



Orbiter feedline for liquid hydrogen, showing axial cracks

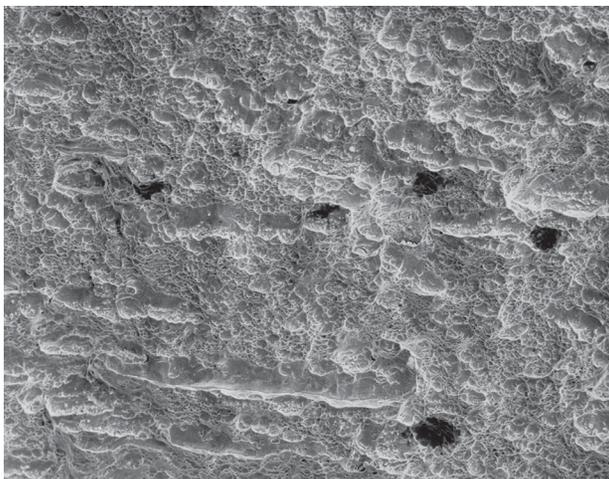


George C. Marshall Space Flight Center
Materials & Processes Laboratory
Metals Engineering Branch

Material Diagnostics

Materials characterization
and failure analysis
for high-performance aerospace systems

Today's aerospace systems operate under new and extreme conditions. Hardware is certified before launch and inspected afterwards to ensure system safety and effectiveness. Flightworthiness is determined in part through materials characterization and microstructural analysis. These techniques enable scientists to study objects from space, as well.



Fracture surface of crack in liquid hydrogen feedline

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Scanning transmission electron microscope



Magnetic sector secondary ion mass spectrometer

Surface science is used to analyze the outermost atomic layers of a material to obtain data about its elemental constituents and behavior during performance.

Electron spectroscopy for chemical analysis can identify constituent elements and their chemical state, with depth profiling capabilities to analyze underlying material.

Magnetic sector secondary ion mass spectrometry has analysis capabilities for the elemental, isotopic, and molecular compositions of a material surface. It is sensitive to all elements at concentrations of parts per million.

Scanning Auger microscopy is used to evaluate distributions and quantitative assessments of elements with low atomic numbers (e.g., boron, carbon, nitrogen, and oxygen). It offers good imaging at high resolution.

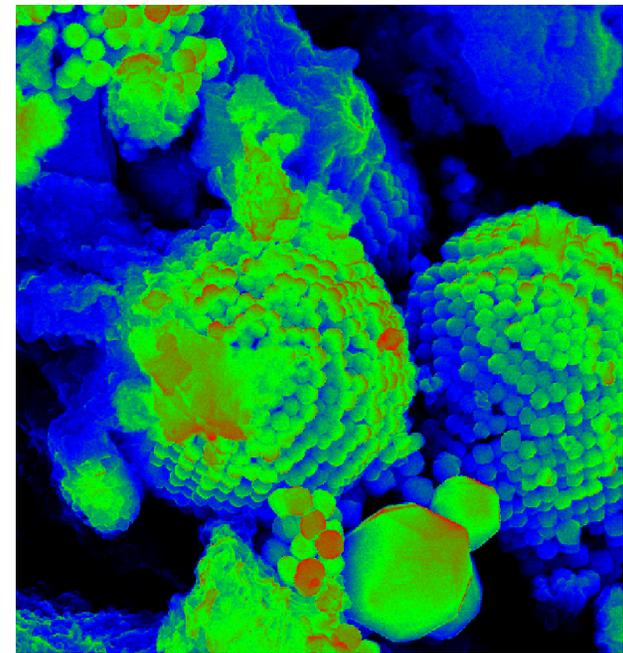
Electron microscopy can capture surface and internal images at high resolution up to 1,000,000 times (x) magnification. It is also used to conduct bulk chemical analysis.

Scanning electron microscopy permits analysis of particles and fracture surfaces and X-ray mapping of chemical segregation.

Field emission scanning electron microscopy uses a very fine electron beam to produce images at ultra-high resolution.

Environmental scanning electron microscopy was originally developed for biologists. It can be used to study "wet" samples without drying them out.

Scanning transmission electron microscopy shows interior structures at extremely high resolution and magnifications.



Biological magnetite from the Tagish Lake Meteorite

The materials research facilities are operated under the direction of the Materials & Processes Laboratory at George C. Marshall Space Flight Center in Huntsville, AL. We are specialists in the development, processing, application, evaluation, and optimization of aerospace structural materials. Facilities include:

The materials diagnostic facility offers electron microscopy and surface analysis techniques for failure analysis and materials characterization.

The hydrogen test facility is used to run standard tests that show the material property effects of exposure to cryogenics and pressurized hot gases.

The mechanical materials test facility allows standard tensile and fatigue tests to be run under simulated service conditions. Precision plating and corrosion research are also conducted.

The thermomechanical processing laboratories permit in-house thermal and mechanical treatment of materials, as well as casting development.