

Faculty Spotlight

Bharati Debnath

Assistant Professor, RISE, TCG CREST

bharati.debnath@tcgcrest.org

Research Focus

Electrocatalysis, sustainable fuel generation, nanostructured catalysts, hydrogen evolution, CO_2 reduction, and green ammonia synthesis.

Profile

Dr. Bharati Debnath works on the rational design of noble metal-free, earth-abundant catalysts for sustainable fuel and chemical production. Her research focuses on developing advanced nanostructured catalytic systems for key electrochemical reactions including water splitting, carbon dioxide reduction, and nitrogen fixation.

Her group investigates scalable catalytic materials and electrochemical pathways that can enable low-emission technologies for clean energy generation and circular energy systems. Through interdisciplinary research spanning nanomaterials, electrocatalysis, and sustainable energy conversion, her work contributes to advancing carbon-neutral technologies and green fuel production.

Prior to joining Research Institute for Sustainable Energy (RISE), Dr. Debnath held research positions at institutions including Indian Institute of Science Education and Research, Kolkata, Indian Institute of Technology, Ropar, Indian Institute of Science Education and Research, Pune, and Ludwig Maximilian University of Munich.

Dr. Debnath is a recipient of the prestigious JSPS Postdoctoral Fellowship, awarded by the Japan Society for the Promotion of Science (JSPS), recognizing her contributions and potential in advanced scientific research.

Academic and Research Journey

- Ph. D., Indian Institute of Science Education and Research, Kolkata (2019)
- Postdoctoral Fellow, Indian Institute of Technology, Ropar (2020)
- Postdoctoral Fellow, Indian Institute of Science Education and Research, Pune (2021)
- Research Scientist, Research Institute for Sustainable Energy (RISE) (2022)
- Postdoctoral Fellow, Ludwig Maximilian University of Munich (2023)

Selected Research Contributions

1. Upcycling Nitrate Waste into Power: Designing Mo Incorporated Ni-Fe Based Phosphide Nanosheets for Electrocatalytic Green Ammonia Synthesis and Zn-Nitrate Batteries. T. Bagaria, A. Rahman, S. U K, A. Adalder, H. K. Basak, U. K. Ghorai, B. Chakraborty, A. Bano, B. Debnath, Small 2026, 22, e13455.

2. Sn-Doped Co-P-Based Trifunctional Electrocatalysts for Accelerating Water Splitting and Hydrogen Generation Concurrent with Ethylene Glycol Electrooxidation, T. Bagaria, S. Saha, S. K. Pati, A. Sadhu, B. Debnath, J. Mater. Chem. A 2025, 13, 15818 – 15831.

3. Tunable Charge Distribution in Self-Supported NiCoP through V and Mo Incorporation for Efficient Hydrogen Evolution in all pH Range and Alkaline Seawater. T. Bagaria, T. Borgohain, S. Jadhav, T. Das, B. Debnath, Small 2025, 21, 2503368.

Research Group

Doctoral Students
- Tanu Bagaria (joined 2024)
- Sameer Rai (joined 2025)
- Rettick Dinda (joined 2025)

Project Intern
- Chirashree Mondal (joined 2025)



Faculty Spotlight

Ambar Banerjee

Assistant Professor, RISE, TCG CREST

ambar.banerjee@tcgcrest.org

Research Focus

Quantum chemistry, photochemical reactions, excited-state dynamics, molecular interactions, and computational studies of energy materials.

Profile

Dr. Ambar Banerjee works on quantum chemical simulations and the fundamental molecular interactions governing energy-relevant systems. His research focuses on understanding photochemical reactions, excited-state dynamics, and light-driven catalytic processes at the atomistic level.

His group investigates mechanistic pathways in reactions such as C–H activation, water splitting, and CO_2 reduction, alongside computational studies of molecular interactions within modern rechargeable battery systems. Through advanced theoretical and spectroscopic investigations, his research aims to provide fundamental insights that support the design of efficient, durable, and sustainable energy materials.

Prior to joining Research Institute for Sustainable Energy (RISE), Dr. Banerjee held research positions at internationally renowned institutions including Weizmann Institute of Science, Stockholm University, and Uppsala University.

