

Environmental and Hydrophilic Effects on the Triboelectric Charging of Insulator Materials

Jonathan Ngai, Daniel C. Park, Juan A. Rodriguez, and Keith M. Forward
Department of Physics, California Polytechnic State University
e-mail: kmforward@csupomona.edu

Abstract—Triboelectric charging is a phenomenon that naturally occurs in nature and often plagues many manufacturing processes. Electrical charge is transferred when two material surfaces contact each other. This phenomenon has been attributed to a wide range of occurrences such as volcanic lightning and grain silo explosions. Currently, the mechanisms and variables that affect triboelectrification are unclear and poorly understood. Three mechanisms: electron, ion, and mass transfer, named respectively by the species which is believed to be responsible for the charge transfer, are being considered to explain the occurrence of triboelectric charging. Variables such as relative humidity and hydrophilicity contribute to the sign and magnitude of charging that transpires. To investigate these variables and the mechanisms responsible for triboelectric charging of insulators, we considered a simple experimental approach where a particle (300-800 μm) is pneumatically driven through an insulator tube (ID 1.5 mm) under varying humidified environments. Different particle materials (soda lime glass, polystyrene) and tube materials (Nylon, Teflon) were studied due to their inherently different hydrophilicities. The charged particles were collected in a Faraday cup and the accumulated charge on each particle was calculated. As the humidity of the environment increases, the charge of the hydrophilic particles (soda lime glass) remains relatively constant until approximately 60% relative humidity where the charge significantly decreases. This behavior suggests that the driving force behind ion transfer diminishes once a critical relative humidity is reached. This study aims to gain a better understanding of the mechanisms responsible for triboelectric charging of insulators.