



## Tanujjal Bora, D. Eng.

### Director

Center of Excellence in Nanotechnology

### Assistant Professor

Bio-Nano Material Science & Engineering

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### Education

- D. Eng. (Nanotechnology), 2012  
AIT, Thailand
- M. Eng. (Microelectronics), 2009  
AIT, Thailand
- B. Tech. (Elec. & Comm. Eng.), 2006  
NERIST, India

### Research Interests

- Nanomaterials for energy harvesting
- Nanocomposite materials
- Water & air purification technologies
- Nanostructured surfaces & thin film coatings
- Photo-electrochemical devices
- Nano- & Bio-sensors
- Optoelectronic devices
- Green technology development

### Research Contributions

- Journal Articles: 46
- Citations: 1546
- H-index: 22
- Patents: 02 (Filed)
- Book Chapter: 02
- Conferences: 18

### Work Experience

#### Director

May 2019 onwards

Center of Excellence in Nanotechnology, Asian Institute of Technology, Thailand

#### Assistant Professor

May 2019 onwards

Bio-Nano Material Science & Engineering, School of Engineering & Technology, Asian Institute of Technology, Thailand

#### Faculty (on contract)

January 2017 – April 2019

Nanotechnology, School of Engineering & Technology, Asian Institute of Technology, Thailand

#### Post-doctoral Fellow

June 2013 – December 2016

Chair in Nanotechnology, Sultan Qaboos University, Oman

### Projects Handled

#### Ongoing projects

1. *Circular System Innovation for Polyurethane Foam: Catalytic approach to upcycle foam waste from mattresses and beyond.* (2021 - 2023)  
Role: Project PI  
Funded by: The Royal Academy of Engineering, UK

#### Completed projects

1. *Evaluation of Metal Oxide Nanostructured Anti-Reflection Coatings for Reduced Optical Losses in Solar Panels.* (2019 - 2020)  
Role: Project PI  
Funded by: Neon Infotech South East Asia Co., Ltd., Thailand
2. *Enhancement of industrial fastener coating processes by application of nanotechnology* (2016 - 2020)  
Role: Project coordinator  
Funded by: IDEAL Fastener Asia Ltd., Hong Kong
3. *Simulation and nanotechnology to enhance selected solar cell materials.* (2018 - 2019)  
Role: Project coordinator  
Funded by: Neon Infotech South East Asia Co., Ltd., Thailand
4. *Low Cost 3D Printed Microfluidic Sensing Devices for Rapid Chemical Detection.* (2019)  
Role: Project PI  
Funded by: AIT, Thailand
5. *Inter-comparison of nanoparticle size measurement.* (2018)  
Role: Project participant  
Funded by: Asia Nano Forum (Coordinated by NANOTEC, Thailand)
6. *Portable Raman spectrometer to differentiate infected from ischemic bone in sickle cell patients.* (2016)  
Role: Project key personnel  
Funded by: The Research Council, Oman

### Teaching

Nanomaterials & Nanotechnology, Characterization Tools in Nanotechnology, Colloids & Nanoparticles, Nanometrology, Nano-Micro Fabrication Technologies, Biosensors & Bioelectronics, Catalysis

### Awards and Achievements

1. The National Research Award 2018 in the category of Best Research Work in Environment and Biological Resources Sector, awarded by The Research Council of Oman.
2. AIT Distinguished Teaching Award in 2018
3. Sheikh Saqr Al Qasimi Graduate Research Fellowship during PhD (2010 – 2012)
4. Best AIT Master Thesis Award in 2009
5. Infineon Prize for Outstanding Academic Performance in Microelectronics in 2009

### Memberships

- Member in IEEE Nanotechnology Council
- Member in IEEE Electron Devices Society
- Member in IEEE Photonics Society

## Patents

1. S. M. A. Nawaz, L. Manohar, K. Kanitpong, G. L. Hornyak and T. Bora (2019), *Preparation of Nanocellulose fiber (NCF) Modified Asphalt Mixture*. Thai Patent Application Number: 1901005204.
2. K. Ponlamuangdee, S. Bamrungsap, G. L. Hornyak and T. Bora (2019), *Plasmonic papers as surface-enhanced Raman scattering (SERS) substrates for analyte and drug detection*. Thai Patent Application Number: 1903001487.

