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ELECTRON-INDUCED DISPLACEMENT DAMAGE EFFECTS IN SI SOLAR CELLS

Abstract

Solar cells in space are exposed to a radiation environment consisting mainly of protons and electrons. These energetic particles degrade the electrical performance of the device.Therefore, understanding the radiation response of the device is extremely important for accurate predictions of the expected mission lifetime. The concept of displacement damage dose (Dd) has been very useful in the prediction of solar cell response in space radiation environment. It was found that a large amount of experimental data could be condensed into a single curve showing the loss of maximum power and other photovoltaic parameters as a function of Dd. The method not only simplified the representation of extensive radiation data sets, but it also showed how experiments could be optimized for the evaluation of new cell types while conserving time and reducing costs. In this paper, the method was utilized to predict a BSR Si solar cell response for a LEO space mssion to provide a reference for the design of the solar array. The type of cells used in this study was a 2cm*4cm n+p type Si solar cell manufactured in China. The irradiations were performed with the incident electrons of different energies by the ILU-6 electron radiation facility located at the Lanzhou Institute of Physics. The performance degradation of the Si cells at different electron energies has been correlated with displacement damage dose. The simulation was executed about the performance degradation of the Si cells with a 120μm thickness of shielded silica coverglass in the LEO (Altitude 799km, Inclination 99) radiation environment, using the displacement damage dose methodology for analyzing and modeling. A 120-μm-thick silica coverglass can neary block off the effects of proton on the Si cells in LEO environment, but it is not as effective for electrons as it did for the protons. Compared with the on-orbit data from a Si solar array of a Chinese satellite (flying from April 2007 to July 2010), a good accordance can be found between the on-orbit data and the predicted results by Dd methodology, indicating the method can proide the valuable reference for solar array design.