

Ananya Banik

Assistant Professor
IIT (ISM) Dhanbad
Dhanbad, India.

EDUCATION

Jawaharlal Nehru Centre For Advanced Scientific Research Ph.D	Bangalore, India 03/2019
Jawaharlal Nehru Centre For Advanced Scientific Research M. S	Bangalore, India 06/2015
Presidency College, University of Calcutta B.Sc	Kolkata, India 07/2012

RESEARCH INTERESTS & EXPERIENCE

RESEARCH INTERESTS/BACKGROUND

Development of functional materials for energy conversion and storage applications

- Solid-state inorganic chemistry of thiophosphate, chalcogenides and halides
- 2D Materials
- Thermal, electronic and ionic transports, crystallography
- Thermoelectric materials
- Solid electrolytes, structure-transport correlation
- Solid-state batteries

EXPERIENCE AFTER PHD

IIT (ISM) Dhanbad Assistant Professor Material design for thermoelectric and Solid state batteries	Dhanbad, India 03/2025-Present
TCG Centres for Research and Education in Science and Technology (TCG-CREST) Senior Research Scientist Designing functional materials for solid-state batteries	Kolkata, India 09/2023-03/2025
University of Münster Postdoctoral researcher Developing halide and thiophosphate sulfide solid electrolyte for solid-state batteries	Muenster, Germany 07/2022 – 07/2023

University of Münster

Alexander von Humboldt postdoctoral fellow

Structure-properties correlation in lithium ion conducting halide solid electrolytes

Muenster, Germany

07/2020 – 06/2022

University of Giessen

Postdoctoral researcher

Thiophosphate solid electrolytes for Li-S batteries

Giessen, Germany

04/2019 – 06/2020

EXPERIENCE BEFORE PHD**Jawaharlal Nehru Centre For Advanced Scientific Research**

Doctoral student

Thermoelectric energy conversion based on Sn-chalcogenides

Bangalore, India

06/2015 – 03/2019

Jawaharlal Nehru Centre For Advanced Scientific Research

M.S. student

Thermoelectric energy conversion based on lead-free chalcogenides

Bangalore, India

07/2012 – 06/2015

FELLOWSHIPS & RECOGNITION**FELLOWSHIPS/AWARDS**

- Elected as Early Career Board Member of ACS Applied Materials & Interfaces and family journals, 2025.
- Young Scientist Award in the Global Conference for Decarbonization of Energy and Materials 2024.
- Alexander von Humboldt Postdoctoral Fellowship for 2020-2022.
- KPIT Shodh Best Thesis Award in ‘Energy and Mobility’ conference 2019, IISER Pune, India.
- International Travel Support Award, SERB, DST, India, 2018.
- Best poster award at “An International Symposium on Solid State Chemistry”, 2016, India.
- INSPIRE Fellowship, Department of Science & Technology, Government of India, for B.Sc. and doctoral studies, from 2009-2019.
- Qualified National Level Indian Institute of Technology (IIT) Entrance Exam JAM – 2012 in Chemistry.

SELECTED LIST of CONFERENCES, SCHOOLS AND WORKSHOPS

- Global Conference for Decarbonization of Energy and Materials, Singapore, 2024
- 23rd International Conference on Solid State Ionics, Boston, MA, USA, 2022 (**Oral presentation**).
- EUROMAT, Graz, Austria, 2021 (**Oral presentation**).
- “256th ACS National Meeting” Boston, MA, USA, 2018 (**Oral presentation**).

- “India-UK Workshop on Thermoelectric Materials for Waste-Heat Harvesting”, Bangalore, India, 2018 (**Poster presentation**).
- “Powder Diffraction and Rietveld Refinement School”, Durham, UK, April 2016.
- “Workshop on Multiferroics, Coorg”, India, Nov, 2015 (**Oral presentation**).

