



## **Shibin Krishna TC**

Shibin Krishna TC  
Post-Doctoral Research Fellow  
Advanced Semiconductor Laboratory  
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### **Professional Preparation**

- 2019      **National Physical Laboratory (CSIR-NPL)**, New Delhi, India  
**Ph.D. in Physical Science**  
*Thesis "Design and Fabrication of Optoelectronic Devices based on III-Nitride Semiconductors"*  
Supervisor: Dr. Govind Gupta, Principal Scientist, CSIR-NPL, New Delhi.
- 2012      **National Institute of Technology (NIT)** Calicut, Kerala, India  
**M.Sc. (Tech) Photonics**  
*Master Project Title "Growth and Characterization of Indium Nitride/Gallium nitride (InN/GaN) on single crystalline Sapphire substrate"*
- 2009      **Pazhassi Raja Nair Service Society (P.R.N.S.S)** College, Mattannur, Kannur University, Kerala  
**B.Sc. Physics.**

### **Professional Experience**

#### **Academic Appointments**

- Jun 2019- Present**      **Post-Doctoral Research Fellow**, Advanced Semiconductor Laboratory, King Abdullah University of Science and Technology (KAUST), Saudi Arabia. Supervisor: Prof. Xiaohang Li.
- Aug 2018- Feb 2019**      **Research Associate**, Department of Physics, Indian Institute of Technology, Delhi (IITD), India. Supervisor: Prof. Rajendra Singh
- Aug 2013- Jul 2018**      **Research Scholar** at CSIR-National Physical Laboratory, New Delhi under the prestigious **Prime Minister Doctoral Fellowship** from Department of Science of Technology (DST). Supervisor: Dr. Govind Gupta.
- Jul 2012- Aug 2013**      **Project Fellow** in the project entitled as Growth & Characterization of III-nitride Hetero-structures for Solid State Lighting under Efficient Silicon Photovoltaic with Smart Electronics and Lighting System a network project sponsored by CSIR under Technologies and Products for Solar energy Utilization through Networks- "TAP-SUN".
- Jan 2012-May 2012**      **Master Project** Physics of Energy Harvesting Division, National Physical Laboratory, (CSIR-NPL), New Delhi under the guidance of Dr. Govind, Senior Scientist. Thesis title "Growth and Characterization of Indium Nitride/Gallium nitride (InN/GaN) on single crystalline Sapphire substrate"



**May 2011- Jul 2011 Summer Research Fellow** at Organic & Inorganic LEDs, Physics of Energy Harvesting Division, National Physical Laboratory, (CSIR-NPL), New Delhi (**Jointly Funded by Indian Academy of Science (IAS), National Academy of Science, India (NASI) and Indian National Science Academy (INSA)**) under the guidance of Dr. Govind, Senior Scientist, CSIR-National Physical Laboratory,(NPL), New Delhi.

### **Industrial Activities**

**Apr 2014-Mar 2018** During the PhD, he served SIMCO Global technology & System Ltd. as an Engineer for SPECS X-Ray Photoemission Spectroscopy (XPS) system and other Ultra High Vacuum (UHV) instruments.

