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IN-ORBIT DEMONSTRATION OF PASSIVE ELECTRON-EMITTING FILM FOR MITIGATION OF SPACECRAFT CHARGING

Abstract

Satellite is greatly affected by the space environment and one of these effects is satellite charging. Various currents flow through the satellite and it is charged in order to keep the current balanced. During the substorm electron inflow is higher and the satellite is charged. In this charging process, the potential difference between the conductor and the insulation surface of the satellite is generated. The secondary electron emission coefficient of insulator determines the charge, responsible for surface potential, depending on the surface material, satellite location and local time, etc. The rapid ejection of electrons due to electrostatic discharge (ESD) results in physical damage to the harness and the satellite body. Some satellite failure due to discharge has been reported. In order to prevent this type of accidents due to ESD, it is essential to mitigate the difference of the potential between insulator and conductor. So, we have developed a passive electron emitter for satellite charging and discharging mitigation. It is possible to generate a strong electric field to the local areas of our emitters by providing triple junction intentionally. So this emitter can emit electrons as long as this electron field exists. Since satellite body acts as the electron source for the emission, it is possible to change the current balance and increase the potential of satellite body. The difference of potential between insulator and conductor is to decrease due to the increase of the satellite potential. Recently, electron emission of this emitter has been confirmed on the ground test. In 2012, emission of electron from this emitter has been measured by a high voltage technology demonstration satellite 'Horyu-2'. However, due to insufficient data and longer time resolution, repeated emission has yet to confirm. In order to have more data in the shorter time resolution, this emitter has been mounted on a small satellite, named 'Hodoyoshi-4' made by Tokyo University, passing through aurora zone, similar to 'Horyu-II'. After the mounting of this emitter and related circuitry for measuring emission current and surface potential on the flight model (FM) of 'Hodoyoshi-4', we confirmed the operation. Sampling rate of emission current measurement of 'Horyu-2' was 4 minutes, whereas for 'Hodoyoshi-4' it is one second only. Therefore, we have been expecting more detailed information.