Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

SIRe Project Number

2025-01-42

(will be assigned by SIRe)

Project Proposal for Ph.D.

Project Details	
Project Title	Fabrication of Resistive Memory Switches and its application for Hardware Development for AI/ML using Transition Metal Oxides and Dichalcogenides.
Project Summary (Minimum 500 and maximum 2000 characters)	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) and metal dichalcogenides (MoS_2, WS_2) 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.

Ph.D. Supervisors

Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
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 qualifications, experience required, etc)
***The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)**

- 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 fellowship/funding
(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)

Student with his own fellowship.

Role of Faculty Members involved:	
Supervisor-1	Understanding both the theoretical and experimental perspectives is 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.).
Supervisor-2	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.).