
Recent advances in development of high-purity chalcogenide glasses for mid-IR fiber optics

Vladimir Shiryaev*^{†1} and Mikhail Churbanov¹

¹G.G. Devyatikh Institute of Chemistry of High-Purity Substances of the Russian Academy of Sciences (ICHPS RAS) – Russia

Abstract

Chalcogenide glasses due to their optical and physico-chemical properties are promising materials for production of optical fibers for the mid-infrared range. The report gives the current status on preparation and investigation of high-purity chalcogenide glasses and fibers, as well as the ways for improvement of their optical properties and functional characteristics for passive and active mid-IR photonics. The methods for preparation of high-purity chalcogenide glasses of various systems, such as As-S, As-Se, Ge-As-Se, Ge-Se-I, Ga(In)-Ge-As(Sb)-Se, Ge-As-Se-Te and Ge-Te-X (X=I, Ga, Se or AgI), including glasses doped with rare-earth elements, have been developed [1,2]. To synthesize the high-purity glass samples, the multi-stage methods included the chemical distillation purification of glass and components, vacuum loading of components, as well as the chemical vapor transport reaction technique have been applied. The optical transmittance of the produced glasses, their structure, physico-chemical, optical linear and non-linear properties and the content of limiting impurities were determined. The prepared glass samples have ultra-low content of limiting impurities (in ppmwt): oxygen - < 0.1, carbon - < 0.5, hydrogen - < 0.02, silicon - < 0.1, transition metals - < 0.05. The main directions of investigations and technological developments for improvement of operational characteristics of chalcogenide glass fibers are considered. Using the "rod-in-tube" and "double crucible" drawing methods, the multimode and single-mode optical fibers were prepared; their optical and mechanical properties were investigated. Minimum optical losses in multimode As-S, As-Se, Ge-As-Se and As-Se-Te glass fibers in the mid-IR range were within 12-100 dB/km depending on composition. Minimum optical losses in REE-doped glass fibers were 400-500 dB/km [3]. The obtained optical chalcogenide fibers were tested for photonics applications.

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References

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*Speaker

[†]Corresponding author: v.shiryaev@mail.ru

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