Impact of Hot Compression on the Stress Optic Coefficient of Oxide Glasses

Bechgaard, Tobias Kjær; Thirion, Lynn M.; Rzoska, Sylwester J.; Bockowski, Michal; Mauro, John C.; Smedskjær, Morten Mattrup

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Impact of Hot Compression on the Stress Optic Coefficient of Oxide Glasses

Tobias K. Bechgaard[1], Lynn M. Thirion[2], Sylwester J. Rzoska[3], Michal Bockowski[3], John C. Mauro[2], Morten M. Smedskjaer[1]

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

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

[3] *Institute of High-Pressure Physics, Polish Academy of Sciences, Warsaw, Poland*

Abstract: The stress-induced birefringence (termed photoelastic response) in oxide glasses has important consequences for several applications. The effect of composition on the photoelastic response is relatively well understood, but here we evaluate the effect of hot isostatic compression on the photoelastic response of ten oxide glasses within the aluminosilicate and boroaluminosilicate glass families. Hot isostatic compression normally results in decreasing modifier-oxygen bond lengths and increasing network-former coordination numbers. These structural changes should lead to an increase in the stress optic coefficient (*C*) according to the model of Zwanziger et al., which can successfully predict the composition and structure dependence of *C*. However, the model fails to predict *C* for compressed glasses as we observe a pressure-induced decrease in the stress-optic coefficient. We discuss this finding based on measured refractive indices and elastic moduli and the atomic and lattice effects from the pioneering work of Mueller in 1935. We propose that changes in the lattice effect and changes in shear modulus due to topological changes are the origin of the pressure-induced decrease in *C*.

Keywords: Photoelastic response; stress-optic coefficient, compression; densification; oxide glass