TRILOK SINGH

Dr. Trilok Singh
Assistant Professor
School of Energy Science & Engineering
3rd Floor, Sir J.C. Bose Laboratory Complex
Indian Institute of Technology Kharagpur
Kharagpur - 721302, West Bengal, India
Phone: (+91) 03222-260803
Mail ID: trilok@iitkgp.ac.in and triloks.iitd@gmail.com

RESEARCH AREA AND EXPERTISE

- Organic-Inorganic lead and lead free Perovskite Solar Cell
- ALD, Plasma-CVD, CVD and Electrodeposition Techniques Photoelectrochemical Water Splitting for Solar Hydrogen Production
- Memory Devices (ReRAM)

EXPERTISE

- Organic-inorganic hybrid perovskite solar cells (solid and flexible substrates) fabrication (Materials synthesis, chemical modification of oxide surfaces, interface engineering and device upscaling).
- Material characterization techniques: XRD (Bruker D8), FTIR, SEM, TEM, UV-visible, AFM, Hall, PL, TRPL and Raman,
- Photovoltaic cell fabrication techniques: spin-coating, spray-coating, doctor blade, atomic layer deposition, plasma enhanced chemical deposition, spray pyrolysis, electrodeposition etc.
- Solar cell characterizations: I-V testing (LED or Xenon sources), MPPT (maximum power point tracking), electrochemical impedance spectroscopy (EIS), Voc decay measurements, light soaking and stability measurements.
- Managements of the Physics and Chemistry laboratory.

Education

- Doctor of Philosophy (Ph. D.) 2012, Physics, Indian Institute of Technology Delhi (IITD), India.
- Master of Technology (M. Tech.) 2007, Opto-Electronics, Shri Govindram Seksaria Institute of Technology and Science (SGSITS), Indore, India.

EMPLYOMENTS

- Assistant Professor, School of Energy Science and Engineering, IIT Kharagpur, **03/2018**
- Researcher, Toin University of Yokohama, Japan (**06/2017 to 3/2018**)
- Japan Society for the Promotion of Science (JSPS) foreign post-doctoral fellow, Toin University of Yokohama, Japan (**05/2015 -05/2017**).
- Post-doctoral researcher, University of Cologne, Cologne, Germany (**11/2011-04/2015**).
- Senior research fellow (SRF), Ministry of Human Resource Development (MHRD), New Delhi, India (**07/2009-09/2011**).

- Junior research fellow (JRF), Ministry of Human Resource Development (MHRD), New Delhi, India (**07/2007-07/2009**).

AWARDS, SCHOLARSHIPS

- JSPS Post-Doctoral Fellowship by Japan Society for the Promotion of Science (2015-2017)
- Presentation award ACeRS meeting, Daytona Beach 2014
- MHRD fellowship by Gov. of India (07/2007 to 09/2011).
- Travel grant from DST 2010
- Council of Scientific and Industrial Research (CSIR) – Eligibility Test (NET) LS qualified 2005.

PROJECT HANDLING

1. Atomic Layer Deposition of Metal Oxide Nanolaminates for Nonvolatile Resistive Switching Memory Device **(MOX-SWITCH) Role:** New materials development, device fabrication and project supervision.
2. Visible-Light Active Metal Oxide Nano-catalysts for Sustainable Solar Hydrogen Production **(SOLAROGENIX)**: **Role:** Atomic layer deposition visible light active metal oxide thin film coating for anode materials.
3. Nanosclae, flexible functional layers to improve the resistance to sliding, wear and diffucion of small elastometer components **(NANOFLEX)**.**Role:** Development of new materials via atomic layer deposition.
4. Interface Engineering of Efficient Environmental Friendly Perovskite Solar Cells **(IE^3-PSCs)**: **Role**: Planning, excution, assesment and report. (JSPS proposal)
5. Advanved Low Carbon Technology **(ALCA)**, **Role**: High efficiency and Flexible plastic based perovskite solar cell fabrication and optimization

List of Publications (Peer-reviewed Journals)