## Book Chapters

1. T. Bora, *Recent Developments on Metal Nanoparticles for SERS Applications*; in: Noble and Precious Metals—Properties, Nanoscale Effects & Applications. Edited by – M. Seehra and A. Bristow, 2018, IntechOpen Ltd. UK
2. T. Bora, H. H. Kyaw & J. Dutta, *Plasmon Resonance Enhanced Zinc Oxide Photoelectrodes for Improvement in Performance of Dye Sensitized Solar Cells*; in: Materials Science Forum, Periodical Vol. 771, Edited by – A. Pandikumar and R. Jothilakshmi, 2013, Trans Tech Publications Ltd. Switzerland.

## Journal Articles

1. C.A. Rico-Yuson, G.L. Hornyak & T.Bora; *Cyanide-free environment-friendly alternative to copper electroplating for zinc die-cast alloys*. **Environmental Science and Pollution Research**, (2021), Just accepted.
2. K. Sharma, T. Bora & W.S. Mohammed; *Effect of solvent absorption on the optical properties of 3D printed methacrylate waveguide*, **Optics & Laser Technology**, 134 (2021) 106573.
3. U. Waiwijit, C. Chananonwathorn, P. Eimchai, T. Bora, G.L. Hornyak & N. Nuntawong; *Fabrication of Au-Ag nanorod SERS substrates by co-sputtering technique and dealloying with selective chemical etching*. **Applied Surface Science**, 530 (2020) 147171.
4. K. Ponlamuangdee, G.L. Hornyak, T. Bora & S. Bamrungsap; *Graphene oxide/gold nanorod plasmonic paper—a simple and cost-effective SERS substrate for anticancer drug analysis*. **New Journal of Chemistry**, 44 (2020) 14087-14094.
5. S. Dobretsov, P. Sathe, T. Bora, M. Barry, M.T.Z. Myint & M.A. Abri; *Toxicity of different zinc oxide nanomaterials at 3 trophic levels: implications for development of low-toxicity antifouling agents*. **Environmental Toxicology and Chemistry**, 39 (2020) 1343-1354.
6. S. Amjad, K. Swargiary, M. Somarapalli, T. Bora, G.L. Hornyak & W.S. Mohammed; *Enhancement of side-coupled surface plasmon resonance sensitivity by application of polymethylmethacrylate thin polymer films*. **Micro & Nano Letters**, 15 (2020) 327-332.
7. A. Agarwal, S. Manna, S. Nath, K. Sharma, P. Chaudhury, T. Bora, I. Solomon & A. Sarma; *Controlling oil/water separation using oleophilic and hydrophobic coatings based on plasma technology*. **Materials Research Express**, 7 (2020) 036411.
8. T. Bora, A. Dousse, K. Sharma, K. Sarma, A. Baev, G.L. Hornyak & G. Dasgupta, *Modeling nanomaterial physical properties: theory and simulation*. **International Journal of Smart and Nano Materials** 10 (2019), 116-143.
9. T. Bora & J. Dutta, *Plasmonic Photocatalyst Design: Metal—Semiconductor Junction Affecting Photocatalytic Efficiency*. **Journal of Nanoscience and Nanotechnology** 19 (2019), 383-388.
10. M. Al-Abri, B. Al-Ghafri, T. Bora, S. Dobretsov, J. Dutta, S. Castelletto, L. Rosa & L. Boretti, *Chlorination disadvantages and alternative routes for biofouling control in reverse osmosis desalination*. **NJP Clean Water** 2 (2019), 1-16.
11. M. Khalid, T. Bora, A. Al Ghaithi, S. Thukral & J. Dutta, *Raman spectroscopy detects changes in bone mineral quality and collagen cross-linkage in Staphylococcus infected human bone*. **Scientific Reports**, 8 (2018) 9417.
