

Charging Analysis Considering Charged Physical Properties of Space Material

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1. Background & Purpose

When we make a spacecraft, we have to take care to discharge phenomenon. Discharge occurs due to potential difference between spacecraft and surface material. Also, there are various factors such as high-energy electrons and ultraviolet rays in outer space. So, the surface material of the satellite continues to deteriorate. Previous research, we have acquired physical property values of various environmental degradation samples of surface materials.

This research, we aim to acquire the change of the surface potential, which is the cause of the discharge phenomenon by material deterioration, by inputting these data to the analysis tool and simulating it.

2. Analysis tool “MUSCAT”

The charge analysis tool, called "MUSCAT (Multi-Utility Spacecraft Charging Analysis Tool)" was created in collaboration with JAXA and Kyushu Institute of Technology. To analyze, it is necessary to input charged physical property values such as "total electron emission yield", "photoelectron emission yield", "resistance" of the material. And, setting related to the space environment such as the plasma density, the direction of the sunlight, magnetic force lines, etc. is required.

3. Analysis conditions

Analysis model, a 3 m cube was created to simplify the calculation. Two analytical materials were used, and the other was aluminum. In order to investigate the influence by sunlight, we compared light receiving / non-light receiving by solar light of analytical material. The analysis model is shown below.

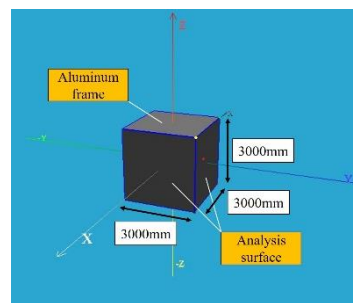


Fig 1. Analysis model

4. Analysis materials

The materials are

- CMG100AR®
- Teflon®
- Kapton®
- Black Kapton®

These are 4 types. CMG 100AR® is a cover glass that covers solar panels, and other three materials are thermal control materials. These four were analyzed using the physical property values of the electron beam degraded or proton ray degraded materials.

5. Analysis result

The results of Teflon® non-sunlight are shown below.

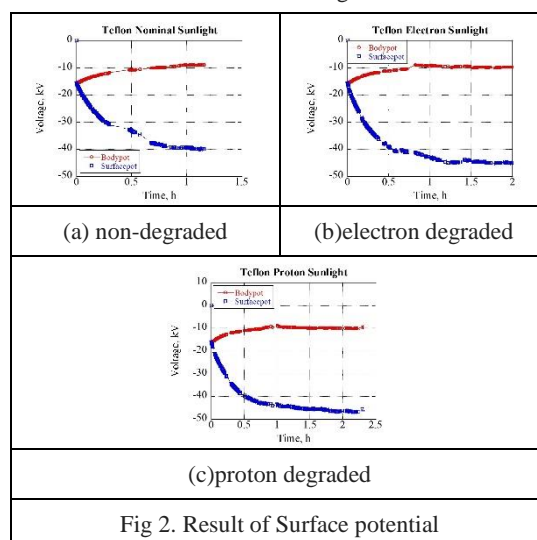


Fig 2. Result of Surface potential

6. Conclusion & Future tasks

The MUSCAT was able to investigate the change the surface potential deterioration of the surface material. Basically, the potential of the material surface lowers, and the risk of discharge is increased. As a future tasks, we will increase the types of materials to be analyzed and the types of deterioration, and investigate to what extent which change in the physical property value affects the surface potential.