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BOOK OF ABSTRACTS

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Synthesis, reversible laser modification and structural characterization of As-S based functional media for ultrafast photonics

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Non-crystalline chalcogenides with high infrared transparency, have stood out as materials of choice for infrared optics. Research into the physical properties of these materials revealed their unique and remarkable structural, electronic, optical properties and large functionality, and has attracted significant attention, representing an important scientific and technological challenge. In addition to their intrinsic infrared properties, they offer wide possibilities in domains such as information technologies (optical data storage, ultrafast optical transmission and information processing), photolithography, renewable energy technologies (high efficiency solar cells, solid electrolytes), medicine, thermal imaging, sensing and biosensing *etc.* thanks to the advantageous combination of infrared properties, optical activity, structural photosensitivity and high third-order optical non-linearity. Recent progress in photonics shows that amorphous chalcogenides are among the best candidates as active optical media for ultrafast *all-optical* processing systems [1].

We report the results of investigation of As-S chalcogenide thin films prepared by thermal evaporation of target As_2S_3 glass and by gold-catalyzed thermally initiated chemical vapor deposition. The crucial difference between the structure and properties of these films was observed. The structure of as-deposited As_2S_3 film prepared by thermal evaporation method contain large concentration of photosensitive realgar-like As_4S_4 inclusions in comparison with the structure of bulk As_2S_3 glass as confirmed by the Raman spectra (Fig. 1, curves 1 and 2). Recently, using synchrotron radiation photoelectron spectroscopy the reversible transformation of the structure of As-S films prepared by thermal deposition in "laser irradiation"-"thermal annealing" cycles was detected [2].

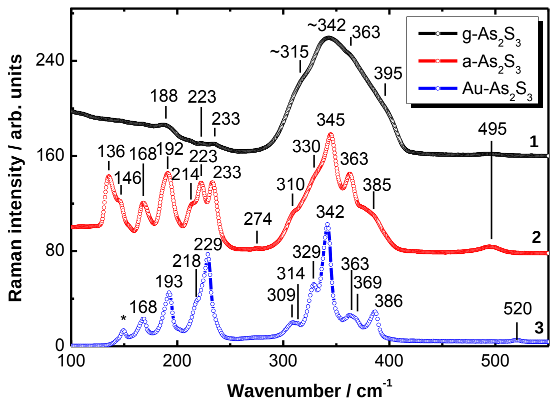

Fig. 1. Raman spectra of bulk As_2S_3 glass (1), amorphous As_2S_3 film prepared by thermal deposition (2) and As_2S_3 nanolayers synthesized by using gold catalysis (3).

In contrast, the growth of molecular nanocrystals on the surface of As_2S_3 films synthesized with using gold-catalysis were observed. The formation of crystallites, their size and shape on the surface of As_2S_3 films are well defined by electron microscopy. These crystallites are built from a new type of cage-like molecules. Surface enhanced Raman spectra (Fig. 1, curve 3) of crystallites used together with the results of density functional theory (DFT) calculations of Raman active modes of different cage-like As-S nanoclusters [3] let us to identify the As_4S_5 cage-like molecules, which form the tetra-arsenic pentasulfide (uzonite).

The structure formation, laser induced modification of the structure and properties of As-S chalcogenide thin films prepared by different methods as well as their application in modern photonics are discussed.

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