The effects of microstructure on propagation of laser-driven radiative heat waves in under-dense high-Z plasma*

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This work was motivated by previous findings that the measured laser-driven heat front propagation velocity in under-dense small-pore, closed-cell TiO_2/SiO_2 foams is slower than simulated [1], but faster than simulated in large-pore, open-cell C/Cu foams [2]. In attempting to test the hypothesis that these discrepancies result from effects of foam microstructure we designed and conducted a comparison experiment on the GEKKO laser using a streak camera to compare heat front propagation velocity in equivalent gas and foam targets. We first discuss the design and results of this comparison experiment. To supplement these streak camera data, we designed and conducted an experiment on the TRIDENT laser using a new high-resolution, spatially resolved crystal spectrometer to image the Ti K-shell spectrum along the axis of an under-dense TiO_2/SiO_2 foam cylinder. We discuss the details of the design of this experiment, and present measured Ti K-shell spectra compared to the spectra simulated with a detailed superconfiguration non-LTE atomic model for Ti incorporated into a 2D radiation hydrodynamics code. We show that there is indeed a microstructure effect on heat front propagation in under-dense foams, and that the measured heat front velocities are consistent with the analytical model of Gus'kov *et al*. [3].

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References

[1] Pérez *et al*., *Phys. Plasmas* **21**, 023102 (2014)

[2] Pérez *et al*., *Phys. Plasmas* **22**, 113112 (2015)

[3] Gus'kov *et al*. *Phys. Plasmas* **18**, 103114 (2011)