# Seminar

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## Institute for Plasma Research

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**Title:** Post-Deposition Engineering of Crystallinity, Bandgap, and Luminescence in Ge Thin Films and Multilayers

**Speaker:** Dr. Komal Shekhawat
Malaviya National Institute of Technology (MNIT), Jaipur

**Date:** 9th October 2025 (Thursday)

**Time:** 10:30 AM

**Venue:** Seminar Hall, IPR

## Abstract

Thin film technology has attracted significant interest due to its widespread applications, such as electronic devices, integrated circuits, optical coatings, and light-emitting diodes. Nanocrystalline Ge in the form of thin films has a rising interest in a wide variety of applications, such as electronics and optoelectronic devices, due to their size-dependent optical and electrical properties. Nowadays, multilayer structures have also gained a lot of interest in applications where enhanced performance is required, such as in optics, electronics, and protective coatings. This study focuses on the controlled modification of structural, optical, and luminescent properties of electron beam–evaporated Ge thin films and Ge/$Al_2O_3$ multilayer through post-deposition treatments such as ion implantation, swift heavy ion (SHI) irradiation, and thermal annealing. In Ge thin films, 100 keV Cu ion implantation at varying fluences introduces lattice disorder and narrows the bandgap, whereas subsequent RTA restores crystallinity, widens the bandgap. Broad visible photoluminescence (PL) arises from defect-related states, suggesting optoelectronic utility. In Ge/$Al_2O_3$ multilayers, annealing drives Ge nanocrystal formation, with nanocrystal growth and bandgap widening governed by quantum confinement, confirmed via XRD, Raman, and optical analyses. SHI irradiation with 80 MeV Ag ions further modifies crystallinity and optical response, with increased bandgap values and reduced PL intensity due to irradiation-induced non-radiative centers. Extending to device applications, Ge/Sn/$Al_2O_3$ multilayer heterostructures were synthesized and crystallized by RTA, and photodetector measurements revealed high responsivity, quantum efficiency, detectivity, and broad spectral operation (UV–SWIR). These results establish Ge-based multilayers as promising candidates for tunable optoelectronic devices.