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Dependence of Electrostatic Field Strength on Voltage Ramp Rates for Spacecraft Materials[1] KRYSTA MOSER, ALLEN ANDERSEN, JR DENNISON, Utah State University — Previous tests done by the USU Materials Physics Group (MPG) using our electrostatic discharge (ESD) custom vacuum chamber have found that, for the polymeric materials polyimide and low density polyethylene (LDPE), the electrostatic field strength at breakdown depends on the voltage ramp rate applied across the materials. At ramp rates an order of magnitude lower than the maximum recommended rate of 500 V/s, the breakdown electrostatic field strength was also found to be significantly lower. The data from these tests were compared to a microscopic mean field theory for dielectric breakdown in highly disordered insulating materials. We present new ramp rate testing data on a third polymeric material, polypropylene. The voltage was incrementally increased at a constant rate across the samples until breakdown occurred. Breakdown is marked by the current increasing significantly and continuing to rise linearly according to Ohm's law. Different ramp rates were used in order to compare the dependence of electrostatic field strength on ramp rate for polypropylene to the theory applied to past experiments for polyimide and LDPE. Understanding these relationships between electrostatic field strength and voltage ramp rates will aid in the understanding and mitigation of ESD related anomalies and failures due to spacecraft interactions with the plasma space environment.

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