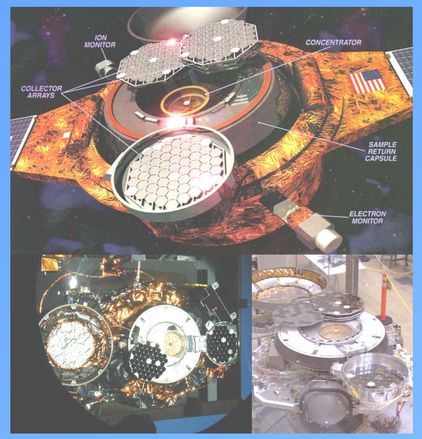
Dr. Don Burnett
CalTech
Genesis Lead PI

Welcome to Genesis Solar Wind Curation Laboratory

Preparation to Launch

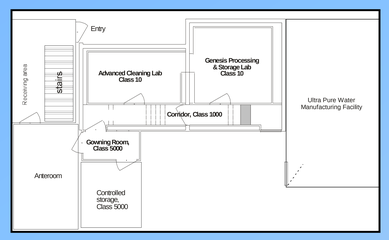
Genesis
Capturing
the Sun

Genesis Regime Collector Design



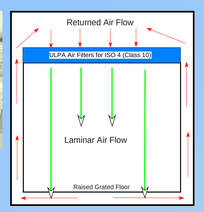
JSC Wafer Testing

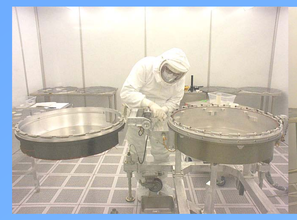
ISO 4 (Class 10) Cleanroom Design

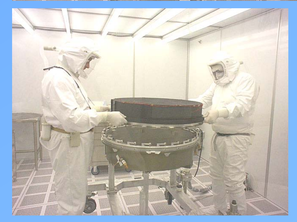


ISO 4 (Class 10) Airflow Design

Installing the raised floor





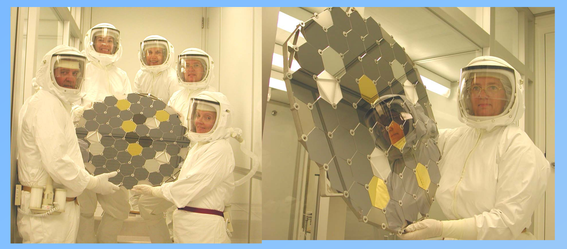


Assembly of the
Science Payload
Canister

Ultrapure Water and
Ultrasonic Cleaning
and Inspection of the
array collector grids.

Installation of nine
ultrapure hexagonal
array materials for solar
wind regime capture.

Completion of Array Material Installation



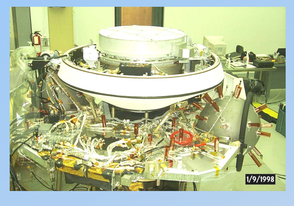
Final preparations and closure
of the science canister payload.

Next Stop, Lagrange 1 Solar Wind Exposure.

Shipment of Science
Canister Payload from
JSC for integration with
spacecraft at Lockheed
Denver facility.

Lockheed Martin Denver Facility
Assembly of the Genesis Spacecraft

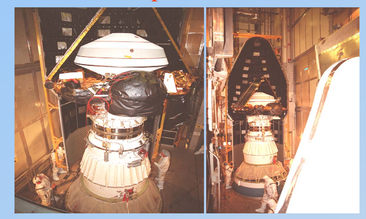
Science Canister Payload Integration

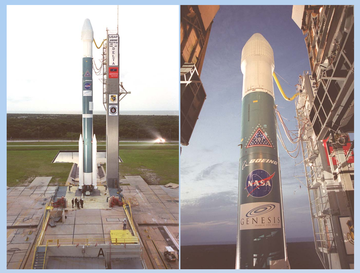


Final Preparations and Testing

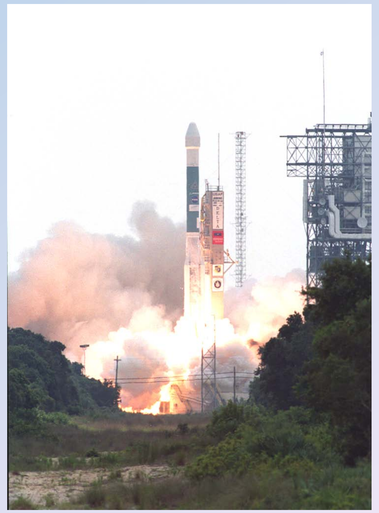
Genesis Spacecraft Shipping
to Kennedy Space Center

