

# Physico-chemical nanomaterials science

## Nanoscale characterization of Sb incorporation effects in Ga-As<sub>20</sub>Se<sub>50</sub>Te<sub>20</sub> glass

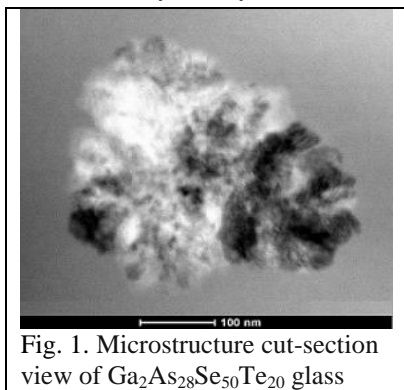
Ya. Shpotyuk<sup>1,2</sup>, J. Szlezak<sup>1,3</sup>, C. Boussard-Pledel<sup>3</sup>, V. Nazabal<sup>3</sup>, A. Dziedzic<sup>1</sup>,  
S. Adamiak<sup>1</sup>, J. Cebulski<sup>1</sup>, B. Bureau<sup>3</sup>

<sup>1</sup>Centre for Innovation and Transfer of Natural Sciences and Engineering Knowledge, University of Rzeszow, 1, Pigionia str., 35-959 Rzeszow, Poland  
E-mail: [cebulski@ur.edu.pl](mailto:cebulski@ur.edu.pl)

<sup>2</sup>Department of Sensor and Semiconductor Electronics, Ivan Franko National University of Lviv, 107, Tarnavskoho str., 79017 Lviv, Ukraine

<sup>3</sup>Laboratoire Verres et Céramiques UMR-CNRS 6226, University of Rennes 1, 35042 Rennes Cedex, France

Chalcogenide glasses (ChG) are known to be an important class of disordered materials for optical device usage in view of their excellent transparency in IR region stretching up to 25  $\mu\text{m}$ . To enhance the functionality of these glassy media, the effects of additional source of light appearance revealed due to incorporation of rare-earth (RE) ions can be employed. However, RE solubility in ChG is very low, as a result RE ions clusterize and scatter the light instead of amplification. This problem can be solved by introducing Ga or In into the ChG, but this process can be restricted by Ga-crystallization.



In this work, numerous experimental techniques including nanoindentation and transmission electron microscopy with EDX analyzer, were employed to study nanoscale mapping of inhomogeneities in Ga modified As<sub>30</sub>Se<sub>50</sub>Te<sub>20</sub> glasses. The appearance of nanoscale inhomogeneities was observed in glasses with more than 2 at. % of Ga (Fig. 1).

To suppress crystallization processes caused by Ga addition, partial substitution of As to Sb was employed. It was shown that Sb create's SbSe<sub>3/2</sub> structural units in chalcogen rich matrix which can be easily linked with AsSe<sub>3/2</sub> ones without significant modification of physical properties of the glass. Addition of Sb allows positively modify the functionality of these chalcogenide glass. Thus, in case of Ga<sub>2</sub>As<sub>20</sub>Sb<sub>8</sub>Se<sub>50</sub>Te<sub>20</sub> crystallization processes are not observed.