Nanocomposites and nanomaterials

Design of the vibrational properties of the phase-change materials

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Phase-change materials (PCM) are promising for the application in future memory devices and smart displays due to the remarkable difference of their electrical and optical properties in the amorphous and crystalline states (1,2).

In the study (3) we have suggested that the crystalline phase of PCM alloys utilizes resonant bonding (RB). Pronounced contrast in the dispersion of the dielectric permittivity of amorphous and crystalline samples in the phonon range is a characteristic feature of PCM and caused by difference in the chemical bonding and different local atomic arrangement in different states (4).

The stable crystal structure of GSTs is hexagonal, in our experiments we used meta-stable crystalline GST samples with distorted rock-salt structure, where the anion sub-lattice is occupied with Te atoms whereas the cation sub-lattice is randomly occupied with Ge atoms, Sb atoms and empty lattice sites (near 20%) (5).

For the industrial applications it is important to have a material with preassigned desired properties. Disorder impact on the electrical and thermal transport properties of PCM has been studied in (6,7). In this work we focus on vibrational properties of PCM. We have studied and discussed the impact of the disorder on the optical properties of the several Ge-Sb-Te alloys along the co-called pseudo-binary line in the far infrared range at different temperatures. Studied anharmonic behaviour of selected PCM has shown that the stoichiometry and the annealing temperature can “tune” the optical properties phase change materials in the phonon range. Therewith information on the dispersion of the dielectric permittivity in this range provides the value close to the static dielectric permittivity and thereby provide better insight into the properties of PCM.

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