Infrared optics of chalcogenide glasses made by mechanical alloying and sintering

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Abstract

Needs in infrared lenses are rising together with the demand in infrared cameras. Chalcogenide glasses are good candidates in order to provide infrared lenses with good resolution at low cost. Sensitive to oxygen, they are synthetized under vacuum, in a sealed silica tube. Non re-usable and expensive, the silica tube accounts for 30% of the final product price. Also, silica has a low thermal conductivity that lessens the quenching rate and thus the size of the lenses and the variety of compositions that can be obtained at large dimensions.
To avoid these limitations, a new process has been developed: it combines mechanical milling and SPS sintering. Mechanical milling allows production of large varieties of glass compositions without any use of silica. The mechanical energy brought to the starting elements (Ge, Ga...) leads to their reaction and the formation of glass powder. The obtained powder is then sintered by SPS. By this process, lenses of desired geometry and a low surface roughness are achieved. The present work took interest in two glasses: Ge28Sb12Se60 and 80GeSe2-20Ga2Se3. The first one is a commercial glass (IG5, Optir3, AMTIR-3). It has used in order to test the feasibility of the technique. The second one is an interesting and unique composition discovered in 2008. Indeed, it can undergo controlled crystallization in order to form glass-ceramics and so improve the mechanical properties of the final product. This type of composition is usually inappropriate for industrial production. Using silica tubes, only 10mm diameters pellets can be obtained. Higher diameter tube generates an important crystallization that is characterized by a tremendous decrease in transmission.

This simple and innovative process is really promising for the shaping of chalcogenide glasses and production of lenses by molding.
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