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Publication date:
2019

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Smedskjær, M. M., Hansen, S. R., Januchta, K., Østergaard, M. B., & Bauchy, M. (2019). *Search for High Poisson's Ratio Oxide Glasses*. 60. Abstract from 25th International Congress on Glass, Boston, United States.

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Search for High Poisson's Ratio Oxide Glasses

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Oxide glasses are brittle materials, i.e., they cannot deform plastically on the macroscale without fracture, which seriously limits the scope of their applications. Intrinsic ductility in metallic glasses has been found to increase with Poisson's ratio, which measures the resistance of a material to volume change balanced against the resistance to shape change. An abrupt brittle-to-ductile (BTD) transition has been found to occur around a Poisson's ratio of 0.32, with simulation results suggesting that the BTD transition is universal and should also occur in silica-based oxide glasses. Moreover, high Poisson's ratio has been related with a high tendency to deform through shear flow during sharp contact loading. Yet, very few oxide glasses with such high Poisson's ratio have been reported and the mechanical properties of oxide glasses with Poisson's ratio ≥ 0.30 are poorly understood. In this talk, we report on our search for oxide glasses with Poisson's ratio > 0.32 using both compositional optimization and pressure treatment. We test the proposed relationships of Poisson's ratio with atomic packing density, indentation deformation mechanism, liquid fragility, and fracture energy.