Polymeric materials have a multitude of different applications on a spacecraft, notably as structural parts, adhesives or as part of the thermal control system. Consequently these materials need to have specific properties and to be able to maintain them in the harsh space environment. A convergence of several factors indeed make space a challenging environment for polymers. The resistance of the studied material.

In an attempt to optimize these costs a new approach of ground testing is presented in this study and more particularly we evaluate the performance of a new type of equipment to change the way we conceive materials for space application can be estimated by on-orbit testing or ground testing which both involve costs in time, technology and money that influence the development of space programs.

In-situ measurement

The main challenge dealing with in-situ ground testing is to recreate the space environment accurately. In this study the test samples are Kapton-H films usually used in thermal control systems. Because of the recuperation phenomenon that occurs with exposure to an air, irradiation is not necessary to keep the sample in a vacuum. This is why in-situ measurement is crucial in order to have a better understanding of the degradation phenomena happening on real-orbit conditions.

The in-situ test facilities have been designed to ensure the continuity of the storage conditions for the sample throughout processing (i.e. vacuum conditions) and thus protect the sample from air exposure.

Importance of in-situ measurement

The gate valve and pump unit keep a vacuum inside the VTV when the pump is not in operation thanks to the getter unit.

The optical window allows the beam from a spectrophotometer to go through the polymer film sample mounted on the sample holder and normally measure optical properties.

Description of the in-situ facilities

The Vacuum Transport Vessel (VTV) : Composed of a magnetic driven linear/rotary feedthrough for transportation and a port of a custom made sample holder, a gate valve to preserve the vacuum, an optical window allows spectrophotometer measurements and a portable vacuum pump, with an ion pump and a getter unit, it can be easily connected with a clamp to a vacuum chamber's port.

Vacuum quality and durability were assessed before proton irradiation by pumping to a rough 10^-4Pa using an external turbo molecular pump. The ion pump was then activated and the pressure was measured regularly. The lowest pressure registered was 4.7×10^-6Pa after a week of pumping.

Conclusion

The development of an in-situ test facilities network constitutes an alternative to bigger and more complex convects such as the SEM-HiMATE facility at ONERA and can prove cheaper and more flexible for different purposes. Its key element, the VTV, has shown its compliance with the basic requirements for its intent. It was able to hold a good vacuum for over 5 days and allows the measurement of transmittance spectra through its optical window. In addition, sample insertion and pick up are fast and easy and it can be fitted with a portable battery to extend the duration of the vacuum. This system is well under development and remains to be standardised in order to make it more versatile and thus more efficient.

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