

**DESIGN and CONSTRUCTION of a MISSE-6 PAYLOAD:
STATE of UTAH SPACE ENVIRONMENT & CONTAMINATION STUDY
(SUSpECS):**

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Student in the Utah State University Microgravity Research Team (MRT), formerly know as the GAS Team, have been actively involved in the design and development of a scientific payload over the last year. Their efforts are a critical part of a cooperative, Utah-based project named *SUSpECS* (State of Utah Space Environment and Contamination Study) that has developed a flight experiment to study the effects of prolonged exposure to the space environment and charge-enhanced contamination on spacecraft materials. Utah researchers from the Utah State University (USU) Microgravity Research Team, the USU Materials Physics Group, the USU Space Dynamics Laboratory Contamination Control/Materials Chemistry Group, the Alliant Technosystems (ATK) Thiokol Health Management Focus Group have teamed with scientists with the James Webb Space Telescope at the NASA Goddard Space Flight Center and the NASA Solar Probe Mission at the Johns Hopkins Applied Physics Laboratory.

The MISSE program objective is to “characterize the performance of new prospective spacecraft materials when subjected to the synergistic effects of the space environment [1]. The MRT have designed and built three separate sample trays for flight on the MISSE-6 (*Materials International Space Station Experiment*) mission sponsored by Air Force Office of Scientific Research (AFOSR). The *SUSpECS* sample panels include pertinent materials and coatings selected and characterized by each group member for a comprehensive study of the effects of the low Earth orbit (LEO) space environment and contamination on electrical, mechanical, and optical properties of materials related to several on-going projects of high relevance to manned space exploration and other long duration space missions.

The overall project has four key objectives: (i) basic research will extend our understanding of the materials/space environment interactions, (ii) specific knowledge will be gained for critical materials in several on-going projects of the team members, (iii) valuable collaborations between team members will be fostered, and (iv) analysis capabilities and flight experience will be developed that will prove useful not only for follow-up for post-flight analysis of the **SUSpECS** sample set, but for other joint ventures involving reliability and aging of materials in the space environment.

Sample material selections, conceptual design of the *SUSpECS* sample panels, and construction of the panels were completed during 2005, led by student researchers from the USU MRT Program. The *SUSpECS* sample panels and samples have been assembled and will be delivered to Boeing in May 2006 for integration with the panels contributed by other industry, university, and government investigators. The sample panels will be installed into two standard MISSE “suitcase” pallets that are powered and instrumented to record relevant space environmental parameters during the on-orbit exposure. The integrated payload will be delivered to NASA Langley Research

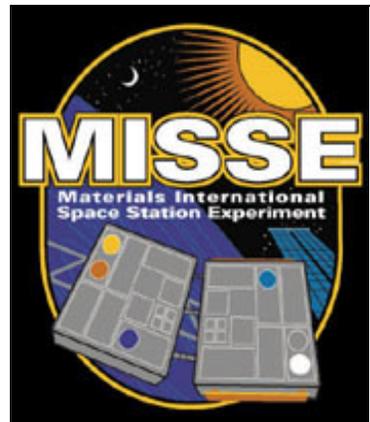


Figure 1. The **MISSE** (**M**aterials **I**nternational **S**pace **S**tation **E**xperiment) program is sponsored by the Air Force Office of Scientific Research (AFOSR). [Ref. 1]

Center by Spring 2006. The Shuttle flight to transport MISSE-6 to the ISS is tentatively scheduled for early 2007, with return after ~6 months exposure in the LEO environment. After retrieval, sample panels will be returned to the *SUSpECS* team for post-flight analyses.

Approximately 145 samples will be mounted on *SUSpECS* panels in both the ram and wake sides on the ISS. They have been carefully chosen to provide needed information for different ongoing studies and a broad cross-section of prototypical materials used on the exteriors of spacecrafts. Pre- and post-flight

characterization measurements include optical and electron microscopy, reflection spectroscopy, resistivity and Auger electron spectroscopy. Most materials will be tested for resistivity and dielectric strength, and for electron-, ion-, and photon-induced electron emission yield curves and emission spectra. Electron emission and transport properties of materials are key in determining

the likelihood of deleterious spacecraft charging effects and are essential parameters in modeling. While preliminary ground-based studies have shown that contamination can lead to catastrophic charging effects under certain circumstances, little direct information is presently available on the effects of sample deterioration and contamination on emission properties for materials flown in space. Additional studies of the service life of composite and ceramic materials of the ATK Thermal Protection Systems and Lightweight Structure Systems will evaluate chemical and mechanical properties as a function of depth from the AO and UV exposure surface. Materials will also be tested for the Space Dynamics Laboratory GIFTS satellite. Studies will be conducted of materials for the James Webb Space Telescope heat shield and cryogenic cable harnesses with an emphasis on the changes in resistivity and electron emission properties at cryogenic temperatures. Materials for the heat shield for the NASA Solar Probe Mission, designed to fly within 4 solar radii of the sun on a future science mission, will be evaluated in terms of optical and electron emission properties for survivability in severe radiation, high temperature and cryogenic environments that the spacecraft will experience near the Sun and in a Jupiter flyby. .

