Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

SIRe Project Number

2022-01-31

(will be assigned by SIRe)

PhD Project

Project Details	
Project Title	Two-terminal steep slope nanoscale devices for cross-point arrays: theory to experiment
Project Summary	Artificial Intelligence recently became ubiquitous, requires large-scale data and computation using state-of-the-art computer hardware. This becomes extremely challenging as traditional Von-Neumann bottleneck between memory and processor units limits the computational time. Hence to circumvent such constraints, neuromorphic computing has been envisioned inspired by the biological nervous system. One possible solution is to use step-slope transition metal oxide (VO2, TiO2) based nanoscale resistive- switch (RRAM) for such device architecture. Therefore, we will explore low-power RRAM devices for cross-point arrays by combining both computational and experimental studies. We will theoretically conduct ab-initio DFT calculation and quantum transport simulations of the above materials and devices, further benchmarking with our experimentally developed nanoscale devices.

PhD Supervisors

Role	**Faculty**	**Academic Unit in IITD and IIITD**	**Email ID**
Supervisor 1	Dr. Ankur Goswami	Materials Science and Engineering (IITD)	agoswami@mse.iitd.ac.in
Supervisor 2	Dr. Ram Krishna Ghosh	Department of Electronics & Communications Engineering (IIITD)	rkghosh@iiitd.ac.in

Project requirements (Student qualications, experience required, etc)

- Candidate should have the qualification of B. Tech or M.Tech. in Electrical, Electronics, Mechanical, Materials Engineering, Or in MSc. in Physics, Electronics. They should be JRF qualified.
- Candidate with any prior experience, working in related areas and in DFT or nanofab, is not mandatory but will be given preference.

Source of funding (IRD/FITT Project details, if any)

- Students applying for this position should be qualified UGC/CSIR JRF/INSPIRE fellowship. The Source of funding (salary/stipend) will be from their own fellowship.
- Consumables and contingency will be provided from both the supervisor's projects.

Role of Faculty Members involved:

Understanding both the theoretical and experimental perspectives are very crucial for a systematic and in-depth understanding of nonvolatile steep slope devices for cross-point architectures. Therefore, this work is completely interdisciplinary, and the supervisors can bring together the required knowledge, experience, and expertise of this research. Dr. Ankur Goswami from IIT Delhi will mainly involve in the experimental part of the project, which comprises various state-of-the-art equipment and transport measurements (such as HRXRD, SEM, TEM and various modules of AFM such EFM, KPFM, MFM, conducting mapping, etc.). Whereas Dr. Ram Krishna Ghosh from IIIT Delhi will be involved in theoretical aspects using various computational algorithms and tools (such as density functional theory (DFT), non-equilibrium Green's function (NEGF) formalism, etc.).