Crystal growth in chalcogenide glass-formes prepared in different forms and its relation to viscosity and diffusion

Jaroslav Bartak*[1], David Vaculík[1], and Michaela Včeláková[2]

[1]Department of Physical Chemistry, Faculty of Chemical Technology, University of Pardubice – Czech Republic

[2]Department of Inorganic Technology, Faculty of Chemical Technology, University of Pardubice – Czech Republic

Abstract

Chalcogenide glass-forming materials prepared in different forms (bulks, fibers, thin films) are very promising materials widely used in practice (e.g. lenses, fibers, filters, diffractive optical elements, diffractive optical elements, filters, optical recording discs for data storage, etc.). Optical and electrical differences between amorphous and crystalline phases of some chalcogenide systems and rapid and reversible switching between these phases are fundamental for using chalcogenide materials in data storage applications.
Knowledge of viscosity behavior, crystal growth phenomenon, and diffusion is important in producing, processing, and applying amorphous solids prepared in different forms (bulk glasses, thin films). This work focuses on crystal growth in Ge25Se75 bulk glasses and thin films prepared by thermal evaporation and solution processing. Crystal growth data were obtained using infrared microscopy measurements, showing a change in crystal morphology within the broad studied temperature region (250 – 550 ∘C). Nevertheless, a single crystal growth model could describe the crystal growth rates. The combination of viscosity and crystal growth data provides an extensive collection essential for crystal growth description in a wide temperature range. The found crystal growth model describing the experimental data provides information about the size of structural units incorporated into the growing crystals. The structural unit size is then used for the estimation of self-diffusion coefficients (D) that show a similar relation with crystal growth rates (u) as was found in molecular glasses (u ≈ Dˆ0.87).

Acknowledgments
This work has been supported by the Czech Science Foundation under project no. 24-10480S, the Ministry of Education, Youth and Sports of the Czech Republic under grant no. LM2023037 and by the Internal Grant Agency of the University of Pardubice under SGS project no. SGS_2024_007. This work was partially supported by the Selected Research Teams program of the University of Pardubice.

Keywords: crystal growth, chalcogenide glass, thin films

*Speaker