MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Environmental Effects and Spacecraft Protection (6)

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FLIGHT EVALUATION ON SURVIVABILITY OF FEP IN SUPER-LOW EARTH ORBIT ENVIRONMENT

Abstract

Super low altitude test satellite (SLATS) is the first Japanese satellite orbiting the altitude of 200 km assisted by an ion engine. This region of space was called super-low earth orbit (SLEO). Because of its low altitude, atomic oxygen flux at ram facing surface of SLATS is more than two to three orders greater than that of the International Space Station. In this environment, standard polyimide film with 25 micron-thick is completely eroded away within a few days. Therefore, protection/selection of the materials used in the outer surface of spacecraft is a key for success of the mission. Based on its low reaction efficiency, fluorinated polymer is the most promising candidate of materials applied in SLEO environment. However, there is no evidence that fluorinated polymer could survive in SLEO environment. Due to its small scale-height, increase in density of N2 with lowering the altitude increases much more than that of atomic oxygen. Therefore, neutral gas collision in SLEO is not only atomic oxygen but also N2 which is almost 50 percent of the total neutral atom density. In the previous study, it was shown that the fluorinated polymer is sensitive to the impinging energy of atoms, and the erosion rate of fluorinated polymer becomes high with collision energies larger than 9 eV. If it is true, life of fluorinated polymers in SLEO environment becomes much shorter than the expectations which was given by the erosion yield with atomic oxygen. In order to study material's survivability in such a low altitude, SLATS carries two material missions. One of them is the material degradation monitor (MDM) mission which will send photographs of sample carrousel back to ground. Kobe University has proposed rather thin fluorinated polymer, 1 mil thickness one-side silver-coated FEP, as a sample of MDM mission. The point is that the erosion yield of FEP in SLEO could be evaluated by the known thickness and exposure time by detecting the breakage of the film. In this presentation, background of the material proposal for MDM mission including past ground-based results will be presented.