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Launch and Deployment of the Misse-6 Payload: State of Utah Space Environment & Contamination Study

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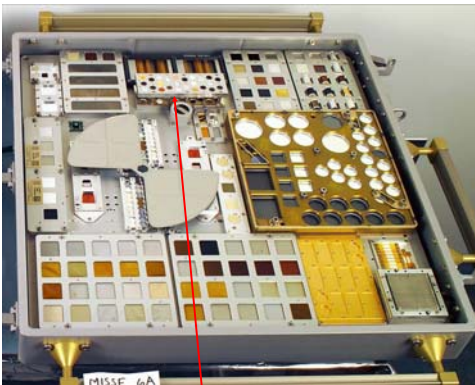
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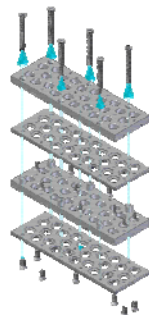


Ram Side

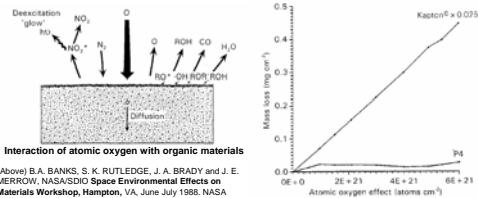


On the ram side of MISSE 6 Utah State has the Double Stack, a two tiered experiment with 75 samples being exposed to space atmosphere and 50 concealed samples experiencing the temperature cycles and pressures of space. The two tiered design allows for varying atomic oxygen (AO) and ultra violet radiation (UV) exposure.

Ram Sample Holder SUSpECS Double Stack



The Double Stack will also investigate oxidation by atomic oxygen and the effects that shadowing have on atomic oxygen exposure. (Below) Measuring the mass erosion rate of Kapton due to atomic oxygen radiation degradation has long been the standard in determining how much atomic oxygen a surface has been exposed to. (Above and Right) Double Stack Ag foils will be evaluated as an accurate AO fluence monitor sensor and calibrated against kapton sensors. This study will use high purity silver and measure the penetration depth of the oxide layers to determine the atomic oxygen exposure. This test will also study the effects caused by shadowing and the possibilities of ballistic scattering of atomic oxygen.



(Above) B.A. BANNIS, S.K. RUTLEDGE, J.A. BRADY and J.E. MERROW, NASA/SIDO Space Environmental Effects on Materials Workshop, Hampton, VA, June July 1988. NASA Conference Publication 3035, Part 1, pp. 197-239.

Mass loss of unprotected and P4 protected Kapton vs exposure to atomic oxygen



Rocky I

Launch and Deployment State of Utah Space



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Orbitium

Misse-6 Payload: Contamination Study



Launch and Deployment Activities



(Left) Shuttle Endeavour (STS-123) launched at 2:14 am on March 11th 2008. Aboard were two passive experiment containers (PEC) containing three experiments from students at Utah State University. (Right) Shuttle Endeavour on a pass by of the International Space Station (ISS) to check for damage to the shuttle that may have occurred during launch. With the shuttle bay open the PEC's can be seen in the top left corner. Each PEC weighs ~78 lbs and is the size of a large suitcase. The PEC's contain numerous experiments from a wide variety of contributors.

Integration of SUSpECS in to MISSE-6



SUSpECS I, II & III: Individual investigators prepared separate sample holders. Holders were integrated into Passive Experiment Containers (PECs). The PEC's were mounted on ISS for 6-12 months stay by astronauts Bob Behnken on EVA 5 March 22nd 2008 with the help of a hammer.

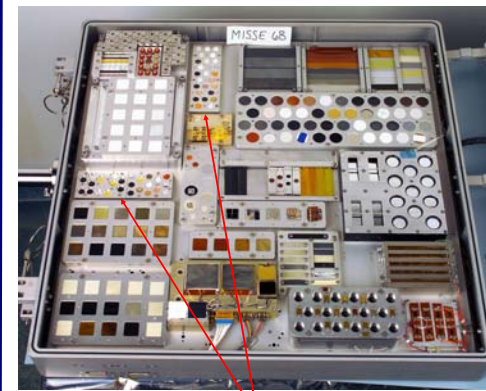


Approximately 125 samples are mounted on three 5 cm by 15 cm panels on both the ram (75) and wake (50) sides of the ISS. They have been carefully chosen to provide needed information for a broad cross section of prototypical materials used on the exteriors of spacecrafts. (See Below) The materials will be tested for electron-, ion-, and photon-induced electron emission yield curves and emission spectra. Characterization measurements include electron microscopy, reflection spectroscopy, resistivity and Auger electron spectroscopy.

- This large communication satellite interface materials which are contained in SUSpECS.
- Graphite Composite
 - Au/Mylar
 - Kapton
 - Black Kapton
 - Aquadag
 - Al
 - White Paint
 - ITO
 - RTV
 - FR4
 - Coverglass

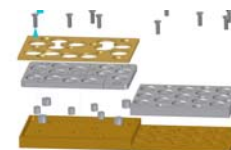
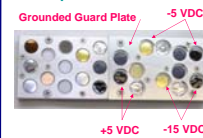


Wake Side

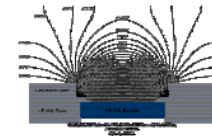


The SUSpECS sample holder on the wake side of the International Space Station will investigate the effects that spacecraft charging has on contamination of samples. Four sets of 4 samples (Ag, Al, graphitic carbon, and Kapton GC) are biased at +5 V, -5 V, and -18 V, in addition to the control set grounded to ISS. These samples will be examined to determine the changes in contamination from the space environment that results from the sample charging.

