International Low-Earth-Orbit Spacecraft Materials Test Program Initiated for Better Prediction of Durability and Performance

Spacecraft in low Earth orbit (LEO) are subjected to many components of the environment, which can cause them to degrade much more rapidly than intended and greatly shorten their functional life. The atomic oxygen, ultraviolet radiation, and cross contamination present in LEO can affect sensitive surfaces such as thermal control paints, multilayer insulation, solar array surfaces, and optical surfaces. The LEO Spacecraft Materials Test (LEO-SMT) program is being conducted to assess the effects of simulated LEO exposure on current spacecraft materials to increase understanding of LEO degradation processes as well as to enable the prediction of in-space performance and durability. Using ground-based simulation facilities to test the durability of materials currently flying in LEO will allow researchers to compare the degradation evidenced in the ground-based facilities with that evidenced on orbit. This will allow refinement of ground laboratory test systems and the development of algorithms to predict the durability and performance of new materials in LEO from ground test results. Accurate predictions based on ground tests could reduce development costs and increase reliability.

The wide variety of national and international materials being tested represent materials being functionally used on spacecraft in LEO. The more varied the types of materials tested, the greater the probability that researchers will develop and validate predictive models for spacecraft long-term performance and durability. Organizations that are currently participating in the program are ITT Research Institute (USA), Lockheed Martin (USA), MAP (France), SOREQ Nuclear Research Center (Israel), TNO Institute of Applied Physics (The Netherlands), and UBE Industries, Ltd. (Japan). These represent some of the major suppliers of thermal control and sensor materials currently flying in LEO. The participants provide materials that are exposed to selected levels of atomic oxygen, vacuum ultraviolet radiation, contamination, or synergistic combined environments at the NASA Lewis Research Center. Changes in characteristics that could affect mission performance or lifetime are then measured. These characteristics include changes in mass, solar absorptance, and thermal emittance. The durability of spacecraft materials from U.S. suppliers is then compared with those of materials from other participating countries. Lewis will develop and validate performance and durability prediction models using this ground data and available space data. NASA welcomes the opportunity to consider additional international participants in this program, which should greatly aid future spacecraft designers as they select materials for LEO missions.

Directed atomic oxygen and synergistic vacuum ultraviolet radiation exposure facility at NASA Lewis can measure the reflectance of samples from 250 to 2500 nm while they are in the vacuum chamber.

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