### **Research Publications: (Published in SCI journals)**

1. **Shibin Krishna**, Neha Aggarwal, Abhiram Gundimeda, Alka Sharma, Sudhir Husale, K. K. Maurya, Govind Gupta "Correlation of Donor Acceptor Pair Emission on the Performance of GaN based UV Photodetector" **Material Science in Semiconductor Processing 98 59-64,(2019)**.
2. Neha Aggarwal, **Shibin Krishna**, Shubhendra K. Jain, Monu Mishra, K.K. Maurya, Sandeep Singh, Mandeep Kaur and Govind Gupta. "Microstructural Evolution of High Quality AlN by modulating the Growth Conditions in PAMBE", **Materials Science & Engineering B, 243, 71 (2019)**.
3. Neha Aggarwal, **Shibin Krishna**, Shubhendra K. Jain, Arzoo Arora, Lalit Goswami, Alka Sharma, Sudhir Husale, Abhiram Gundimeda and Govind Gupta. "Impact on Photon-Assisted Charge Carrier Transport by Engineering Electrodes of GaN based UV Photodetectors", **Journal of Alloys and Compounds, 785, 883 (2019)**.
4. Shubhendra Kumar Jain, Monu Mishra, Neha Aggarwal, **Shibin Krishna**, Bhasker Gahtori, Akhilesh Pandey, Govind Gupta "Influence of temperature and Al/N ratio on structural, chemical & electronic properties of epitaxial AlN films grown via PAMBE" **Applied Surface Science 455 919-923 (2018)**.
5. Monu Mishra, Abhiram Gundimeda, **Shibin Krishna**, Neha Aggarwal, Lalit Goswami, Bhasker Gahtori, Biplab Bhattacharyya, SudhirHusale, and Govind Gupta "Surface-Engineered Nanostructure-Based Efficient Nonpolar GaN Ultraviolet Photodetectors" **ACS Omega 3 (2), 2304-2311 (2018)**.
6. Shubhendra Kumar Jain, Neha Aggarwal, **Shibin Krishna**, Rahul Kumar, Sudhir Husale, Vinay Gupta, Govind Gupta "GaN-UV photodetector integrated with asymmetric metal semiconductor metal structure for enhanced responsivity" **Journal of Materials Science: Materials in Electronics 29 (11) 8958-8963 (2018)**.
7. **Shibin Krishna**, Alka Sharma, Neha Aggarwal, Sudhir C. Husale and Govind Gupta "Ultrafast photo-response and enhanced photo-responsivity of Indium Nitride based broad band photodetector" **Solar Energy Materials and Solar Cells 172, 376-383 (2017)**.
8. **Shibin Krishna**, Anurag G. Reddy, Neha Aggarwal, Mandeep Kaur, Dinesh Singh. Rajib Rakshit, K.K. Maurya and Govind Gupta "Enhanced current transport in GaN/AlN single and double barrier hetero-structure" **Solar Energy Material & Solar Cells 170, 160-166 (2017)**.
9. Neha Aggarwal, **Shibin Krishna**, Alka Sharma, Lalit Goswami, Dinesh Kumar, Sudhir Husale, and Govind Gupta "A Highly Responsive Self-Driven UV Photodetector Using GaN Nanoflowers" **Advanced Electronic Materials 1700036 (2017)**.
10. Monu Mishra, **Shibin Krishna**, Neha Aggarwal, Govind Gupta "Influence of metallic surface states on electron affinity of epitaxial AlN films" **Applied Surface Science 407, 255-259, (2017)**.



11. Abhiram Gundimeda, **Shibin Krishna**, Neha Aggarwal, Alka Sharma, Nita Dilawar Sharma, KK Maurya, Sudhir Husale, Govind Gupta "Fabrication of non-polar GaN based highly responsive and fast UV photodetector" *Applied Physics Letters* **110**, 103507 (2017).
12. Monu Mishra, Abhiram, Gundimeda, **Shibin Krishna**, Neha Aggarwal, B. G. Bhasker, Nita Dilawar, Manju Singh, R. Rakshit, Govind Gupta "Wet chemical etching induced stress relaxed nanostructures on polar & non-polar epitaxial GaN films" *Physical Chemistry Chemical Physics* **19**, 8787-8801 (2017).
13. Monu Mishra, **Shibin Krishna**, Neha Aggarwal, Abhiram Gundimeda "Electronic Structure and Chemical State Analysis of Nanoflowers Decorated GaN and AlGaN/GaN heterostructure" *Journal of Alloys and Compounds* **708**, 385-391 (2017).
14. **Shibin Krishna**, Neha Aggarwal, Monu Mishra, K. K. Maurya, Sandeep Singh, Nita Dilawar, Subramaniam Nagarajan and Govind Gupta "Correlation of growth temperature with stress, defect states and electronic structure in an epitaxial GaN film grown on c-sapphire via plasma MBE" *Physical Chemistry Chemical Physics*, **18**, 8005 (2016).
15. **Shibin Krishna**, Neha Aggarwal, Monu Mishra, K. K. Maurya, Mandeep Kaur, Geetanjali Sehgal, Sukhveer Singh, Nita Dilawar, Bipin Kumar Gupta and Govind Gupta "Epitaxial growth of high In-content  $\text{In}_{0.41}\text{Ga}_{0.59}\text{N}/\text{GaN}$  heterostructure on (11-20)  $\text{Al}_2\text{O}_3$  substrate" *Journal of Alloys and Compounds*, **658**, 470-475 (2016).
16. Neha Aggarwal, **Shibin Krishna**, Monu Mishra, K.K. Maurya and Govind Gupta "Influence of active nitrogen species on surface and optical properties of epitaxial GaN films" *Journal of Alloys and Compounds*- **661**, 461-465 (2016).
17. **Shibin Krishna**, Neha Aggarwal, Anurag Reddy, Palak Dugar, Monu Mishra, Lalit Goswami, Nita Dilawar, Mahesh Kumar, K. K. Maurya and Govind Gupta "Probing the correlation between structure, carrier dynamics and defect states of epitaxial GaN film on (1120) sapphire grown by RF-molecular beam epitaxy" *RSC Advances*, **5**, 73261 (2015).
18. Monu Mishra, **Shibin Krishna**, Neha Aggarwal, MandeepKaur, Sandeep Singh, and Govind Gupta "Pits Assisted Oxygen Chemisorption on GaN Surfaces" *Physical Chemistry Chemical Physics*, **17**, 15201 (2015).
19. Amit Kumar Singh Chauhan, **Shibin Krishna**, Neha Aggarwal, Monu Mishra, AsadNiazi, Lekha Nair, Govind Gupta "Triangular  $\text{Si}_3\text{N}_4$  nano-scale pits on the stepped Si (553) surface by ion induced reaction" *Advanced Materials Letters*, **6(11)**, 941-946 (2015).
20. PalakDugar, Mahesh Kumar, **Shibin Krishna**, Neha Aggarwal and Govind Gupta "Carrier relaxation dynamics in defect states of epitaxial GaN/AlN/Si using ultrafast transient absorption spectroscopy" *RSC Advances*, **5**, 83969 (2015).
21. Anurag G. Reddy, Neha Aggarwal, **Shibin Krishna**, Manju Singh, RajibRakshit, and Govind Gupta "Correlation of current-voltage-temperature analysis with deep level defects in epitaxial GaN films" *Applied Physics Letters* **106**, 233501 (2015).
22. Monu Mishra, **Shibin Krishna**, Neha Aggarwal, SaketVihari and Govind Gupta "Electronic structure analysis of GaN films grown on r- and a-plane sapphire " *Journal of Alloys & Compounds*- **645**,230-234 (2015).
23. Monu Mishra, **Shibin Krishna**, Neha Aggarwal and Govind Gupta "Surface chemistry and electronic structure of nonpolar and polar GaN films" *Applied Surface Science*-**345**, 440-447 (2015).



