How Does Sand Get Unipolar Charge in an Electrodynamic Screen (EDS)?

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***Abstract*—The Electrodynamic Screen (EDS) is a scalable and commercially viable technology for water-free cleaning of sand and dust deposited on CSP mirrors and PV modules. When the electrodes of the EDS are activated with three-phase pulsed voltages, the dust particles deposited on the surface of the EDS become electrostatically charged and an electrostatic repulsion force levitates the dust layer and removes it by an electromagnetic traveling wave. The charging mechanisms cause the particles (primarily sand dust) on the dielectric (glass) surface of the EDS to attain charge and was expected to produce a bipolar charge distribution of the particles. In experimental studies, we found that the particles are charged with positive polarity in all cases. The exact cause for this charge distribution and the mechanism of how the dust particles are charged remains unclear. We postulate two charging mechanisms, either of which could cause the dust particles to become positively charged: (1) the formation of microfilaments around the electrodes which inject a positive (holes or ions to the EDS surface) thereby charging the dust particles or (2) contact and triboelectric charging process cause the particles acquire a bipolar charge distribution but the negative charges (electrons) undergo leakage to the glass surface leaving the positive charges on the particles. Regardless of which one of the two charging mechanisms are involved on the surface of the EDS, the result would be a net positive charge-to-mass (Q/M) ratio obtained when the dust is collected on a Faraday Cup and analyzed. We report here experimental studies on the analysis of the charging mechanisms on the EDS film subjected to different magnitudes of pulsed voltage applied to the electrodes printed on the backside of the EDS film and measuring the charge-to-mass ratio (Q/M) of the collected dust. Analysis of the experimental studies is conducted to see if Q/M increases linearly with the increase in dc voltages or in a random fashion. If the positive Q/M results from pulsed voltage application exceed a certain threshold value, micro-filamentary discharge is likely the cause, to produce a higher net positive charge of the collected dust particles.**