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Vibrational properties of amorphous As-S-Ge glasses studied by Raman spectroscopy

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Amorphous chalcogenides have received much attention in recent years, due to their unique properties and versatile technological applications such as infrared optical elements, acousto-optic and all-optical switching devices, holography recording media etc.
The aim of this study is to carry out the detailed study of vibrational properties of the pseudo-binary (As₂S₃)_x(GeS₂)_{1-x} chalcogenide system (x = 0.0, 0.1, 0.2, 0.4, 0.6, 0.8, 1.0) as a function of composition x with high-resolution Raman spectroscopy. The polarized-VV, depolarized-VH and depolarization ratio Raman spectra for the investigated glasses were obtained.
Raman spectra were analyzed and fitted using series of Gaussians peaks. The observed bands can be explained by vibrational modes of As₂S₃ and GeS₂ glasses. At least eleven vibrational modes are detected in the Raman spectra at 20-25, 110, 190, 205, 237, 260, 320, 342, 370, 430 and 490 cm⁻¹. Raman spectra of (As₂S₃)_x(GeS₂)_{1-x} samples showed that the backbones of the studied samples consist of AsS_{3/2} pyramidal units, edge- and corner-shared GeS₄ tetrahedral units. Compositional dependencies of the Raman bands in studied glasses are observed.
The highest values of the depolarization ratio, practically independent on composition are detected in the low-frequency Raman spectra region. The lowest values of the depolarization ratio are found to be composition dependent with numerical maximum or minimum in the height for the alloy with x = 0.4.
Thus, Raman data show that (As₂S₃)_x(GeS₂)_{1-x} chalcogenide glasses contain different nanophases whose concentration is changing along chosen compositional cross-section.

Topics

Session A. Physics of condensed matter and spectroscopy

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