Compositional Investigations of the As-Se Nanolayers Using X-ray Photoelectron Spectroscopy

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Amorphous films of As_xSe_{100-x} ChG system are currently of interest as materials for optoelectronic devices as well as optical information storage. It was found that $As_{50}Se_{50}$ exhibits high light sensitivity during photostructural transformations due to the presence of homopolar As-As bonds [1]. The excess of As in $As_{50}Se_{50}$ relative to stoichiometric $As_{40}Se_{60}$ leads to an increase of the optical gap E_g (from 1.90 to 1.95 eV for bulk $As_{40}Se_{60}$ and $As_{50}Se_{50}$, respectively) and of other related energy intervals. Evaporated films have been shown to have a large degree of structural disorder which was found to depend on the deposition method and conditions. In addition to structural disorder of the amorphous state connected with the absence of long range order and translation symmetry, the two types of defects: (i) coordination defects (*i.e.* so called charged D^+ and D^- centers or valence-alternation pairs (VAPs)) and (ii) homopolar bonds defects (sometimes referred to as "wrong bonds") can be found in non-crystalline structures too.

Amorphous $As_{20}Se_{80}$, $As_{40}Se_{60}$ and $As_{50}Se_{50}$ thin films with thickness of about 0.5 μm were prepared by thermal evaporation from bulk glass on the (100) silicon crystal wafer substrates. The high-resolution photoemission spectra were taken using the Mg K-α (hν=1253.6 eV) X-rays source. The photoelectron As 3d and Se 3d core-level spectra of films were measured and analyzed.

The composition and local structure of the surfaces were determined by curve fitting of the experimental As 3d and Se 3d core levels, and studies show significant Se-enrichment in the top surface layers of the films. The interconnection between the surface composition, local structure formation and the features of the valence band spectra of $As_{20}Se_{80}$, $As_{40}Se_{60}$ and $As_{50}Se_{50}$ films are analyzed and discussed in detail. Obtained results are in a good agreement with results of the compositional analysis of the same samples with using of the synchrotron radiation photoelectron spectroscopy [2].

1. V.M. Lyubin, *J. Non-Cryst. Solids* 97-98 (1987) 47-54.
2. O. Kondrat*, R. Holomb, N. Popovich, V. Mitsa, M. Veres, A. Csik, N. Tsud, V. Matolín, and K.C. Prince, *Journal of Non-Crystalline Solids* 410 (2015) 180–185.