

# Curriculum Vitae

## Upkar Kumar Verma

Assistant Professor

Department of Physics

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**Carrier Objective:** Foreseeing an opportunity to work as a scientist in an organization dealing with the physics of thin film based optoelectronic devices suitable for biomedical applications, where I can utilize my past experiences, skills sets to Initiative & Innovative things based on my Academic & Applied Research knowledge gained at highly Interdisciplinary working environment present at National Center for Flexible Electronics, IIT-Kanpur.

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### Research Interest:

- Electrical and optoelectronic properties of organic semiconductors and devices
  - Developing novel optical and electrical characterization methods
  - Charge carrier dynamics using transient measurements
  - Device physics and the mechanisms operative in organic/perovskite solar cells
  - Flexible optoelectronic devices using printing techniques for biomedical applications
  - Special emphasis on physics of *organic/perovskite solar cells*
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**Present Status:** *Assistant professor* in the department of *physics*, B S N V PG College Lucknow since 16<sup>th</sup> April 2022

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### Academic Profile:

- **PhD:** Physics, 2017, from *Indian Institute of Technology Kanpur, India*.  
*Thesis Title:* Trapping & Recombination in P3HT:PCBM Bulk Heterojunction Solar Cells: influence of device structure using photocapacitance, impedance, and photovoltage decay techniques  
*Advisor:* Prof. Y. N. Mohapatra
  - **M.Sc.:** Physics (Specialization Electronics), 2007, University of Lucknow, Lucknow, Uttar Pradesh, India.
  - **B.Sc.:** (Physics, Mathematics), 2005, University of Lucknow, Lucknow, Uttar Pradesh, India.
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### Employment History (*Post Ph.D.*):

1. *Assistant Professor* in the Department of Physics, B S N V PG College, Lucknow since 16<sup>th</sup> April 2019.
2. *Project Scientist* at Centre of Excellence for Large Area Flexible Electronics, IIT Kanpur from 1<sup>st</sup> April 2017 to 15<sup>th</sup> April 2019.

## Publications:

1. Sunil Kumar, **Upkar K. Verma**, Y. N. Mohapatra, “Negative contribution to the reverse bias capacitance of organic diodes due to field dependent mobility: determination of barrier height and transport parameters” *Journal of Applied Physics* vol. 124 (3), p.035501, 2018.
  2. **Upkar K. Verma**, Sunil Kumar, Y. N. Mohapatra, “Measurement of contact surface photovoltage from forward bias C-V characteristics of P3HT:PCBM based BHJ solar cells”, *Solar Energy Materials & Solar Cells*, vol. 172, pp.25-33, 2017.
  3. **Upkar K. Verma**, Sunil Kumar, Y. N. Mohapatra, “Comparison between conventional and inverted solar cells using open circuit voltage decay transients”, *Journal of Applied Physics*, vol. 122, p. 085503, 2017.
  4. **Upkar K. Verma**, Durgesh C. Tripathi, Y. N. Mohapatra, “Direct determination of defect density of states in organic bulk heterojunction solar cells”, *Applied Physics Letters*, vol.109, p. 113301, 2016.
  5. Sunil Kumar, **Upkar K. Verma**, Y. N. Mohapatra, “Estimation of the Occupied Density of States Using Capacitance–Voltage Measurement in the NPB System”, *In: R. Sharma, D. Rawal (eds) The Physics of Semiconductor Devices. IWPSD2017. Springer Proceedings in Physics, Springer, Cham*, vol. 215, pp. 1065-1070, 2019.
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## Conferences/Workshops:

1. **Poster presentation** titled “Estimation of the Occupied Density of States Using Capacitance–Voltage Measurement in the NPB System”, in *XIX<sup>th</sup> International Workshop on the Physics of Semiconductor Devices (IWPSD-2017)* at Indian Institute of Technology Delhi, India, 11<sup>th</sup>-15<sup>th</sup> Dec. 2017.
2. **Oral presentation** titled “Trap Identification in Organic Bulk Heterojunction P3HT:PCBM device using Impedance Spectroscopy under Light and Dark Conditions”, in *XVIII<sup>th</sup> International Workshop on the Physics of Semiconductor Devices (IWPSD-2015)* at Indian Institute of Science Bangalore, India, 7<sup>th</sup>-9<sup>th</sup> Dec. 2015.
3. **Poster presentation** titled “Photocapacitance-Voltage Characteristics of Organic Bulk Heterojunction Solar Cell”, in *XI<sup>th</sup> International Conference on Organic electronics (ICOE-2015)* at Friedrich-Alexander University Erlangen, Germany, 15<sup>th</sup>-17<sup>th</sup> June 2015.
4. **Poster presentation** titled “Capacitance Changes in Bulk Heterojunction Solar Cell under Illumination”, in *XVII<sup>th</sup> International Workshop on the Physics of Semiconductor Devices (IWPSD-2013)* at Amity University Noida, India, 10<sup>th</sup>-13<sup>th</sup> Dec. 2013.
5. **Oral presentation** titled “Gold Nano-Particles Embedded MIS structure acting as a Non-volatile Organic Memory Device”, in *International conference on Frontiers in Nanoscience, Nanotechnology and Their Applications (Nanoscitech-2012)* at Punjab University Chandigarh, India, 16<sup>th</sup>-18<sup>th</sup> Feb. 2012.
6. **Poster presentation** titled “Gold Nano-Particles Embedded Organic Semiconductor used in MIS structure for Memory Applications”, in *XVI<sup>th</sup> International Workshop on Physics of Semiconductor Devices (IWPSD-2011)* at IIT Kanpur, India, 19<sup>th</sup>-22<sup>nd</sup> Dec. 2011.
7. **Poster presentation** titled “Nonvolatile Organic Memory Device based on Embedded Gold Nano-Particles” in *National Review and coordination Meeting of Nano Mission Council- Nano Science and Nano Technology 2011* at IIT Delhi, India, 25<sup>th</sup>-27<sup>th</sup> Feb. 2011.

