Paper ID: 19818
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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Environmental Effects and Spacecraft Protection (6)

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THERMAL-STRUCTURAL ANALYSIS OF SOLAR CELLS ON FLEXIBLE SOLAR ARRAY

Abstract

he space station is a useful instrument for human beings in exploring outer space, and light-weighted flexible solar array can be used as power system on space station. It is very important to simulate and analyze the temperature field and thermal deformation of the large flexible solar array with some finite method software, for it is difficult and cost to do the thermal vacuum simulation test on ground. In the low earth orbit, solar array are exposed to solar radiation, heat from earth albedo and infrared-radiation, undergo large changes in temperature. In this paper, the transient temperature fields of 4 cycles in orbit of the flexible solar array are calculated, and the periodic change regulations in each part of the solar array are obtained. The solar array could reach heat balance in 2 cycles, and temperature gradient in the structure is small. The flat cable is used to deliver electrical energy in the flexible solar array circuit, which partially bonded to flexible plate with silicone rubber, and thermal stress will appear at the bonded area due to differences in their thermal expansions. According to the flat cable's temperature result, the thermal deformation in all directions and the thermal stress in the flat cable are studied. Solar array is composed of many solar cells and interconnectors through parallel connection, which provided the current and voltage to space station. With the change in temperature, the size of the solar cells and flexible plate will change. The gap between solar cells also changed imperceptibly, which will induce large thermal stress in the interconnectors. The stress of the interconnectors at different temperatures is studied in the paper. These results may provide some reasonable references and advices for the thermal design and the thermal analysis of solar arrays.