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Ultrafast X-Ray Diffraction Study of Potential Energy Surface Evolution in InSb Under Intense Laser Excitation PATRICK HILLYARD, Stanford University, Department of Chemistry, KELLY GAFFNEY, AARON LINDENBERG, SIMON ENGEMANN, PULSE Center, Stanford Linear Accelerator Center, DAVID REIS, FOCUS Center, University of Michigan, ANIRUDDHA DEB, PULSE Center, Stanford Linear Accelerator Center, DREW MEYER, Stanford University, Department of Chemistry, JEROME HASTINGS, PULSE Center, Stanford Linear Accelerator Center — Ultrafast time-resolved x-ray diffraction has been used to directly monitor atomic disordering in InSb as a function of carrier density. The carrier dependent curvature of the potential energy surface has been determined from the time evolution of the atomic structure. Three regimes have been identified. At low carrier densities, atomic disordering occurs via a thermal mechanism with an exponential time constant determined by the electron-phonon coupling constant. Upon increasing excited carriers to roughly 5% of the valence band electron population, a sharp transition is observed and the predominant disordering mechanism is inertial motion on a softened potential energy surface with a Gaussian time constant of ∼400 fs. For a carrier density above ∼20%, accelerated atomic motion on an inverted potential energy surface is observed. This inverted regime was previously predicted by theory but had been unobserved until now.

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