

Hemam Rachna Devi

Assistant Professor

Department of Materials Science and Metallurgical Engineering

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Personal details

Date of Birth: 14-11-1991

Nationality: Indian

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Academic details

Degree	Subject	Institution	Year	CGPA (or %)
10 th	Science, Mathematics etc.	Jawahar Navodaya Vidyalaya, Churachandpur, Manipur	2006	80.6%
12 th	Science	Jawahar Navodaya Vidyalaya, Churachandpur, Manipur	2008	78%
Bachelor	Physics	Vivekanandha Institute of Arts and Sciences for Women, Salem, Tamil Nadu	2009-2012	7.93/10
Masters	Physics	Christ University, Bangalore, Karnataka	2012-2014	3.54/5
-	Physics	Qualified NET and GATE	2015	-
Ph.D. (Course work)	Materials Science	Indian Institute of Science, Bangalore, Karnataka	2016	6.8/8

- Ph.D. Scholar, Materials Research Centre, *Indian Institute of Science (IISc), Bangalore-560012, India* (Jan 2016- Sep 2021)

Supervisor: Prof. Karuna Kar Nanda

- Joint student at School of Materials Science and Engineering, *Nanyang Technological University (NTU), Singapore- 639798* (Jun 2019-Oct 2020)

Co-Supervisor: Prof. Chen Zhong

Thesis title: “*Determining Functional Parameters of Hybrid Catalysts for Sustainable Energy Storage and Conversion Applications*”

Research Interests

Advanced materials for:

- (i) Sustainable energy technologies,
- (ii) Green hydrogen generation and utilization,
- (iii) Catalysis (including electrocatalysis, photocatalysis, photoelectrocatalysis, and photothermal catalysis), and
- (iv) Photothermal sensors.

Work experience

- **Assistant Professor**
Place: *Indian Institute of Technology*, Hyderabad
Period: 17th Sep 2024- present
- **Post-doctoral researcher**
Place: *National Institute of Materials Science*, Japan
Period: 15th Apr 2022 to 31st Aug 2024
Supervisor: Prof. Tadaaki Nagao
- **Research Assistant**
Place: *Indian Institute of Science*, Bangalore, India
Period: 1st Jan 2022 to 31st Mar 2022
Supervisor: Prof. Karuna Kar Nanda
- **Research Assistant**
Place: *Indian Institute of Science*, Bangalore, India
Period: 1st Apr 2021 to 30th Sep 2021
Supervisor: Prof. Karuna Kar Nanda

Awards, Honors, Fellowships

- **Selected for prestigious *Japan Society for the Promotion of Science (JSPS) postdoctoral fellowship*** in Aug 2024.
- **Selected for *Indian Institute of Science (India) – Nanyang Technological University (Singapore) Joint-Supervision Programme*** (16 months, Jun 2019 to Oct 2020).
- **Best Poster Award** in International Conference on Surface Engineering (INCOSURF, 2018)
- **Best Poster Award** in 63rd DAE Solid State Physics Symposium (2018)
- Recipient of Institute fellowship, *Indian Institute of Science*, Bangalore, India (2015/2016)
- Ranked in All India Common Merit List (**GATE** and **NET**, 2015)

Research Experience

- Transition metal-based oxides/hydroxides, carbon nanostructures and their hybrids, high entropy alloys, as catalyst for various sustainable energy storage and conversion applications like water splitting devices (electrolyzers and photo-assisted), metal air batteries and fuel cells
- Metal oxides for dark and photocatalytic organic pollutant degradation
- Metal oxides as optical and resistive gas sensors
- Metals and dielectrics for photothermal infrared sensors

