyulu, Kuruva, Adil Meersha, **Jeevesh Kumar**, and Mayank Shrivastava. "Unveiling Unintentional Fluorine Doping in TMDs During the Reactive Ion Etching: Root Cause Analysis, Physical Insights, and Solution." IEEE Transactions on Electron Devices 69, no. 4 (2022): 1956-1963. DOI: [10.1109/TED.2022.3152459](https://doi.org/10.1109/TED.2022.3152459)

10. **Jeevesh Kumar**, Ansh, and Mayank Shrivastava. "Introduction of Near to Far Infrared Range Direct Band Gaps in Graphene: A First Principle Insight." ACS omega 6, no. 8 (2021): 5619–5626. DOI: [10.1021/acsomega.0c06058](https://doi.org/10.1021/acsomega.0c06058)
11. Mishra, Abhishek, Adil Meersha, N. K. Kranthi, **Jeevesh Kumar**, NS Veenadhari Bellamkonda, Harsha B. Variar, and Mayank Shrivastava. "Unified Mechanism for Graphene FET's Electrothermal Breakdown and Its Implications on Safe Operating Limits." IEEE Transactions on Electron Devices 68, no. 5 (2021): 2530–2537. DOI: [10.1109/TED.2021.3068081](https://doi.org/10.1109/TED.2021.3068081)
12. **Jeevesh Kumar**, Ansh, and Mayank Shrivastava. "Stone–Wales Defect and Vacancy–Assisted Enhanced Atomic Orbital Interactions Between Graphene and Ambient Gases: A First-Principles Insight." ACS omega 5, no. 48 (2020): 31281–31288. DOI: [10.1021/acsomega.0c04729](https://doi.org/10.1021/acsomega.0c04729)
13. Ansh, **Jeevesh Kumar**, Gaurav Sheoran and Mayank Shrivastava, "Electrothermal Transport Induced Material Re-Configuration and Performance Degradation of CVD-Grown Monolayer MoS₂ Transistors", npj 2D Mater Appl 4, 37 (2020). DOI: [10.1038/s41699-020-00171-3](https://doi.org/10.1038/s41699-020-00171-3)
14. Shankar Bhawani, Swati Shikha, Anant Singh, **Jeevesh Kumar**, Ankit Soni, Sayak Dutta Gupta, Srinivasan Raghavan, and Mayank Shrivastava. "Time Dependent Shift in SOA Boundary and Early Breakdown of Epi-Stack in AlGaIn/GaN HEMTs Under Fast Cyclic Transient Stress." IEEE Transactions on Device and Materials Reliability 20, no. 3 (2020): 562–569. DOI: [10.1109/TDMR.2020.3007128](https://doi.org/10.1109/TDMR.2020.3007128)
15. Andrew E. Naclerio, Dmitri N. Zakharov, **Jeevesh Kumar**, Bridget Rogers, Cary L. Pint, Mayank Shrivastava, and Piran R. Kidambi "Visualizing Oxidation Mechanisms in Few-Layered Black Phosphorus via In Situ Transmission Electron Microscopy" ACS Applied Materials & Interfaces 2020 12 (13), 15844–15854. DOI: [10.1021/acsami.9b21116](https://doi.org/10.1021/acsami.9b21116)
16. Ansh, **Jeevesh Kumar**, Gaurav Sheoran, Harsha B. Variar, Ravikesh Mishra, Hemanjaneyulu Kuruva, Adil Meersha, Abhishek Mishra, Srinivasan Raghavan, and Mayank Shrivastava. "Chalcogen–Assisted Enhanced Atomic Orbital Interaction at TMD–Metal Interface and Sulfur Passivation for Overall Performance Boost of 2-D TMD FETs." IEEE Transactions on Electron Devices 67, no. 2 (2020): 717–724. DOI: [10.1109/TED.2019.2958338](https://doi.org/10.1109/TED.2019.2958338)
