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Structural Transformations during Shock Compression/Release of Germanium[1] PRITHA RENGANATHAN, S. J. TURNEAURE, S. M. SHARMA, Y. M. GUPTA, Washington State University — To examine the structural changes in germanium during dynamic loading conditions, in situ x-ray diffraction measurements were obtained in Ge (100) shocked to 40.6 GPa and released. The experimental results demonstrated that shocked Ge transforms from the ambient cubic diamond (cd) structure to the tetragonal β-Sn structure above 15.7 GPa, the phase observed under static loading conditions at comparable pressures, and to the liquid state beyond 31.5 GPa. The observation of a significant decrease in the β-Sn phase texture as the shock melting stress is approached suggests that texture loss in the high-pressure phase of shocked single crystals may serve as a general indication of the temperature being near the solid-liquid phase boundary. Upon full stress release (while maintaining uniaxial strain), high-pressure germanium phases (both solid and liquid) revert to the ambient cd phase indicating a reversible phase transformation under shock compression and release. These findings demonstrate that the cd to β-Sn phase change is reversible, and that recrystallization from the liquid phase can occur on nanosecond timescales during planar stress release. These results are consistent with the equilibrium Ge phase diagram determined from static compression experiments.

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Michael Winey
Washington State University

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