Physico-chemical nanomaterials science

Nano-inhomogeneities in Ga-containing Ge-Se-Te glasses caused by Bi incorporation

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Chalcogenide glasses (ChG) are considered as convenient and cost-effective media for various applications in modern photonics, mostly because of their high IR transparency, excellent fiber drawing capability and large optical nonlinearities [1,2]. Many Se- and Te-based glasses have been engineered to optimize the performance of different photonic devices. Conventionally, this goal is achieved by variation in chemical composition of complex ChG, which allows tailoring their physical properties to match the requirements.

Using more than three constituents in ChG composition opens a wide range of possibilities for improving the medium properties, but simultaneously complicates enormously the understanding of its structure. This, in turn, limits our ability to develop adequate microstructural models that allow to predict the material's reliability during exploitation in various conditions, and, as a consequence, to avoid the unwanted side effects.

In this work, the physical properties of Bi and Ga-modified glassy $GeSe_4$-$GeTe_4$ are studied by X-ray diffraction, nanoindentation and SEM/TEM imaging. Partially ordered nanoscale regions observed with high-resolution TEM are shown to correlate with FSDP parameters determined through XRD measurements. The created nano-inhomogeneities are shown to serve as source of useful glass matrix modifications for applications in optoelectronics and photonics.

1. *Eggleton B. J., Luther-Davies B., Richardson K.*, Chalcogenide photonics // Nature Photonics -2011.-**5**, -P. 141–148.
2. *Adam J-L., Zhang X. (Eds)*, Chalcogenide Glasses: Preparation, properties and application // Woodhead Publishing series in Electronic and Optical Materials -2014.