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Publication date:
2019

Deformation and fracture behavior of Na_2O-Al_2O_3-B_2O_3-SiO_2 glasses

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Understanding the link between the chemical composition of oxide glasses and their mechanical properties is the key to designing novel materials for current and emerging applications. Much insight into this correlation can be gathered from studying glasses in the Na2O-Al2O3-B2O3-SiO2 system, as they exhibit widely different structures, packing efficiencies, and a large span of hardness and modulus values. Using Vickers indentation, we here present a study of the deformation mechanism and resistance to cracking in twenty Na2O-Al2O3-B2O3-SiO2 glasses with fixed soda content. The observed compositional trends in mechanical behavior are discussed in light of the structural characteristics of the investigated glasses, as well as their atomic packing density and fracture toughness values. The latter is measured by the single-edge-precracked-beam method. Our results suggest that network topology considerations are crucial in the design of new crack-resistant and tough silicate glass compositions.