

CV

Sreyan Raha

Educational Details

➤ **December 2022-present: Postdoctoral Fellow**

NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore, Piazza San Silvestro, Pisa, Italy.

Project Name: Light-matter interactions and the collective behavior of quantum 2D materials.

As a postdoctoral fellow, I am engaged in a comprehensive and multidimensional research project centered around the fascinating realms of light-matter interaction and the collective behavior of quantum materials. My work here has equipped me with an extensive skill set, particularly in the fabrication of twisted Transition Metal Dichalcogenide (TMDC) and graphene heterostructures through dry transfer techniques. Furthermore, I have gained proficiency in device fabrication employing both optical and electron lithography methods. In addition to my specialization in optical spectroscopies during Ph.D. studies, my current role at NEST, Italy has expanded my horizons, and I am actively involved in magneto-transport measurements conducted at extremely low temperatures.

➤ **2016-2022: Ph. D in Physics (experimental condensed matter)**

(Thesis submitted: June, 2022; Degree awarded: July, 2023)

Bose Institute, University of Calcutta, Kolkata, India.

Thesis Title: Vibrational and Optical Properties of Semiconductor Nanostructured Materials using Raman and Optical Spectroscopy

Supervisor: Prof. Achintya Singha

The thesis aims to study optical and vibrational properties of 1D and 2D semiconductor systems mainly using Raman and Photoluminescence spectroscopy. Like plasmonic nanostructure, we realized electric field enhancement in germanium nanowire. Depending on the diameter of the nanowire and wavelength of incident radiation, we demonstrated dipolar (antenna effect) and quadrupolar resonances through a polarized Raman study. For the first time, we explored complete lattice dynamics of polymorph ST12 germanium nanowire through Raman spectroscopy and calculations. A systematic Raman study has been carried out to explore the lattice dynamics of the Sn doped direct bandgap Ge_{1-x}Sn_x alloy nanowire. Our study also involves probing anomalous phonon behavior of SnSe nanoribbon at various thermodynamic conditions. Finally, we demonstrate tuning optical

and vibrational properties of the Mn-doped MoSe₂ 2D sheet through photoluminescence and Raman spectroscopy.

➤ **2014-2016: M. Sc in Physical Sciences (2 years)**

Bose Institute, University of Calcutta, Kolkata, India.

Percentage: 72.80 (First Class)

Principal topics: Mathematical Physics, Classical Mechanics, Quantum Mechanics, Statistical Physics, Electrodynamics, Semiconductor Physics, Electronics and Communication, Special Theory of Relativity, Solid State Physics, Atomic Physics, Molecular Physics, Laser Physics, Nuclear Physics, Particle Physics, Nonlinear Dynamics, Instrumentation, Experiments, Computation.

M.Sc. dissertation: Enhanced Raman Scattering from Individual Germanium Nanowire.

Supervisor: Prof. Achintya Singha

➤ **2011-2014: B. Sc in Physics (3 years)**

Krishnagar Govt. College, University of Kalyani, West Bengal, India.

Percentage: 84% (First class)

Major Subject: Physics.

Other Subjects: Chemistry, Mathematics.

Skill Set

Sample Preparation

- ✓ Exfoliation from single crystal.
- ✓ Chemical Vapour Deposition.
- ✓ Hydrothermal method.
- ✓ Dry transfer technique for heterostructures and moire lattices.

Device Fabrication

- ✓ Optical Lithography.
- ✓ Electron beam lithography.

Characterization

- ✓ XRD
- ✓ Scanning Electron Microscopy

Vibrational and Optical Spectroscopy

- ✓ Micro Raman spectroscopy (Polarized Raman spectroscopy, Temperature dependent Raman spectroscopy).

- ✓ High pressure Raman study using DAC.
- ✓ Optical absorption spectroscopy.
- ✓ Micro Photoluminescence spectroscopy (ambient, low and high temperature).

Transport measurements

- ✓ Magneto transport measurements at dry He cryostat.

Software and Simulation

- Origin Lab.
- Microsoft Excel.
- COMSOL Multiphysics.
- Mathematica (beginner).

Other Interests

Literary works, both fiction and non-fiction, particularly in my mother tongue deeply attract me. As extracurricular, I am involved in writing for magazines and editing books. I have interest in music as well, and got training in Indian music, with a wish to explore different music genres across the world.

Conferences and Workshops Attended

- Attended Summer School at 2D QUANTUM MATTER 2023, organised by University of Pisa at Lucca, Italy.
- **Oral presentation at QMAT 2020, S N Bose National Centre for Basic Sciences, India.**
- Poster presentation at IWPSD 2019, S N Bose National Centre for Basic Sciences, India.
- Poster presentation at ICOPVS 2018 at Bhaba Atomic Research Centre, Mumbai, India.
- Poster presentation at NAWCMP 2018 at Visva Bharati University, Bolpur, India.
- Poster presentation at RTCMP 2017 at Bose Institute, Kolkata, India.
- Poster presentation at ABSMSNW 2017 at IIT BHU, Varanasi, India.

Recognitions

- **Prof. Shyamadas Chatterjee Outstanding Student Award for the year 2021 awarded by Bose Institute, Kolkata.**
- UGC-National Eligibility Test (NET) June 2016 conducted by Govt. of India.
- Qualified Joint Entrance Screening Test (JEST) conducted by the Science & Engineering Research Board (SERB), Govt. of India 2016, All India Rank: 161.
- Qualified Graduate Aptitude Test in Engineering (GATE) 2016 conducted by Indian Institute of Technology (IITs), All India Rank: 202.
- INSPIRE Scholarship 2011 offered by Department of Science and Technology (DST), Govt. of India.

