Amorphous to crystalline transition in Phase Change Materials (GeTe) studied by coupled techniques

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The objective of this work is to characterize the crystallization of Phase Change Materials (PCMs, namely GeTe) by using a combination of different experimental techniques. PCMs (Ge-Sb-Te alloys) are used for data storage devices like PCRAM (Phase-Change Random Access Memory). The memory mechanism is based on the quick and reversible transition from amorphous to crystalline state [1-3]. During the transition, the 8% increase in GeTe density [4] leads to stress and fatigue that create defects, potentially leading to the failure of the device. Model samples considered here consisted of 100 to 5 nm GeTe thin films, capped with 10 nm of TaN to prevent oxidation [5] and deposited on 100 µm thick Si(001) substrates. Samples were characterized using a unique set-up installed on DiffAbs beamline (Synchrotron SOLEIL) allowing, during *in situ* annealing of the sample, the combination of X-ray Diffraction (XRD), X-ray Reflectivity (XRR) and optical curvature measurements (MOS, Multi-beam Optical Sensor). These coupled measurements give complementary information such as the evolution of microstructure, densification, stress and strain for different GeTe film thickness (1D confinement). Lattice parameter (XRD), film thickness (XRR) and average stress (MOS) evolutions are extracted and will be shown. The behavior of GeTe films during annealing and the crystallization mechanism (isothermals) will be detailed and discussed as well.

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