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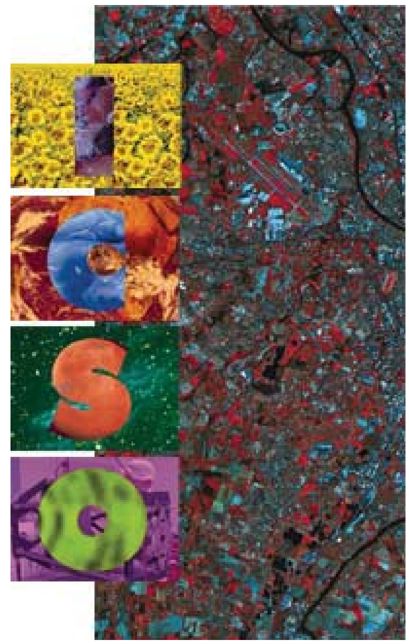

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ABSTRACT

A MINI-SPECTROMETRE FOR THE ON-ORBIT CONTROL OF OPTICAL WINDOW AGEING ON THE ISS

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Optical windows transmission, and their evolution as a consequence of the exposure to the space environment are of primary interest for spacecraft designers and must be accurately predicted.

In most cases the behaviour of such materials can be ground-tested using simulation facilities such as solar simulators, atomic oxygen sources, thermal cycling facilities, charged particle accelerators etc... However, real space is difficult to simulate and synergistic effects between several parameters of the space environment acting together on materials have been evidenced for instance by past flight experiments after sample retrieval from space [Whi 92] and [Sil 95]. Because of constraints of technical and financial nature, ground simulation has to be limited to these space environment parameters which are expected as the most active in actual flight conditions, according to what can been known from past experience in space (involving sample return). Therefore comparison of the degradation predicted in laboratory testing with that obtained in space is of the highest interest. It is also of great importance to know about the real effect and dynamic of the degradation. Past experiments, with degradation measurements after sample return to air didn't show the real in-space degradation as some of them are recovered by Oxygen and saturation effects are not fully understood.

In this context, a mini-spectrometer system is foreseen to be mounted on a general test bed called MEDET [Din 00] developed in a co-operation between CNES, ESA, the University of Southampton and ONERA, and that will be implemented on EuTEF, the European Technology Exposure Facility. MEDET comport several experiments aiming at a better understanding of the ISS environment and at the monitoring of the optical and thermo-optical properties of materials used in space.

The mini-spectrometer system, described here, is designed in order to study possible effects of contamination on the optical surfaces present on-board ISS, and also to evidence degradation of optical window materials as a consequence of the space exposure. It is foreseen to make use of two commercially available, mini-spectrometers adapted respectively to the range - 190-735 nm and 350-1100 nm . Each spectrometer consists of a grating, a photodiode array detector and associated nearby electronics. The UV-visible and visible-NIR spectrometers, with their associated fibre and electronics, will be put in a pressurised cylinder in order to avoid out-gassing. Twenty two transparent optical windows to be tested (including synthetic ultra-pure SiO_2 and other radiation stable materials to evaluate contamination effects) will be placed on a rotating sample wheel on an external surface facing ram. Two more holes will remain empty in order to look directly to the sun which will be used as the light source. Space resistant optical fibres will be used to transmit light from the filter wheel to the cylinders (two will be built for redundancy). The optical spectral transmission of the samples in the wavelength range 200-1100 nm will be measured by looking the sun alternatively through an empty hole and- each sample. Due to geometric considerations, the measurements will be allowed only when the sun is detected by an optical sensor in an acceptance angle of ± 40°. Typical dimensions of a window is Ø 10mm. Spectra will be send to earth via the ISS data link every day. The total orbital life is foreseen to last three years, then the experiment will be returned on earth for further investigations.

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