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Author: Mr. Jarred Novak
Wichita State University, United States, jcnovak@shockers.wichita.edu

POURABLE AND DESTROYABLE COSMIC RAYS RADIATION SHIELD FOR SPACECRAFT

Abstract

Historically, materials such as Lead, Tungsten, and Iron have been used in spacecraft to shield scientific detectors from Cosmic Rays. These materials work well when reentry to Earth is not an issue, but what happens to missions that are designed to come back down? The typical strategy is to have a controlled descent of the spacecraft or to have very limited shielding, if any, due to NASA's requirement that all impacting parts must impact with no greater than 15 J of energy. This is an issue Wichita State University NuSol team is facing for its 3U CubeSat demonstrator. The CubeSat will be scientific equipment with the purpose of detecting solar neutrinos, and the less background noise from Cosmic Rays the better the study will be. Through simulations, density tests, and burn tests, I was able to develop an epoxy-based shield doped with either Iron or Tungsten powder. The simulations were conducted by firing protons, positrons, and electrons into the shield material with energies ranging from 1 MeV to 500 MeV using Geant4. The limits for these simulations are the base epoxy at 1.15 g/cm3 to solid steel at 8 g/cm3. Mixing tests have determined for Iron, a density of 4 g/cm3 is achievable, which is 53Due to the current weight requirements of the mission, a density of 3.5 g/cm3 of Tungsten has been best studied. Both materials have been tested to determine if they burn upon reentry and neither shield survived past 400 degree Celsius. With the data collected from both simulations and test samples, several prototypes of varying densities were made by pouring the mixture into 3D printed models. The results indicate that the 4 g/cm3 Iron doped epoxy does not have a 90