PROFESSIONAL ACTIVITIES

Peer reviewer

ACS: ACS Applied Energy Materials, Chemistry of Materials

RSC: Journal of Materials Chemistry A, RSC Advances, Energy & Environmental Science

Wiley: Advanced Functional Materials, Advanced Materials

PUBLICATIONS

Total-36 (Includes: 4 review articles and 3 book chapters)

Citations: 3164; h-index: 22, i10-index: 26

(Google scholar: <https://scholar.google.com/citations?user=eJY5FOEAAAAJ&hl=en>)

JOURNAL PUBLICATIONS

1. Hartel, J.; **Banik, A.**; Ali, M. Y.; Helm, B.; Strotmann, K.; Faka, V.; Maus, O.; Li, C.; Wiggers, H.; Zeier, W. G. Investigating the Influence of Transition Metal Substitution in Lithium Argyrodites on Structure, Transport, and Solid-State Battery Performance. *Chem. Mater.* **2024**, *36* (21), 10731–10745.
2. **Banik, A.***; Samanta, B.; Helm, B.; Kraft, M. A.; Rudel, Y.; Li, C.; Hansen, M. R.; Lotsch, B. V.; Bette, S.; Zeier, W. G. Exploring Layered Disorder in Lithium-Ion-Conducting $\text{Li}_3\text{Y}_{1-x}\text{In}_x\text{Cl}_6$. *Inorg. Chem.* **2024**, *63*(19), 8698–8709. (* = corresponding author)
3. Helm, B.; Strotmann, K.; Böger, T.; Samanta, B.; **Banik, A.**; Lange, M. A.; Li, Y.; Li, C.; Hansen, M. R.; Canepa, P.; Zeier, W. G. Reducing the Defect Formation Energy by Aliovalent Sn(+IV) and Isovalent P(+V) Substitution in Li_3SbS_4 Promotes Li^+ Transport. *ACS Appl. Energy Mater.* **2024**, *7*(5), 1735–1747.
4. Hartel, J.; **Banik, A.**; Gerdes, J. M.; Wankmiller, B.; Helm, B.; Li, C.; Kraft, M. A.; Hansen, M. R.; Zeier, W. G. Understanding Lithium-Ion Transport in Selenophosphate-Based Lithium Argyrodites and Their Limitations in Solid-State Batteries. *Chem. Mater.* **2023**, *35* (12), 4798–4809.
5. Chatterjee, A.; Sachat, E. A.; **Banik, A.**; Biswas, K.; Castro-Alvarez, A.; Sotomayor Torres, C. M.; Santiso, J.; Chávez-Ángel, E. Improved High Temperature Thermoelectric Properties in Misfit $\text{Ca}_3\text{Co}_4\text{O}_9$ by Thermal Annealing. *Energies* (Basel) **2023**, *16*, 5162.
6. Chatterjee, A.; **Banik, A.**; El Sachat, A.; Caicedo Roque, J. M.; Padilla-Pantoja, J.; Sotomayor Torres, C. M.; Biswas, K.; Santiso, J.; Chavez-Angel, E. Enhanced Thermoelectric Properties of Misfit $\text{Bi}_2\text{Sr}_{2-x}\text{Ca}_x\text{Co}_2\text{O}_y$: Isovalent Substitutions and Selective Phonon Scattering. *Materials* **2023**, *16* (4), 1413.
7. Helm, B.; Gronych, L.-M.; **Banik, A.**; Lange, M. A.; Li, C.; Zeier, W. G. Investigating the Li^+ substructure and ionic transport in $\text{Li}_{10}\text{GeP}_{2-x}\text{Sb}_x\text{S}_{12}$ ($0 \leq x \leq 0.25$). *Phys. Chem. Chem. Phys.* **2023**, *25*, 1169–1176.
8. Pal, S.; Arora, R.; **Banik, A.**; Glazyrin, K. V.; Muthu, D. V. S.; Biswas, K.; Waghmare, U. V.;

