Abstract Submitted
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Ultrafast melting of copper studied with femtosecond electron diffraction.[1] MIANZHEN MO, BENJAMIN OFORI-OKAI, SLAC, BASTIAN WITTE, MAXIMILIAN SCHRNER, Univ. Rostock, XIAOZHE SHEN, ZHIJIANG CHEN, VALERIE BECKER, MIKE DUNNING, RENKAI LI, STEPHEN WEATHERSBY, SLAC, RONALD REDMER, Univ. Rostock, XIJIE WANG, SIEGFRIED GLENZER, SLAC — Understanding ultrafast melting of metals is crucial for applications ranging from laser micro-machining to warm dense matter (WDM) experiments. Here we report results of using femtosecond electron diffraction to study structural evolution of Cu as it underwent ultrafast laser-induced solid-liquid phase transition. In our experiments, 40-nm-thick polycrystalline Cu films were irradiated by 400nm, 130fs laser pulses to produce WDM states. Structural evolution of irradiated target was measured with 3.2MeV, 350fs electron pulses. We observed homogeneous melting that occurs within 10ps at absorbed energy densities of ˜1.2-2.5 MJ/kg. The measured melting times are understood with two-temperature model simulations. The experimental results are consistent with TTM simulations using electron-ion coupling strength G_{ei} that is inferred from the T_i evolution from Laue peak dynamics. The inferred G_{ei} has a much weaker T_e dependence and is about a factor of four lower than the T_e-dependent value calculated by density functional theory [Z. Lin, PRB (2008)].

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Mianzhen Mo
SLAC

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