Launch Preparations at KSC

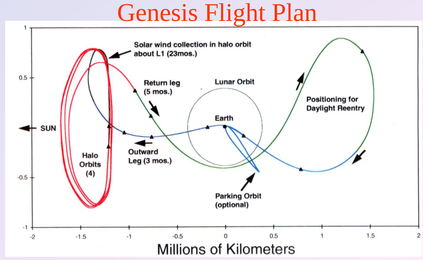


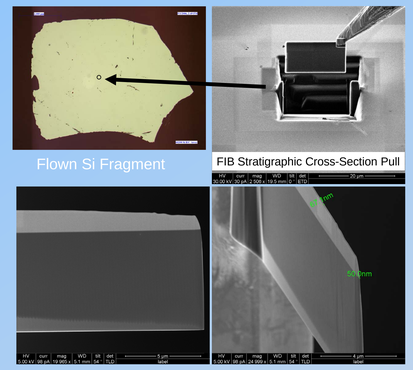


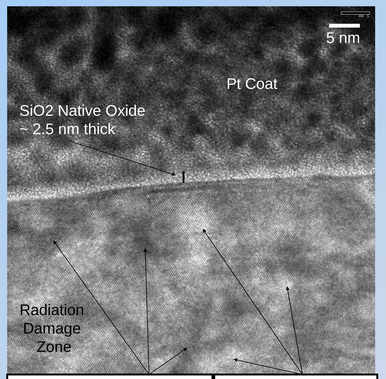
Launch of Discovery Mission Genesis

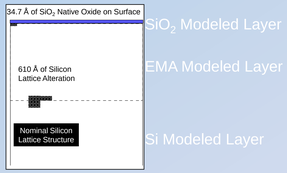


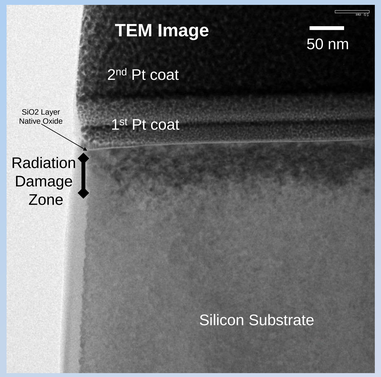
Genesis Flight Plan

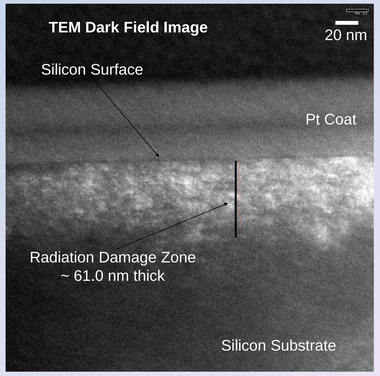












TEM Results and Future Work

The B/C array silicon substrate lattice structure shows signs of multiple vacancies and interstitial nodes in approximately the first 600 Å below the native oxide layer. This is primarily due to the accumulation of bombarding hydrogen and helium ions from the solar wind. The radiation damaged zone can be interpreted roughly as the bulk solar wind implantation zone. Therefore, the Genesis Mission was successful in capturing atoms from the sun as seen by the TEM images.

The thickness measurement of the damaged region can also provide a gross check for the concentration of hydrogen atoms collected by the Genesis mission. This radiation damage zone can also provide an insight into the fluence threshold required to alter Si materials, which is below 2 X 10^{16} atoms/cm^2 for solar wind exposure.

The spacecraft was in continual Halo orbit at L1 while the bulk collector arrays were deployed and is the first look at solar wind radiation damage outside the magnetosphere at L1. This study provides a direct measurement of how solar wind effects silicon over time. Since silicon is a well studied semiconductor material, a future model of the damage threshold could be used for assessing lifespan of future spacecraft and solar panel materials in space outside the magnetosphere when exposed to solar wind.

Acknowledgements

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ARES at NASA Johnson Space Center

FIB Pull Team: Nick Teslich, John Bradley & Giles Graham
Lawrence Livermore National Laboratory

Genesis Curation Team: Judy Allton & Melissa Rodriguez
ARES at NASA Johnson Space Center

ASTROMATERIALS

Genesis

Solar Wind

ACQUISITION

CURATION

Team

Genesis Curation Team

Judy Allton
Solar Wind Curator (NASA)

Michael Calaway
Laboratory Lead (ESCG)

Melissa Rodriguez
Sample Processor (ESCG)

Genesis Curation Laboratory's Mission

- Protect and curate the United States limited resource of solar wind samples for future studies.
- Allocate solar wind samples to the multinational science community for study as directed by NASA and CAPTEM.
- Characterize all flown samples and develop a solar wind sample catalog.
- Maintain an auditable inventory.
- Conduct wafer alteration and contamination assessments.
- Remove particular and molecular contamination.

