Convergence Of Electron Kinetic, Two-Temperature, And One-Temperature Models For Laser Short-Pulse Heating

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Summary

The laser short-pulse heating of metallic workpieces initiates the non-equilibrium heating in the surface vicinity of the substrate. The material response to the non-equilibrium heating cannot be predicted accurately by the one-temperature model. Consequently, new models pertinent to laser short-pulse heating are needed. In the present study, laser short-pulse heating of gold, copper, and lead is considered. The material responses to the laser short-pulse due to the electron kinetic theory and the two-temperature and the one-temperature models are examined in detail. The differences between the collisional and diffusional heating mechanisms are presented. The conditions for the convergence of conduction mechanisms are discussed. The electron kinetic theory, the two-temperature, and the one-temperature predictions are compared for three substrates. It is found that the electron kinetic theory predictions differ from the predictions of the one-temperature model in the surface vicinity of the substrate during the early heating duration. As the heating progresses, both models predict similar temperature profiles. The electron kinetic theory and the two-temperature model predictions are in good agreement.

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