Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

SIRe Project Number

2025-01-15

(will be assigned by SIRe)

Project Proposal for Ph.D.

Project Details (The research problem must clearly indicate the need for an interdisciplinary approach)	
Project Title	Synthesis and Characterization of Multiferroic Composites for High Frequency Applications
Project Summary (Minimum 500 and maximum 2000 characters)	The interest in controlling the magnetization by an electric field stem from the possibility of designing power-efficient and non-volatile magnetic devices. These devices include voltage-driven magnetic random-access memories, voltage-tunable RF/microwave magnetic devices and memristive devices. In this sense, several natural and artificial multiferroic heterostructures of ferroelectric (FE) and ferromagnetic (FM) layers are being studied due to their magnetoelectric coupling (MEC), either by the strain induced by the FE on the FM layer (magnetoelastic coupling) or by the charge screening at the FE/FM interface (magneto electronic coupling) upon applying an electric field. However, novel lead-free multiferroic composites have recently attracted much attention due to large magneto-electric coupling achieved via mechanical strain. This project aims to synthesize such epitaxially engineered, high quality multiferroic structures using PLD and sputtering techniques. The phase formation, microstructure as well as static and dynamic magnetic properties will be investigated successively for RF/microwave device applications.

Ph.D. Supervisors
(Supervisor 1 and Supervisor 2 cannot be from the same department of IITD)

Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Prof. Ankur Goswami	Department of Material Science and Engineering	agoswami@mse.iitd.ac.in
Supervisor 2	Prof. Dhiman Mallick	Department of Electrical Engineering	dhiman@ee.iitd.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 MSc. in Physics, Applied Physics or Electronics OR B.Tech/M.Tech in Electronics, Physics, Materials Engineering, Nanotechnology or elated areas. Students qualified CSIR/UGC JRF are strongly encouraged to apply. Candidates with any prior knowledge on materials synthesis or magnetic/electrical characterizations will be given preference although not mandatory.

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

Candidate with his/her own fellowship

Role of Faculty Members involved:	
Supervisor-1	In the proposed project two faculty members (Prof. Mallick and Prof. Goswami) have few overlap areas of research, and have broad complementary expertise. For example, both the faculties have experience in materials characterizations. Prof. Ankur Goswami's expertise is largely in materials synthesis and micro/nano-fabrication, nanomechanical devices characterizations, characterizations of materials (HRXRD, SEM, and various modules of AFM such EFM, KPFM, MFM, conducting mapping) and electrical transport measurements.

Supervisor-2	Prof. Mallick's experience and expertise is in micromagnetic analysis as well as functional material integration, magnetic property characterization, electrical characterization etc. The student assigned for this project will have access to both EE and DMSE departmental facilities and various central facilities of IITD.