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Densification of Glasses at the Glass Transition: Universal Behavior and Trends

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Densified glasses recovered from a high-pressure state are of potential technological interest due to their modified physical and chemical properties. Here we apply hot isostatic compression to study structure-property relations in compressed oxide glasses. Although this approach is somewhat modest in both temperature and pressure (~T_g and <2 GPa), it enables the densification of relatively large glass pieces (cm^2) suitable for comprehensive characterization. We show that permanent densification at 1 GPa sets in at temperatures above $0.7T_g$ and the degree of densification increases with increasing compression temperature and time, until attaining an approximately constant value for temperatures above T_g. For glasses compressed at the same temperature/pressure conditions, we demonstrate direct relations between the degree of volume densification and the pressure-induced change in mechanical properties such as elastic moduli and extent of the indentation size effect across a variety of glass families.