Dynamic Triboelectrification of Gas-Solids Flows in Metallic Tubes

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***Abstract*—Using a low pressure (800 kPa) gas gun, a high-speed electrometer, and a variety of powdered materials, we report on a series of experiments designed to elucidate the major parameters controlling tribocharge development in dynamic, turbulent gas-solids flows launched by sudden step change in differential pressure in a metallic tube. It is our goal that these studies provide insight into the complex material and mechanical processes behind the tribocharging transients observed upon discharge of gunpowder-based firearms. Our principle variables include solids mass loading, driving pressure, and barrel length. The charge developed on the gas-solids mixture as it exits the barrel is measured with a parallel wire capacitor connected to a high-speed electrometer (100 kSamples/sec), enabling the capture of fine details of the resulting charge transient. Several different types of powdered materials were used, including cellulose, zinc oxide and silicon dioxide to explore the effects of organic vs. inorganic materials, as well as differences in size distribution and dielectric constant. Pre- and post-shot composition analyses and electron microscopy were performed on the powders to identify chemical, morphological and size distribution changes occurring during the journey down the air-gun barrel.**