

Overview of Research Work and List of Publications of Dr. Jhasaketan Nayak

Dr. Jhasaketan Nayak (myself) has been working as one of the faculty members in the Department of Physics in Indian Institute of technology (Indian School of Mines) Dhanbad (IIT(ISM) Dhanbad), India, since 26th August 2013.

Currently, our research group consists of four PhD research scholars and two master students. These days, our research is focused on nanostructured metal oxide semiconductors and ceramic materials for applications in gas sensors and UV-Vis photocatalysts.

Recently we have observed that the gas sensing properties of MoS₂ can be significantly enhanced by compositing with nanostructured WO₃ [1]. Graphitic carbon nitride (g-C₃N₄) is one of the most interesting metal free organic semiconductors which finds its applications in photocatalysis and gas sensing. We have observed that g-C₃N₄ nanoshoots can efficiently detect ammonia gas at room temperature in highly humid atmosphere [2]. The room temperature sensitivity and the stability of the metal oxide semiconductor based gas sensors can be significantly enhanced by forming nanocomposites [3].

These days, our research is focused on fabrication of gas sensor devices using metal oxide semiconductor nanocrystals [4]. We have observed that the baseline resistance drift of WO₃ nanorod based gas sensor can be significantly suppressed by compositing with g-C₃N₄ [5]. Our recent results show that WO₃/CdS nanocomposites can act as efficient glucose sensor under visible light illumination [6]. Optical properties of CdS: Zn has been studied for application in photovoltaic sensors [7].

Earlier, we synthesize CaCu₃Ti₄O₁₂ and HfO₂ nanoparticles by chemical techniques and research their gas sensing properties. We observed a very strong response of the above nanomaterials towards the volatile organic compound gases such as acetone, ethanol and formaldehyde in room temperature ambiances [8–12].

Nanorods, nanoparticles and nanocomposites in form of free standing powders and self-assembled thin films have been extensively synthesized by our research group during recent years. Especially, metal oxide semiconductors such as TiO₂, ZnO, and CeO₂ have been synthesized by simple low cost chemical techniques. The above materials have been applied for visible light photocatalysis, ultraviolet light and humidity sensors and photo electrochemical solar cells [13–21].

Prior to joining IIT (ISM) Dhanbad, Dr. J. Nayak worked as a special researcher in the department of Electrical Engineering (Prof. Heeje Kim's laboratory) at Pusan National University, Busan, South Korea from September 2010 to August 2013 where he synthesized TiO₂ nanorods and ZnO/CdS composites for applications in dye sensitized solar cells and quantum dot sensitized solar cells [22–26].

During February 2009 to August 2010, Dr. J. Nayak worked as assistant professor (on contract) in Department of Physics & Meteorology at Indian Institute of Technology Kharagpur, India where he synthesized ZnO/CdS nanocomposites for visible light photocatalysis. [27].

From March 2008 to February 2009, Dr. J. Nayak worked as a postdoctoral researcher in the department of Chemical Engineering (Prof. Kijung Yong's laboratory) at Pohang University

of Science & Technology (POSTECH), Busan, South Korea where he synthesized Copper Indium Gallium Selenide nanoparticles for applications in solar cells.

During November 2004 to February 2008, Dr. J. Nayak worked as a postdoctoral researcher in the department of Electrical Engineering (Prof. Shinji Nozaki's laboratory) at University of Electro-communications, Tokyo, Japan where he synthesized ZnO nanoparticles for white light emitting diodes. The visible photoluminescence in the blue-yellow region was observed from ZnO nanopowder and it was significantly enhanced by co-doping with aluminum and lithium [28–32].

As a research scholar, Mr. J. Nayak deposited nanostructured GaAs thin films on transparent conducting oxide substrates such as ITO/FTO coated glass sheets in Prof. S.N. Sahu's laboratory at Institute of Physics, Bhubaneswar, India for applications in solar cells [33–42].

Bibliography

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Research articles in conference proceedings

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9. Morphology, structure and optical properties of hydrothermally synthesized CeO₂/CdS nanocomposites; B. Mohanty, J. Nayak; *AIP Conference Proceedings* **1942**, 050041 (2018).
10. Low cost synthesis of TiO₂-C nanocomposite powder for high efficiency visible light photocatalysis; A.K. Mohapatra, J. Nayak, *AIP Conference Proceedings* **1942**, 050048 (2018).
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Presentations in conferences

