PHYSICAL ELECTRONICS
A DIVISION OF ULVAC-PHI

HIGH ENERGY RESOLUTION AUGER DEPTH PROFILING of Zn Metal Surfaces

OVERVIEW

Zinc, widely used in many industrial products, is most commonly used as an anti-corrosion agent. Zinc is also a critical part of the interfacial chemistry between metal tire cords and the rubber used to manufacture tires. Researchers developing new materials for industries such as the automobile industry will benefit from having instrumentation that allows them to obtain compositional and chemical information from submicron features and thin layers including Zn and Zn alloy passivation layers. This application note demonstrates the ability of the PHI *700Xi* Scanning Auger NanoProbe to detect and estimate the thickness of a thin zinc oxide layer on a zinc substrate. In addition to thin film characterization, the PHI *700Xi* provides the ability to perform Auger compositional analysis, depth profiling, and imaging using a focused electron beam to probe submicron features and surfaces.

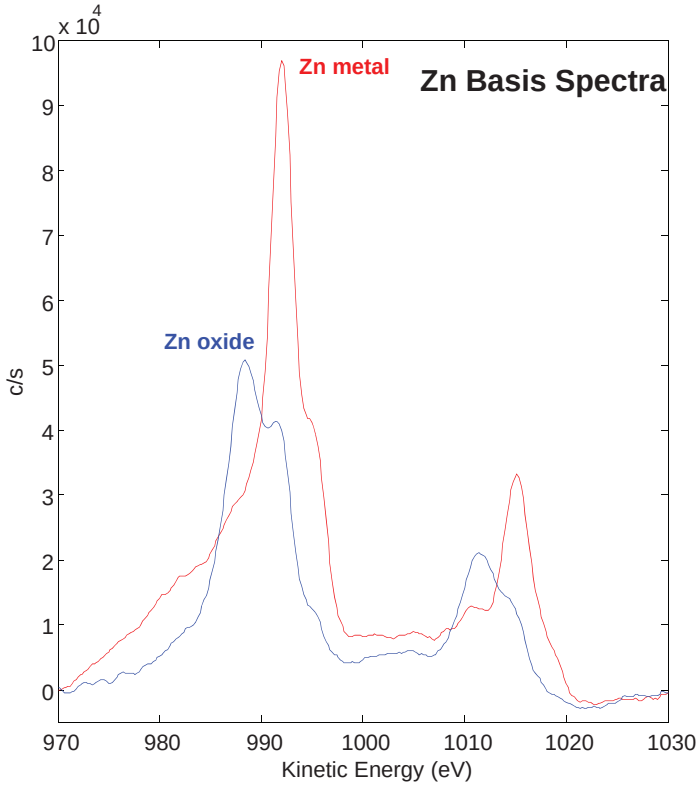

Figure 1: High energy resolution (0.1%) Zn basis spectra for Zn metal and Zn oxide extracted from the depth profile data set as part of the Linear Least Squares (LLS) fitting process used to create the chemical state depth profile shown in Figure 2.

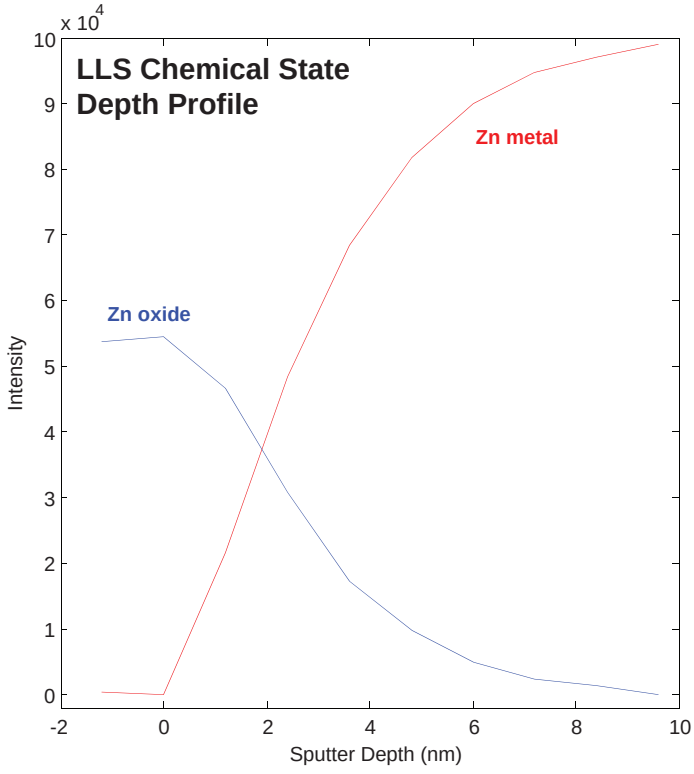

Figure 2: Chemical state Auger depth profile showing the presence of a thin Zn oxide layer on a Zn metal surface.

The field emission electron gun, which has a minimum electron beam size of 7 nm, is located coaxially in the center of the cylindrical mirror analyzer (CMA) used to detect Auger electrons. This unique instrument geometry is very effective for characterizing rough and curved surfaces. A newly developed high energy resolution capability for the PHI *700Xi* can be used to provide detailed chemical state information for many materials while maintaining the unique capabilities of the PHI *700Xi* for characterizing real world materials with rough surfaces and irregular shapes.

EXPERIMENTAL PROCEDURE AND RESULTS

A zinc metal foil with a surface oxide was inserted into the PHI *700Xi* Scanning Auger NanoProbe for chemical state thin film analysis. Using the high energy resolution analysis mode, Auger spectra were obtained with 0.1% energy resolution and the following electron beam conditions: 10 kV, 10 nA, and a beam diameter of 22 nm. Thin film analysis was accomplished by alternately collecting Auger spectra and sputtering the sample surface with a 2 kV, 1 uA, Ar^+ ion beam rastered over a 2 X 2 mm area of the sample. Chemical state depth profiles were extracted from the data using the Linear Least Squares fitting software in PHI *MultiPak*. The basis (reference) spectra for Zn metal and Zn oxide shown in Figure 1, were extracted from the depth profile data set and used by the Linear Least Squares fitting routine to create the chemical state depth profile shown in Figure 2. This chemical state depth profile shows the presence of a thin (˜3 nm) Zn oxide layer on the surface the Zn metal sample.

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