12. B. Al-Ghafri, T. Bora, P. Sathe, S. Dobrestov & M. Al-Abri, *Photocatalytic microbial removal and degradation of organic contaminants of water using PES fibers*. **Applied Catalysis B: Environmental**, 233 (2018) 136-142.
13. J. Al-Sabahi, T. Bora, M. Claereboudt, M. Al-Abri & J. Dutta, *Visible light photocatalytic degradation of HPAM polymer in oil produced water using supported zinc oxide nanorods*. **Chemical Engineering Journal**, 351 (2018) 56-64.
14. S.A.J. Sulaiman, T. Bora & O. K. Abou-Zied, *Spectroscopic characterization of the warfarin drug-binding site of folded and unfolded human serum albumin anchored on gold nanoparticles: Effect of bioconjugation on the loading capacity*. **RSC Advances**, 8 (2018) 7523-7532.
15. H.H.M. Yusof, S. W. Harun, K. Dimyati, T. Bora, W. S. Mohammed & J. Dutta, *Optical dynamic range maximization for humidity sensing by controlling growth of zinc oxide nanorods*. **Photonics and Nanostructures-Fundamentals and Applications**, 30 (2018) 57-64.
16. P. Loiko, T. Bora, J.M. Serres, H. Yu, M. Aguiló, F. Díaz, U. Griebner, V. Petrov, X. Mateos & J. Dutta, *Oriented zinc oxide nanorods: A novel saturable absorber for lasers in the near-infrared*. **Beilstein Journal of Nanotechnology** 9 (2018), 2730-2740
17. H.H.M. Yusof, S.W. Harun, K. Dimyati, T. Bora, K. Sterckx, W.S. Mohammed & J. Dutta, *Low-Cost Integrated Zinc Oxide Nanorod-Based Humidity Sensors for Arduino Platform*. **IEEE Sensors Journal** 19 (2018), 2442-2449.
18. T. Bora, P. Sathe, K. Laxman, S. Dobretsov & J. Dutta, *Defect engineered visible light active ZnO nanorods for photocatalytic treatment of water*. **Catalysis Today**, 284 (2017) 11-18
19. M. J. Al-Saadi, S. H. Al-Harhi, H. H. Kyaw, M. T. Z. Myint, T. Bora, K. Laxman, A. Al-Hinai & J. Dutta, *Influence of Atomic Hydrogen, Band Bending, and Defects in the Top Few Nanometers of Hydrothermally Prepared Zinc Oxide Nanorods*. **Nanoscale Research Letters**, 12 (2017), 22.
20. E. H. Alsharaeh, T. Bora, A. Soliman, F. Ahmed, G. Bharath, M. G. Ghoniem, K. M. Abu-Salah & J. Dutta, *Sol-Gel-Assisted Microwave-Derived Synthesis of Anatase Ag/TiO<sub>2</sub>/GO Nanohybrids toward Efficient Visible Light Phenol Degradation*. **Catalysts**, 7 (2017), 133.
21. J. Al-Sabahi, T. Bora, M. Al-Abri & J. Dutta, *Efficient visible light photocatalysis of benzene, toluene, ethylbenzene and xylene (BTEX) in aqueous solutions using supported zinc oxide nanorods*. **PloS One**, 12 (2017), e0189276.
22. F. Karim, T. Bora, M. Chaudhari, K. Habib, W. Mohammed & J. Dutta, *Measurement of aluminum oxide film by Fabry-Pérot interferometry and scanning electron microscopy*. **Journal of Saudi Chemical Society**, 21 (2017), 938-942
23. T. Bora, D. Zoefl & J. Dutta, *Importance of plasmonic heating on visible light driven photocatalysis of gold nanoparticle decorated zinc oxide nanorods*. **Scientific Reports**, 6 (2016) 26913.
24. M. Al-Hamdi, M. Sillanpää, T. Bora & J. Dutta, *Efficient photocatalytic degradation of phenol in aqueous solution by SnO<sub>2</sub>: Sb nanoparticles*. **Applied Surface Science**, 370 (2016) 229–236.