Academic and Research Journey

- Ph. D., Indian Association for the Cultivation of Science / University of Calcutta (2017)
- Postdoctoral Fellow, Weizmann Institute of Science (2018–2019)
- Postdoctoral Fellow, Stockholm University (2019–2021)
- Postdoctoral Fellow, Uppsala University (2021–2024)

Selected Research Contributions

1. Metal–ligand covalency of C–H activating iridium complexes from L-edge valence-to-core resonant inelastic X-ray scattering, R. M. Jay *, A. Banerjee*, Just accepted, Chemical Science, 2026.
2. Accessing Metal-Specific Orbital Interactions in C-H Activation using Resonant Inelastic X-ray Scattering, A. Banerjee*, et.al, Chemical Science, 15, 2024, 2398 – 2409.
3. Tracking C-H activation with orbital resolution, R. M. Jay,*† A. Banerjee,*†, et.al. Science, 380, 2023, 955–960.
4. Simulating non-adiabatic dynamics of photoexcited phenyl azide: Investigating electronic and structural relaxation towards the formation of phenyl nitrene, S. Das, M. Odelius, A. Banerjee,* Chemistry -A European Journal, 30 (7), 2023, e202302178
[† as equal 1st author]

Research Group

Doctoral Students
- Shrestha Ghosh (joined 2025)
- Neha Saha (joined 2025)

Intern
- Samriddhi Mondal



Faculty Spotlight

Kingshuk Roy

Assistant Professor, RISE, TCG CREST

kingshuk.roy@tcgcrest.org

Research Focus

Electrochemical interfaces, sodium metal batteries, aqueous zinc batteries, interphase chemistry, and next-generation energy storage systems.

Profile

Dr. Kingshuk Roy works on understanding electrochemical interfaces and interphases in next-generation battery systems, with a primary focus on anode-free sodium metal batteries. His research investigates how solvation structures, charge-transfer kinetics, nucleation behaviour, SEI formation, and current collector design influence sodium plating and stripping reversibility, ultimately governing battery stability and performance.

By integrating mechanistic electrochemistry, interfacial materials design, advanced characterisation techniques, and practical cell testing, his group aims to establish fundamental design principles for highly reversible and safe sodium metal batteries. His research also extends to aqueous zinc metal batteries, particularly in areas related to hydrogen evolution, interphase chemistry, and long-term cycling stability.

Prior to joining Research Institute for Sustainable Energy (RISE), Dr. Roy worked at institutions including Indian Institute of Science Education and Research, Pune and Purdue University.

Academic and Research Journey

- Ph. D., Indian Institute of Science Education and Research, Pune (2020)
- Research Scientist, Research Institute for Sustainable Energy (RISE) (2020–2022)
- Postdoctoral Research Associate, Purdue University (2022–2024)

Selected Research Contributions

1. Translating Molecular Order into Interfacial Function: Sodium Nucleation and Interphase Evolution Regulation for Ultra-Stable Anode-less Cycling, Srija Ghosh,.....Kingshuk Roy*, Advanced Functional Materials, 2026 (Just accepted).
2. Probing Battery Interfaces and Interphases with Microelectrodes: Spatially and Temporally Resolved Single-Entity Measurements, Animesh Khaund, ...Kingshuk Roy*, Advanced Energy Materials, 2026, 16, e04512.
3. Decoding Anode Stability: From nucleation kinetics to Pattern-Guided Flux Control for Long-Cycling Anode-Less Sodium Metal Batteries, Srija Ghosh,..... Kingshuk Roy*, Advanced Energy Materials, 2025, e03588.

Research Group

Doctoral Students
- Animesh Khaund (joined 2025)
- Srija Ghosh (joined 2025)
- Mayuri De (joined 2025)
- Laxman Kaulage (joined 2025)

Postdoctoral Scholar
- Dr. Koushik Barman (joined 2025)

Project Associate
- Deblina Banerjee (joined 2026)
- Isha Kabra (joined 2026)



Faculty Spotlight

Manas K Bhunia

Assistant Professor, RISE, TCG CREST

manas.bhunia@tcgcrest.org

Research Focus

Aqueous batteries, zinc metal batteries, sodium-ion batteries, sustainable energy storage, and earth-abundant energy materials.

Profile

Dr. Manas K. Bhunia works on the development of next-generation electrochemical energy storage systems, with a particular emphasis on aqueous batteries, zinc metal batteries, and sodium-ion batteries. His research focuses on designing sustainable and scalable battery technologies using earth-abundant materials for large-scale energy storage applications.

His group investigates energy storage solutions aimed at supporting the integration of intermittent renewable energy sources such as solar, wind, hydro, geothermal, and biomass energy into future energy infrastructures. Through materials innovation and electrochemical engineering, his research contributes to the development of clean, safe, and sustainable battery technologies for societal resilience and long-term energy sustainability.

Prior to joining Research Institute for Sustainable Energy (RISE), Dr. Bhunia held research and academic positions at institutions including Indian Association for the Cultivation of Science, University of California Davis, King Abdullah University of Science and Technology, Central University of Tamil Nadu, and Tokyo Institute of Technology.

