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Ultrafast Phase Transitions Driven by Intense X-ray Pulses
NICHOLAS HARTLEY, SLAC - Natl Accelerator Lab — X-ray Free Electron Lasers deliver sufficiently high intensities to drive samples directly to high energy density states. This occurs faster than heating by charged particle beams, and with much greater uniformity than optical irradiation. However, since the energy deposition occurs by exciting high-energy photo- and Auger electrons, it is complex to model, and tends to heat a larger region of the sample than the irradiated spot. This talk will present results from the Japanese XFEL SACLA (SPring-8 Angstrom Compact free electron LAser). Using its two-color split and delay mode, we irradiated samples with incident X-ray intensities on the order of 10ˆ19 W/cm2, and probed changes in the atomic structure by diffraction and scattering at delays of up to 300 fs. In silicon, nonthermal melting occurs within 100 fs, with the appearance of the liquid state discerned from the rise in incoherent scattering. In graphite, anisotropic disordering proceeds on a similar timescale, with weak interplanar bonds breaking, but in-plane Bragg peaks becoming stronger as the intact planes deform.

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