24. Neha Aggarwal, **Shibin Krishna**, Lalit Goswami, Monu Mishra, Govind Gupta, K.K. Maurya, Sandeep Singh, Nita Dilawar and MandeepKaur "Extenuation of stress and defects in GaN films grown on MOCVD-GaN/c-sapphire substrate by PAMBE" *Crystal Growth & Design- 15, 2144–2150 (2015)*.
25. Monu Mishra, **Shibin Krishna**, Mukesh Kumar and Govind Gupta " Origin of surface electron accumulation and Fermi level pinning in low energy ion induced InN/GaN heterostructure" *Materials chemistry and Physics 162, 640-644 (2015)*.
26. **Shibin Krishna**, Prachi Rastogi, Neha Aggarwal, Amit Kumar Singh Chauhan, Mukesh Kumar and Govind Gupta "Competition between layering & Nano-clustering of Indium atoms on reconstructed Si (113) 3x2 surface" *Advanced Materials Letters, 6(8), 690-694 (2015)*.
27. Monu Mishra, **Shibin Krishna**, Neha Aggarwal, Saket Vihari, Amit Kumar Singh Chauhan and Govind Gupta "A Comparative Photoelectron Spectroscopic Analysis of MBE and MOCVD grown epitaxial GaN films" *Science of Advanced Materials 7, 546-551 (2015)*.
28. **Shibin Krishna**, and Govind Gupta "Band alignment and Schottky behaviour of InN/GaN heterostructure grown by low temperature low energy ion bombardment" *RSC Advances, 4, 27308-27314 (2014)*.
29. Neha Aggarwal, **Shibin Krishna**, Anuj Upadhyay, Amit Kumar Singh Chauhan, Mahesh Kumar and Govind Gupta "Temperature Dependent Size Tunability of Gallium Nanoclusters on Si (111) 7x7 Surface" *Adv. Sci. Eng. Med. 6, 1015-1019 (2014)*.
30. Mukesh Kumar, S.K. Pasha, **Shibin Krishna**, Avanish Pratap Singh, Pawan Kumar, Bipin Kumar Gupta and Govind Gupta "Facile Synthesis and Photoluminescence Spectroscopy of 3D-Triangular GaN Nano Prism Islands" *Dalton Transaction 43, 11855-61 (2014)*.
31. Monu Mishra, **Shibin Krishna**, Prachi Rastogi, Neha Aggarwal, Amit Kumar Singh Chauhan, LalitGoswami and Govind Gupta "New Approach to Clean GaN Surfaces" *Materials Focus 3, 218-223 (2014)*.
32. **Shibin Krishna**, Rahul Deshmukh, Amit Kumar Singh Chauhan, Lalit Goswami and Govind "Influence of Temperature on the Controlled Growth Kinetics and Super-structural Phase Formation of Indium on Reconstructed Si (113) 3x2 Surface" *Material Research Express, 1, 015909 (2014)*.
33. **Shibin Krishna**, Neha Aggarwal, Monu Mishra, Govind Gupta, K. K. Maurya, Mandeep Kaur and Sandeep Singh "Effect of Ga flux and rf-power on homoepitaxial growth of single crystalline GaN films" *IEEE Xplore (Emerging Electronics (ICEE), 2014)*.

