

## Pressure-Induced Changes in Inter-Diffusivity and Compressive Stress in Chemically Strengthened Glass

Svenson, Mouritz Nolsøe; Thirion, Lynn M.; Youngman, Randall E.; Mauro, John C.; Rzoska, Sylwester J.; Bockowski, Michal; Smedskjær, Morten Mattrup

*Publication date:*  
2014

*Document Version*  
Early version, also known as pre-print

[Link to publication from Aalborg University](#)

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

Svenson, M. N., Thirion, L. M., Youngman, R. E., Mauro, J. C., Rzoska, S. J., Bockowski, M., & Smedskjær, M. (2014). *Pressure-Induced Changes in Inter-Diffusivity and Compressive Stress in Chemically Strengthened Glass*. Abstract from 2014 MRS Fall Meeting, Boston, United States. <http://www.mrs.org/fall-2014-program-uu/>

### **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.

# Pressure-Induced Changes in Inter-Diffusivity and Compressive Stress in Chemically Strengthened Glass

Mouritz N. Svenson<sup>1</sup>, Lynn M. Thirion<sup>2</sup>, Randall E. Youngman<sup>2</sup>, John C. Mauro<sup>2</sup>, Sylwester J. Rzoska<sup>3,4</sup>, Michal Bockowski<sup>3</sup>, Morten M. Smedskjaer<sup>1,\*</sup>

<sup>1</sup> Section of Chemistry, Aalborg University, 9000 Aalborg, Denmark

<sup>2</sup> Science and Technology Division, Corning Incorporated, Corning, NY 14831, USA

<sup>3</sup> Institute of High Pressure Physics, Polish Academy of Sciences, 00-142 Warsaw, Poland

<sup>4</sup> Institute of Physics, University of Silesia, 41-500 Chorzow, Poland

\* Corresponding author. e-mail: [mos@bio.aau.dk](mailto:mos@bio.aau.dk)

## ABSTRACT

Glass exhibits a significant change in properties when subjected to high pressure, since the short- and intermediate-range atomic structures of a glass are tunable through compression. Understanding the link between the atomic structure and macroscopic properties of glass under high pressure is an important scientific problem, since the glass structures obtained via quenching from elevated pressure may give rise to properties unattainable under standard ambient pressure conditions. In particular, the chemical strengthening of glass through Na<sup>+</sup>-for-K<sup>+</sup> ion exchange is currently receiving significant interest due to the increasing demand for stronger and more damage resistant glasses. However, the interplay among isostatic compression, pressure-induced changes in alkali diffusivity, compressive stress generated through ion exchange, and the resulting mechanical properties are poorly understood. In this work, we employ a specially designed gas pressure chamber to compress bulk glass samples isostatically up to 1 GPa at elevated temperature before or after the ion exchange treatment of a commercial sodium-magnesium aluminosilicate glass. Compression of the samples prior to ion exchange leads to a decreased Na<sup>+</sup>-K<sup>+</sup> inter-diffusivity, increased compressive stress, and slightly increased hardness. Compression after the ion exchange treatment changes the shape of the potassium-sodium diffusion profiles and significantly increases glass hardness. We discuss these results in terms of the underlying structural changes in network-modifier environments and overall network densification.