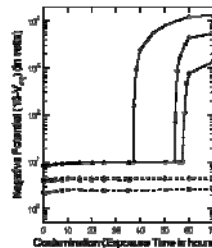
Wake Sample Holder SUSpECS Electrical



(Right) Modeling electronic fields and particle trajectories of the biased wake-side samples. A side view shows the equipotential lines on a single sample charged to +5 volts. This charging attracts ions that can damage materials, and enhance contamination.

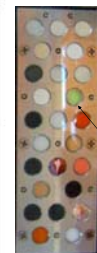


(Right) Studies at USU have shown that very thin layers of contamination—even a few monolayers—can potentially cause significant changes in electron emission properties that can dramatically affect the charging of satellites. The graph shows the differential charging of clean Au and 2-3 monolayers carbon-contaminated Au surfaces on a hypothetical satellite in GEO orbit.



SUSpECS Material Samples List

Material	Source	
001	ZnO ASAN725 Oxide (CMC)	ATK
002	ZnO S200 Nanoscale CMC	ATK
003	Thiokol Carbon-Carbon Composite #1	ATK
004	Thiokol Carbon-Carbon Composite #2	ATK
005	Thiokol Carbon-Fiberglass Carbon Composite	ATK
006	Thiokol Carbon-Phenolic Composite	ATK
007	Thiokol Graphite Epoxy Fill - No Hole	ATK
008	Thiokol Graphite Epoxy Fill - With Hole	ATK
009	ZnO S400 Nanoscale CMC	ATK
010	ZnO S2000 Nanoscale CMC	ATK
011	ZnO S300 Nanoscale CMC	ATK
012	Kapton on Aluminum	Sheshtadt
013	Mylar on Aluminum	Sheshtadt
014	Nylon 66	McMaster-Carr
015	BCO (Fused Quartz)	LOGO Optics
016	PILO (Sapphire)	LOGO Optics
017	Epoxy resin on Kapton	Sheshtadt
018	Anodized Aluminum (Chromic Acid Etch)	NASA / MSFC
019	Anodized Aluminum (Sulfuric Acid Etch)	NASA / MSFC
020	1% Cr-doped Cover Glass	EG&G
021	FR4 Printed Circuit Board Material	CRES/NASA
022	ITO 114 10V on Copper	Browning
023	SPC-500 RTV on Copper	Browning
024	Rene-80 Glass	LOGO Optics
025	East 68 (99.99% Purity)	ESPI
026	Aluminum (99.999% Purity)	ESPI
027	316 Stainless Steel	McMaster
028	304 Stainless Steel	McMaster
029	302 Stainless Steel	McMaster
030	301 Stainless Steel	McMaster
031	300 Stainless Steel	McMaster
032	309 Stainless Steel	McMaster
033	310 Stainless Steel	McMaster
034	321 Stainless Steel	McMaster
035	347 Stainless Steel	McMaster
036	354 Stainless Steel	McMaster
037	304L Stainless Steel	McMaster
038	316L Stainless Steel	McMaster
039	304LN Stainless Steel	McMaster
040	316LN Stainless Steel	McMaster
041	304Ti Stainless Steel	McMaster
042	316Ti Stainless Steel	McMaster
043	304H Stainless Steel	McMaster
044	316H Stainless Steel	McMaster
045	304S Stainless Steel	McMaster
046	316S Stainless Steel	McMaster
047	304SS Stainless Steel	McMaster
048	316SS Stainless Steel	McMaster
049	304Ti Stainless Steel	McMaster
050	316Ti Stainless Steel	McMaster
051	304LN Stainless Steel	McMaster
052	316LN Stainless Steel	McMaster
053	304H Stainless Steel	McMaster
054	316H Stainless Steel	McMaster
055	304S Stainless Steel	McMaster
056	316S Stainless Steel	McMaster
057	304SS Stainless Steel	McMaster
058	316SS Stainless Steel	McMaster
059	304Ti Stainless Steel	McMaster
060	316Ti Stainless Steel	McMaster
061	304LN Stainless Steel	McMaster
062	316LN Stainless Steel	McMaster
063	304H Stainless Steel	McMaster
064	316H Stainless Steel	McMaster
065	304S Stainless Steel	McMaster
066	316S Stainless Steel	McMaster
067	304SS Stainless Steel	McMaster
068	316SS Stainless Steel	McMaster
069	304Ti Stainless Steel	McMaster
070	316Ti Stainless Steel	McMaster
071	304LN Stainless Steel	McMaster
072	316LN Stainless Steel	McMaster
073	304H Stainless Steel	McMaster
074	316H Stainless Steel	McMaster
075	304S Stainless Steel	McMaster
076	316S Stainless Steel	McMaster
077	304SS Stainless Steel	McMaster
078	316SS Stainless Steel	McMaster
079	304Ti Stainless Steel	McMaster
080	316Ti Stainless Steel	McMaster
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194	316H Stainless Steel	McMaster
195	304S Stainless Steel	McMaster
196	316S Stainless Steel	McMaster
197	304SS Stainless Steel	McMaster
198	316SS Stainless Steel	McMaster
199	304Ti Stainless Steel	McMaster
200	316Ti Stainless Steel	McMaster



Wake Side SUSpECS 3

Passive UV Exposure
 25 Grounded Samples
 10 Concealed Samples

Scientific Solutions Inc has technology that uses nematic liquid crystal as the tuning medium in Fabry-Perot interferometers. The Liquid Crystal Fabry-Perot (LCFP) has passed temperature and vibration testing but the final test will be to see if it can withstand the atmosphere of lower earth orbit (LEO).