1. **Trilok Singh*,** Senol Oez, Alexander Sasinska, Robert Frohnhoven, Sanjay Mathur, Tsutomu Miyasaka, Sulfate-assisted interfacial engineering for high yield and efficiency of triple cation perovskite solar cell with alkali-doped TiO_2 electron transporting layers, ***Advanced Functional Materials***,2018, DOI: 10.1002/adfm.201706287. (****Corresponding Author) (Impact factor= 12.124)***
2. Ashish Kulkarni, **Trilok Singh**, Ajay K. Jena, Peerathat Pinpithak, Masashi Ikegami, Tsutomu Miyasaka, Vapour annealing controlled crystal growth and photovoltaic performance of bismuth triiodide embedded in mesostructured configurations, ***ACS Applied Materials and Interfaces***, 2018, DOI: 10.1021/acsami.8b00430. (**Impact factor= 7.504**)
3. **Trilok Singh*,** Tsutomu Miyasaka, Stabilizing the efficiency beyond 20% with mixed cation perovskite solar cell fabricated in ambient air under controlled humidity, ***Advanced Energy Materials*****,** 2017, 8, 1700677**.** ***(Impact factor= 16.721)***

4. **Trilok Singh***, Yosuke Udagawa, Masashi Ikegami, Hideyuki Kunugita, Kazuhiro Ema and Tsutomu Miyasaka, Tuning of perovskite solar cell performance via low-temperature brookite scaffolds surface modifications, ***APL Materials*** 5 (2017) 7. ***(Impact factor= 4.335)***

5. Ashish Kulkarni, **Trilok Singh***, Masashi Ikegami and Tsutomu Miyasaka, Tuning the morphology of bismuth-based lead-free perovskite $(CH_3NH_3)_3Bi_2I_9$ solar cells by solvent engineering technique, ***RSC Advances***,7(2017) 9456. ***(Impact factor= 3.108)***
6. Alexander Sasinsika, D. Bialuschewski, I. M. Mazharul, **Trilok Singh**, Meenal Deo, Sanjay Mathur, Experimental and theoretical insights into influence of hydrogen and nitrogen plasma on the water splitting performance of ALD grown TiO_2 thin films ***J. Physical Chemistry C***, 121 (29) (2017) 15538-15548. ***(Impact factor= 4.536)***
7. **Trilok Singh***, Jai Singh and Tsutomu Miyasaka, Role of metal oxide electron-transport layer modification on the stability of high performing perovskite solar cells, ***ChemSusChem***. 9 (2016)2559-2566. ***(Impact factor= 7.226)***
8. **Trilok Singh***, Ashish Kulkarni, Masashi Ikegami, Tsutomu Miyasaka, Effect of electron transporting layer on bismuth-based lead-free perovskite $(CH_3NH_3)_3Bi_2I_9$ for photovoltaic applications, ***ACS Applied Materials and Interfaces***, 8 (2016) 14542–14547. ***(Impact factor= 7.504)***
9. **Trilok Singh***, Tsutomu Miyasaka, High performance perovskite solar cell via multi-cycle low temperature process of lead acetate precursor solutions, ***Chemical Communications***, 52 (2016), 4784– 4787. ***(Impact factor= 6.319)***
10. Senol Öz, Jan-Christoph Hebig, Eunhwan Jung, **Trilok Singh**, Ashish Lepcha, Selina Olthof, Jan Flohre, Yajun Gao, Raphael German, Paul H.M. van Loosdrecht, Klaus Meerholz, Thomas Kirchartz, Sanjay Mathur, Zero-dimensional $(CH_3NH_3)_3Bi_2I_9$ perovskite for optoelectronic applications, ***Solar Energy Materials and Solar Cells,*** 158 (2016) 195-201. ***(Impact factor= 4.784)***
11. **Trilok Singh**, Ralf Mueller, Jai Singh and Sanjay Mathur, Tailoring of surface states in WO_3 photoanodes for efficient water splitting, ***Applied Surface Science***, 347 (2015) 448-453. ***(Impact factor= 3.387)***
12. **Trilok Singh**, Tessa Leuning, Thomas Lehnen, and Sanjay Mathur, Atomic layer deposition processed MOx for solar water splitting prospects and challenges, ***J. Vacuum Science and Technology A,*** 33 (1) (2015) 010801. ***(Impact factor= 1.724)***
13. Alexander Sasinska**#**, **Trilok Singh#**, Shuangzhou Wang and Sanjay Mathur, Enhanced photocatalytic performance of ALD grown TiO_2 thin films via hydrogenation, ***J. Vacuum Science***

and Technology A, 33 (1), (2015) 01A152. (**# *First author equal contribution***) ***(Impact factor= 1.724)***