25. J. Al-Sabahi, T. Bora, M. Al-Abri & J. Dutta, *Controlled defects of zinc oxide nanorods for efficient visible light photocatalytic degradation of Phenol*. **Materials**, 9 (2016) 238
26. T. Bora, M. T. Z. Myint, S. H. Al-Harhi & J. Dutta, *Role of surface defects on visible light enabled plasmonic photocatalysis in Au-ZnO nanocatalyst*. **RSC Advances**, 5 (2015) 96670 – 96680
27. T. Bora, M. H. Al-Hinai, A. T. Al-Hinai & J. Dutta, *Phase transformation of metastable ZnSnO<sub>3</sub> upon thermal decomposition by in-situ temperature dependent Raman spectroscopy*. **Journal of the American Ceramic Society**, 98 (2015) 4044 – 4049.
28. K. Saoud, R. Alsoubaihi, N. Bensalah, T. Bora, M. Bertino & J. Dutta, *Synthesis of supported silver nano-spheres on zinc oxide nanorods for visible light photocatalytic applications*. **Materials Research Bulletin**, 63 (2015) 134 – 140.
29. S. B. D. Borah, T. Bora, S. Baruah & J. Dutta, *Heavy metal ion sensing using surface plasmon resonance of metallic nanostructures*. **Groundwater for Sustainable Development**, 1 (2015) 1–11.
30. T. Bora, H. Fallah, M. Chaudhari, T. Apiwattanadej, S. W. Harun, W. S. Mohammed & J. Dutta, *Controlled side coupling of light to cladding mode of ZnO nanorod coated optical fibers and its implications for chemical vapor sensing*. **Sensors and Actuators B: Chemical**, 202 (2014) 543 – 550.
31. T. Bora, H. H. Kyaw & J. Dutta, *Plasmon Resonance Enhanced Zinc Oxide Photoelectrodes for Improvement in Performance of Dye Sensitized Solar Cells*. **Materials Science Forum**, 771 (2014) 91 – 101.
32. T. Bora & J. Dutta, *Applications of Nanotechnology in Wastewater Treatment – A Review*. **Journal of Nanoscience and Nanotechnology**, 14 (2014) 613 – 626.
33. K. Laxman, T. Bora, S. H. Al-Harhi & J. Dutta, *Improved sensitization of zinc oxide nanorods by cadmium telluride quantum dots through charge induced hydrophilic surface generation*. **Journal of Nanomaterials**, 2014 (2014) Article ID: 919163.
34. T. Bora, K. Lakshman, S. Sarkar, A. Makhil, S. Sardar, S. K. Pal & J. Dutta, *Modulation of defect mediated energy transfer from ZnO nanoparticles for the photocatalytic degradation of bilirubin*. **Beilstein Journal of Nanotechnology**, 4 (2013) 714 – 725.
35. H. Fallah, M. Chaudhari, T. Bora, S. W. Harun, W. S. Mohammed & J. Dutta, *Demonstration of Side Coupling to Cladding modes through Zinc oxide Nanorods grown on Multimode Optical Fiber*. **Optics Letters**, 38 (2013) 3620 – 3622.
36. M. A. Mahmood, T. Bora & J. Dutta, *Studies on hydrothermally synthesized zinc oxide nanorod arrays for their enhanced visible light photocatalysis*. **International Journal of Environmental Technology and Management**, 16 (2013) 146 – 159.
37. F. Karim, T. Bora, M. B. Chaudhari, K. Habib, W. S. Mohammed & J. Dutta, *Optical fiber-based sensor for in situ monitoring of cadmium sulfide thin-film growth*. **Optics Letters**, 38 (2013) 5385 – 5388.
38. T. Bora, H. H. Kyaw & J. Dutta, *Zinc oxide–zinc stannate core–shell nanorod arrays for CdS quantum dot sensitized solar cells*. **Electrochimica Acta**, 68 (2012) 141 – 145.
39. S. Sarkar, A. Makhil, T. Bora, K. Lakshman, A. Singha, J. Dutta & S. K. Pal, *Hematoporphyrin-ZnO nanohybrids: Twin applications in efficient visible-light photocatalysis and dye-sensitized solar cells*. **ACS Applied Materials & Interfaces**, 4 (2012) 7027 – 7035.
40. S. Sarkar, A. Makhil, K. Lakshman, T. Bora, J. Dutta & S. K. Pal, *Dual-sensitization via electron and energy harvesting in CdTe quantum dots decorated ZnO nanorod-based dye-sensitized solar cells*. **The Journal of Physical Chemistry C**, 116 (2012) 14248 – 14256.
41. H. H. Kyaw, T. Bora & J. Dutta, *One-diode model equivalent circuit analysis for ZnO nanorod-based dye-sensitized solar cells: Effects of annealing and active area*. **IEEE Transactions on Nanotechnology**, 11 (2012) 763 – 768.
42. T. Bora, H. H. Kyaw, S. Sarkar, S. K. Pal & J. Dutta, *Highly efficient ZnO/Au Schottky barrier dye-sensitized solar cells: Role of gold nanoparticles on the charge-transfer process*. **Beilstein Journal of Nanotechnology**, 2 (2011) 681 – 690.
43. S. Sarkar, A. Makhil, T. Bora, S. Baruah, J. Dutta & S. K. Pal, *Photoselective excited state dynamics in ZnO-Au nanocomposites and their implications in photocatalysis and dye-sensitized solar cells*. **Physical Chemistry Chemical Physics**, 13 (2011) 12488 – 12496.
44. S. Baruah, M.A. Mahmood, M.T.Z. Myint, T. Bora & J. Dutta, *Enhanced visible light photocatalysis through fast crystallization of zinc oxide nanorods*. **Beilstein Journal of Nanotechnology**, 1 (2010) 14 – 20.
45. A. Makhil, S. Sarkar, T. Bora, S. Baruah, J. Dutta, A. K. Raychaudhuri & S. K. Pal, *Role of resonance energy transfer in light harvesting of zinc oxide-based dye-sensitized solar cells*. **The Journal of Physical Chemistry C**, 114 (2010) 10390 – 10395.
46. A. Makhil, S. Sarkar, T. Bora, S. Baruah, J. Dutta, A. K. Raychaudhuri & S. K. Pal, *Dynamics of light harvesting in ZnO nanoparticles*. **Nanotechnology**, 21 (2010) 265703 – 265707.