Solar Wind Sample Characterization

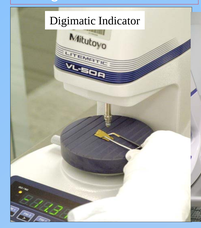
- **Assess Material Type**
  > 15,000 samples from 5 array frames once held 9 different types of ultra-pure semiconductor wafers.
  Other Genesis Materials: Concentrator Targets, bulk metallic glass, gold foil, polished aluminum, & Mo-Pt.
- **Measure size and area of sample**
- **Assess the four types of Solar Wind Regime** via wafer thickness: Bulk (B/C), coronal mass ejection (E), high speed (H), & Low speed (L) solar wind).
- **Assess Particle Contamination** > 0.3 micron size particles using optical microscopy
- **Assess Molecular Contamination** > 1 angstrom thick films using spectroscopic ellipsometry
- **Assess silicon types** (float-zone or Czochralski) via FT-IR Spectroscopy

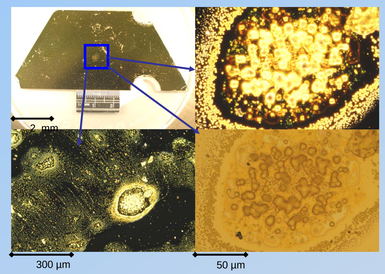
Concentrator Target Characterization
UCLA MegaSIMS Fit-Check

Genesis Sample Cabinets

Genesis Sample Cabinet in Lunar RSV

Wafer Thickness	B & C Array (Bulk Solar Wind) = 700 µm
Preliminary Solar Wind Regime Identification	E Array (Coronal Mass Ejections) = 650 µm
	H Array (High Speed Solar Wind) = 600 µm
	L Array (Low Speed Solar Wind) = 550 µm

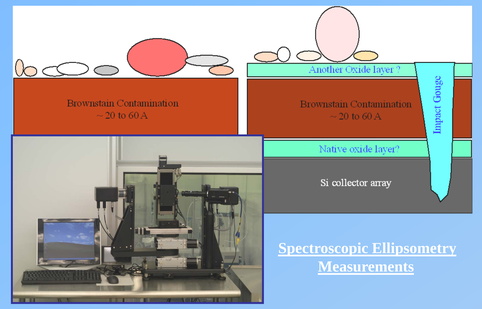




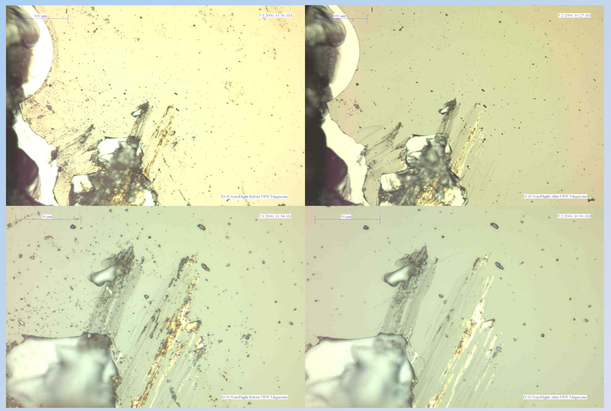
Ellipsometer

Digimatic Indicator

Microscope

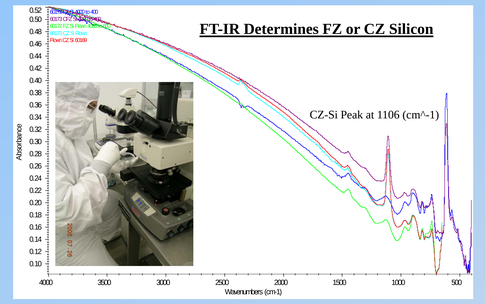


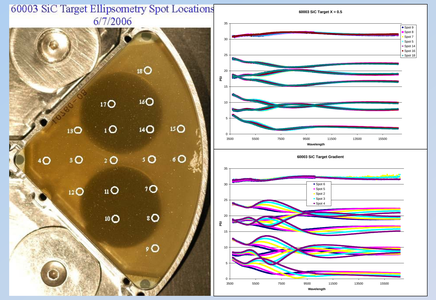
Spectroscopic Ellipsometry Measurements



Stereomicroscope

FT-IR Spectrometer





UPW/Megasonic Cleaning
Macro Particle Decontamination