Chemical Durability and Crack Resistance of Alkali and Alkaline Earth Aluminoborate Glasses

Mascaraque Alvarez, Nerea; Januchta, Kacper; Frederiksen, Anne Kristine F.; Youngman, Randall E.; Bauchy, Mathieu; Smedskjær, Morten Mattrup

Publication date:
2017

Chemical Durability and Crack Resistance of Alkali and Alkaline Earth Aluminoborate Glasses

Nerea Mascaraque[1,*], Kacper Januchta[1], Anne Kristine Fledelius Frederiksen[1], Randall E. Youngman[2], Mathieu Bauchy[3], Morten M. Smedskjaer[1]

[1]*Department of Chemistry and Bioscience, Aalborg University, 9220 Aalborg, Denmark*

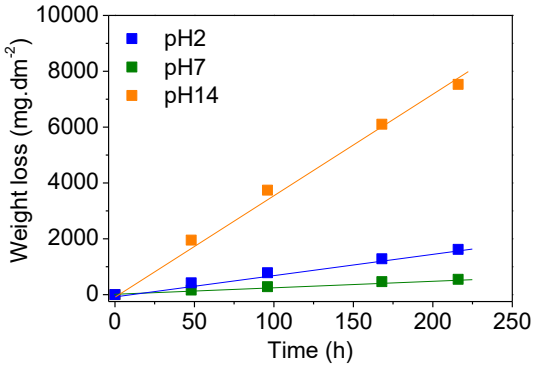
[2]*Science and Technology Division, Corning Incorporated, Corning, USA*

[3]*Department of Civil and Environmental Engineering, University of California, Los Angeles, California 90095, USA*

Poster

Abstract

Aluminoborate glasses have recently been found to exhibit favourable mechanical properties, especially high crack resistance. However, a fundamental understanding of the composition dependence of crack initiation and growth is still lacking. Moreover, the expected low chemical durability of these glasses could be a limiting factor for their potential applications. We therefore here study the dissolution kinetics and crack resistance of a wide range of aluminoborate compositions: (1) $25Na_2O$-xAl_2O_3-$(75-x)B_2O_3$ with x=5, 10, 15, 20, 25, 27.5, 30, (2) $25MgO$-xAl_2O_3-$(75-x)B_2O_3$ with x=15, 20, 25, 30, (3) $25(M_2O$ or $MO)$-$20Al_2O_3$-$55B_2O_3$ where M is Li, Na, K, Rb, Cs, Mg, Ca, Sr, Ba, and (4) $(25-x)Li_2O$-$xBaO$-$20Al_2O_3$-$55B_2O_3$ with x=0, 6.25, 12.5, 18.75, 20 (all in mol%). The structure and properties of the samples are characterized through Nuclear Magnetic Resonance (NMR), Raman Spectroscopy, Differential Scanning Calorimetry (DSC), micro-indentation, aqueous durability test and Atomic Absorption Spectroscopy (AAS). We demonstrate and discuss how the crack resistance and chemical durability are affected by the local chemical environment in the glasses.



Brief Biographical Notes

Nerea Mascaraque *is PostDoc in the Department of Chemistry and Bioscience at Aalborg University, Denmark. She graduated from Faculty of Chemistry at Universidad Autónoma de Madrid (Spain) in 2009 and received her PhD degree in materials chemistry from the same university and Ceramic and Glass Institute (ICV-CSIC) under the supervision of Dr. Francisco Munoz and Prof. Alicia Durán in 2014. Her PhD project was focused on glassy materials as solid electrolytes in all solid-state batteries (7 journal articles). Her current research focuses on atomistic design of chemically durable glasses under the supervision of Prof. Morten M. Smedskjaer (2 journal articles).*