

# Analytical Solutions

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for BioTechnology

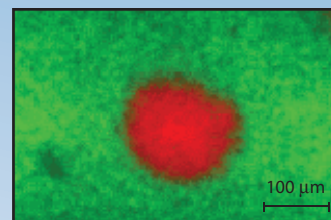
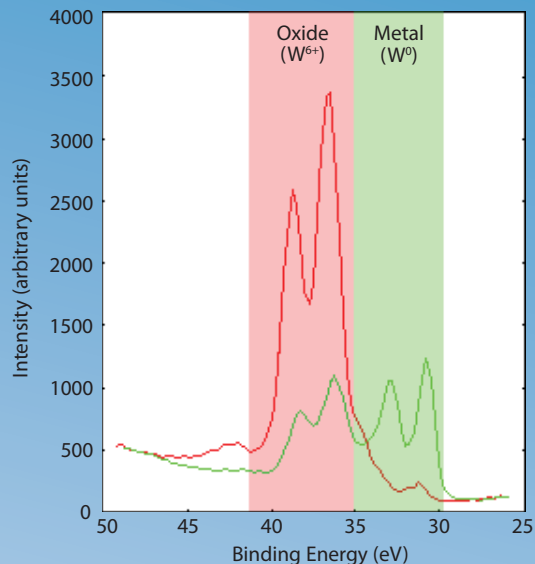
## BN 1405

### Evaluating Corrosion Chemistry with $\mu$ -XPS

#### Discussion

Localized corrosion can adversely affect a variety of materials. X-ray Photoelectron Spectroscopy (XPS), also known as ESCA, can quantitatively evaluate the surface chemistry associated with corrosion products and similar residues. Identifying the amount and form of a corrosion product provides a means to measure the effectiveness of processes designed to minimize corrosion related problems.

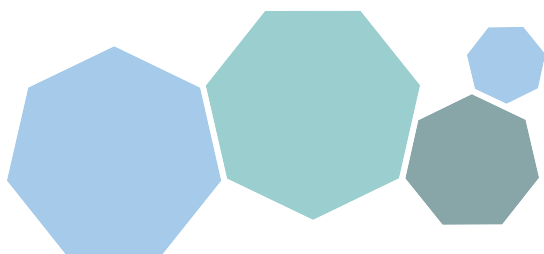
In the example shown below, a  $\sim 100 \mu\text{m}$  corrosion pit in an Al-13W metal film was analyzed by small spot XPS. Quantitative data is tabulated below comparing the uncorroded, 'as-received' surface chemistry with areas inside and outside a corrosion pit. An XPS chemical state map contrasting the oxidation state of tungsten inside and outside the pit is also shown. Enrichment of the total tungsten concentration and depletion of aluminum inside the pit relative to the surrounding area is evident. In addition, the highly oxidized form of tungsten ( $\text{W}^{6+}$ ) is concentrated inside the pit. Combining quantitative chemical state characterization with a spatial resolution approaching  $10 \mu\text{m}$ , as demonstrated here, allows small spot XPS to address a wide range of corrosion (and other) problems.



W4f XPS Chemical Image  
Tungsten oxide is shown in red and the less oxidized region surrounding the pit is shown in green (above). These features correspond to the shaded areas on the spectrum (left).

Area	Relative Atomic Concentration (%)						
	C	O	Al <sup>0</sup>	Al <sup>3+</sup>	W <sup>0</sup>	W <sup>4+</sup>	W <sup>6+</sup>
As Received	36	39	5	16	3	-	-
Outside Pit	22	49	6	17	3	~0.5	2
Inside Pit	14	60	-	11	0.5	1	12

Elemental and chemical state composition of surfaces from Al-13W samples before and after undergoing localized corrosion.



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