«Penta-Optics» Experiment

RESEARCH OF OPTIC-PHYSICAL PROPERTIES OF STRUCTURAL MATERIALS BY THE MONITORING OF THE FACTORS OF A SPACE FLIGHT

Solodovnik L. L., Verhovtzeva E. T., Yaremenko V. I.

Special Research and Development Bureau for Cryogenic Technologies of the ILTPE, NAS of Ukraine
47 Lenin Ave., Kharkiv 61164 Ukraine
Tel/fax: (380) + 572 +308551, e-mail: sktb@ilt.kharkov.ua

Implementing long-time space flights is one of the major problems at the current stage of development of cosmonautics. For solving this problem, there exist numerous rather strict requirements to reliability and service life of the spacecraft, including the structural materials used. In the course of a long-term orbital operation of a spacecraft, there occurs a degradation of thermo-controlling coatings. Investigations demonstrated different levels of optical materials stability in outer space. It is assumed that the most decisive factor in degradation of the mechanical and optical properties of TEFLON-FEP is the X-ray irradiation by solar flares.

Another important problem nowadays is related to identification of space contamination influence on optical properties of materials. It is universally known that substances being released into space environment as a result of outgassing and degradation of materials, are first absorbed on the material's surface, and then polymerized, thus resulting in increased Solar absorption coefficient.

Brief background and current status of the problem. Investigation of the actual changes in the optical properties of materials in long-term flights can be conducted by several methods for:

— employment of ground-based test facilities for simulation of space flight factors;

— implementation of experiments in a real space flight;

— implementation of experiments in a real space flight at simultaneous investigations in ground-based test facilities.

The first method is the most widely used, and is less expensive. However, the ground-based test facilities do not, in most cases, provide a simulation of the entire set of the actual space conditions. For instance, X-ray irradiation by Solar flares is not simulated in many test facilities, which is the factor, which may be the determining one in degradation of the optical and mechanical properties of a whole range of materials. In addition, in some cases of laboratory experiments, the simulation of individual factors of space is inaccurate. The researchers quite often neglect modeling of the spacecraft own exterior atmosphere, which, in particular, can contaminate the optical materials surface, thus deteriorating their optical properties. A certain ambiguity in interpretation of ground-based testing results arises in many cases from the lack of scientific justification of the «accelerated» testing procedure, i. e., shortening of test time at the expense of intensification of the acting factors. Therefore, the data on degradation of material properties generated in the ground-based test facilities may be different from the relevant data obtained in a real space flight.

Expediency of space experiment performance in space. The trustworthiest information about the change of material properties can be obtained from experiments staged in open space. The first space-borne experiments were mainly dedicated to exposure of materials samples to outer space (and in many cases, without monitoring the space flight factors) with their consequent delivery back to Earth and a detailed comparative investigation of their properties prior to and after the flight. Current activities include such efforts as exposure of materials samples during a space flight with a simultaneous measurement of the optical characteristics (such as Solar-absorption integral coefficient, and materials emmissivity).

The most resultative are the investigations that combine both trends, i. e., exposure of materials in a real space flight with simultaneous investigations in the ground-based simulation test facilities. Irradiation of materials in the ground-based test facilities with subsequent investigations of their properties can be performed both by individual space environment factors and by all of them as a complex. This allows determination of the mechanisms of materials degradation.

Description of space experiment. Under this project it is proposed to create on-going scientific