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Characterization of deformation and cracking behavior of high Poisson's ratio oxide glasses with La2O3

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Poisson's ratio () is the negative of the ratio of the transverse strain to the longitudinal strain for a uniaxial stress state. The adjustment of is receiving increasing interest as a means of tailoring the ductility of glasses. This has been motivated by the observation of intrinsic ductility in high- (above 0.32) bulk metallic glasses, but it is unknown whether the same relation between ductility and exists in oxide glasses since all known oxide compositions exhibit -values below or around 0.32. In this study, we attempt to manufacture high- oxide glasses using two approaches both based on La2O3 incorporation: (i) Known high- glass compositions (La2O3-containing aluminoborate, aluminogermanate, and aluminosilicate) are first synthesized, and then subjected to hot compression treatment to further increase their atomic packing density and thus likely high . (ii) ZnO-B2O3 glass composition is doped with increasing amounts of La2O3 to increase . These glass systems are investigated using various characterization techniques to understand the mechanical response of high- oxide glasses. Elastic moduli including -values are determined through Brillouin light scattering and ultrasonic echography techniques. Hardness, crack resistance, and cracking patterns of all glasses are investigated using Vicker's microindentation. For selected compositions, annealing-induced volume recovery of indentation imprints is studied to shed light on the deformation mechanisms controlling the response of glass to sharp-contact loading. Finally, micro-Raman spectroscopy is used to acquire Raman spectra in the as-made and the hot compressed glasses, as well as inside the Vicker's indentation imprints of the as-made glasses. The deformation and cracking characteristics are linked with structural features of the investigated glass compositions.

Keywords: indentation, poisson's ratio, cracking, deformation

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