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Mechanically informed identification of shear instabilities in disordered covalent network glass

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The mechanical behavior of oxide glasses is governed by their disordered covalent networks. Using a local mechanical probing technique, we show that regions with low local stress thresholds correlate strongly with soft spots in two-dimensional network glass samples. Despite its accuracy, this approach is computationally intensive, requiring mechanical simulations at each atomic site. To address this limitation, we develop purely geometrical indicators based on fabric tensors, leveraging topological characteristics of the elastic structural response. Our findings reveal a strong correlation between shear transformation zones and regions of maximal bond stretch variance when projected along the macroscopic deformation axis. While directional factors contribute to this relationship, bond stretch variance is the predominant factor, highlighting the invariant nature of shear transformation zones in network glasses. Since our indicators rely exclusively on geometric measures, they offer intuitive physical interpretation and can be extracted directly from structural images with minimal computational cost.

Keyword-1

Glass

Keyword-2

Shear transformation zones

Keyword-3

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