# Role of Ag addition in the structural transition of GeSbTe thin films

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**Abstract:**

Amorphous to polycrystalline phase transition, accompanied by a drastic change in optical and electrical properties, on the nanosecond timescale, makes $Ge_2Sb_2Te_5$ (GST) a central candidate for various technological applications. Phase transition in GST can be achieved by applying a variety of ways, such as laser pulses, voltage pulses, local heating, and pressure. Presently, GST is a potential candidate for resistive switching, phase change random access memory (PCRAM), optical data storage, active lattice tuning photonic components, and IR-reversible window.

$(Ge_2Sb_2Te_5)_{100-x}Ag_x$ (x = 0, 1, 3, 5 and 10) bulk alloys were prepared from highly pure (99.999%) Ge, Sb, Te and Ag elements using melt quenching technique. Thin films of prepared alloys were deposited on glass substrate using thermal evaporation technique under high vacuum $\sim 5\times10^{-6}$ mbar. Thickness of thin films was measured *in-situ* using digital thickness monitor (DTM-101). Deposited thin films were annealed at different temperature in vacuum. Structural properties of as-deposited and annealed thin films were determined from X-ray diffraction (XRD) patterns. Optical properties were studied from transmission spectra taken in the wavelength range of 800-3300 nm using UV-Vis-NIR spectrophotometer. Survey and core level spectra (Ge 3d, Te 3d, Sb 3d and Ag 3d) of thin films were taken using lab source X-ray photoelectron spectroscopy setup. Ge *K*-edge of all thin films was measured to study the local arrangement around Ge element.

Composition of prepared bulk samples and thin films was verified using energy dispersive X-ray spectroscopy and found to be comparable with starting stoichiometry. XRD patterns of as-deposited thin films did not contain any sharp peak and revealed the amorphous nature. Phase transition was observed with annealing. Optical band gap increases with Ag addition upto 3% and then starts decreasing at higher Ag content. Atomic arrangement was investigated from X-ray absorption spectroscopy. Effect of Ag on electronic structure of GST thin film was studied from X-ray photoelectron spectroscopy.

In the present study, role of Ag addition on optical, structural, atomic and electronic properties is investigated.

This work is financially supported by Department of Science and Technology, New Delhi under Research Project (Sanction No. SB/FTP/PS-075/2013 dated 29/05/2014).