## Experimental Skills:

### **Fabrication:**

- Working in the class 1000 clean room environment.
- Experience in handling (operation and maintenance) vacuum systems based on Rotary, Diffusion and Turbo Molecular pumps
- Handling of Nitrogen glove-box integrated with spin coater and thermal evaporator.
- Basics of Fabricating OPVs, OLEDs, OTFTs, Organic sensors etc.
- Photolithography technique to form desired patterns of thin films.
- Thin film deposition using a variety of deposition techniques (standard and homemade), such as Spin-coating, Langmuir–Blodgett technique, Drop-casting, and Vacuum sublimation.

### **Characterization:**

- Routine electrical characterizations like I-V measurement, Impedance spectroscopy (C-V, C-f, Z-f) at room temperature as well as low temperatures
- Optical spectroscopic studies like UV-Visible absorbance, Photoluminescence (PL), Time Resolved Photoluminescence (TRPL), Electroluminescence (EL).
- Self designed advanced characterization tools such as transient of open circuit voltage, DLTS, capacitance transient, and Electroluminescence transient (ELT).
- Spectral response measurements for solar cells.
- In a process to design a tool for ultrafast transient absorption spectroscopy to study nonradiative recombination in optoelectronic devices.
- Morphological study using Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Optical Microscope, Thickness measurement using Profilometer.

## Personal Skills:

- Comprehensive problem solving abilities.
- Ability to deal with people diplomatically and willingness to learn.
- Team facilitator and hard worker.

## Technical Skills:

- **Simulation:** Silvaco Device simulator, Aimspace, MATLAB, Mathematica and Origin.
- **Programming:** Basics of Lab-VIEW, Visual Basic Dot-Net, C, C++.

## Professional Exposure:

- Working in the field of organic/hybrid optoelectronic devices since January 2009.

### **Present Work**

- Detailed Physical Processes such as charge generation, transport, collection etc., controlling the performance of organic optoelectronic devices such as organic/perovskite hybrid solar cells and OLEDs.
- Physical mechanisms like injection, transport, and recombination governing the characteristics of OSCs and OLEDs.
- Striving on various Organic Electronics Projects with a major focus on gaining the in-depth Knowledge of the subject, Fabricating Conventional & Printed Organic Solar Cells.
- My major focus here is to study about OPV Cells and OLEDs, both conventional and printed on flexible substrates, which is one of the major projects at NC-FLEX, for which I'm studying the physical properties of the fabricated devices.

- Fabricating Organic Non-Volatile Memory Embedded with Gold Nano Particles/CdSe Quantum dots.
- Gaining the issue based expertise on handling the Dimatix Material Printer 2800.
- Linking the Technological aspects of the Conventional optoelectronic devices with the Printed ones when the need arises.
- Characterizing and hence interpreting the obtained results of the fabricated devices.

### Modelling of Organic Optoelectronic Devices:

- Have been using various software tools to “Model and Simulate” the desired results of the organic optoelectronic devices.
- Have good knowledge of the Silvaco Device Simulator for various Simulations of organic electronic devices such as solar cells and OLEDs.
- Knowledge of MATLAB and Mathematica for device simulation.
- **Printing Section:** Getting hands on experience *Dimatix Material Printer* (DMP-2800) for printing on flexible substrates. *Initial exposure of LP50 Inkjet Printer.*

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### Academic Achievements:

- **National Level Exams Qualified.**
  - (a) **GATE-2009**, All India Rank-100, jointly conducted by IISc and IITs.
  - (b) **Joint CSIR–UGC Test for Junior Research Fellowship**, conducted by Council of Scientific and Industrial Research, Ministry of Human Resource Development.
  - (c) **Joint Admission Test to M.Sc. (JAM–2006)**, All India Rank-310.

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### References:


- **Dr. Y N Mohapatra**  
*Professor*, Department of Physics, Indian Institute of Technology Kanpur, India  
e-mail: [ynm@iitk.ac.in](mailto:ynm@iitk.ac.in), Ph: +91-512-2597033
- **Dr. T K Ghosh**  
*Professor*, Department of Physics, Indian Institute of Technology Kanpur, India  
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- **Dr. Ashutosh Singh**  
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### Declaration:

I hereby declare that the information provided above is correct to the best of my knowledge and I bear the responsibility for the correctness of the above mentioned particulars.

**Date:** 09/11/22  
**Place:** IIT Kanpur

  
(Upkar Kumar Verma)