Toward electron temperature profiles in hot-dense plasmas from x-ray spectral ensembles

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High repetition rate laser systems enable new strategies for diagnosing plasma behavior with large datasets. We define an ensemble technique that relies on randomized targeting of x-ray tracer micro-stripes. On each shot, a high-intensity laser pulse is focused on a solid target with Ti tracer stripes embedded in an Al foil, randomly targeting a micro-stripe, a portion of a stripe, or a gap between stripes. High-resolution, time-integrated x-ray spectrometers capture line emission from the portion of the micro-stripe that is heated to sufficiently high electron temperatures. Accumulation of many such cases is used to construct ensemble distributions of x-ray line intensities that encompass all relative offsets of the laser focus to the micro-stripe centers. Synthetic intensity distributions are likewise generated using collisional-radiative modeling. Bayesian fitting of modeled to measured intensity distributions establishes the most likely radial temperature profiles, enabling comparison to hydrodynamic models and calling into question the cylindrical symmetry of these micro-stripe-embedded systems [1]. Ensemble techniques have significant potential for high-energy-density plasma diagnostics, especially with the advent of high repetition rate experiments.

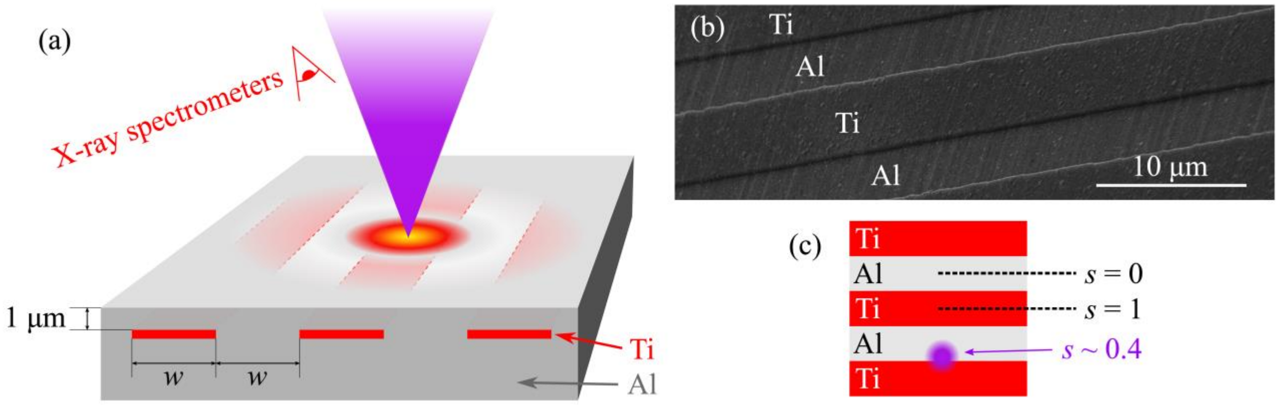

Figure 1. Schematic of micro-stripe layout. (a) A cartoon showing the laser focusing above embedded micro-stripes. (b) An electron microscope image of untamped Ti stripes deposited on Al. (c) An indication of *s*, the relative alignment of the laser focus with a stripe center, which randomly varies between 0 and 1.

References

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