

A Model for Tribocharging of Regolith Grains

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In mixtures of dielectric grains, triboelectric charging causes significant charge separation even between chemically identical grains. Tribocharging may occur on airless bodies as a result of spacecraft surface operations ranging from roving and sampling to ISRU. Charged grains will interact with the local plasma environment and may impair the function of spacecraft mechanisms. However, existing models are unable to quantitatively predict the magnitude of charge transfer between dielectric grains of the same material. Existing models and experimental results indicate that larger grains tend to acquire a more positive charge, while smaller grains charge negatively. We have developed a semi-analytical model to predict the charge distribution in a granular mixture with an arbitrary size distribution. The model applies to a broader range of granular mixtures than previous models, and makes new predictions that would change our understanding of the polarity of charge separation. We have also developed an experimental set-up for testing the charging predictions of our model. A validated model of dielectric tribocharging will allow the evaluation of the hazard posed by this effect as well as enable the exploitation of this effect for future regolith size sorting efforts.