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DEVELOPMENT OF THE PROTECTING HIGH VOLTAGE SOLAR ARRAY BASE PLATE FROM ATOMIC OXYGEN

Abstract

In LEO , principal environmental element consists of O(80%) and N2(20%).Atomic oxygen (AO) has a high chemical activity and can erodes polymeric material severely. Solar array is an important power subsystem of spacecraft. If it has some trouble, spacecraft would lose part duty or fail in mission completely. Common solar array consists of composite base plate and solar cells which stuck on the base plate. In order to keep insulation between composite base plate and solar cells, base plate is covered a polyimide film first. Then solar cells are stuck on the polyimide film. Recentlyas space station and LEO large spacecrafts have been developed, over 100V high voltage solar array has been applied. Charge and discharge may occur on high solar array in LEO plasma environment. Polyimide film eroded by AO is ready to be broken through by discharge. It would result in short circuit between composite base plate and solar cells. The damage is fatal for spacecraft. The paper introduces a coat produced with Sol-gal process. AO erosion rate of the coat is 100 times lower than pristine substrate. The sol-gal process is simple and cheap. It is suitable to protect the large and complex surface of spacecrafts against AO. The anti-AO coats with sol-gal process developed by Beijing Institute of Spacecraft Environment Engineering can satisfy the spacecraft design requirement. Test results show that total mass loss (TML) of the coats is 0.37% and collected volatile condensable material (CVCM) is 0.37%. All of both are better than spacecraft design requirement. More, both of adhesion and tensile strength between base plate and solar cells are higher than pristine samples. The coats can resist harsh space environment effects and have no peeling and crack defects after extreme temperature alternation, radiation and atomic oxygen ground tests. AO erosion rate of the coats is 10-26cm3/AO. Now, Beijing Institute of Spacecraft Environment Engineering is carrying out the vibration tests and thermo-vacuum simulation tests for anti-AO solar array models. Base on this, standardized products of high voltage solar array will be produced and be applied to LEO large spacecrafts design in the near future.