Technical skills

- **Synthesis/ Fabrication techniques:** Solution growth method (hydrothermal, solvothermal, solution combustion, co-precipitation etc.), pyrolysis, electrodeposition, spin coating, thermal and e-beam evaporation, sputtering, Lithography (photo and e-beam).
- **Characterizations:** X-Ray Diffractometer data analysis, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (including High Resolution TEM, SAED, Elemental mapping), Energy dispersive X-ray spectroscopy (EDX), X-Ray photoelectron spectroscopy (XPS), Photoluminescence (PL), Raman and FTIR spectroscopy, Time resolved fluorescence spectroscopy (TRFS), Cyclic and Linear sweep voltammetry, Impedance spectroscopy, UV-Visible spectroscopy, Thermogravimetric analysis (TGA), BET surface area analysis, Ellipsometry.
- **Applications:** (i) Catalysis: Photocatalysis, electrocatalysis and photo-electrocatalysis (oxygen evolution reaction (OER), oxygen reduction reaction (ORR), hydrogen evolution reaction (HER)), organic pollutant degradation, (ii) Sensors: gas and analyte sensing (electrical and optical), photothermal based sensors.
- **Instrumentation:** Hand on experience on X-Ray Diffractometer, Scanning Electron Microscope (SEM), Photoluminescence spectrophotometer, Raman Spectrophotometer, UV-Visible Spectroscopy, CHI Electrochemical workstation, Gamry Electrochemical workstation, Solar simulator, Keithley instruments, Photoreactor, Thermogravimetric analysis (TGA), Surface profilometry, contact angle measurement, Sputtering, BET instrument, lithography (photo and e-beam), Rapid thermal annealing (RTA), E-beam evaporator, Ellipsometry, nanofabrication and clean room activities.

Publications

- Kanhai Kumar[‡], **Hemam Rachna Devi**[‡], Gokul Raj and Karuna Kar Nanda. Stimuli-free Zn/soda-lime glass/CuO-based MIS device for sensing human skin moisture. *J. Mater. Chem. C*, **2024**, *12*, **4026**.
- Vibrational Coupling to Quasi-Bound States in the Continuum under Tailored Coupling Conditions. Keisuke Watanabe, **Hemam Rachna Devi**, Masanobu Iwanaga, and Tadaaki Nagao. *Adv. Optical Mater.* **2023**, *12*, **2301912**.
- **Hemam Rachna Devi**, Ramachandra Chikkegowda, Dinesh Rangappa, Ashok Kumar Yadav, Zhong Chen, Karuna Kar Nanda. Trimetallic oxide-hydroxide porous nanosheets for efficient water oxidation. *Chemical Engineering Journal* **435** (2022) **135019**.
- **Hemam Rachna Devi**, Omeshwari Yadorao Bisen, Zhong Chen, Karuna Kar Nanda. Spatially dispersed one-dimensional carbon architecture on oxide framework for oxygen electrochemistry. *Chemical Engineering Journal* **433** (2022) **133649**.
- **Hemam Rachna Devi**, Ravi Nandan and Karuna Kar Nanda Mechanistic Investigation into Efficient Water Oxidation by Co–Ni-Based Hybrid Oxide–Hydroxide Flowers. *ACS Appl. Mater. Interfaces* **2020**, *12*, **13888–13895**.
- **Hemam Rachna Devi**, Omeshwari Yadorao Bisen, Xun Cao, Zhong Chen, Karuna Kar Nanda. Design of hierarchical oxide-carbon nanostructures for tri-functional electrocatalytic applications. *Adv. Mater. Interfaces* **2022**, *9*, **2200071**.
- **Hemam Rachna Devi**, Boon Chong Ong, Xin Zhao, Zhilli Dong, Karuna Kar Nanda and Zhong Chen. Insights into improving photoelectrochemical water splitting performance using hematite anode. *Energy Technol.* **2021**, *10*, **2100457**.
- **Hemam Rachna Devi**, Vanaraj Solanki, Karuna Kar Nanda. Modulating the Midgap States of 3D–2D Hybrid ZnO by Codoping and Its Effect on Visible Photocatalysis. *Ind. Eng. Chem. Res.* **2022**, *61*, **4244–4254**.
- **Hemam Rachna Devi**, Omeshwari Yadorao Bisen, Sankalpa Nanda, Ravi Nandan, and Karuna Kar Nanda. Current Science (2021). Internal versus external quantum efficiency of luminescent materials, photovoltaic cells, photodetectors and photoelectrocatalysis. *CURRENT SCIENCE*, VOL. **121**, NO. **7**, **10 OCTOBER 2021**.
- **Hemam Rachna Devi**, Vanaraj Solanki, KK Nanda. ZnO hybrid microstructures as dark catalyst. *ZnO hybrid microstructures as dark catalyst*.

