Nanocomposites and nanomaterials

Vibrations properties of Ge-Sb-Te phase change alloys at different temperatures

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Ge-Sb-Te alloys, which belong to the class of phase change materials, exhibit a remarkable difference of their electrical and optical properties in the amorphous and crystalline state. They are widely used in optical data storage, data visualization applications and are considered as a promising material for non-volatile memory technology [1]. A fundamental understanding of the properties of the phase change alloys has important implications for the optimization of materials for the next generation of storage media and smart displays. The crystalline phase of Ge-Sb-Te alloys utilizes resonant bonding, therefore the dielectric permittivity of the crystalline phase above the reststrahlen and below the optical band gap is several times bigger than that of the amorphous phase [2]. Phase-change materials reveal a remarkably low thermal conductivity in the crystalline state. A change of bonding upon crystallization leads to an increase of the sound velocity and a softening of the optical phonon modes [3].

Three amorphous Ge-Sb-Te alloys along the co-called pseudo-binary line have been investigated in this study. Infrared and Raman active phonon modes show up in the spectra. Correlation between stoichiometry, intensity and width of peaks in Raman spectra of amorphous $Ge_1Sb_2Te_4$, $Ge_2Sb_2Te_5$, and $Ge_3Sb_2Te_6$ samples has been analyzed and discussed. We found that phonons' contributions modes to the dielectric function in the crystalline samples are more temperature dependent than those in amorphous samples. This finding is attributed to the more anharmonic behavior of the crystalline state of Ge-Sb-Te phase change alloys, which also causes higher thermal atomic displacements in the crystalline Ge-Sb-Te samples.

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