Metallic Dust Size Distribution in Tokamaks

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Dust is directly associated with the erosion of wall materials done by heavy Plasma Surface Interactions (PSIs) e.g. ELMs and disruptions. In addition, if tokamak inner surfaces mostly consist of metals, e.g. tungsten, beryllium, lithium, etc., the metals can be melted and surface tension contributes to the spherical shape. Some dust collection experiments, e.g. [1], have been carried out and found that the collected (or survived) dust is in an order of 1 micron in size, especially for spherical dust. Furthermore, the amount of the spherical dust is not negligible. To study dust ablation, we can relied on high speed camera for tracking its trajectories via light from thermal radiation and optical emission spectroscopy for tracking impurity generation via vaporization in edge plasma. Study of dust motion in fusion via simulation need the integration of various physical models, e.g. heating equation, equation of motion, phase changes. Due to the fact that dust is not always solid and plasma is a pool of free charges, electrostatic breakups and the pressure variation of material properties are also unavoidable to be considered [2, 3]. This implied that impurity generation from dust ablation may not be solely done by plasma heat flux but electrostatic instability during which dust becomes droplet leads to material disintegration at a certain size. The critical size corresponds to plasma parameters where the molten dust is.

By taking into account the physical models mentioned earlier, we should be able to predict the size distribution and the critical size, as a cut-off size, of the survived dust. The work is computationally conducted and the dust materials we focus on are tungsten, beryllium, and lithium.

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[3] M. Coppins, Phys. Rev. Lett. **104(6)**, 065003 (2010).