![Analytical Answers logo]

The Information You Need...When You Need It.

Scanning Auger Microanalysis

Scanning Auger Microscopy (also known as Auger Electron Spectroscopy) allows for the analysis of the elemental composition of surfaces and interfaces at a highly detailed level. This technique typically analyzes at a depth of 2-3 nm, and with our high-accuracy instrumentation (field emission source) we have the ability to sample with a lateral resolution of better than 30nm. This allows for the inspection of films with the thickness of only a few monolayers from top down, or layers a few tens of nanometers thick when examined in cross section.

Auger analysis can detect all elements except hydrogen and helium, at concentrations as low as 0.1 atomic percent (depending on element and matrix).

When information about material below the surface is of interest, an in situ ion beam can be used to remove material from the sample to allow analysis of buried layers. These so-called Depth Profiles produce plots of composition versus depth and can extend up to several microns below the surface.

While Auger analysis performs best on semiconductors or conductive samples, less insulating materials can sometimes be analyzed.

How it Works:

First, we scan a sample with a focused electron beam, which causes low-energy Auger electrons to be emitted from the surface. We then measure the energies of the Auger electrons with an electron kinetic energy analyzer, which will provide an analysis of the elements found in the first few monolayers of the sample.

SAM Applications Include:

Materials Evaluation

- Verification of surface homogeneity
- Catalyst degradation
- Interface analysis

- Diffusion studies
- Identification of surface contaminants

Failure Analysis

- Material delamination analysis
- Metal embrittlement evaluation
- Corrosion analysis

- Stain identification
- Lifted lead bond evaluation

Quality Control

- Comparison of good to bad samples
- Verification of surface process modification
- Relative thickness on thin films
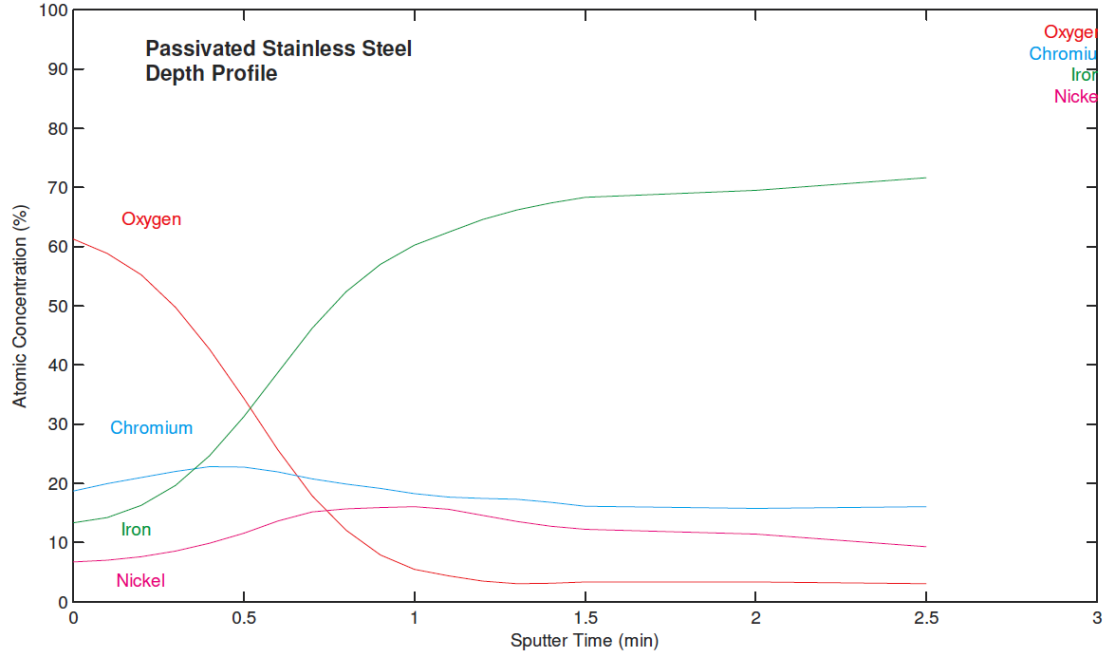
Data Presentation:

- Raw qualitative SAM data is presented as a plotted spectra
- Semi-quantified data is presented as tables
- Elemental maps (distributions) are presented as electronic images
- Depth profiles are presented as plotted spectra
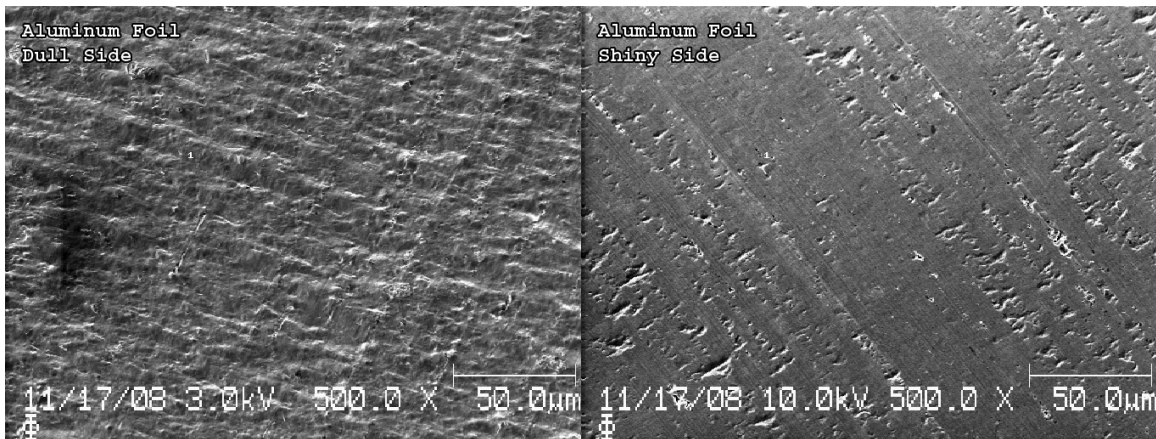
Sample Constraints:

