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Abstract

At extremely high altitudes, spacecraft are submitted to solar radiation of varying charged-particle fluxes. This radiation can induce charging of the spacecraft itself, creating unwanted and disastrous effects on electrical components from electrostatic breakdown or arc-induced damage of structural or optical components. To prevent these effects, space-like environment tests are performed on materials to understand how they interact with the space plasma environment.

Geometric and molecular structure models were developed for Low-Density Polyethylene (LDPE), a simple polymer which is used extensively in many industries. Polymers have become of interest for space-faring expandable habitat modules, due to their high general resilience, pliability, and yield characteristics. This polymer with a linear chain of carbon atoms decorated with hydrogen was chosen for study due to its molecular simplicity, highly-negative electron affinity, and very high electrical resistivity. These models of LDPE are used as a way to predict electron yield. The electron yield—the ratio of the number of emitted electrons to incident electrons—is a key material property that characterizes how materials will charge due to exposure to electron fluxes seen in solar radiation. Measurements and models for LDPE of the electron yield versus incident energy and emission spectra versus emitted electron energy are compared with those of various atomic structural forms of elemental carbon, from very low yield crystalline graphite, through disordered graphitic and diamond-like carbons, to very high yield microcrystalline diamond. Deviations from predictions made from the models are discussed.