### Invited Talks

1. Invited speaker in the *Regional Policy Dialogue on the Sustainable Lifestyles for SCP focusing on Packaging with an additional focus on COVID-19*, UN Environment Program, Thailand (2020).
2. Invited speaker in the *3<sup>rd</sup> ASEAN Conference on Failure Analysis and Inspection of Materials and Products 2018*, Thailand Institute of Scientific & Technological Research (TISTR), Ministry of Science & Technology, Thailand.
3. Invited speaker in *Marine Corrosion – An Important Impact on Structural Integrity Workshop 2018*, National Metal and Materials Technology Center (MTEC), Thailand Science Park, Thailand.
4. Invited speaker in CHEMSYMPIUM 2015, May 2015, organized by Salalah College of Technology, Oman.
5. Invited speaker in the 6th Engineering Gathering Activity, March 2014, organized by Sultan Qaboos University, Oman.

### Conferences

1. K. Sharma, W.S. Mohammed & T. Bora, *Modeling the dynamic optical gain in a 3D printed waveguide due to polymer swelling*; in Optics & Photonics International Congress 2021, Japan.
2. T.T. Khan, A.M.H.S. Abeykoon, T. Bora & G.F. Mullick, *Design of a Prototype of a Ferrofluid Based Soft Actuator*. 2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT), Bangladesh
3. T.T. Khan, A.M.H.S. Abeykoon, T. Bora & G.F. Mullick, *Simulation of Ferrofluid Based Soft Actuator Using Magnetic Field Optimization Approach*. 2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT), Bangladesh