The sample can be up to 1.5 cm x 1.5 cm x .5 cm in size. We can analyze most solid conductive samples (metals, microelectronics, powders) and some insulating samples (polymers, glasses, and ceramics). The sample must be compatible with a 10-9 torr vacuum and not susceptible to electron beam effects such as decomposition or desorption.

Examples of Data:

Passivated Stainless Steel Depth Profile

Y-axis: Atomic Concentration (%), from 0 to 100
X-axis: Sputter Time (min), from 0 to 3
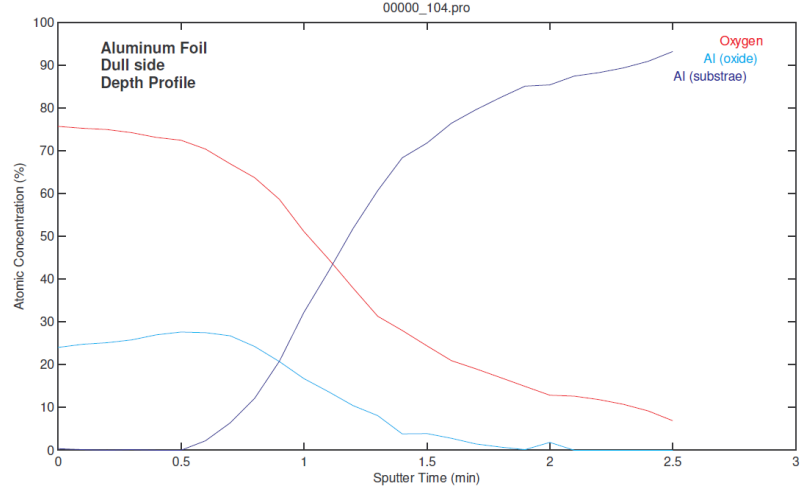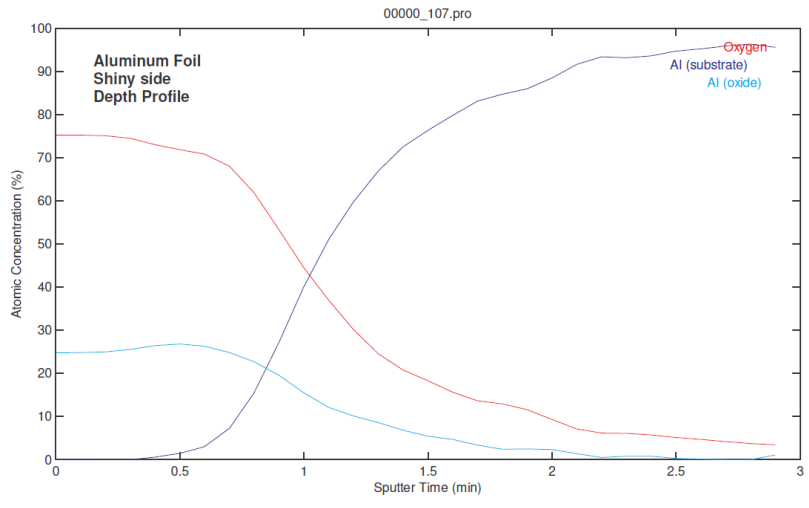
Curves labeled: Oxygen, Chromium, Iron, Nickel

Depth profile (measurement of concentration versus depth into the sample) of Stainless Steel

In the bulk of the material, iron is the most abundant element. However, on a well-passivated sample there is a surface layer of chromium oxide, so the chromium concentration is higher than the iron concentration at the surface (on the left).

Aluminum Foil Dull Side — 11/17/08 3.0kV 500.0 X 50.0μm

Aluminum Foil Shiny Side — 11/17/08 10.0kV 500.0 X 50.0μm

Aluminum Foil Samples

The two sides of a piece of aluminum foil look distinctly different to the eye, and that difference is easily seen in secondary electron images taken of the surface. The dull side is rougher which scatters more light.

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Aluminum Foil
Shiny side
Depth Profile

Oxygen
Al (substrate)
Al (oxide)

00000_104.pro

Aluminum Foil
Dull side
Depth Profile

Oxygen
Al (oxide)
Al (substrae)

Depth Profile of Aluminum Foil

Compositionally, the two sides are nearly identical on the surface and when examining the oxide thickness using a depth profile.