Fatigue striations in a Monel bolt

HOUSTON ELECTRON MICROSCOPY, INC.
Fully digital SEM with integrated EDS system

Secondary and Backscattered Electron Imaging

Modern EDS System

Chemical analysis for elements from Be to Pu (includes C, N, O and F)

High & Low Vacuum Op (Non-conductive samples)
Dennis Manuel, a 30 year veteran in metallurgical analysis.

BSME from UTEP

Materials failure analysis, materials processing, and scanning electron microscopy

Industries including oil & gas, petrochemical, medical, and heavy equipment.
LOCATED IN NEAR NW HOUSTON

7035 W Tidwell Rd.
Ste. J111A
Houston, TX 77092

281-888-4261
281-704-0188-Cell
SCANNING ELECTRON MICROSCOPE

Secondary & Backscattered Electron imaging

SE mode provides topographical imaging

BSE mode provides elemental imaging
(Light elements appear dark, heavier elements appear light)

Secondary Electron image of WC powder
Backscattered Electron image of WC powder
A chemical analysis of anything we can see in the SEM using EDS X-ray analysis.

EDS analysis of Spot 1 showed the clay to be an Aluminum Silicate ($\text{Al}_2\text{SiO}_5$) clay.
Each pixel in an image can be analyzed and displayed in an X-ray map of elements present.
EDS X-RAY COMPOUND MAPPING

Each pixel in an image can also be analyzed and displayed in an X-ray map of compounds.
SEM/EDS APPLICATIONS

- Failure analysis
- Corrosion analysis
- Identification of contamination debris
- Particle and inclusion analysis
- Phase analysis
- Analysis of Coatings
- Tungsten Carbide and PDC Diamond
- Non-metallic materials
FAILURE ANALYSIS

- Identification of failure mechanism
  - Fatigue, ductile or brittle overload, intergranular failure, etc.

Secondary Electron image of fatigue in weldment

Intergranular fracture from Hydrogen attack
Premature failure of a rupture disk caused by intergranular attack followed by fatigue, and final fracture.
CONTAMINATION DEBRIS IDENTIFICATION

Particles on a Q-tip

Particles extracted from oil samples
EDS ANALYSIS OF FILTERED PARTICLES

Particle 1 is primarily SiO$_2$, a sand particle.
Particle 2 is primarily Al$_2$O$_3$, an alumina particle.
Percentage of various phases in a material

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
<th>Area</th>
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<tbody>
<tr>
<td>W2C</td>
<td></td>
<td>4.31</td>
</tr>
<tr>
<td>WC</td>
<td></td>
<td>58.94</td>
</tr>
<tr>
<td>Co Binder</td>
<td></td>
<td>36.73</td>
</tr>
</tbody>
</table>

Original Backscattered Electron image

Phase analysis image
Percentage porosity is measured on multiple frames of processed images.
Backscattered Electron imaging provides much more information than just Secondary imaging.
**NON-METALLIC MATERIALS**

- Low vacuum SEM allows examination of non-metallic (i.e. non-conductive) samples without the need for gold coating.

*Images: Torsional overload of PVC pipe fitting, Wood contamination in extruded PVC pipe*
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Low magnification view of a sea shell – 50X

Magnified view of sea shell surface – 2000X
CONTACT US

- Call us at 281-888-4261 to set up an appointment
- Send samples to:
  Houston Electron Microscopy
  7035 W Tidwell Rd., Ste. J111A
  Houston, TX 77092
- Emergency or after hours: Call Dennis Manuel at 281-704-0188 anytime