Academic and Research Journey

- Ph. D., Indian Association for the Cultivation of Science (2012)
- Postdoctoral Associate, University of California Davis (2012–2013)
- Postdoctoral Associate, King Abdullah University of Science and Technology (2013–2017)
- Assistant Professor, Central University of Tamil Nadu (2017–2018)
- Assistant Professor, Tokyo Institute of Technology (2019–2022)
- Research Scientist, Research Institute for Sustainable Energy (RISE) (2022–2026)

Selected Research Contributions

1. Enhancement of Zn/Zn^{2+} Reversibility Using Molecular Materials in Aqueous Zinc-Ion Batteries: A Review, A. Manna, A. Patra, M. K. Bhunia, Small, 2026, e13372.
2. Transition-Metal-Free Electrodes for Rechargeable Sodium-Ion Batteries: a Path towards Sustainable Energy Storage, N. Roy, A. Patra, G. Barik, S. Ogale, and M. K. Bhunia, Small, 2025, 2504826.
3. Modulation of Electron Push–Pull by Redox Non-Innocent Additives for Long Cycle Life Zinc Anode, A. Manna, S. Pal, B. Das, S. Ogale, M. K. Bhunia, Small, 2024, 20 (46), 2404752

Research Group

Doctoral Students
- Nishita Roy (joined 2024)
- Gurupada Barik (joined 2025)
- Arghyadip Manna (joined 2025)

Project Assistant
- Anubhab Patra (joined 2024)



Faculty Spotlight

Tanmoy Paul

Assistant Professor, RISE, TCG CREST

tanmoy.paul@tcgcrest.org

Research Focus

Materials modelling, solid-state ionics, electrochemical systems, battery materials, density functional theory, and machine learning for energy materials.

Profile

Dr. Tanmoy Paul works on computational modelling and advanced simulations of energy materials with a focus on solid-state ionics, electrochemical systems, and next-generation battery technologies. His research investigates the fundamental structure–property relationships and ion transport mechanisms governing oxide ion conductors, lithium-ion batteries, and sodium-ion battery materials.

By integrating density functional theory (DFT), machine learning approaches, and experimental validation, his group aims to design and optimise high-performance electrode and electrolyte materials for future energy storage technologies. His work contributes to accelerating the discovery of advanced battery materials through computationally driven materials design and predictive modelling.

Prior to joining Research Institute for Sustainable Energy (RISE), Dr. Paul held research positions at institutions including Indian Association for the Cultivation of Science, Technion – Israel Institute of Technology, National Taiwan University, Academia Sinica, and S. N. Bose National Centre for Basic Sciences.

Academic and Research Journey

- Ph. D., Indian Association for the Cultivation of Science (2016)
- Postdoctoral Fellow, Indian Association for the Cultivation of Science (2016–2017)
- Postdoctoral Fellow, Technion – Israel Institute of Technology (2017–2019)
- Postdoctoral Fellow, National Taiwan University (2019–2020)
- Postdoctoral Fellow, Academia Sinica (2020–2021)
- Postdoctoral Fellow, S. N. Bose National Centre for Basic Sciences (2021–2022)
- Research Scientist, Research Institute for Sustainable Energy (RISE) (2022–2026)

Selected Research Contributions

1. Ab initio study of point defects in disordered solid electrolytes Li_3ACl_6 (A= Y, Er, In) for all solid-state Li-ion batteries, T. Paul, Phys. Rev. Mater. 2026, 10, 025404.
2. First-Principles Investigation of Point Defects in Na-Antiperovskite Cathodes, A. K. Das and T. Paul, Adv. Theory Simul. 2026, 9, e02286.
3. Theoretical Design of Na-Rich Antiperovskites as Cathode Material for Sodium-Ion Batteries, R. Boral and T. Paul, ACS Appl. Energy Mater. 2025, 8, 14363.
4. Designing layered oxides as cathodes for sodium-ion batteries: Machine learning and density functional theory based modelling, N. Mishra, R. Boral and T. Paul, Mater. Today Phys. 2025, 51, 101634.

Research Group

Doctoral Students
- Rajdeep Boral (joined 2023)

Postdoctoral Scholar
- Dr. Kishan Mali

Project Students (Alumni)
- Nishant Mishra (2023–2025)
- Pritish Ranjan Joshi (2024–2025)
- Arnab Kumar Das (2025–2026)



Faculty Spotlight

Ritesh Kumar

Assistant Professor, RISE, TCG CREST

ritesh.kumar@tcgcrest.org

Research Focus

Computational battery materials discovery, multiscale modeling, AI/ML for electrochemical energy

Profile

Dr. Ritesh Kumar leads the Intelligent Electrochemical Energy (IE^2) research group, which focuses on accelerating materials discovery and understanding electrified interfaces for next-generation batteries and value-added chemical production. His research integrates artificial intelligence, automated experimentation, and electrochemical science to enable data-driven discovery of advanced energy materials.

The group develops trustworthy and interpretable foundation AI models, automated literature-mining pipelines for high-fidelity database construction, and self-driving laboratories guided by digital twins. By combining AI-driven insights with automated experimentation and literature-derived design rules, the research aims to close the materials discovery loop and significantly accelerate the development of sustainable energy technologies.

