**GENESIS SOLAR WIND SAMPLE CURATION FACILITY.** J. H. Allton[1], C. P. Gonzalez[2], C. D. Calva[2], K. K. Allums[2], M. C. Rodriguez[2], and M. J. Calaway[2], [1]NASA/Johnson Space Center, Mail Code XI2, 2101 NASA Parkway, Houston TX 77058. Judith.H.Allton@nasa.gov. [2]Jacobs – JETSII at NASA Johnson Space Center, Houston, TX.

**Introduction:** The controlled access facility designed and constructed for storing and examining Genesis solar wind samples consists of two adjacent laboratories, both ISO Class 4 cleanrooms (vertical laminar flow, ULPA filtered). One cleanroom is equipped with ultrapure water (UPW) for experimental cleaning of containers and tools used in handling the solar wind samples, flight hardware and witness plates. The ultrapure water is also used for cleaning the solar wind samples. The other cleanroom is for long-term nitrogen storage of samples and for examination and processing of Genesis samples (Fig. 1).

**Ultra Pure Water:** UPW is generated, at 8 gallons per minute, for 7 curation labs and one research lab at JSC. The high resistivity water (>18MΩ-cm) is a result of having ion concentrations in the low parts per trillion, thus, the UPW is a reactive cleaning solvent used for cleaning Genesis sample containers and tools.

**Sample Cleaning:** Upon request by a researcher, we clean Genesis sample fragments by applying megasonically energized ultrapure water using a wafer spin cleaner at 3000 rpm to remove surface particles (Fig. 1B) [1]. UV ozone can be used to reduce molecular film, as needed [2].

**Instrumentation for Characterizing Samples:** The work horse of Genesis instruments is a high resolution optical microscope with automated stage and mosaicking feature. The Leica DM6000 captures excellent images of the polished wafer fragments, showing damage/debris from hard landing. Acquiring good optical images, between each cleaning or analytical session by researchers, is useful for indicating cleaning process effectiveness or contamination from analytical technique [3]. These baseline images also allow precision area calculations of irregular shaped fragments [4]. The Nicolet 6700 FT-IR/Continuum microscope is used to distinguish Czochralski silicon, with diagnostic C-O peak, from Float Zone silicon. The Woollam M-2000 spectroscopic ellipsometer was originally acquired to map the molecular film, from spacecraft off-gassing, deposited on whole hexagon wafers. Ellipsometry is a non-destructive, rapid measurement for collector surfaces, having possibilities for screening samples. The modeling is complex because ellipsometric measurements are affected by molecular films, surface oxide formation, and structural changes due to solar wind irradiation [5].


Fig. 1 A. ISO 4 UPW cleaning room.
Fig. 1B. Megasonic UPW spin cleaner for samples, 3000 RPM.


Fig. 1 C. ISO 4 sample handling and storage room. Pictured Leica DM 6000 and Woollam M2000 ellipsometer.
Fig. 1D. Nicolet 6700 FT-IT with Continuum microscope.

**Example of Frequent Optical Imaging in Curation to Document Sample Sharing**: Consistent optical imaging at JSC is an efficient way to document cleaning and analytical effects as samples are shared among collaborators. Genesis sample 60336, a bulk solar wind sample collected in CZ silicon, was imaged between multiple cleaning and analytical steps [6].

Table 1. From [6].

| | |
|---|---|
| 2/21/07 | Imaged; no flounder is visible |
| 2/26/07 | UPW cleaned 5min @40C at JSC. *The Flounder can be seen in this image.* |
| 2/26/07 | Sent to PI Grabowsky |
| 2/16/12 | PI returned unopened sample |
| 5/14/13 | Imaged using DM6000M at JSC |
| sum2013 | SEM analysis at PSI. Kim finds Flounder |
| 8/1/2013 | Imaged using DM6000M at JSC |
| 8/6/13 | UPW cleaned and imaged at JSC |
| 8/13/13 | Aqua regia and hot xylene at Caltech |
| 9/12/13 | Imaged using DM6000M at JSC |
| 9/16/13 | UPW cleaned and imaged at JSC |
| 10/14/13 | ToF SIMS analysis at Smithsonian |
| 10/21/13 | Optical imaging at Smithsonian |
| 11/12/13 | Low-vacuum nanoSEM at Smithsonian |
| 11/12/14 | Imaged using DM6000M at JSC |
| 11/24/14 | 10 min RCA1 cleaning at Dartmouth |
| 12/2/14 | 25 min RCA1 cleaning at Dartmouth |
| 12/4/14 | Imaged using DM6000M at JSC |
| 12/4/14 | UPW clean 5min, 40C at JSC |
| 12/4/14 | Imaged using DM6000M at JSC |
| 12/18/14 | ToF SIMS analysis and SEM at Smithsonian |
| 2/24/15 | Imaged, UPW clean, re-imaged AT JSC |
| 3/3/15 | ToF SIMS analysis at Smithsonian |
| 3/15 | SEM imaging at Smithsonian |
| 3/15 | SIMS analysis at Caltech |
| 4/15 | SIMS pit measurments at Dartmouth |
| 5/7/15 | Imaged, UPW cleaned at JSC |
| 5/15 | ToF SIMS ion images at Smithsonain |
| 6/15 | ToF-SIMS depth profiles at Smithsoanian |

