Abstract

A number of research instruments are available at NASA's Marshall Space Flight Center (MSFC) to support SB researchers and their investigations. These modern analytical tools yield valuable and sometimes new information resulting from sample characterization. Instruments include modern scanning electron microscopes equipped with field emission guns providing analytical capabilities that include microanalysis of the image resolution of dry, wet and biological samples. These microscopes are also equipped with silicon drift X-ray detectors (SDD) for X-ray spectroscopy. X-ray mapping capability allows for X-ray spectral analysis of the sample and can be used to map areas of interest or to map specific elements within a sample. Sample chambers allow for sample manipulation and preparation. Quantitative analyses are also performed using advanced software to determine element composition and concentration. Other analytical techniques include X-ray photoelectron spectroscopy (XPS) that can determine the elemental composition of a sample, and X-ray diffraction that can determine crystallographic structure.EMP analysis is also performed using a JEOL Superprobe (JXA-8800R) which includes X-ray microanalysis, with a large chamber size that can accommodate either fractured or flat samples.

Microprobe Analysis of An Amalgam Composite

Field Emission-SEM (FEI Quanta 600): Provides very high resolution and depth of field. It is equipped with X-ray detectors for mapping and is ideal for samples up to 50 µm in diameter. X-ray microanalysis is one of the most powerful tools in X-ray microanalysis. It is a versatile tool for analytical and microstructural investigations. X-ray microanalysis is used to determine the elemental composition of a sample, and X-ray diffraction that can determine crystallographic structure.

EBSD Images for A Partially Recrystallized Aluminum Alloy

JEOL Superprobe (JXA-8800R): Scanning Microprobe allows for precise chemical analysis down to ppb levels using x-rays. Uses four spectrometers with a large chamber size that can accommodate either fractured or flat samples.

ESCA- Auger System (Kratos AXIS Ultra): Instrument uses both white and monochromatic Al Kα radiation for high resolution analysis. Can identify elements and their chemical compositions and oxidation states. Applications include imaging and identification of compounds, films, and polymers.

Perform Qualitative and Quantitative Chemical Analysis of Slag Cross Sections

Secondary Ion Mass Spectrometry (SIMS, Cameca MS-6): A useful analytical tool for the determination of trace elements and their oxidation states. It is sensitive to all elements and can be used to map the distribution of trace elements in complex samples. The technique is based on the principle of secondary ion mass spectrometry (SIMS), which involves the use of a primary ion beam to induce the desorption of secondary ions from a sample surface. These secondary ions are then mass analyzed to determine their mass-to-charge ratio, allowing for the identification and quantification of elements present in the sample. SIMS is a powerful tool for the analysis of complex materials, such as glass, ceramics, and biological samples, and is widely used in the fields of materials science, environmental science, and geology.