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# Crystallization behavior of $(\text{GeTe}_4)_x(\text{GaTe}_3)_{100-x}$ glasses for far-infrared optics applications

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## Abstract

Differential scanning calorimetry (DSC), X-ray diffraction (XRD), infrared microscopy and Raman spectroscopy were used to study the crystallization behavior of the  $(\text{GeTe}_4)_x(\text{GaTe}_3)_{100-x}$  glasses for far-infrared optics. Two independent overlapping crystallization processes were found – the initial surface-located precipitation of hexagonal Te and  $\text{Ga}_2\text{Te}_5$  phases, followed by formation of the rhombohedral GeTe phase. The initial precipitation process, and in particular the formation of the  $\text{Ga}_2\text{Te}_5$  phase, was found to be catalyzed by presence of mechanically induced defects. Finely powdered materials with higher  $\text{GaTe}_3$  content also exhibited more pronounced separation of the two crystallization sub-processes. Glass stability of the prepared glasses was evaluated in terms of the Hrubý criterion - the  $(\text{GeTe}_4)_{86}(\text{GaTe}_3)_{14}$  composition was found to be the most stable and most resilient to the negative crystallization-enhancing influence of structure defects. Pros and cons of the compositional evolution of the crystallization behaviour (determined via full kinetic description of the involved crystallization sub-processes and kinetic prediction of the crystallization behavior) were discussed with regard to the ceramics and glass-ceramics applications. Glasses with low  $\text{GaTe}_3$  content appear to be most suitable for preparation of fully ceramic materials, whereas glasses with high  $\text{GaTe}_3$  content seem to be most suitable for the glass-ceramics applications.

Keywords: Ge-Ga-Te glasses; crystallization kinetics; DSC; XRD; glass-ceramics

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