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Potential Measurement of an Insulator Surface under Charged Particle Irradiation
荷電粒子照射下の絶縁体表面電位測定

Kei Ikeda, Toshirou Kasuya and Motoi Wada
池田　慧, 粕谷俊郎，和田　元

Graduate School of Engineering, Doshisha University
1-3 Tatara Miyakodani, Kyotanabe-shi, Kyoto 610-321, Japan
同志社大学大学院工学研究科　〒610-321　京田辺市多々羅都谷1-3

Cover glasses on the solar panels of satellites are exposed to high energy particle bombardments in space. The surface of cover glasses emits secondary electrons and acquires positive electrical charges. Thus, it is extremely important to measure the secondary electro emission coefficients of cover glass materials, but the measurement requires complexity as any insertion of the potential measurement probe can alter electrical field structure created by positive charge on insulating substrate. An approach to measure potential distribution around the insulating material surface is proposed based upon the ion beam method.

1. Introduction

Solar panels supplying electrical power to space satellites are covered with protecting glass. Surfaces of these cover glasses are charged positively under exposure of cosmic ray mainly composed of high energy protons. The surface will emit secondary electrons which should charge up the surface even more positively, and the precise data on secondary electron emission yield are necessary to compute electrical potential distributions around the satellite solar panels.

2. Experimental apparatus

To measure the secondary electron emission coefficients of insulating materials, an experimental setup schematically shown in Fig. 1 is being assembled. No electrode will be positioned close to the surface of the insulating target, but a probe ion beam will be launched in the direction parallel to the target surface. To measure the secondary electron emission coefficient;

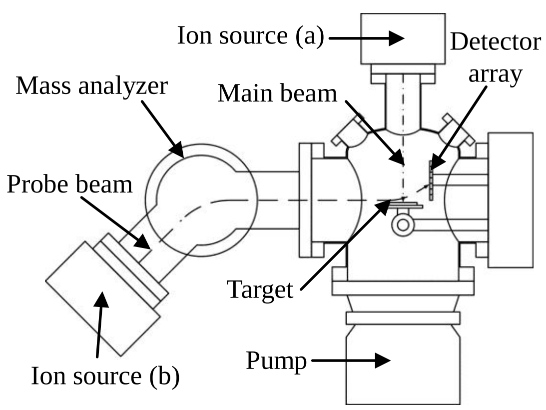

Fig.1 Experimental setup

- A beam of He ions is extracted from ion source (a) and the surface of the insulating target will be charged up positively.
- Another beam of He ions is launched into the region close to the target with the direction parallel to the surface of the insulating target.
- The probe beams are detected by a detector array, and the amount of surface charge is determined from the beam trajectories.

3. Potential calculation

Accurate determination of the secondary electro emission coefficient relies on the trajectory calculation based upon potential distribution around the target. The potential distributions are calculated by TriComp® with the boundary condition corresponding to the experimental apparatus. A typical equipotential contour is shown in Fig. 2, and the ion beam trajectory calculation will be carried out based on this result.

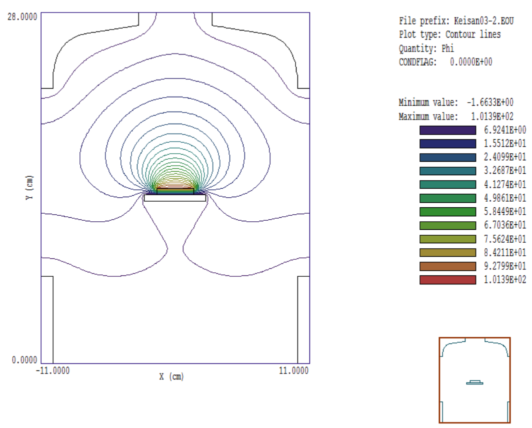

Fig. 2. Example of the potential distribution calculation with the positive charge on the insulating target.