Prior to joining Research Institute for Sustainable Energy (RISE), Dr. Kumar conducted research at Indian Institute of Science and University of Chicago, where he also served as an Eric and Wendy Schmidt AI in Science Fellow.

Academic and Research Journey

- Ph. D., Indian Institute of Science, Bengaluru (2022)
- Postdoctoral Scholar, University of Chicago (2022–2023)
- Eric and Wendy Schmidt AI in Science Fellow, University of Chicago (2023–2026)

Selected Research Contributions

1. R. Kumar†, K.-H. Wang†, C. V. Amanchukwu, "Using Electrolyte Solvent Embeddings to Guide Battery Electrolyte Discovery." Mol. Syst. Des. Eng. (2026) (https://doi.org/10.1039/D5ME00188A).
2. P. Ma†, R. Kumar†, K.-H. Wang, C. V. Amanchukwu, "Active Learning Accelerates Electrolyte Solvent Screening for Anode-Free Lithium Metal Batteries." Nat. Commun. 16, 8396 (2025).
3. H. Fejzic, R. Kumar, R. J. Gomes, L. He, T. J. Houser, J. Kim, N. Molten, C. V. Amanchukwu. "Water Clustering Modulates Activity and Enables Hydrogenated Product Formation during Carbon Monoxide Electroreduction in Aprotic Media." J. Am. Chem. Soc. 147, 18445-18459 (2025).
4. R. Kumar, M. C. Vu, P. Ma, C. V. Amanchukwu. "Electrolytomics: A Unified Big Data Approach for Electrolyte Design and Discovery." Chem. Mater. 37, 2720-2734 (2025).
5. R. J. Gomes, R. Kumar, H. Fejzic, B. Sarkar, I. Roy, C. V. Amanchukwu. "Modulating Water Hydrogen Bonding within a Nonaqueous Environment Controls its Reactivity in Electrochemical Transformations" Nat. Catal. 7, 689-701 (2024).
[† as equal 1st author]



Faculty Spotlight

Amreen Bano

Senior Research Scientist, RISE, TCG CREST

amreen.bano@tcgcrest.org

Research Focus

Computational modelling of energy materials, battery materials design, electrochemical systems, molecular dynamics, density functional theory, and machine learning for energy storage.

Profile

Dr. Amreen Bano leads the AMREEN Group (Advanced Modelling and Research in Energy and Electrochemical Navigation), which focuses on the development of next-generation energy storage materials through advanced computational approaches. Her research addresses critical challenges in designing efficient, safe, and sustainable battery technologies for renewable energy systems, electric mobility, and grid-scale storage applications.

Her group works on the computational design and optimisation of cathodes, anodes, and electrolytes using methods such as density functional theory (DFT), molecular dynamics (MD), ab initio molecular dynamics (AIMD), and machine learning. By integrating physics-based simulations with data-driven modelling, the group aims to accelerate materials discovery and enable the rational design of advanced electrochemical energy systems.

Prior to joining Research Institute for Sustainable Energy (RISE), Dr. Bano conducted research at institutions including Indian Institute of Science Education and Research, Pune and Bar-Ilan University.

Academic and Research Journey

- Ph. D., University Teaching Department (UTD)–Physics, Barkatullah University (2016–2020)
- Postdoctoral Researcher, Indian Institute of Science Education and Research, Pune (2020–2021)
- Postdoctoral Researcher, Bar-Ilan University (2021–2024)
- Research Scientist, Research Institute for Sustainable Energy (RISE) (2024–2026)

Selected Research Contributions

1. Upcycling Nitrate Waste into Power: Designing Mo Incorporated Ni–Fe Based Phosphide Nanosheets for Electrocatalytic Green Ammonia Synthesis and Zn-Nitrate Batteries, T. Bagaria, A. Rahman, Soumya U K, et al. Small 2026: smll.202513455.

2. A Hybrid Bilayer Design to Control Lithium Nucleation and Dendrite Growth in Lithium Metal Batteries, Ashwin P V, S. Sau, N. Seal, A. Bano, S. Mitra, ACS Applied Materials & Interfaces, 2026, acsami.5c23307.

3. Decoding Anode Stability: From Nucleation Kinetics to Pattern-Guided Flux Control for Long-Cycling Anode-Less Sodium Metal Batteries, S. Ghosh, A. Rana, A. Mohini, P. Jenis, S. Renjitha, M. A. Faisal, K. Barman, J. H. Ngyuen, A. Bano*, J. E. Dick*, K. Roy, , Advanced Energy Materials, 2025, aenm.202503588.

Research Group

Doctoral Students

- Antra Mohini (joined 2025)
- Novotna Seal (joined 2025)
- Soumya UK (joined 2025)



