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Name of the Scholar: Shahin Parveen

Name of the Supervisor: Dr. Pumlianmunga

Name of the Department: Physics

Topic of Research: Investigation of the Phase Change Properties of $\text{Ge}_2\text{Sb}_2\text{Te}_5$ based Chalcogenide Materials for Memory Devices

Findings

- Fabricated doped $\text{Ge}_2\text{Sb}_2\text{Te}_5$ (GST)-based phase change memory (PCM) materials using GeSe_2 , GeS_2 , As_2Se_3 , and As_2S_3 dopants to enhance thermal stability and data retention.
- Improved activation energy ($2.79 \rightarrow 4.86$ eV) and 10-year data retention temperature ($78 \rightarrow 133$ °C) through controlled chalcogenide doping.
- Observed widening of the optical band gap after doping, leading to improved amorphous phase stability and suppression of unwanted crystallization.
- Established the correlation between structural modifications and electrical transport mechanisms through detailed XRD, Raman spectroscopy, HR-TEM, and electrical characterization (R-T measurements and I-V characteristic) studies.
- Analyzed temperature-dependent structural and electrical behavior and confirmed the role of localized states in charge transport mechanisms.
- Achieved a significant reduction in threshold current ($1.45 \rightarrow 0.235$ mA), enabling low-power PCM operation.
- Demonstrated enhanced thermal confinement and localized Joule heating via COMSOL simulations, confirming improved switching efficiency
- Proposed a novel dopant-engineering strategy for developing energy-efficient and thermally stable non-volatile memory devices.