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Invited Talk

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Indentation Deformation and Crack Resistance of Oxide Glasses

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Keywords: indentation, deformation, densification, crack resistance, oxide glasses

Abstract:
Improving the fracture resistance of oxide glasses through adjustment of the chemical composition remains a challenging task, although composition-mechanical property relations have been established for simple model systems. The glass mechanical properties are, among other methods, conventionally tested using instrumented indentation, which is a fast and convenient technique that mimics the real-life damage for certain applications. Early indentation experiments have shown that oxide glasses exhibit pronounced tendency to densify under compressive load compared to metals and ceramics. After decades of investigations, it is now known that the extent of densification is strongly dependent on the glass' chemical composition and in turn its atomic packing density and Poisson's ratio. Spectroscopic techniques have shed light on the mechanism of densification, which include changes in the bond angle distributions as well as increase in the coordination number of the network-forming cations. Knowledge of such details is crucial for understanding the link between chemical composition and resistance to cracking in oxide glasses, since densification is an efficient way to dissipate the elastic energy applied to the material during indentation. Here, we review the experimental work on identification and quantification of densification in glasses, as well as on probing the accompanying structural changes in the glassy network. We also review the outcomes of computer simulations of indentation deformation mechanisms in glasses. Finally, we discuss the correlation between the mechanism of deformation and the crack resistance.