A KINETIC STUDY OF RADIATION INDUCED CONTAMINATION EFFECTS

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GLOSSARY
UV/VUV radiation induced surface contamination, kinetic of the degradation, thermo-optical properties

ABSTRACT
UV/VUV radiation induced contamination on surfaces of spacecraft, their optical instruments and solar arrays in space can result in significant loss of their performance and eventually in the complete failure. Several studies have been focused on the prediction of the contamination effects on different sensitive surfaces in the presence of UV/VUV radiation and outgassing products from different materials [1,2]. Surface photofixation of gas-phase organic molecules outgassing from materials of a spacecraft under the UV/VUV radiation is considered as a main mechanism of surface contamination. A detailed photofixation modelling was developed in [2]. An experimental approach to investigate radiation induced contamination effects was developed during the BepiColombo mission development and presented in [1]. Here surface contamination is a result of a competition between the deposition of incoming contaminants, their reemission, the surface temperature of the target and the temperature of the source(s) as well as radiation intensities [1].

However, there is a lack of experimental information related to the dependence of the degradation rate of thermo-optical surfaces on the impingement rate of gas molecules (contamination flux) and intensity of UV/VUV radiation (photon flux). This information is crucial for predicting the performance of long duration space mission and for the ground testing when UV/VUV intensities and/or contamination fluxes are increased to accelerate the testing. Moreover, further transformation of molecules in the contamination deposit is also contributing to the changes of surface reflectivity and must also be taken into account.

In this paper we present results of an experimental parametric study of the UV/VUV radiation induced contamination on different surfaces in vacuum. Responses of several white ceramic coatings to simulated space environment were investigated. Contamination sources and ceramic coatings were representative to materials used for the Bepicolombo mission. During the experiments the optical degradation of samples was measured in-situ by two independent spectroscopic instruments specifically designed for this investigation. Obtained data allowed us to study in-situ the kinetic of the sample degradation as a function of contamination fluxes, UV/VUV intensities and temperatures. Kinetic parameters of the sample degradation, the transformation of contamination deposits and “bleaching” effects were evaluated.

REFERENCES