- Inner Sphere Electron Transfer Promotion on Homogeneously Dispersed Fe-N_x Centers for Energy-Efficient Oxygen Reduction Reaction. Ravi Nandan, **Hemam Rachna Devi**, Ritesh Kumar, Abhishek Kumar Singh, Chandan Srivastava and Karuna Kar Nanda. *ACS Applied Materials & Interfaces* **2020**, *12*, **36026-36039**.
- High entropy alloy for water oxidation: A new class of electrocatalysts to lookout. Ravi Nandan, Mahendrakar Y. Rekha, **Hemam Rachna Devi**, Chandan Srivastava and Karuna Kar Nanda. *Chem. Commun.*, **2021**, *57*, **611-614**.
- Effect of inhomogeneous mesoporosity and defects on the luminescent properties of slanted silicon nanowires prepared by facile metal-assisted chemical etching. T. K. Adhila, **Rachna D. Hemam**, K. K. Nanda, and Harish C. Barshilia. *JOURNAL OF APPLIED PHYSICS* **124**, **104303 (2018)**.
- Development of pedagogical concepts for various phenomena associated with oxygen adsorption. Ravi Nandan, Sankalpa Nanda, Omeshwari Yadrao Bisen, **Hemam Rachna Devi** and Karuna Kar Nanda. (Under review)

Invited Talks

- International Conference on Laser & other Deposition techniques (iCOLD25) at IIT Hyderabad.

Participations

- Presented in National conference on Sensing and Technologies (NCST-2024)
- Participated on 11th International Hydrogen & Fuel Cell Conference (2024)
- Member of Japan Society of Applied Physics (JSAP, 2022-2024)
- Participated in JSAP meeting (2023)
- Presented paper in ISAJ (Indian Scientist Association in Japan) Symposium (2022)
- Member of the organizing committee in ISAJ (Indian Scientist Association in Japan) Symposium (2022)
- Presented paper in 13th International Symposium on Atomic Level Characterizations for New Materials and Devices '21, Japan (2021)
- Presented paper in ICPN Conference (2021)
- Attended India-Japan Webinar on Nanotechnology (2020)
- Presented paper in the International Conference on Materials for Advanced Technologies (ICMAT, 2019)
- Presented paper in Annual General Meeting of MRSI and the Indian Materials Conclave held at IISc, Bangalore (2019)
- Presented paper in 63rd DAE Solid State Physics Symposium held at Hisar, Haryana (2018)
- Presented paper in International Conference on Surface Engineering at IISc, Bangalore (INCOSURF, 2018)
- Presented paper in International Conference on Science and Technology Future Challenges and Solutions (STFCS) in Mysore University, Mysore (2016)
- Participated in 6th Annual KSTA Conference in Christ University, Bangalore (2013)
- Participated in National Conference on Recent Trends in Nanoscience and Technology in Salem, Tamil (2012)
- Active participation in "Open Day", an annual event organized by IISc to showcase research activities to the general public in the form of experimental demonstration, exhibition and poster presentation to motivate school and college students (2016-2018)

Teaching Merit

- Course instructor for Physics of Solids: MS1230 (2025)
- Course instructor for Energy Materials and Devices: MS5120 (2025)