14. Ashish Kumar, Parmod Kumar, Kaushal Kumar, **Trilok Singh**, R Singh, K Asokan, D Kanjilal, Role of growth temperature on the structural, optical and electrical properties of ZnO thin films, ***J. Alloys and Compounds***, 649 (2015) 1205-1209. ***(Impact factor= 3.133)***
15. **Trilok Singh,** Shuangzhou Wang, Nabeel Aslam, Hehe Zhang, Susanne Hoffmann-Eifert, Sanjay Mathur, Atomic Layer Deposition of transparent VOx thin films for resistive switching applications, ***Chemical Vapor Deposition*** 20 (2014) 1-7. ***(Impact factor= 1.33)***
16. **Trilok Singh,** Thomas Lehnen, Tessa Leuning, D.R. Sahu and Sanjay Mathur, "Thickness dependent fluctuations in structural, optical and electrical properties of ALD grown ZnO films, ***Applied Surface Science*** 289 (2014) 27-32. ***(Impact factor= 3.387)***
17. Andreas Mettenbörger**#**, **Trilok Singh#**, Aadesh P. Singh, Tommi T. Järvi, Michael Moseler, Martin Valldor and Sanjay Mathur, Plasma-chemical reduction of Iron oxide photoanodes for efficient solar hydrogen production, ***International Journal of Hydrogen Energy*** 39 (2014) 4828-35. (**# *First author equal contribution***) ***(Impact factor= 3.582)***
18. Sudheer Kumar, Vipin Kumar, **Trilok Singh** and R. Singh, The effect of deposition time on the structural and optical properties of β-Ga2O3 nanowires grown using CVD technique ***J. Nanoparticle Research***, 16 (2014) 2189. ***(Impact factor= 2.02)***
19. Naresh Kumar, **Trilok Singh**, 2.50 Gbit/s optical CDMA over FSO communication system, ***Optik - International Journal for Light and Electron Optics***, 125 (2014) 4538. ***(Impact factor = 0.769)***
20. Ashish Kumar, **Trilok Singh**, Mukesh Kumar, R. Singh, Sulphide passivation of GaN based Schottky diodes, ***Current Applied Physics*** 14 (2014) 491-95. ***(Impact factor= 1.971)***
21. **Trilok Singh***, D. K. Pandya and R. Singh, Effect of supporting electrolytes on the growth and optical properties of electrochemically deposited ZnO nanorods, ***Optical Materials***, 35 (2013) 1493-1497. ***(Impact factor= 2.023)***
22. **Trilok Singh*,** D.K. Pandya and R. Singh, Concentration dependent structural and optical properties of electrochemically grown ZnO thin films and nanostructures, ***Applied Surface Science***, 270 (2013) 578-583. ***(Impact factor= 3.387)***
23. **Trilok Singh***, D. K. Pandya and R. Singh, Surface plasmon driven enhancement in UV-emission of electrochemically grown $Zn_{1-x}Cd_xO$ nanorods using Au nanoparticles, ***J. Alloys and Compounds***, 552 (2013) 294-298. ***(Impact factor= 3.133)***
24. **Trilok Singh***, D. K. Pandya and R. Singh, Surface plasmon enhanced bandgap emission of electrochemically grown ZnO nanorods using Au nanoparticles, ***Thin Solid Films*** 520 (2012) 140-143. ***(Impact factor= 1.867)***

