Paper ID: 45650
interactive

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

Author: Dr. Maciej Sznajder
German Aerospace Center (DLR), Bremen, Germany

DEGRADATION STUDIES OF SPACE MATERIALS AT DLR-BREMEN

Abstract

Materials used in space applications have to withstand a harsh environment including: high vacuum, corpuscular and electromagnetic radiation, impacts caused by space debris and micro meteorites. DLR in Bremen has specialized in experimental and theoretical studies of the material response to the corpuscular and electromagnetic radiation.

For performing the irradiation tests, DLR in Bremen has three facilities which can simulate different space environments. First, the so-called Complex Irradiation Facility (CIF), is an Ultra High Vacuum facility combined with an electron and proton gun generating particles within the energy range of 2 keV to 100 keV. Particle current can be set from 1 nA to 100 μA. The parameters allow to simulate a particle spectrum at Low Earth Orbits (LEOs), Geostationary orbit as well as interplanetary medium. Additionally, the facility has three light sources: an Argon-VUV source, a Deuterium lamp and a solar simulator (equipped with a Xenon lamp). All working together can simulate Sun's spectrum from deep VUV range of 40 nm to far infrared light of 2150 nm. All sources can work simultaneously. An effective irradiation area of 36 cm^2 makes the CIF a suited facility of performing realistic irradiation experiments. There are additionally two facilities equipped with solar simulators, both working within the wavelength range of 200 nm to 2150 nm. The facilities can generate light with a maximum intensity of 1 SC. One facility has a light beam diameter of approx. 16cm, while the other facility hat approx. 100cm. Both facilities operate in vacuum of 10^{-6} mbar range.

In particular, the CIF has been used in many irradiation experiments. In the ESA funded project Deployable Membranes test samples of thin membrane foil have been exposed to high vacuum and a wide range of electromagnetic radiation from 40 nm to 2150 nm followed by Atomic Oxygen exposure tests at ESA. The objective was to experimentally simulate how a membrane material of a drag-sail will behave in LEO environment for over 20 years. The test results clearly show that elastic polyimide foils covered with vacuum deposited Aluminum layers are suited as a base material for deployable structures in LEO. Within DLR a researcher group is working on basic studies of degradation mechanisms caused by electromagnetic and corpuscular radiation on commonly used materials for space applications.

Irradiation facilities at DLR in Bremen are well suited for performing a wide range of degradation tests dedicated for variety of space environments.