

Triboelectric charging through particle-particle contact using acoustic levitation

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Abstract—Triboelectric charging is a common yet poorly understood process that is difficult to study, primarily due to the complexity of interactions involved. Triboelectric charging appears in many industries, such as pharmaceutical production, where granular materials have numerous interactions causing significant charging. It would be ideal to understand how two different particles, such as drug and carrier particles, charge each other during contact, but this is difficult to study without the material contacting instruments and other surfaces or using large amounts of particles. Here, we describe a method of studying solely particle-particle charging by means of acoustic levitation. A piezoelectric transducer operated at ~40 kHz and a reflector form a standing wave, where particles of various sizes (~10-1000 microns) levitate in low-pressure nodes. An ionizer is used to remove any initial charge that may be present on the particles, and after a period of time (~5 minutes), an electric field is applied to two electrodes surrounding the levitating particles in order to separate the particles based on the bias of their triboelectric charge. An ammeter is attached to the ground electrode in order to determine the charge of the particles that had been separated. Using this system, we successfully levitate small samples of particles, charge them only against other particles, separate them based on their electric bias, and determine the amount of charge exchanged between the particles. This will allow the triboelectric charging behavior of particles to be determined simply and without large quantities of particles.