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Nanosecond homogeneous nucleation and crystal growth in shock-compressed SiO_2 YUAN SHEN, Stanford Univ, SHAI JESTER, TINGTING QI, EVAN REED, Stanford University — Understanding the kinetics of shock-compressed SiO2 is of great importance for mitigating optical damage for high-intensity lasers and for understanding meteoroid impacts. Experimental work has placed some thermodynamic bounds on the formation of high-pressure phases of this material, but the formation kinetics and underlying microscopic mechanisms are yet to be elucidated. Here, by employing multiscale molecular dynamics studies of shock-compressed fused silica and quartz, we find that silica transforms into a poor glass former that subsequently exhibits ultrafast crystallization within a few nanoseconds. We also find that, as a result of the formation of such an intermediate disordered phase, the transition between silica polymorphs obeys a homogeneous reconstructive nucleation and grain growth model. Moreover, we construct a quantitative model of nucleation and grain growth, and compare its predictions with stishovite grain sizes observed in laser-induced damage and meteoroid impact events.

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