25. **Trilok Singh***, Jai singh, Atomic Layer Deposition of transparent conducting oxides, ***Reviews in Advanced Sciences and Engineering***, 2 (2013) 313-323.
26. Jai Singh, P. Kumar, D. J. Late, **Trilok Singh**, M. A. More, R. S. Tiwari, K. S. Hui, K. N.Hui and O. N. Srivastava, Optical and field emission properties in different nanostructures of ZnO, ***Digest Journal of Nanomaterials and Biostructures***, 7 (2012) 525-536. ***(Impact factor= 0.836)***
27. **Trilok Singh***, D. K. Pandya and R. Singh, Synthesis of cadmium oxide doped ZnO nanostructures using electrochemical deposition, ***J. Alloys and Compounds*** 509 (2011) 5095-5098. ***(Impact factor= 3.133)***
28. **Trilok Singh***, D. K. Pandya and R. Singh, Electrochemical deposition and characterization of elongated CdO nanostructures, ***Materials Science and Engineering B.*** 176 (2011) 945-949. ***(Impact factor = 2.552)***
29. **Trilok Singh***, D. K. Pandya and R. Singh, Growth of CdO and ZnCdO-based novel nanostructures using electrochemical deposition, ***International Journal of Nanoscience*** 10 (2011) 827-831. ***(SJR = 0.18)***
30. **Trilok Singh***, D. K. Pandya and R. Singh, Template assisted growth of Zinc oxide-based nanowires by electrochemical deposition, ***Journal of Nano-and Electronic Physics*** 3 (2011) 146-150. ***(SJR = 0.24)***
31. **Trilok Singh***, D. K. Pandya and R. Singh, Annealing studies on the structural and optical properties of electrodeposited CdO thin films, ***Materials Chemistry and Physics*** 130 (2011) 1366-1371. ***(Impact factor = 2.101)***

Book Chapters

1. Thomas Fischer, Aadesh P. Singh, **Trilok Singh**, Francisco Hernández Ramírez, Daniel Prades and Sanjay Mathur, “Metal oxide Nano-architectures and Heterostructures for Chemical Sensors”, Metal Oxide Nanomaterials for Chemical Sensors, *Springer* (2013) 397-438**. (*Book chapter*)**
2. Sanjay Mathur**, Trilok Singh**, Mahboubeh Maleki and, Thomas Fischer, Plasma-Assisted Surface Treatments and Modifications for Biomedical Applications**”,** *Biomaterials Surface Science, Wiley* (2013) 375-408. (***Book Chapter***)

Publications in proceedings of seminars / conferences

1. M. Govender, B. W. Mwakikunga, S. Mathur, **T. Singh**, A. Kaouk, Y. Gönüllü, A. G.J. Machatine and H. W. Kunert, Selective room-temperature sensing of NO_2 by WO_3 film/Graphene layers, ***SENSORS, 2014 IEEE***, 301-314.
2. **T. Singh,** T. Fischer, J. Singh, S. K. Gurram and S. Mathur, Plasma Enhanced CVD of transparent and conductive Tin oxide films, Nanostructured Materials and Nanotechnology VII: ***Ceramic Engineering and Science Proceedings*** 34, Issue 7 (2013) 99-105
3. B. Mwakikunga, **T. Singh**, I. Giebelhaus, T. Fischer, A. Lepcha, E. E. Gad, F. Guido and S. Mathur, Development of single-few-and multiple nanowires gas-sensor two terminal device on ceramic substrates and characterization by impedance spectroscopy, Nanostructured Materials and Nanotechnology VII: ***Ceramic Engineering and Science Proceedings,*** 34, 2013, 149-156.
4. B. Mwakikunga, S. S. Ray, M. Mokwena, J. Dewar, I. Geibelhaus, **T. Singh**, T. Fischer and S. Mathur, Tin dioxide nano-wire device for sensing kinetics of acetone and ethanol towards diabetes monitoring, ***Sensors, 2013 IEEE***, (2013) 1-4.
5. **T. Singh**, R. Scholz, S. H. Christiansen, U. Goesele and R. Singh, Surface exfoliation in ZnO by hydrogen implantation and its smoothening by high temperature annealing, ***Physica Status Solidi C.,*** 7, 2010, 444-447.
6. **T. Singh***, D. K. Pandya and R. Singh, Growth of ZnO based ternary nanostructures by electrodeposition, ***AIP Proceedings*** 1313, 2010, 115-117.

Presented more than 40 papers (oral and poster) in various international conferences also delivered Four Invited talks **(American ceramic Society, Daytona Beach, 2014, MRS Fall Meeting Boston 2016, IWPSD 2017, New Delhi, ISEPD2018, Jaipur 2018).**