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Model of Secondary Electron Emission from Small Dust Grains – Shape Influence

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Dust grains are exposed to high-energy electrons in many plasma environments - in laboratories (e.g., tokamaks, electron beams) as well in space or in planetary magnetospheres. The electrons impinging a grain surface release low-energy secondary electrons. Some primary electrons can be scattered out of a grain prior to lose all their energy. Such slowed electrons then could impact another grain. We developed the numerical model of secondary emission from small spherical bodies. Assuming that only those electrons having a sufficient energy to leave a particular dust grain can contribute to its charging, our model can predict the grain equilibrium potential. The model fits measured characteristics of spherical dust grains in a wide range of grain diameters and materials (Richterova et al., 2010). However, spherical dust grains are rather rare, thus we enhanced the model to various convex blocks and their sets. In the model, secondary emission yields of walls of convex blocks or spheres are the same but the yields increase close to edges and vertices. Nevertheless, the energy profiles of total yields are similar in both cases. On the other hand, emitted electrons could re-entry a non-convex body several times and, thus, the energy profiles of total yields differ from those of convex bodies. In this contribution, we study a surface density of emitted electrons and discuss an influence of shape on dust grain charging. We demonstrate our model performance comparing its results with measured equilibrium potential of milled glass-based minerals.

Richterova et al. (2010), Richterova, I., Beranek, M., Pavlu, J., Nemecek, Z., and Safrankova, J. (2010), Electrons scattered inside small dust grains of various materials, Phys. Rev. B, 81, 075406.