Ignition of Aluminum Powders by Electrostatic Discharge

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Metal powder heating and ignition by an Electro-Static Discharge, ESD (or spark) was investigated. For different spark voltages, ESD discharge energies transferred to the powder samples and respective spark radii are evaluated experimentally. Al powder was chosen as a popular metal fuel additive for many energetic formulations, and as a metal, for which spark initiation typically results in ignition of individual particles rather than in an aerosol flame consuming bulk of the powder. Al powders with nominal particle sizes of 3-4.5 μm and 10-14 μm were used in experiments. The finer powder was found to be strongly agglomerated while almost no agglomeration was observed for the coarser powder. Emission traces of burning particles were acquired by a photodiode to determine burn times for the particles ignited by sparks with different energies. From the burn times, particle diameters were estimated using correlations reported in the literature. Burn times for the ignited Al particles clearly correlated with the Joule heat energy for the coarser (nom. 10-14 μm) powder, while the correlation was tentative for the finer powder used in this work. The results are interpreted considering the particle size distributions and assuming that particles are Joule heated so that the heating is more efficient for finer particles, with greater surface to volume ratio. It is further suggested that strong agglomeration observed for the finer Al powder skewed the expected correlation between the Joule heating energy and the size of ignited particles.