BALPARTAP SINGH

balpartap31@gmail.com | Ph: +91-9868512786 | Google Scholar | LinkedIn

EDUCATION

Bachelor of Technology, Textile Technology, Indian Institute of Technology Delhi, GPA: 8.22 Aug 2018 to May 2022

AWARDS AND ACHIEVEMENTS

2023 Prime Minister Research Fellowship

The Prime Minister's Research Fellowship (PMRF) is India's most prestigious scholarship program that aims to attract talented students to pursue research in cutting-edge science and technology fields. My solid research background in my undergrad studies and willingness to contribute towards research and development led to me being awarded the PMRF Scholarship.

2019 REX Karmaveer Global Fellowship and Karmaveer Chakra Award

The fellowship aims to mentor young leaders to understand the value of character-rooted leadership. I was awarded for contributing to Girl Up Wings, Delhi Chapter, which aimed to strengthen underprivileged girls.

RESEARCH EXPERIENCE

Multidimensional 3D-2D Perovskites for Ultrastable Photovoltaics
Indian Institute of Science Bangalore **Jan 2023 to Present**

- Fabricated solar cell devices based on 3D-2D halide perovskites using glovebox synthesis.
- Preparation of 2D spacer molecules and perovskite crystals using hot injection synthesis.
- Mastered multiple characterization tools such as FESEM, EDS Mapping, UV-Vis-NIR, Raman spectroscopy, TCSPC, etc.
- Focused on understanding the interface formed between 3D and 2D layers w.r.t charge carrier and lattice dynamics.
- **Courses Done:** Optical Materials and Devices, Organic Electronics, Solar Devices, Electron Microscopy, and Materials Synthesis: Quantum Dots to Bulk Crystals.

Structural Health Monitoring of Nonwoven Materials via Self-Similar Arrays of Carbon Nanotubes
IIT Delhi and University of Szeged, Hungary **Aug 2021 to Apr 2022**

- Engineered statistical self-similarity in glass fiber-based nonwoven and functionalized multiwalled CNT (f-MWCNTs).
- Examined strain sensing using a custom-designed benchtop stretching assembly.
- Demonstrated the fractal nature of f-MWCNTs and proposed a four-stage deformation model.

Auxetic Behavior of Buckypaper through Coarse-Grained Molecular Dynamics Simulations
IIT Delhi and Clemson University, USA **May 2021 to July 2021**

- Developed bead spring models for single-walled- and double-walled CNT buckypaper using Python script.
- Formulated simulation scripts for LAMMPS and performed using high performance computing (HPC) cluster.
- Modelled characteristic pair-potentials demystifying buckypaper behavior under tensile strain and explored the origin of the negative Poisson ratio in CNT buckypapers.

Analyzing Parallel Combination of Lock-In-Amplifiers
IIT Delhi **May 2019**

- Designed graphical flow with the LabVIEW application programming interface for connection between lock-in-amplifiers and output sources.
- Extracted real-time data from lock-in-amplifiers and performed further analysis.

WORK EXPERIENCE

Prime Minister Research Fellow **Jan 2023 to Present**
Indian Institute of Science Bangalore

Fabrication of Perovskite Solar Cells | Interface Characterization | Charge and Exciton Dynamics in 3D-2D Heterostructures

Junior Research Fellow **June 2022 to Aug 2022**
Indian Institute of Technology Delhi

Theoretical modelling of sustainable nonwoven-based Gas Diffusion Layers in PEM Fuel Cells for compression-recovery behavior| Fabricated C-fiber/PA6 reinforced conductive nonwoven composites

Research Intern **Nov 2019 to Dec 2019**
Centre of Excellence, Sportech, Wool Research Association

Investigated polyurethane and para-aramid shear thickening fluid-based-composites for sportswear applications demanding high impact resistance | Utilized tricot and raschel warp knitting machines to fabricate stretch and non-stretch sportswear

PUBLICATIONS

1. **Singh, Balpartap, et al. "Unravelling Interface-Driven and Loss Mechanisms-Centric Phenomena in 3D/2D Halide Perovskites: Prospects for Optoelectronic Applications".** ACS Omega 2024, 9, 9, 10000-10016
   The review discusses various complications and degradation pathways at the interface of multidimensional heterojunction semiconductors. It focuses on four of the prime factors that impact device efficiency, namely, lattice mismatch, energy level alignment, loss mechanisms, and charge carrier dynamics.

2. **Singh, Balpartap, et al. "Structural health monitoring of nonwoven materials via self-similar arrays of carbon nanotubes."** Composites Communications 32 (2022): 101155
   A facile, scalable, and cost-effective vacuum filtration process was employed to successfully prepare SS-NI-MWCNTs that eventually explored the 'self-sensing' ability of carbon nanotubes. The merits of the disordered nature of random arrays of MWCNTs and glass-fiber nonwoven were investigated. Eventually, a four-stage deformation mechanism was proposed.

3. **Rahane, Ganesh, et al. "Phase and Morphology Engineered TiO_2 for Interface Optimization in Mesoporous Perovskite Solar Cells".** Under Review
   The work focused on examining the impact of interface characteristics between the mesoporous electron transport layer (TiO_2) and perovskite layer on device performance through phase and morphology modulation in the mesoporous layer. Further, DFT was employed to understand the adhesion chemistry and alignment between the Perovskite-ETL interface.

4. **Jagadish, Kusuma, et al. "Charge Carrier Dynamics in Bandgap Modulated Covellite-CuS Nanostructures".** Accepted in Small
   The study revealed the importance of transition metal doping primarily impacting valence band positions and the hole transport in doped CuS nanostructures. With terahertz and transient spectroscopy, we disentangled the trapping, de-trapping and scattering phenomena in the doped systems.

5. **Schiller, Ulf, et al. "Experimental and numerical analysis of the impact of decontamination treatments on the filtration performance of N95 respirators."** APS March Meeting Abstracts. Vol. 2022, pp. W10-002. 2022
   We investigated the filtration performance of the critical filtration layers of melt-blown nonwovens after treatment with four different decontamination methods.

TECHNICAL SKILLS

Application Software MATLAB, LAMMPS, Visual Molecular Dynamics, LaTeX, Blender, Nanoscope

Modelling and Analysis MS Excel, Origin, OVITO, Python, Design Expert, ImageJ

Experimental Techniques	Perovskite Device Fabrication, Hot Injection Synthesis, Hydrothermal Synthesis, Vacuum Filtration, Thermal Evaporation Deposition
Hands-on Tools	X-ray diffraction, FE-SEM, EDS Mapping, UV-visible spectroscopy, Raman Spectroscopy, Time-resolved Photoluminescence, Cathodoluminescence, Confocal PL Mapping

CONFERENCES/WORKSHOPS

Organizing Committee Member: International Conference on Advanced Characterization Techniques -2023 (Online) conducted on 18th Aug 2023 at the Indian Institute of Science Bangalore.

Conference Attended

1. Device Physics Characterization and Interpretation in Perovskite and Organic Materials (DEPERO), 3-5th October 2023
2. Molecularly Designed Functional Materials 2023 (MDFM 23), 28-30th September 2023 (Online)

Poster Presentation titled "The Goods and Bads of 2D-Perovskite Passivation: The Case of Triple Cation Mixed Halide Perovskite" at the 37th Annual Students' Symposium held at the Indian Institute of Science Bangalore, 29-30th February