Nanostructured surfaces

Laser modification of the structure and morphology of chalcogenide nanolayers studied by X-ray photoelectron, optical absorption edge and Raman spectroscopy.

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Nowadays, the amorphous nanostructured chalcogenides are very promising materials for ultrafast photonic transmitting and processing systems. The nanooptics technology requires detail knowledge about the structure and properties of surface layers in order to fabricate the high quality photonic elements.

The near- and over-band gap laser modifications of the local structure and surface morphology of As_xS_{100-x} (x=40,45,50) chalcogenide nanolayers prepared by thermal deposition were studied in detail using high resolution X-ray photoelectron spectroscopy (XPS) and surface profilometry. The influence of laser irradiation on optical absorption of As-S nanolayers were also analyzed together with the valence band spectra of radiated and non-radiated samples.

It was established that the laser irradiation of As-S nanolayers in air did not change the composition of $As_{40}S_{60}$ nanolayers. However, the laser irradiation of $As_{45}S_{55}$ leads to increase of the concentration of As (by ~1.5 %) Opposite effect connected with the laser stimulated depletion of As content (~1.0%) was observed for $As_{50}S_{50}$ nanolayers. Detail analysis of As 3d core level spectra show that these induced changes are connected with the transformations of As-rich As-As-2S and 2As-As-S structural units (s.u.) with homopolar bonds.

The peculiarities were also observed in optical absorption, valance band spectra and surface morphology of non-radiated and radiated As_xS_{100-x} nanolayers. The molecular origin of induced phenomena is discussed in detail using the results of Raman spectroscopy.