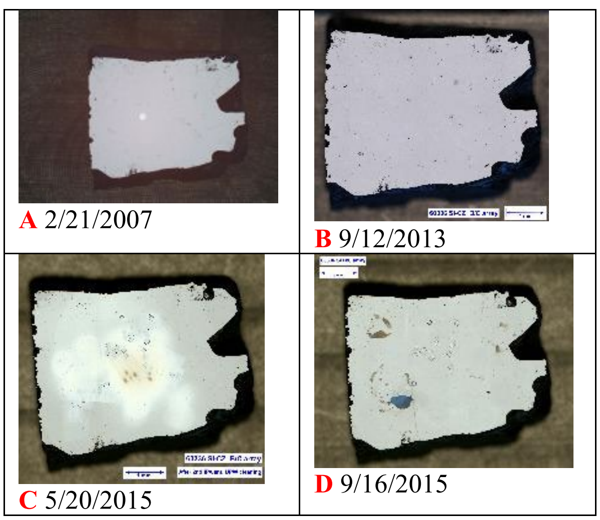


Fig. 2. Excerpted images from list in Table 1.

**Support for Other Missions:** Genesis Lab ISO 4 level cleanliness and availability of UPW has supported several sample missions (Figs. 3-5). Witness coupons were prepared and cleaned for **OSIRIS-REx** assembly monitoring. Mars Perseverance **SHERLOC** target and **MMX** hardware were cleaned for flight with UPW. Genesis resources were used for inspection of a non-flight Hubble mirror specimen (Fig. 6) and for post-flight impact damage to space shuttle window.

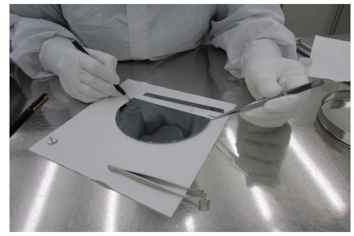

Fig. 3. Witness coupon preparation and cleaning.

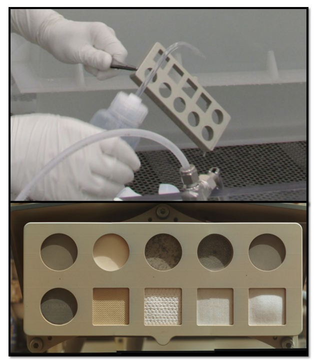

Fig. 4. UPW SHERLOC.

Fig. 5 UPW MMX.

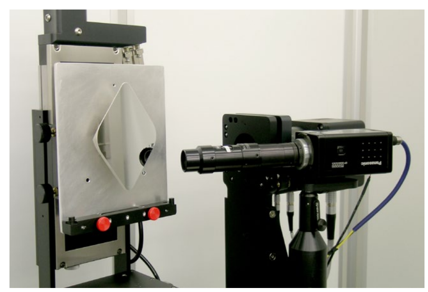

Fig. 6. Ellipsometry non-flight Hubble mirror item.

**Data Sources:** Jurewicz A.J.G.et al. (2003) *The Genesis solar-wind collector materials*. Spa. Sci. Rev. 105, 535-560. Genesis laboratory UPW and laboratory airborne molecular contamination analytical history: *Organic Contamination Baseline Study in NASA Johnson Space Center Astromaterials Curation Laboratories*, NASA/TP-2014-21793. *Cleaning Genesis Sample Return Canister for Flight: Lessons for Planetary Sample Return*, JSC-29742.

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