17. Ansh, **Jeevesh Kumar**, Gaurav Sheoran, Ravikesh Mishra, Srinivasan Raghavan, and Mayank Shrivastava. "Selective Electron or Hole Conduction in Tungsten Diselenide (WSe₂) Field-Effect Transistors by Sulfur-Assisted Metal-Induced Gap State Engineering." IEEE Transactions on Electron Devices 67, no. 1 (2019): 383–388. DOI: [10.1109/TED.2019.2956781](https://doi.org/10.1109/TED.2019.2956781)
18. Hemanjaneyulu Kuruva, **Jeevesh Kumar**, and Mayank Shrivastava. "MoS₂ doping using potassium iodide for reliable contacts and efficient FET operation." IEEE Transactions on Electron Devices 66, no. 7 (2019): 3224–3228. DOI: [10.1109/TED.2019.2916716](https://doi.org/10.1109/TED.2019.2916716)
19. Sayak Dutta Gupta, Ankit Soni, Vipin Joshi, **Jeevesh Kumar**, Rudrarup Sengupta, Heena Khand, Bhawani Shankar et al. "Positive Threshold Voltage Shift in AlGaIn/GaN HEMTs and E-Mode Operation By Al_xTi_{1-x}O Based Gate Stack Engineering." IEEE Transactions on Electron Devices 66, no. 6 (2019): 2544–2550. DOI: [10.1109/TED.2019.2908960](https://doi.org/10.1109/TED.2019.2908960)
20. **Jeevesh Kumar**, Hemanjaneyulu, Kuruva, Harsha B. Variar, Utpreksh Patbhaje, and Mayank Shrivastava. "Atomic-level Insight and Quantum Chemistry of Ambient Reliability Issues of the TMDs Devices" In 2023 IEEE International Reliability Physics Symposium (IRPS), IEEE, 2023. DOI: [10.1109/IRPS48203.2023.10118245](https://doi.org/10.1109/IRPS48203.2023.10118245)
21. Utpreksh Patbhaje, Rupali Verma, **Jeevesh Kumar**, Ansh, and Mayank Shrivastava, "Unveiling Field Driven Performance Unreliabilities Governed by Channel Dynamics in MoSe₂ FETs", In 2023 IEEE International Reliability Physics Symposium (IRPS), IEEE, 2023. DOI: [10.1109/IRPS48203.2023.10117743](https://doi.org/10.1109/IRPS48203.2023.10117743)
22. Rupali Verma, Utpreksh Patbhaje, **Jeevesh Kumar**, Anand Kumar Rai, and Mayank Shrivastava, "OFF State Reliability Challenges of Monolayer WS₂ FET Photodetector: Impact on the Dark and Photo-illuminated state", In 2023 IEEE International Reliability Physics Symposium (IRPS), IEEE, 2023. DOI: [10.1109/IRPS48203.2023.10117978](https://doi.org/10.1109/IRPS48203.2023.10117978)
23. Asif A. Shah, **Jeevesh Kumar**, Aadil Bashir Dar and Mayank Shrivastava, "Unveiling Root Cause of Defect Assisted Filamentation and Implication on Resistive Switching in MoS₂ Atomristor", In 2023 IEEE Electron Devices Technology and Manufacturing (EDTM), IEEE, 2023. DOI: [10.1109/EDTM55494.2023.10102955](https://doi.org/10.1109/EDTM55494.2023.10102955)
24. **Jeevesh Kumar**, Utpreksh Patbhaje, and Mayank Shrivastava. "Unveiling Additional Ambient Degradation Issues of Phosphorene FETs under Laser Exposer and Positive Gate Bias", In 2022 IEEE international conference on emerging electronics (ICEE). IEEE, 2022. DOI: [10.1109/ICEE56203.2022.10118342](https://doi.org/10.1109/ICEE56203.2022.10118342)
25. **Jeevesh Kumar**, and Mayank Shrivastava. "Are Argon and Nitrogen Gases Really Inert to Graphene Devices?" In 2022 Device Research Conference (DRC), pp. 1–2. IEEE, 2022. DOI: [10.1109/DRC55272.2022.9855822](https://doi.org/10.1109/DRC55272.2022.9855822)

