Abstract to be submitted to: 13th International Symposium on Materials in the Space Environment (13th ISMSE)
Pau, France, 22 – 26 June 2015
http://w3.onera.fr/ismse2015/

Spacecraft Charging Sensitivity to Material Properties

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Evaluating spacecraft charging behavior of a vehicle in the space environment requires knowledge of the material properties relevant to the charging process. Implementing surface and internal charging models requires a user to specify a number of material electrical properties including electrical resistivity parameters (dark and radiation induced), dielectric constant, secondary electron yields, photoemission yields, and breakdown strength in order to correctly evaluate the electric discharge threat posed by the increasing electric fields generated by the accumulating charge density. In addition, bulk material mass density and/or chemical composition must be known in order to analyze radiation shielding properties when evaluating internal charging. We will first describe the physics of spacecraft charging and show how uncertainties in material properties propagate through spacecraft charging algorithms to impact the results obtained from charging models. We then provide examples using spacecraft charging codes to demonstrate their sensitivity to material properties. The goal of this presentation is to emphasize the importance in having good information on relevant material properties in order to best characterize on-orbit charging threats.