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Laboratory studies of aerosol electrification and experimental evidence for electrical breakdown at different scales.

Stefano Alois (1,2), Jonathan Merrison (1), Jens Jacob Iversen (1), and Joern Sesterhenn (2)

(1) Aarhus University, Physics and Astronomy, Aarhus, Denmark (stefano.alois@phys.au.dk), (2) Institute of Fluid Mechanics and Engineering Acoustics, Technische Universität Berlin, Müller-Breslau-Str. 15, 10623 Berlin, Germany

Contact electrification between different particles size/material can lead to electric field generation high enough to produce electrical breakdown. Experimental studies of solid aerosol contact electrification (Alois et al., 2016) has shown various electrical breakdown phenomena; these range from field emission at the contact site (nm-scale) limiting particle surface charge concentration, to visible electrical discharges (cm-scale) observed both with the use of an electrometer and high-speed camera.
In these experiments micron-size particles are injected into a low-pressure chamber, where they are deviated by an applied electric field. A laser Doppler velocimeter allows the simultaneous determination of particle size and charge of single grains. Results have shown an almost constant surface charge concentration, which is likely to be due to charge limitation by field emission at the contact site between particle and injector. In a second measurement technique, the electrically isolated injector tube (i.e. a Faraday cage) is connected to an oscilloscope and synchronised to a high speed camera filming the injection. Here the electrification of a large cloud of particles can be quantified and discharging effects studied.
This study advances our understanding on the physical processes leading to electrification and electrical breakdown mechanisms.