NO#:203

Xe erosion effect on the electron emission yield of coverglass

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Hall Effect Thrusters (HET) allows thrust generation by acceleration of neutralized plasma in an electrostatic field. The plasma is obtained by electron bombardment of the propellant gas (typically Xenon) inside the thrusters' discharge canal. HET are used for station-keeping, deep space mission and orbit rising. The effects of the propellant interaction with spacecraft (erosion, contamination and Xe implantation) may considerably affect the materials proprieties [1-2]. Among these proprieties the interest here was focussed on the electron emission due to electron impact. Indeed, the electrostatic equilibrium of spacecraft submitted to irradiations is partly controlled by the electron emission properties of surface materials. In particular, the electron emission yield (EEY), defined as the ratio between the number of emitted electrons and the number of incident electrons), must be known. The most critical EEY parameter is the second crossover energy, E_{C2}, (incident energy for which the EEY=1). E_{C2} is usually measured on non-eroded samples. However, many works (on metallic materials) shows that ion erosion leads to an overall decrease of the EEY and in particular to lower E_{C2} (see for instance ref [3]). The aim of this paper is to assess the effect of Xe irradiation on a representative space material. For this purpose, two samples of solar cells cover glasses, CMX 100 AR and CMX 100 UVR were submitted to 300 eV Xe erosion at 45° incidence angle. The Xe dose was varied step by step from 0 ion /cm² to 10^{18} ion/cm². The evolution of the EEY was monitored in situ at different Xe exposure doses. The results were qualitatively similar to that previously observed on metallic materials [3]: an overall drop of the electron emission yield was observed for the two cover glasses. The crossover energies for the CMX100 AR and the CMX 100 UVR decreased from their nominal energies of 4.3 keV and 4 keV respectively to 3.1 keV and 2 keV after 10^{18} ion/cm² irradiation. The impact of the EEY change of the eroded surfaces on the spacecraft charging in GEO is thereafter analysed with help of SPIS (Spacecraft Plasma Interaction System) software.

[1] T. Tondu, V. Inguimbert, F. Darnon, J.F. Roussel Angular Characterisation of erosion and contamination by electric propulsion proc. 4th Space Propulsion Conference, Caliari, Sardinia, Italy 2-4 june 2004.
[2] Ayez Yalin, James Topper, Casey Farnell, Greg Yoder Effect of ion sputtering on transmission of coverglass with magnesium fluoride coating 3nd International Propulsion Conference, Wiesbaden Germany, 11-15 September 2011
[3] Hai-Bo Zhang, Xiao-Chuan Hu, Rui Wang, Meng Cao, Na Zhang, Wan-Zhao Cui Measuring effects of Ar-ion cleaning on the secondary electron yield of copper due to electron impact Rev. Sci. Instrum. 83, 066105 (2012)