

Topic for a Project Thesis / Bachelor Thesis

„ Effect of Pre-annealing on the Crystallization Behavior of Ge-Sb-Te Material System “

Phase-change materials (PCMs) have attracted significant research interest in the field of neuromorphic computing. Chalcogenides are considered promising candidates for future non-volatile memory applications due to their large optical and electrical contrast between the crystalline and amorphous states.

$\text{Ge}_3\text{Sb}_6\text{Te}_5$ (GST-365), an Sb-rich composition compared to those on the $\text{GeTe-Sb}_2\text{Te}_3$ pseudobinary line e.g. $\text{Ge}_2\text{Sb}_2\text{Te}_5$ (GST-225), exhibits a high crystallization temperature and a stable amorphous phase, contributing to improved thermal stability and compositional homogeneity. [2] By adjusting the pre-annealing parameters, the crystallization behavior of the material could be tuned, leading to changes in its optical and electrical properties.

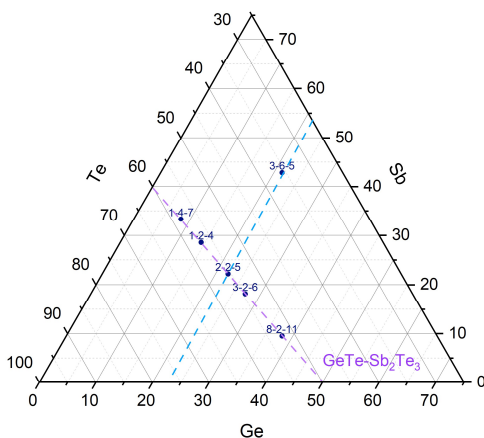


Fig. 2: The ternary phase diagram of Ge-Sb-Te material system.

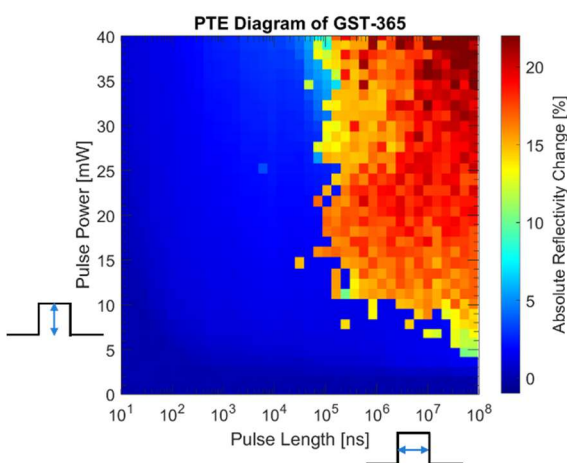


Fig. 3 (left): An example of the Power-Time-Effect (PTE) diagram measured by the POT measurement, showing how the laser parameter effects the

Fig. 4 (right): An example of the EBSD measurement, showing how the grains in the crystallized spots distribute.

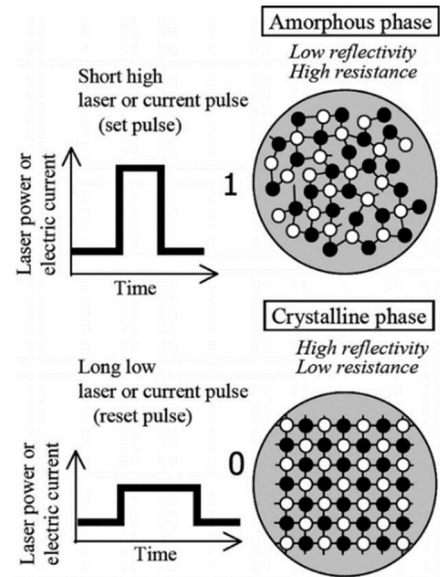


Fig. 1: The schematic diagram of phase change material. Taken from [1].

This thesis aims to understand how pre-annealing can alter the crystallization behavior of GST-225 and GST-365. In this project, the samples will be prepared by magnetron sputtering. Structural and compositional characterization will be proceeded using Grazing-incidence X-ray Diffraction (GI-XRD), X-ray Reflectivity (XRR) and Energy-dispersive X-ray Spectroscopy (EDX). The crystallization behavior will be mainly investigated using Phase Change Optical Tester (POT) and Electron Backscatter Diffraction (EBSD).

[1] Wuttig et al. "The Science and Technology of Phase Change Materials", Zeitschrift für anorganische und allgemeine Chemie (2012)

[2] Daoudi et al. "The role of Sb-over-Te ratio on the structural evolution of GeSbTe phase-change materials", Scientific Reports (2025)