- Sood, A. K. Pressure-induced topological and structural phase transitions in natural van der Waals heterostructures from the $(\text{SnTe})_m(\text{Bi}_2\text{Te}_3)_n$ homologous family: Raman spectroscopy, x-ray diffraction, and density functional theory. *Phys. Rev. B* **2022**, 106, 134104.
9. Hogrefe, K.; Minafra, N.; Hanghofer, I.; **Banik, A.**; Zeier, W. G.; Wilkening, H. M. R. Opening diffusion pathways through site disorder: the interplay of local structure and ion dynamics in the solid electrolyte $\text{Li}_{6+x}\text{P}_{1-x}\text{Ge}_x\text{S}_5\text{I}$ as probed by neutron diffraction and NMR. *J. Am. Chem. Soc.* **2022**, 144, 1795–1812.
 10. **Banik, A.**; Liu, Y.; Ohno, S.; Rudel, Y.; Jiménez-Solano, A.; Gloskovskii, A.; Vargas-Barbosa, N.; Mo, Y.; Zeier, W. Can substitutions affect the oxidative stability of lithium argyrodite solid electrolytes? *ACS Appl. Energy Mater.* **2022**, 5, 2045–2053.
 11. Helm, B.; Schlem, R.; Wankmiller, B.; **Banik, A.**; Gautam, A.; Ruhl, J.; Li, C.; Hansen, M. R.; Zeier, W. G. Exploring aliovalent substitutions in the lithium halide superionic conductor $\text{Li}_{3-x}\text{In}_{1-x}\text{Zr}_x\text{Cl}_6$ ($0 \leq x \leq 0.5$). *Chem. Mater.* **2021**, 33, 4773–4782.
 12. Schlem, R.; **Banik, A.**; Ohno, S.; Suard, E.; Zeier, W. G. Insights into the lithium sub-structure of superionic conductors Li_3YCl_6 and Li_3YBr_6 . *Chem. Mater.* **2021**, 33, 327–337.
 13. **Banik, A.**; Famprikis, T.; Ghidui, M.; Ohno, S.; Kraft, M. A.; Zeier, W. G. On the underestimated influence of synthetic conditions in solid ionic conductors. *Chem. Sci.* **2021**, 12, 6238–6263.
 14. Schlem, R.; **Banik, A.**; Eckardt, M.; Zobel, M.; Zeier, W. G.; $\text{Na}_{3-x}\text{Er}_{1-x}\text{Zr}_x\text{Cl}_6$ —A Halide-based fast sodium-ion conductor with vacancy-driven ionic transport. *ACS App. Energy Mater.* **2020**, 3, 10164–10173.
 15. Sarkar, D.; Ghosh, T.; **Banik, A.**; Roychowdhury, S.; Sanyal, D.; Biswas, K. Highly converged valence bands and ultralow lattice thermal conductivity for high-performance SnTe Thermoelectrics. *Angew. Chem., Int. Ed.* **2020**, 59, 11115–11122.
 16. Ohno, S.; **Banik, A.**; Dewald, G. F.; Kraft, M. A.; Krauskopf, T.; Minafra, N.; Till, P.; Weiss, M.; Zeier, W. G. Materials design of ionic conductors for solid state batteries. *Prog. Energy* **2020**, 2, 022001.
 17. Schlem, R.; Muy, S.; Prinz, N.; **Banik, A.**; Shao-Horn, Y.; Zobel, M.; Zeier, W. G. Mechanochemical synthesis: a tool to tune cation site disorder and ionic transport properties of Li_3MCl_6 ($\text{M} = \text{Y}, \text{Er}$) superionic conductors. *Adv. Energy Mater.* **2020**, 10, 1903719.
 18. **Banik, A.**; Biswas, K. A game-changing strategy in SnSe thermoelectrics. *Joule* **2019**, 3, 636–638.
 19. **Banik, A.**; Ghosh, T.; Arora, R.; Dutta, M.; Pandey, J.; Acharya, S.; Soni, A.; Waghmare, U. V.; Biswas, K. Engineering ferroelectric instability to achieve ultralow thermal conductivity and high thermoelectric performance in $\text{Sn}_{1-x}\text{Ge}_x\text{Te}$. *Energy Environ. Sci.* **2019**, 12, 589–595.
 20. Haque, A.; **Banik, A.**; Varma, R. M.; Sarkar, I.; Biswas, K.; Santra, P. K. Understanding the chemical nature of the buried nanostructures in low thermal conductive Sb-doped SnTe by variable-energy photoelectron spectroscopy. *J. Phys. Chem. C* **2019**, 123, 10272–10279.
 21. Roychowdhury, S.; Samanta, M.; **Banik, A.**; Biswas, K. Thermoelectric energy conversion and topological materials based on heavy metal chalcogenides. *J. Solid State Chem.* **2019**, 275, 103–123 (Review article).
 22. **Banik, A.**; Roychowdhury, S.; Biswas, K. Journey of tin chalcogenides towards high performance thermoelectrics and topological material. *Chem. Commun.* **2018**, 54, 6573–6590 (Feature article).
 23. Chandra, S.; **Banik, A.**; Biswas, K. n-Type ultrathin few-layer nanosheets of Bi doped SnSe:

- Synthesis and thermoelectric properties. *ACS Energy Lett.* **2018**, 3, 1153-1158.
24. Pal, P.; Saha, S.; **Banik, A.**; Sarkar, A.; Biswas, K. All-solid-state mechanochemical synthesis and post-synthetic transformation of inorganic perovskite-type halides. *Chem. - Eur. J.* **2018**, 24, 1811-1815.
 25. **Banik, A.**; Biswas, K. Synthetic nanosheets of natural van der Waals heterostructures. *Angew. Chem., Int. Ed.* **2017**, 56, 14561-14566.
 26. **Banik, A.**; Shenoy, U. S.; Saha, S.; Waghmare, U. V.; Biswas, K. High power factor and enhanced thermoelectric performance of SnTe-AgInTe₂: Synergistic effect of resonance level and valence band convergence. *J. Am. Chem. Soc.* **2016**, 138, 13068-13075.
 27. Saha, S.; **Banik, A.**; Biswas, K. Few layer nanosheets of n-type SnSe₂. *Chem. - Eur. J.* **2016**, 22, 15634-15638.
 28. **Banik, A.**; Vishal, B.; Perumal, S.; Datta, R.; Biswas, K. The origin of low thermal conductivity in Sn_{1-x}Sb_xTe: Phonon scattering via layered intergrowth nanostructures. *Energy Environ. Sci.* **2016**, 9, 2011-2019.
 29. **Banik, A.**; Aggarwal, L.; Anand, S.; Waghmare, U. V.; Biswas, K.; Sheet, G. Local ferroelectricity in thermoelectric SnTe above room temperature driven by competing phonon instabilities and soft resonant bonding. *J. Mater. Chem.* **2016**, 2, 196-202.
 30. **Banik, A.**; Biswas, K. AgI alloying in SnTe boosts the thermoelectric performance via simultaneous valence band convergence and carrier concentration optimization. *J. Solid State Chem.* **2016**, 242, 43-49.
 31. **Banik, A.**; Shenoy, U. S.; Anand, S.; Waghmare, U. V.; Biswas, K. Mg Alloying in SnTe facilitates valence band convergence and optimizes thermoelectric properties. *Chem. Mater.* **2015**, 27, 581-587.
 32. **Banik, A.**; Biswas, K. Low-temperature soft-chemical synthesis and thermoelectric properties of barium-filled p-type skutterudite nanocrystals. *Mater. Sci. Semicond. Process* **2014**, 27, 593-598.
 33. **Banik, A.**; Biswas, K. Lead free thermoelectrics: promising performance in p-type SnTe_{1-x}Se_x system. *J. Mater. Chem. A* **2014**, 2, 9620-9625.

BOOK CHAPTER

1. **Banik, A.**; Agne M.; Zeier, W. Materials for thermoelectric devices. *Applied Inorganic Chemistry* vol2, De Gruyter, **2022**, 26.
2. **Banik, A.**; Perumal, S.; Biswas, K. Thermoelectric properties of metal chalcogenides nanosheets and nanofilms grown by chemical and physical routes. *Thermoelectric Thin Films: Materials and Devices*, Springer International Publishing, **2019**, 157-184.
3. Guin, S. N.; **Banik, A.**; Biswas, K. Thermoelectric energy conversion in layered metal Chalcogenides. *2d Inorganic Materials Beyond Graphene*, 2018, 239-274.

CONTRIBUTIONS TO THE INSTITUTES

- **At TCG Centres for Research and Education in Science and Technology (TCG-CREST)**
 - As an independent researcher, currently supervising one PhD student.
 - Developed the instrumental facilities work in solid electrolytes and solid-state batteries.
 - Course instructor of Materials Synthesis & Characterizations-II offered to Ph.D. students.

- **At University of Münster, Germany**

- Mentored four graduate students for their PhD projects during postdoctoral research period, which generated five publications in prestigious peer-reviewed scientific journals.
- As a postdoctoral researcher supervised thesis projects of two M. Sc and two B. Sc students, which generated publication in prestigious peer-reviewed scientific journal.
- Participated in Prof. Wolfgang Zeier's laboratory set up at the University of Münster, Germany.

OTHERS

- Worked as a teaching assistant for the course "Energy and Environment" (JNC-206) instructed by Prof. Kanishka Biswas and Prof. Sebastian C. Peter at JNCASR, India (2015-2016).
- Mentored and helped three undergraduate students as a part of project oriented chemical education (POCE) program, three M.Sc. students during their summer internship as a part of summer research fellowship program (SRFP) at JNCASR, India.