SPACE ENVIRONMENTAL EFFECTS

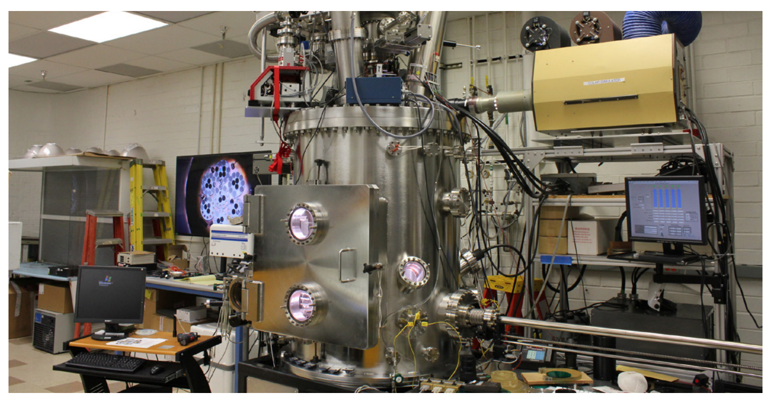
The space environment is an operational regime that can be challenging to even the most robust materials. The Space Environmental Effects (SEE) Lab has established a multi-decade history of space environmental effects testing and evaluating the performance of spacecraft materials in many orbital environments.

The SEE Lab maintains multiple state-of-the-art exposure facilities dedicated to high-fidelity simulation of space environment effects. Each ultrahigh vacuum facility features multiple radiation sources (broadband and vacuum ultraviolet illumination, 1–100 keV electrons, 2–100 keV protons) and vacuum-compatible in situ spectrometers. The facilities are designed to operate 24/7 during exposure tests, which can last for months at a time.

The SEE Lab's exposure facilities are regularly employed to perform accelerated laboratory test programs that simulate the effects of space radiation environments in a variety of surface spacecraft materials:

- Thermal control materials
- Optics and optical coatings
- Solar cell cover glass materials
- Radome materials

The SEE Lab supports a wide range of national security space programs by providing high-fidelity material performance data. The SEE Lab continues to expand its capabilities to meet the growing demands of our customer base.



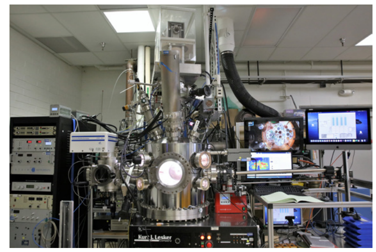
A space environmental effects exposure facility used to perform accelerated simulated space radiation exposure testing and characterization of materials.

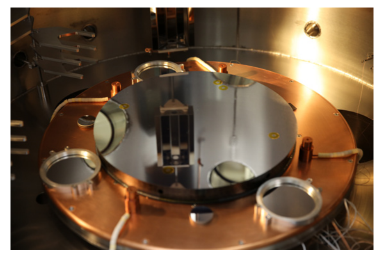
Space Environmental Effects Testing

The Aerospace Corporation has established a multi-decade history of expertise in space environmental effects (SEE) testing and evaluation of materials and maintains multiple state-of-the-art exposure facilities dedicated to the high-fidelity simulation of space environment effects. The Aerospace Corporation's SEE Group performs environment-specific modeling of the absorbed energy dose in test materials to design multiple energy charged particle laboratory simulations and provides comprehensive induced-properties characterization and post-test material analyses.

Capabilities	Description
Combined-Effects Exposure Facility – R2D2	Large ultrahigh vacuum (~10^{-9} Torr) space environment simulation facility capable of delivering low-energy electrons (1–100 kV) and protons (2–100 kV) concurrent with broadband (200–400 nm) and vacuum (115–180 nm) UV illumination. Large 13-in.-dia exposure area allows for numerous samples (>50 1-in.-dia) to be exposed simultaneously. Vacuum-compatible instruments enable in situ optical characterization of test specimens: • UV-VIS spectral transmittance (250–1100 nm) • UV-VIS-NIR spectral reflectance (250–2800 nm) • IR spectral transmittance and reflectance (2–6 µm)
Combined-Effects Exposure Facility – VADAR	Ultrahigh vacuum (~10^{-9} Torr) space environment simulation facility capable of delivering low-energy electrons (1–100 kV) and protons (2–100 kV) concurrent with broadband (200–400 nm) and vacuum (115–180 nm) UV illumination. Elliptical (7.5-in. x 8-in.) exposure area allows for simultaneous exposure of up to 25 samples (1-in.-dia). Vacuum-compatible instruments enable in situ optical characterization of test specimens: • UV-VIS spectral transmittance (250–1100 nm) • UV-VIS spectral transmittance (900–2500 nm) • UV-VIS-NIR spectral reflectance (250–2800 nm)
Combined-Effects Exposure Facility – SITH	Large ultrahigh vacuum (~10^{-9} Torr) space environment simulation facility presently capable of delivering low-energy electrons (1–100 kV) concurrent with broadband (200–400 nm) and vacuum (115–180 nm) UV illumination. A variable-energy (2–100 kV) proton source will soon (CY25) be added. Large 16-in.-dia exposure area allows for numerous (>70 1-in.-dia) samples to be exposed simultaneously. Vacuum-based in situ sample characterization capability to be added in the future.
Atomic Oxygen Test Facility	Ground-based atomic oxygen (AO) test facility focused on testing metallic reflectors. This facility utilizes a thermalized AO source capable of producing an AO flux >10^{15} atoms/cm^2 over a 5.5-in-dia. exposure area. The facility is equipped with a plasma mass/energy analyzer, quartz crystal monitor sensor, and Faraday cup for in-situ characterization of both the neutral and ion species produced in the simulated environment.
Optical Characterization (Ex situ)	Full suite of high-accuracy bench-top instruments for characterization of materials and test samples: • UV-VIS-NIR spectral transmittance and reflectance (200–2500 nm) • IR spectral transmittance and reflectance (2–25 µm) • IR emittance (<3 – >30 µm)


Samples of thermal control materials under test in the VADAR Facility


The VADAR space environmental effects exposure facility.


A 16-in.-dia mirror and three 4-in.-dia samples being simultaneously exposed to electron radiation in the SITH Facility.

The Aerospace Corporation

The Aerospace Corporation is a national nonprofit corporation that operates a federally funded research and development center and has more than 4,600 employees. With major locations in Chantilly, Virginia; El Segundo, California; Albuquerque, New Mexico; and Colorado Springs, Colorado, Aerospace addresses complex problems across the space enterprise and other areas of national and international significance through agility, innovation, and objective technical leadership. For more information, visit www.aerospace.org.

The Aerospace Corporation | 14745 Lee Road, Chantilly, VA 20151 USA | www.aerospace.org