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Probing the disassembly of ultrafast laser heated gold using frequency domain interferometry. TOMMY AO, University of British Columbia, YUAN PING, KLAUS WIDMANN, DWIGHT PRICE, AL ELLIS, ANDREW NG, Lawrence Livermore National Laboratories, EDWARD LEE, University of British Columbia — Ultrafast laser heating of a solid offers a unique approach to examine the behavior of non-equilibrium high energy density states. Initially, the electrons are optically excited while the ions in the lattice remain cold. This is followed by electron-electron and electron-phonon relaxation. Recently, experiments were performed in which ultrathin freestanding, gold foils were heated by a femtosecond pump laser to a strongly overdriven regime with energy densities reaching 20 MJ/kg. Interestingly, femtosecond laser reflectivity and transmission measurements on the heated sample revealed a quasi-steady-state behavior before the onset of hydrodynamic expansion. This led to the conjecture of the existence of a metastable, disordered state prior to the disassembly of the solid. To further examine the dynamics of ultrafast laser heated solids, frequency domain interferometry (FDI) was used to provide an independent observation. The highly sensitive change in the phase shift of the FDI probe clearly showed evidence of the quasi-steady-state behavior. The new experiment also yielded a detailed measurement of the time scale of such a quasi-steady-state phase that may help elucidate the process of electron-phonon coupling and disassembly in a strongly overdriven regime.

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