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Observing Real-Time Electron-Hole Plasma Recombination to Lattice Heat[1] MING-FU LIN, SLAC - Natl Accelerator Lab, MAX VERKAMP, KRISTIN BENKE, KAILI ZHANG, ELIZABETH RYLAND, University of Illinois at Urbana-Champaign, CLEMENS WENINGER, XIAOZHE SHEN, RENKAI LI, XIJIE WANG, DAVID FRITZ, UWE BERGMANN, SLAC - Natl Accelerator Lab, JOSH VURA-WEIS, University of Illinois at Urbana-Champaign — Using tabletop extreme ultraviolet (XUV) transient absorption spectroscopy allows us to directly capture optical generated electron hole plasma and to monitor subsequent relaxation to lattice heat in real time. Lead iodide is optically excited at 3.1 eV and relaxation of generated electron hole pairs are measured by delayed XUV pulses which separately probe the partial density of states of iodine in valence and conduction bands, respectively. Short-lived core-level absorption features associated with transitions from iodine inner-shell 4*d* electrons to valence and conduction bands are separated at optical excitation energy, corresponding to photo-generated electron and hole pairs that recombine and generate lattice heat in 5.60.6 ps. Ultrafast electron diffraction verifies the appearance of lattice vibration in several picoseconds in consistent with the XUV results. The obtained Debye-Waller response from electron diffraction further supports a full conversion of 3.1 eV photon energy to thermal heat in the lattice. Direct observation of electron-hole plasma using femtosecond XUV light source illustrates its ability to probe carrier recombination in real time with 50 fs and chemical element sensitivity.

[1]NSF, AFOSR, UIUC start-up, DOE-BES

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