Structure-Property Transformations in Hot Compressed Phosphate Glasses

Invited Talk

Smedskjær, Morten Mattrup; Kapoor, Saurabh; Youngman, Randall E.

Publication date:
2017

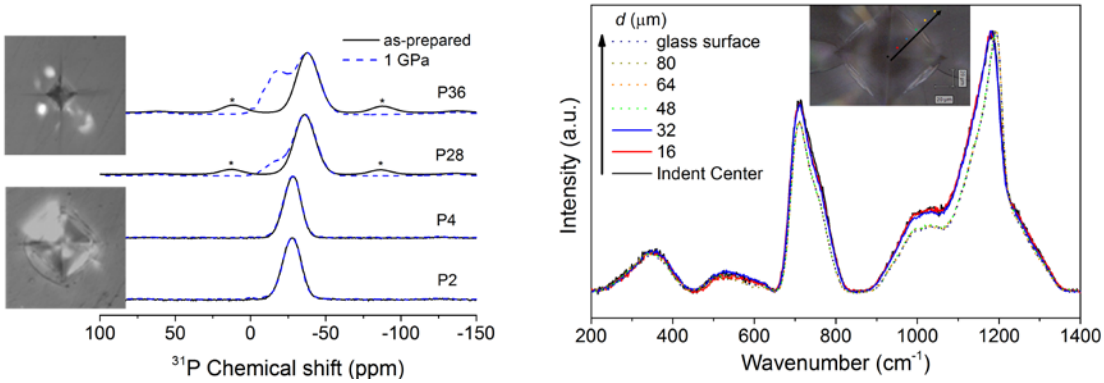
Structure-Property Transformations in Hot Compressed Phosphate Glasses

Morten M. Smedskjaer[1,*], Saurabh Kapoor[1], Randall E. Youngman[2]
[1]*Department of Chemistry and Bioscience, Aalborg University, 9220 Aalborg, Denmark*
[2]*Science and Technology Division, Corning Incorporated, Corning, New York 14831, USA*

Invited talk

Abstract

Understanding pressure-induced structural transformation in glasses is important for designing more damage resistant compositions, since the contact damage that leads to fracture induces high pressure levels. However, although phosphorus oxide is an important component in various glasses of industrial interest including cover glasses, knowledge of the structural response of phosphate-based glasses to high pressure remains very limited. Here, we investigate the pressure-induced changes in volume, structure, and mechanical properties (hardness and crack resistance) of different phosphate-based glasses, including zinc phosphate, calcium aluminophosphate, and modifier free Al_2O_3-B_2O_3-P_2O_5-SiO_2 systems. The glasses are isostatically compressed up to 2 GPa at the glass transition temperature, enabling permanent densification of large (~cm^2) sample specimens. We discuss the pressure-induced changes in glass properties in relation to the structural changes quantified through Raman and solid state NMR spectroscopy. We also compare the structural densification mechanisms during indentation and hot compression and discuss how the mechanically applied energy during contact damage can be consumed by the pressure-driven structural changes.



Brief Biographical Notes

Morten M. Smedskjaer *is Professor MSO in the Department of Chemistry and Bioscience at Aalborg University, Denmark. He received his PhD degree in materials chemistry from the same university in 2011, and worked as a research scientist at Corning Inc. from 2011 to 2012. His current research focuses on the structure, topology, dynamics, and mechanical properties of oxide glasses. As the PI, he has attracted more than €3 million in funding and his research group currently consists of 2 Postdocs and 3 Ph.D. students. He has published nine patent applications (two granted) and over 95 journal articles. His awards include the Norbert J. Kreidl Award and Best PhD Award from the Danish Academy of Natural Science.*