#### International/National Conferences attended

1. **Shibin Krishna**, Neha Aggarwal, Abhiram Gundimeda, Sudhir Husale, Govind Gupta "A Corollary of Donor-Acceptor Pair Mid Bandgap States on GaN based Photodetection Devices" **International Workshop on Nitride Semiconductor (IWN-2018)**, 12-16 November 2018, Kanazawa, Japan.
2. **Shibin Krishna**, Anurag G. Reddy, Neha Aggarwal, MandeepKaur, Sudhir Husale, Dinesh Singh, Manju Singh, Rajib Rakshit, K.K. Maurya and Govind Gupta" Enhanced current transport in GaN/AlN/GaN double barrier hetero-structure" **XIX International Workshop on the Physics of Semiconductor Devices (IWPSD 2017)**, 11-15 December 2017, jointly organised by Solid State Physics Laboratory (SSPL) and Indian Institute of Technology (IIT) Delhi, India.



3. **Shibin Krishna**, Neha Aggarwal, Mandeep Kaur, Geetanjali Sehgal, K. K., Maurya and Govind “Epitaxial growth of GaN/AlN Double Heterostructures by Plasma-Assisted Molecular Beam Epitaxy” **International Conference on Thin Films (ICTF-2017)**, 14-17 November 2017, National Physical Laboratory (CSIR-NPL), New Delhi, India.
4. **Shibin Krishna**, Anurag G. Reddy, Neha Aggarwal, Mandeep Kaur, Sudhir Husale, Dinesh Singh, Manju Singh, Rajib Rakshit, K.K. Maurya and Govind Gupta “Current transport enhancement in GaN/AlN based double barrier heterostructures using AlN as barrier layer” **European Union-Material Research Society (E-MRS) International Conference on Nitride (ICNS- 12) Meeting**, 24-28 July 2017, Strasbourg, France.
5. **Shibin Krishna**, Alka Sharma, Neha Aggarwal, Sudhir Husale and Govind Gupta “Ultrafast Indium Nitride based VIS-NIR photo-detector” **International Workshop on Nitride Semiconductor (IWN-2016)**, 2-7 October 2016, Orlando, Florida, USA.
6. **Shibin Krishna**, Neha Aggarwal, Monu Mishra, Abhiram Gundimeda, K.K Maurya, Sandeep Singh, Nita Dilawar, Subramaniam Nagarajan and Govind Gupta “Defects minimization via stress relaxation in epitaxial GaN film/c-sapphire grown by PAMBE” **International Conference on Materials Science & Technology (ICMTECH - 2016)**, 1-4 March 2016, Conference Centre, University of Delhi, Delhi.
7. **Shibin Krishna TC**, Neha Aggarwal, Monu Mishra, Lalit Goswami, Govind Gupta, Sandeep Singh and K. K. Maurya “Epitaxial growth of single crystalline GaN film on A-plane (11-20) sapphire substrate” **International Symposium on Semiconductor Materials and Devices (ISSMD-3)**, 2-5 February 2015, Anna University, Chennai.
8. **Shibin Krishna TC**, Neha Aggarwal, Monu Mishra, Govind Gupta, K. K. Maurya, Mandeep Kaur and Sandeep Singh “Effect of Ga flux and rf-power on homoepitaxial growth of single crystalline GaN films” **2nd IEEE International Conference on Emerging Electronics (ICEE)**, 3rd -6th December 2014, Indian Institute of Science (IISc), Bangalore.
9. **Shibin Krishna TC**, Neha Aggarwal, Monu Mishra, Lalit Goswami, Geetanjali Sehgal, Mandeep Kaur, Geetanjali Sharma, Sandeep Singh, Manju Singh, RajibRakshit, K.K Maurya, Sukhvir Singh, Govind Gupta “Realization of GaN/AlN Double Heterostructures grown by RF-MBE” **International Workshop on Nitride Semiconductors (IWN 2014)**, 24th – 29th August 2014, Poland (Abstract Accepted).
10. **Shibin Krishna T.C.**, Rahul Deshmukh, Amit Kumar Singh Chauhan, Lalit Goswami and Govind “Indium Metal Induced various superstructures on Si(113) 3x2 surface” **International Workshop on Physics of Semiconductor Devices (IWPSD-17)**, during 10-13 December 2013, Amity University, Noida.
11. **Shibin Krishna T.C.** and Govind “Growth of low temperature In-polar InN/GaN hetero-interface and determination of valance band offset” **International Conference on Nitride Semiconductors (ICNS-10)** during 25-30 August, 2013, Washington DC, USA.
12. **Shibin Krishna T.C.**, Prachi Rastogi, Mukesh Kumar, Amit Kumar Singh Chauhan, Lalit Goswami and Govind “Competition between layering & Nano-clustering of Indium atoms on reconstructed Si (113)3x2 surface” **International Conference on Nanotechnology (ICNANO)**, July 25-26, 2013, Ansal University, Gurgoan, India.
13. **Shibin Krishna T.C.**, Rahul Deshmukh, Amit Kumar Singh Chauhan, Mukesh Kumar, Lalit Goswami and Govind “Kinetically Controlled Growth of Indium 3D- Nanoclusters on Reconstructed Si(113) surface” **24th -National Conference on Crystal Growth (NSCG-24)** Dec 20-22, 2012, Anna University, Chennai.