1. Observation of enhanced visible light photocatalytic activity of rutile TiO₂ nanorod thin films having surface defects created by thermal annealing; Oral presentation in 16th International Nanotech Symposium & Nano-Convergence Exhibition, NANO KOREA 2018, 10th – 13th July 2018, KINTEX, Seoul, Korea.
2. “Synthesis of ZnO-cellulose nanocomposite for high UV photoconductivity sensor”; K. Sahoo and J. Nayak, poster presentation in “International Conference on Functional Materials” (ICFM 2016), 12th – 14th Dec. 2016, IIT Kharagpur.
3. “Effects of synthesis parameters on morphology, structure and optical properties of CeO₂ nanoparticles”, B. Mohanty and J. Nayak, poster presentation in 61st DAE-Solid State Physics Symposium (DSSPS-2016), 26th – 30th Dec. 2016, KIIT University, Bhubaneswar, India.
4. “TiO₂ nanocrystals for application in dye-sensitized solar cells”; AK Mohapatra, J. Nayak, H. Kim, poster presentation in ICONSEA-2014 (International Conference on Nanoscience and

Engineering Applications), 26th – 28th June 2014, Jawaharlal Nehru Technological University (JNTU), Hyderabad, India.

5. "Effect of synthesis temperature on the morphology, structure and photocatalytic activity of TiO₂ nanocrystals", A.K. Mohapatra, J. Nayak, Heeje Kim, Poster presentation in 59th DAE Solid State Physics Symposium; 16th -20th Dec. 2014, Vellore Institute of Technology (VIT), Tamilnadu, India.

6. "Phase pure anatase TiO₂ nanocrystalline powder for application in dye-sensitized solar cell and sonocatalysis" J. Nayak, JW Park, H. Kim, oral presentation in "International conference on Electronic Materials and Nanotechnology for Green Environment" 16th-19th September 2012, Hotel Ramada Plaza, Jeju island, South Korea.

7. "Single step solvothermal synthesis of nanorod thin film of TiO₂ and their application as photo anodes in Dye Sensitized Solar Cells", J. Nayak, Jung-Wook Park, Hee-Je Kim, Oral presentation in International Conference in Advanced Electromaterials (ICAE 2011), 7th-10th November 2011, Hotel Ramada Plaza, Jeju Island, South Korea.

8. "Synthesis and Characterization of Metal Oxide Nanocrystals and Nanorods" J. Nayak, S.N. Sahu, S. Nozaki, Invited talk in national conference, "Physics & Technology of Novel Materials", Feb. 25-27, 2010, Sambalpur University, Jyotivihar, Odisha, India.

9. "Yellowish-white photoluminescence from ZnO Nanoparticles Doped with Al and Li"; J. Nayak, S. Kimura, S. Nozaki, H. Ono, and K. Uchida, poster presentation in European Material Research Society, spring 2006 meeting, 29th May to 2nd June 2006, Nice, France.

10. "Synthesis and Characterization of Sb₂O₃ Cluster assembled Nanostructured Thin Films"; J. Nayak, S.N. Sarangi, S. Rath and S.N. Sahu; poster presentation in "*Indo-US workshop on Nanoscale Materials: From Science to Technology*", 5-8th April 2004, Puri, India.

11. "Properties of GaAs Nanoparticles synthesized by an electrochemical technique"; J. Nayak, S. Nozaki and S.N. Sahu; poster presentation in "*Indo-US workshop on Nanoscale Materials: From Science to Technology*", 5-8th April 2004, Puri, India.

12. "Room temperature photoluminescence from electrochemically synthesized GaAs Nanocrystals"; J. Nayak and S.N. Sahu; poster presentation in "*International Conference on Nanoscience and Technology*", 17th to 20th December 2003, Hyatt Regency, Kolkata, India.

13. "Nanoparticulate GaAs Thin Films; Synthesis, Structure and Optical Properties"; J. Nayak, S.Rath, A.K. Mohapatra and S.N. Sahu; poster presentation in "*National Symposium on Nanomaterials*", 5-6 December 2002 at Indian Institute of Technology, Delhi, India.

14. "Study of Structure and Optical properties of GaAs Nanocrystalline Thin Film", J. Nayak and S.N. Sahu; poster presentation in "*International Workshop on Nanomaterials*", February 2001, Saha Institute of Nuclear Physics, Kolkata, India.

15. "Photoluminescence properties of GaAs Nanocrystals"; J. Nayak, B.K. Patel and S.N. Sahu; oral presentation in "*International conference on Science and technology of Nanomaterials*", April 2001, Puri, India.

16. "Observation of Quantum Size Effect in GaAs Nanocrystalline Thin Film"; J. Nayak, S. Rath and S.N. Sahu; oral presentation in "*National Conf. on Science and Technology of Nanomaterials and Clusters*", 23-25th November 2000, Barkatullah University, Bhopal, India.