

SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE  
ACTIVITIES (D5)  
Space Weather Prediction and Effects on Space Missions (3)

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EVALUATION OF PERFORMANCE AND RESISTANCE TO SPACE ENVIRONMENT OF  
ELECTRON-EMITTING FILM (ELF) FOR SPACECRAFT CHARGING MITIGATION

**Abstract**

As geo-stationary (GEO) satellite bus voltage increased due to the increased size of the satellites, the number of solar array failures due to spacecraft charging increased. It is believed that the failures are initiated by the potential difference between an insulator such as cover glass and the spacecraft chassis that sharply drops negatively under substorm plasma environment. The potential difference leads to an electrostatic discharge. If the spacecraft chassis potential can be maintained near zero potential even when the spacecraft encounters the substorm, the danger of discharge can be greatly reduced. We are developing an electron emitter that emits electrons from the conductor by using the enhanced electric field at the triple junction which occurs simultaneously as the inception of spacecraft charging. The emitter is composed of a polymer on top of a copper plate. Parts of the copper plate are exposed through the polymer making the opening triple junctions that are the source of electron emission. This emitter operates in a completely passive fashion. It has a number of advantages over other spacecraft charging mitigation methods; compact size, lightweight, powerless, cableless and low cost. As the emitter is expected to operate for a long time in orbit, it needs resistance to prolonged space environment exposure. This study aims to upgrade the emitter performance and to evaluate resistance of it to space environment. We have carried out a series of environment exposure tests, such as heat cycle and various radiation (proton, electron and ultraviolet). The surfaces of the emitters were coated with a special material to enhance the electron emission current. In the ground test, the emitters were biased to a highly negative potential with respect to a vacuum chamber ground and exposed to an electron beam. Through this test, the emission current from each sample emitter is evaluated. At the symposium, the latest results of the development are reported, which also includes a proposed system for orbital demonstration experiment.