Space Environments Simulation Facility

Purpose:

To enable the testing, evaluation, and qualification of materials for use on external surfaces in space.

Typically, materials are exposed to laboratory simulations of space environments followed by flight experiments when possible. These simulations provide spacecraft designers, engineers, and scientists with valuable information on the behavior of materials in a space environment. The facilities have been used for the space shuttle, the International Space Station, and the Solar X-Ray Imager. They have also been used in postflight analyses of experiments flown in space to determine the changes in optical, mechanical, and electrical properties.

Enhanced Ultraviolet (UV) System

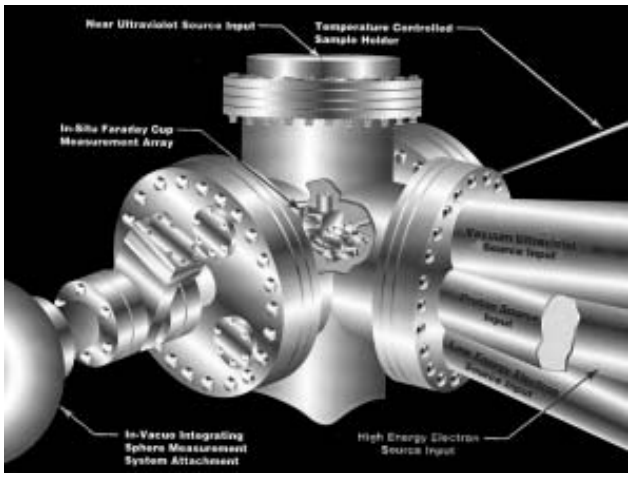
For ultraviolet radiation simulation, the Space Environments and Effects (SEE) team uses a variety of solar simulators, which closely match the solar spectrum from 200 nm to 1500 nm. Infrared radiation is dampened with a water filter to minimize sample heating. The Enhanced UV System can irradiate up to 10 equivalent UV suns in the 200 nm to 400 nm wavelengths. All UV systems operate in a 5 x 10^{-8} torr vacuum.

Combined Environment Effects Test Chamber

Synergistic effects are studied in the Combined Environment Effects Test Chamber. This system consists of a 2.5 MeV electron accelerator, a 1.0 MeV proton accelerator, a 50 KeV electron flood gun, and near ultraviolet (200-400 nm) and vacuum ultraviolet (118-200 nm) solar simulators. In-situ measurement of total integrated reflectance is possible.

The Marshall Magnetic Mirror (M3)

The Marshall Magnetic Mirror (M3) system is an important research tool in the field of advanced propulsion technology. The M3 system is a versatile plasma creation and confinement system that is capable of generating 10 eV (>100,000 ^{o}C) plasma with densities up to 1 x 10^{11} particles/cm^3. The basic components of the system include a stainless steel vacuum vessel with multiple diagnostic port locations, a 2 kW microwave source, a flexible magnet coil set rated for 1000 Gauss operation, as well as a high current electron beam source (>100 amps). Brought on-line in 1999, the M3 facility has been investigating the interaction of an electron beam with a magnetically confined plasma. Future experiments will focus on characterizing plasma particle distributions, studying plasma-material interactions, and plasma diagnostic development.



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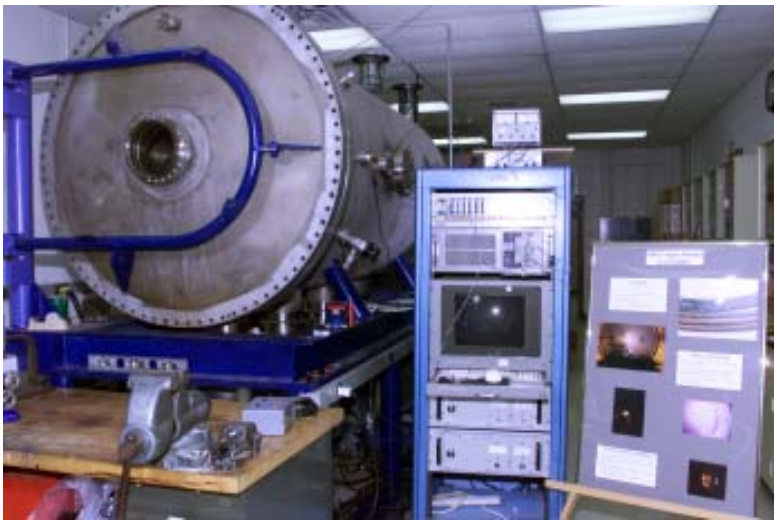
Plasma Interaction Chamber

The Space Environmental Effects Team operates two large volume vacuum chambers capable of simulating a variety of space plasmas. These chambers can produce plasma densities and energies for orbital environments ranging from Low Earth Orbit (LEO) to Geosynchronous Earth Orbit (GEO). Plasmas are generated using either a hollow cathode source or electron filaments. These systems offer the capability to measure the real-time plasma density and energy. These plasma systems were used to develop the tether material for ProSEDS and perform life testing on the ProSEDS plasma contactor. Recently, these chambers were used to study plasma interaction with the International Space Station (ISS) external coatings.



Photon Pressure Measurement System

Recent interest in using solar sails for spacecraft propulsion and station keeping provided the motivation for the Environmental Effects Group to develop a test system capable of measuring photon pressure. This test system characterizes candidate material for solar sail missions by measuring the photon pressure produced by photon illumination. The test system accepts samples as large as 6 inches in diameter. A solar simulator that has a tunable photon intensity illuminates the candidate material with photons. The resultant pressure on the candidate material is measured.

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