## Book Chapters

1. Neha Aggarwal, **Shibin Krishna**, Govind Gupta, "GaN Nanoflowers: Growth to Optoelectronic Device" 21st Century Nanoscience – A Handbook Nanophotonics, Nanoelectronics, and Nanoplasmonics CRC press, **Taylor & Francis Group**, Editor Klaus D. Sattler, 2020

## Highlights

- **Nature India** published a news article on December 2017 titled as "Ultrafast light-sensing devices for military purposes".
- **Nature India** published a news article on May 2017 titled as "Nano-flower-shaped ultraviolet photodetectors".
- **Semiconductor Today** published a news article on May 2017 titled as "Ultraviolet photodetection with gallium nitride nano-flowers on silicon".
- **Semiconductor Today** published a news article on March 2017 titled as "Non-polar gallium nitride ultraviolet photodetector on sapphire".

## Awards/Recognitions

- April-2014 **Prime Minister Fellowship for Doctoral Research** (Department of science and Technology (DST), Govt. of India)
- July- 2011 **CSIR UGC -NET** All India rank-123
- May- 2011 Summer Research Fellowship of **Indian Academy of Science (IAS)**
- **Best Poster Award** in XIX International Workshop on the Physics of Semiconductor Devices (**IWPSD 2017**), 11-15 December 2017, jointly organised by Solid State Physics Laboratory (SSPL) and Indian Institute of Technology (IIT) Delhi, India. "Enhanced current transport in GaN/AlN/GaN double barrier hetero-structure" by **Shibin Krishna**, Anurag G. Reddy, Neha Aggarwal, MandeepKaur, SudhirHusale, Dinesh Singh, Manju Singh, RajibRakshit, K.K. Maurya and Govind Gupta
- **International Travel Grant (ITS) from Science and Engineering Research Board (SERB)**, Govt. of India to present oral and poster presentation in **International Workshop on Nitride Semiconductor (IWN-2016)**, 2-7 October 2016, Orlando, Florida, USA.
- **Best Paper Award** in 24<sup>th</sup>- National Conference on Crystal Growth (**NSCG-24**) Dec 20-22, 2012, Anna University, Chennai. "Kinetically Controlled Growth of Indium 3D- Nanoclusters on Reconstructed Si(113) surface" by **Shibin Krishna T.C.**, Rahul Deshmukh, Amit Kumar Singh Chauhan, Mukesh Kumar, Lalit Goswami and Govind.

## Technical Skills

Hands-on experience with the following techniques:

- **Plasma-Assisted Molecular Beam Epitaxy (PA-MBE) –RIBER**
- Metal Organic Chemical Vapour Deposition (MOCVD)
- Pulsed Laser Deposition (PLD)
- High Resolution X-Ray Diffraction (HRXRD)
- Reflection High Energy Electron Diffraction (RHEED)
- X-Ray Photoelectron Spectroscopy (XPS)
- Scanning Tunneling Microscope (STM)
- Atomic Force Microscope (AFM)
- Scanning Electron Microscopy (SEM)
- Photoluminescence (PL)
- Auger Electron Spectroscopy (AES)
- Low Energy Electron Diffraction (LEED), Sputtering Technique