4. T. Bora, *Photocatalytic antibiofouling coatings for the prevention of marine corrosion*; in 3rd ASEAN Conference on Failure Analysis and Inspection of Materials and Products 2018, June 2018, Thailand. (Invited Speaker)
5. N. Kongsai, T. Bora, O. Shipin & G. L. Hornyak, *Photocatalytic antibiofouling nanocoating for marine and freshwater environments*; in Annual Congress on Emerging Materials and Nanotechnology, September 2018, Thailand.
6. S. Shamim, T. Bora, D. Crespy & G. L. Hornyak, *Controlled fluorescence in chemically modified porous silica nanoparticles*; in Annual Congress on Emerging Materials and Nanotechnology, September 2018, Thailand. (Abstract Accepted)
7. P. Khardekar, G. L. Hornyak & T. Bora, *Photothermal response of carbon nano-micro materials for sensing applications*; in 2nd World Congress & Expo on Nanotechnology & Material Science, June 2018, Dubai.
8. P. Loiko, T. Bora, J. M. Serres, X. Mateos, H. Yu, A. Baranov, M. Aguiló, F. Díaz, U. Griebner, V. Petrov & J. Dutta; *Oriented ZnO Nanorods: A Novel Saturable Absorber for Lasers at 1-2  $\mu\text{m}$* ; in *The European Conference on Lasers and Electro-Optics and the European Quantum Electronics Conference (CLEO®/Europe-EQEC)*, June 2017, Munich, Germany.
9. J. Al-Sabahi, T. Bora, M. Z. Al-Abri & J. Dutta; *Photocatalytic degradation of phenol using zinc oxide nanorods*; in the 2nd International Symposium on Catalytic Science and Technology in Sustainable Energy and Environment (EECAT 2016), October 2016, Tianjin, China.
10. T. Bora, J. N. Al-Sabahi, A. M. Al-Hamdi & J. Dutta; *Visible light plasmonic photocatalytic degradation of phenol by gold - zinc oxide nanocomposite*; in the 7th European Meeting on Chemical Industry and Environment (EMChIE 2015), June 2015, Tarragona, Spain.
11. A. Al Ghait, A. Al Bimani, T. Bora, J. Dutta, M. Khalid & S. Thakral; *Systematic Raman spectroscopy to probe Osteomyelitis in human bone: an in-vitro study*; in European Congress and Exhibition on Advanced Materials and Processes (EUROMAT 2015), September 2015, Warsaw, Poland.
12. A. Al Ghait, M. Khalid, T. Bora, S. Thakral, A. Al Bimani & J. Dutta; *Systematic Raman spectroscopy to probe Osteomyelitis in human bone: an in-vitro study*; Poster presentation in 7th International Workshop on Advanced Materials (IWAM 2015), February 2015, Ras Al Khaimah, UAE.
13. T. Bora, H. H. Kyaw & J. Dutta; *Zinc oxide/zinc stannate core/shell nanorods for cadmium sulfide quantum dot sensitized solar cell*; Poster presentation in the 4th International workshop on advanced materials (IWAM-2012), February 2012, Ras Al Khaimah, UAE.
14. T. Bora, H. H. Kyaw & J. Dutta; *Hydrothermally grown zinc oxide/zinc stannate core/shell nanorods and their application in quantum dot sensitized solar cells*; in NanoThailand 2012, April 2012, Khon Kaen, Thailand.
15. T. Bora, H. H. Kyaw & J. Dutta; *Zinc oxide/zinc stannate core/shell photoelectrode for improved performance of dye sensitized solar cell*; Poster presentation in the 3rd International workshop on advanced materials (IWAM-2011), February 2011, Ras Al Khaimah, UAE.
16. T. Bora, H. H. Kyaw, M. Poyai & J. Dutta; *Improved ZnO nanorod dye sensitized solar cell efficiency through better charge separation by gold nanoparticles*; Poster presentation in the 2nd International workshop on advanced materials (IWAM-2010), February 2010, Ras Al Khaimah, UAE.
17. T. Bora, H. H. Kyaw & J. Dutta; *ZnO/Au Schottky junction dye sensitized solar cell: improved efficiency*; in NanoThailand 2010, November 2010, National Nanotechnology Center (NANOTEC), Thailand.
18. H. H. Kyaw, T. Bora & J. Dutta; *Zinc oxide nanorods dye sensitized solar cell: Effect of annealing temperature*; in the 3rd Thailand Nanotechnology Conference, December 2009, Bangkok, Thailand.

