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TRANSPORT ANALYSIS AND EXPERIMENTS ON THE DEEP DIELECTRIC CHARGING OF SPACECRAFT MATERIALS

Abstract

Spacecraft dielectric materials are subjected to a variety of space radiation environments. Very high electric field strength can be built up in the internal of the dielectric materials, and even electrostatic discharge can occur. This phenomenon is known as deep dielectric charging, which can be damaging to the function and security of the satellites. However, existing codes for estimating deep dielectric charging need improvements in simulation methods and parameters. And getting the dielectric internal charge distribution according tests becomes the challenge in further research on the deep dielectric charging. To solve these problems, we propose novel methods both in simulation and tests to study the deep dielectric charging character of spacecraft materials under electron-beam irradiation. With transport analysis of the incident electron based on Geant4 involving more accurate and detailed physical processes, a 1-D deep dielectric charging simulation method and model for typical spacecraft materials will be developed. Measurement of the time-dependent depth profile of charge density, potential and electric field strength of the dielectric-metal structure, which is made of Kapton film and quartz glass respectively in tests, will be taken for the first time.