Core-shell spheres for quantitative ablation physics in magnetic fusion

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Plasma-material interaction physics is an important subject in the ITER era. Besides plasma-wall interactions, plasma interactions with isolated or a cloud of microspheres are also of growing presence and significance in magnetic fusion [1]. Here a microsphere is broadly defined as any object less than about 1 mm in size but much larger than an atom or a nano-cluster when the surface physics dominates and bulk ablation is absent. For several decades, the phenomena of dust-plasma interaction has been known empirically, although little quantitative experimental data exist even to this day. The growing number of mass injection technologies such as dust injection, shattered pellet injection, laser surface ablation, powder injection and granule injection provides new thrusts to understand microsphere ablation more quantitatively. Commercial fast cameras can be used for tracking of moving objects [2]. Here we first describe advantages of using core-shell microspheres for ablation physics. A core-shell microsphere is distinctive from a uniform microsphere in that it can provide sensitive spectroscopy signatures for ablation physics. A uniform microsphere on the other hand has the same material composition throughout and therefore less radially sensitive spectroscopy signatures during ablation. We also describe various core-shell spheres and their characterization, followed by an analysis of spectroscopy signatures that we plan to validate in upcoming experiments in EAST, NSTX-U and elsewhere.

References

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