GENESIS CONCENTRATOR TARGET PARTICLE CONTAMINATION MAPPING AND MATERIAL IDENTIFICATION

Particle Contamination Features

Surface particle contamination on three Genesis concentrator targets [1, 2] was closely examined to evaluate cleaning strategies. Two silicon carbide (Genesis sample # 60001 and 60003) and one chemical vapor deposited (CVD) C\textsubscript{3}N\textsubscript{4} concentrator target (60002) were imaged with optical microscopes. The targets were first imaged with a Leica MZ9.5 stereoscope. This produced a good overview of the larger particles and impact features. Individual contamination features originating from the crash environment were also imaged with a Leica DM6000M automated microscope using 5X, 10X, and 50X objective lens. This resulted in particle feature maps encompassing the entire target area. Particle morphologies were subsequently compared with non-flight, but flight-like, concentrator targets and sample return capsule (SRC) materials.

Mosaic Mapping and Particle Counts

Full mosaic images were constructed for each target using Surveyor software interfaced with ImageProPlus software on a Leica DM6000M microscope using a 5X objective lens (see images below). In addition - 1 mm\textsuperscript{2} areas were mosaic mapped with the 50X objective lens. ImageProPlus software was used to identify and count all particles > 0.3 \mu m in diameter within the ~1 mm\textsuperscript{2} area. The following graphs show the particle distribution in the scanned area for each target material.

SEM Imaging and EDS Analysis

Non-flight reference SRC materials were examined for comparison with contamination found on the flown targets. Microscopic inspection shows that microspheres from the orange insulation foam and carbon-carbon fibers from the heat shield from the SLA are similar to contamination found on the flown SiC and CVD targets.

Summary:

The majority of surface particles were found to be > 5 \mu m in diameter with increasing numbers close to the optical resolution limit of 0.3 \mu m. Acceleration grid EDS results show that the majority of materials appear to be from the SRC shell and SLA materials which include carbon-carbon fibers and Si-rich microspheres in a possible silicone binder. Other debris material from the SRC included white paint, kapton, collector array fragments, and Al. Image analysis also revealed that SRC materials were also found mixed with the Utah mud and salt deposits. The EDS analysis of the acceleration grid showed that particles < 1 \mu m where generally carbon based particles. These studies were also used to help qualify Xylene cleaning SiC target 60001. In December 2007, the JSC team removed a large amount of particle contamination on SiC 60003 with a 30 minute ultra-pure Xylene ionization treatment under the guidance of Don Burnett and Dimitri Papamastasios at JPL.

Chemical cleaning techniques with Xylene and HF in an ultrasonic bath are continuing to be investigated for removal of small particles by the Genesis science team as well as ultra-pure water megasonic water spin cleaning by the JSC team [5]. Removal of organic contamination from target materials are also being investigated and practiced by the science team with the use of UV-ozone cleaning devices at JSC and Open University [6].

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