**Ablator - laser preheating simulations for diagnostic optimization**

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Laser preheating of the solid ablator is of major importance for inertial confinement fusion studies. Ablator coatings are preheated to increase the mass ablation velocity and thus to reduce the growth of the developed Rayleigh-Taylor instability [1]. In this study, to simulate the initial phases of solid-to-plasma transition, a ns pulsed laser interacts with a monocrystalline solid Si target-sample. The 532 nm laser pulse used, has a duration of 6 ns. Multiphysics finite element simulations are performed to explore the influence of the thermoelastoplastic (TEP), melting and ablation phases, during the ablator’s heating, considering its intrinsic TEP properties. For the TEP mechanical response of the heated solid a strength material model is adopted coupled with a suitable equation of state that considers the hydrodynamic response of the Si target [2]. Simulation results provide key insights on the thermomechanical behavior of the irradiated target, which changes phases from solid to plasma. The resulting data may provide the initial conditions for further studies of hydrodynamic/magnetohydrodynamic simulations for the plasma evolution and the shock wave dynamics. Such studies are crucial not only for the ablator dynamics at early times but also for the optimization of nm scale diagnostic devices for monitoring the ablator’s surface spatiotemporal dynamics [3].

**References**

[1] S. X. Hu, G. Fiksel, V. N. Goncharov et al. Mitigating laser imprint in direct-drive inertial confinement fusion implosions with high-Z dopants, Phys. Rev. Lett. 108, 195003 (2012).

[2] S. X. Hu, R. Gao, Y. Ding et al. First-principles equation-of-state table of silicon and its effects on high-energy-density plasma simulations, Phys. Rev. E 95, 043210 (2017).

[3] E. Kaselouris, I. Fitilis, A. Skoulakis et al. The importance of the laser pulse-ablator interaction dynamics prior to the ablation plasma phase in inertial confinement fusion studies, Phil. Trans. R. Soc. A 378, 20200030 (2020).

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