26. **Jeevesh Kumar**, Ansh, Hemanjaneyulu Kuruva, and Mayank Shrivastava. "Defect Assisted Metal-TMDs Interface Engineering: A First Principle Insight." In 2020 Device Research Conference (DRC), pp. 1-2. IEEE, 2020. DOI: [10.1109/DRC50226.2020.9135158](https://doi.org/10.1109/DRC50226.2020.9135158)
27. **Jeevesh Kumar**, *et al.* "Physical Insights into Phosphorene Transistor Degradation Under Exposure to Atmospheric Conditions and Electrical Stress." In 2020 IEEE International Reliability Physics Symposium (IRPS), pp. 1-4. IEEE, 2020. DOI: [10.1109/IRPS45951.2020.9129123](https://doi.org/10.1109/IRPS45951.2020.9129123)
28. Ansh, Ansh, Gaurav Sheoran, **Jeevesh Kumar**, and Mayank Shrivastava. "First Insights into Electro-Thermal Stress Driven Time-Dependent Permanent Degradation Failure of CVD Monolayer MoS₂ Channel." In 2020 IEEE International Reliability Physics Symposium (IRPS), pp. 1-4. IEEE, 2020. DOI: [10.1109/IRPS45951.2020.9129173](https://doi.org/10.1109/IRPS45951.2020.9129173)
29. **Jeevesh Kumar**, Adil Meersha, and Mayank Shrivastava. "A First Principle Insight into Defect Assisted Contact Engineering at the Metal-Graphene and Metal-Phosphorene Interfaces." In 2019 International Conference on Simulation of Semiconductor Processes and Devices (SISPAD), pp. 1-4. IEEE, 2019. DOI: [10.1109/SISPAD.2019.8870396](https://doi.org/10.1109/SISPAD.2019.8870396)

Invited Talks

1. *Unveiling ambient degradation issues of phosphorene devices using DFT and Raman characterization*, dated 21/08/2024, in a Refresher Course on "X-Ray Crystallography, X-Ray Photoelectron Spectroscopy (XPS) with Density Functional Theory (DFT) Calculations," organized under the aegis of the Malaviya Mission Teacher Training Programme (UGC-MMTTC) IIT(ISM) Dhanbad
2. *Defect Engineering in Graphene Using DFT*, dated 20/08/2024, in a Refresher Course on "X-Ray Crystallography, X-Ray Photoelectron Spectroscopy (XPS) with Density Functional Theory (DFT) Calculations," organized under the aegis of the Malaviya Mission Teacher Training Programme (UGC-MMTTC) IIT(ISM) Dhanbad

Skills and Expertise

Simulation Skills & Tools	■ Density Functional Theory (DFT), Molecular Dynamics (MD), QuantumATK, VASP.
Device Processing	■ 2D material back gated FETs using exfoliation to the lift-off process flow, Ebeam lithography (Raith Pioneer), RIE (Oxford), Ebeam evaporator (TEC-PORT).
Device & Material Characterization	■ DC & Pulse Measurements (Keithley 4200), Raman Spectroscopy & Photoluminescence (Horiba LabRam HR), Atomic Force Microscopy (Park NX10 AFM Systems), Thermoreflectance (Microsanj).
Soft Skills & Languages	■ UNIX, MATLAB, Verilog HDL, Shell, Python, C.

Employment History

NOV, 2023 – Present	■ Assistant Professor , Department of Electronics Engineering, IIT ISM, Dhanbad, India.
JUN, 2022 – OCT, 2023	■ Research Associate I in Nanoelectronics team, <i>MSD Lab</i> , DESE, IISc, Bangalore, India.
JUN, 2013 – JUN, 2016	■ ASIC Digital Design Engineer I & II in USB team, <i>Solution Group</i> , Synopsys, Bangalore, India.

Selected Awards and Honors

2024 ■ Tag Corporation Medal for the Best PhD Thesis, by IISc Bangalore.

Technical Committees & Professional Organizations

2019–Present ■ Member, IEEE EDS Kolkata Chapter.