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Effect of ion radiation on the indentation response of oxide glasses

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Radiation is known to affect the surface structure and properties of glasses. In this work, we investigate the effect of ion irradiation (Xe ions) treatment on the mechanical properties of two series of oxide glasses. First, a series of sodium borosilicate (NBS) glasses with varying Si/B and Na/B ratios, finding that radiation reduces the hardness and increases the crack initiation resistance. Second, a series of calcium aluminoborosilicate (CABS) glasses that feature high crack initiation resistance prior to any treatment. Again, we find a decrease in hardness and increase in crack initiation resistance upon irradiation. In order to explore the mechanism of the irradiation effects, we also perform surface structural analysis (Raman, infrared spectroscopy) as well as atomistic simulations. Finally, in order to achieve more damage-resistant oxide glasses, we also explore the possibility to improve the mechanical properties through combining radiation treatment with other extrinsic post-treatment methods (hot compression, humid aging).