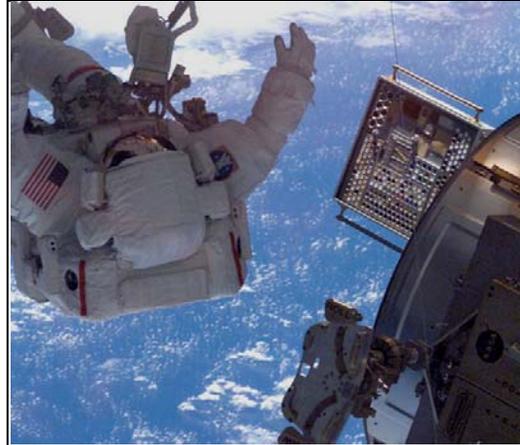


Figure 2. Astronaut deploying MISSE-2 on the International Space Station. [Ref. 1]

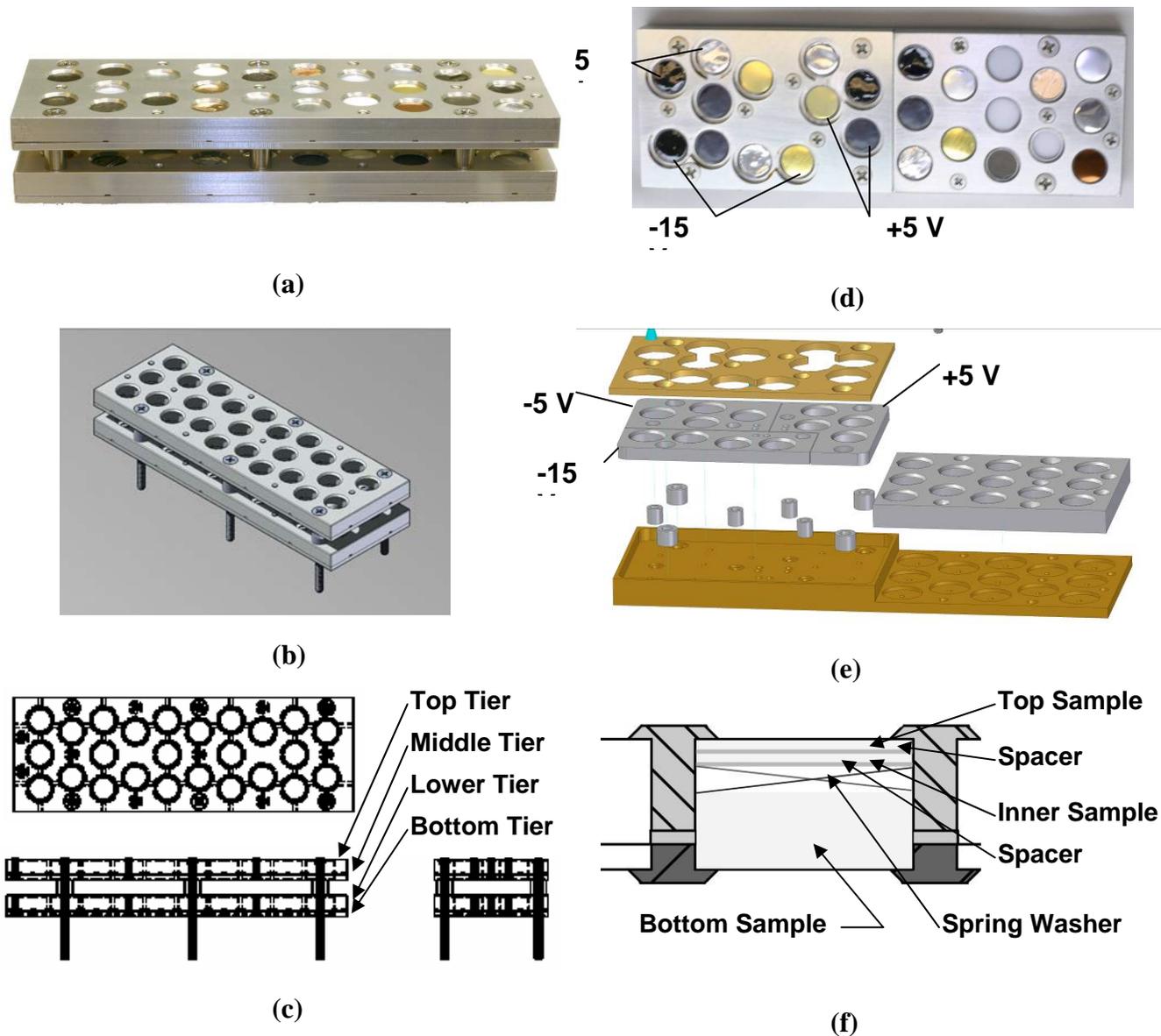


Fig. 3. Configuration of 5 cm x 30 cm, 78 cm² SUSpECS sample panels. (a-c) Ram side sample panels. All samples are passive experiments held at ground potential. A three tiered configuration design is used with 25 samples exposed on each tier. (d-e) Wake side sample panel. Thirteen exposed samples at right are passive experiments held at ground potential. The three sub-panels at left each contain four identical samples held at +5 VDC, -5 VDC and -15 VDC, respectively. (f) Cross sectional detail of typical stacked samples and sample clamping mechanism.