

Triboelectric Charging of Binary Granular Mixtures due solely to Particle-Particle Interactions

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Abstract— Triboelectric charging is widely observed in granular systems, but the physics underlying the phenomenon is not well understood. A critical challenge for experimental studies of triboelectric charging is to obtain reproducible data that can be linked to theoretical predictions. Towards this end, we develop and perform experiments on the triboelectric charging of granular mixtures with varying composition. A bench-top particle flow apparatus has been constructed which operates under low vacuum (70 Torr); performing experiments in a clean and controlled environment reduces the effects on charging caused by contaminants, humidity, etc. The apparatus is designed such that only particle-particle interactions occur (i.e. no particle-wall interactions). A non-contact method of measuring charge is employed to limit probe-particle charging (or discharging). Both time-dependent and steady-state behaviors are investigated. Various granular insulator materials are studied to investigate the effect of system composition on the triboelectric charging. In all cases, the binary mixtures produce much greater triboelectric charging than the single component systems.