Publications

A. Publications with peer review process

1. Masanta S., Nayak S., Maitra S., Rudra S., Chowdhury D., **Raha S.**, Pradhan M., Satpati B., Pal P., Singha A.*, Engineering Multifunctionality in MoSe₂ Nanostructures Via Strategic Mn Doping for Electrochemical Energy Storage and Photosensing, *ACS Applied Nano Materials* 6 (7), 5479-5492 (2023).
2. **Raha S.**, Doherty J., Mondal P. K., Biswas S., Holmes J. D., Singha A.*, Lattice dynamics in Ge_{1-x}Sn_x alloy nanowires, *Nanoscale* 14, 7211-7219 (2022).
3. Bisht R.S.*, Chatterjee S., **Raha S.**, Singha A., Kabiraj D., Kanjilal D., Raychaudhuri A. K.*, Disorder induced cross-over of Mott Insulator to weak Anderson localized regime in Argon irradiated NdNiO₃ film, *Phys. Rev. B* 105, 205120 (2022).
4. Mohid Sk. A., Sharma P., Alghalayini A., Saini T., Datta D., Willcox M. D. P., Ali H., **Raha S.**, Singha A., Lee D., Sahoo N., Cranfield C. G., Roy S., Bhunia A.*, A rationally designed synthetic antimicrobial peptide against Pseudomonas-associated corneal keratitis: Structure-function correlation, *Biophysical Chemistry* 106802 (2022).
5. Garcia A., Biswas S.*, McNulty D., Roy A., **Raha S.**, Trabesinger S., Nicolosi V., Singha A., Holmes J. D., One-step Grown Carbonaceous Germanium Nanowires and their Application as Highly-efficient Lithium-ion Battery Anodes, *ACS Applied Energy Materials* 5, 2, 1922–1932 (2022).
6. Davitt F., Rahme K., **Raha S.**, Garvey S., Gutierrez M., Singha A., Chang S., Biswas S.*, Holmes J. D., Solution phase growth and analysis of super-thin zigzag tin selenide nanoribbons, *Nanotechnology*, 13 (33), 135601 (2022).
7. **Raha S.**, Srivastava D., Biswas S., Garcia A., Karttunen A. J., Holmes J. D., Singha A.*, Probing lattice dynamics in ST12 phase germanium nanowires by Raman spectroscopy, *Appl Phys Lett* 119, 232105 (2021).
8. Das L., Ray S., **Raha S.**, Dey D., Sen K.*, Aqueous biphasic system in differential extraction of arseno and phospho molybdenum blue: Consequent sensing of glutathione in acid-free medium, *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, Volume 611, 2021, 125808 (2021).
9. **Raha S.**, Mitra S., Mondal P. K., Biswas S., Holmes J. D., Singha A.*, Probing dipole and quadrupole resonance mode in non-plasmonic nanowire using Raman spectroscopy, *Nanotechnology* 31 (42), 425201 (2020).

10. Chakraborty A., Das A., **Raha S.**, Barui A.*, Size-dependent apoptotic activity of gold nanoparticles on osteosarcoma cells correlated with SERS signal, *Journal of Photochemistry and Photobiology B: Biology*, 111778 (2020).
11. Ratha B. N., Kar R. K., Bednarikova Z., Gazova Z., Kotler S. A., **Raha S.**, De S., Maiti N. C., Bhunia A.*, Molecular Details of a Salt Bridge and Its Role in Insulin Fibrillation by NMR and Raman Spectroscopic Analysis, *The Journal of Physical Chemistry B* 124 (7), 1125-1136 (2020).
12. Pariary R., Ghosh B., Bednarikova Z., Varnava K. G., Ratha B. N., **Raha S.**, Bhattacharyya D., Gazova Z., Sarojini V., Mandal A. K., Bhunia A.*, Targeted inhibition of amyloidogenesis using a non-toxic, serum stable strategically designed cyclic peptide with therapeutic implications, *Biochimica et BiophysicaActa (BBA)-Proteins and Proteomics* 1868 (5), 140378 (2020).
13. Doherty J., Biswas S.*, McNulty D., Downing C., **Raha S.**, O'Regan C., Singha A., O'Dwyer C., Holmes J. D.*, One-step fabrication of GeSn branched nanowires, *Chemistry of Materials* 31 (11), 4016-4024 (2019).
14. Ghosh A., **Raha S.**, Dey S., Chatterjee K., Roy Chowdhury A., Barui A.*, Chemometric analysis of integrated FTIR and Raman spectra obtained by non-invasive exfoliative cytology for the screening of oral cancer, *Analyst* 144 (4), 1309-1325 (2019).
15. Ratha B. N., Kar R. K., Kalita S., Kalita S., **Raha S.**, Singha A., Garai K., Mandal B., Bhunia A.*, Sequence specificity of amylin-insulin interaction: a fragment-based insulin fibrillation inhibition study, *Biochimica et BiophysicaActa (BBA)-Proteins and Proteomics* 1867 (4), 405-415 (2019).

B. Submitted publications with peer review process

1. Tanner D.¹, **Raha S.**¹, Doherty J., Biswas S., Holmes J. D., O'Reilly E. P., Singha A., Broderick C. A., Raman spectroscopy of group-IV Ge_{1-x}Sn_x Alloy alloys: theory and experiment, submitted to *Phys Rev Mat.* ¹co first author

*= corresponding author.

The following above mentioned publications have evolved from my doctoral dissertation: A2, A7, A9, B1