



Aalborg Universitet

AALBORG UNIVERSITY  
DENMARK

## Characterization of deformation and cracking behavior of high Poisson's ratio oxide glasses with La<sub>2</sub>O<sub>3</sub>

Januchta, Kacper; Sun, Ruofu; Huang, Liping; Smedskjær, Morten Mattrup

*Publication date:*  
2018

[Link to publication from Aalborg University](#)

### *Citation for published version (APA):*

Januchta, K., Sun, R., Huang, L., & Smedskjær, M. M. (2018). *Characterization of deformation and cracking behavior of high Poisson's ratio oxide glasses with La<sub>2</sub>O<sub>3</sub>*. Abstract from 15th International Conference on Physics of Non-Crystalline Solids & 14th European Society of Glass Conference , Saint Malo, France.

### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- ? Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- ? You may not further distribute the material or use it for any profit-making activity or commercial gain
- ? You may freely distribute the URL identifying the publication in the public portal ?

### **Take down policy**

If you believe that this document breaches copyright please contact us at [vbn@aub.aau.dk](mailto:vbn@aub.aau.dk) providing details, and we will remove access to the work immediately and investigate your claim.

# Characterization of deformation and cracking behavior of high Poisson's ratio oxide glasses with La<sub>2</sub>O<sub>3</sub>

Kacper Januchta <sup>\*† 1</sup>, Ruofu Sun <sup>2</sup>, Liping Huang <sup>2</sup>, Morten Smedskjaer <sup>1</sup>

<sup>1</sup> Department of Chemistry and Biosciences, Aalborg University – Aalborg, Denmark

<sup>2</sup> Dept. Materials Science and Engineering, Rensselaer Polytechnic Institute – Troy, New York 12180, United States

Poisson's ratio ( $\nu$ ) is the negative of the ratio of the transverse strain to the longitudinal strain for a uniaxial stress state. The adjustment of  $\nu$  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- $\nu$  (above 0.32) bulk metallic glasses, but it is unknown whether the same relation between ductility and  $\nu$  exists in oxide glasses since all known oxide compositions exhibit  $\nu$ -values below or around 0.32. In this study, we attempt to manufacture high- $\nu$  oxide glasses using two approaches both based on La<sub>2</sub>O<sub>3</sub> incorporation: (i) Known high- $\nu$  glass compositions (La<sub>2</sub>O<sub>3</sub>-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  $\nu$ . (ii) ZnO-B<sub>2</sub>O<sub>3</sub> glass composition is doped with increasing amounts of La<sub>2</sub>O<sub>3</sub> to increase  $\nu$ . These glass systems are investigated using various characterization techniques to understand the mechanical response of high- $\nu$  oxide glasses. Elastic moduli including  $\nu$ -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

---

\*Speaker

†Corresponding author: kja@bio.aau.dk