AES

PHYSICAL ELECTRONICS

NEW HIGH ENERGY RESOLUTION OPTION

for the PHI *700* Scanning Auger Nanoprobe

The power of the PHI *700* Scanning Auger Nanoprobe equipped with the new high energy resolution (HR) option is illustrated here with a nanotechnology application. Nanocones grown from 3 nm seed particles of 75-25 Fe-Pt on a silicon wafer substrate using a plasma-enhanced chemical vapor deposition method were characterized with the PHI *700* HR. Figure 1 shows the secondary electron image (SEI) of a nanocone and standard mode Auger maps of the Fe and N distributions. The HR spectrum in Figure 2 clearly shows that the base of the nanocone is a mixture of Si oxide and Si nitride. In support of this conclusion reference spectra for Si oxide and Si nitride are also displayed.

The PHI *700* with the HR option can be used for spectroscopy, chemical state imaging and sputter depth profiling.

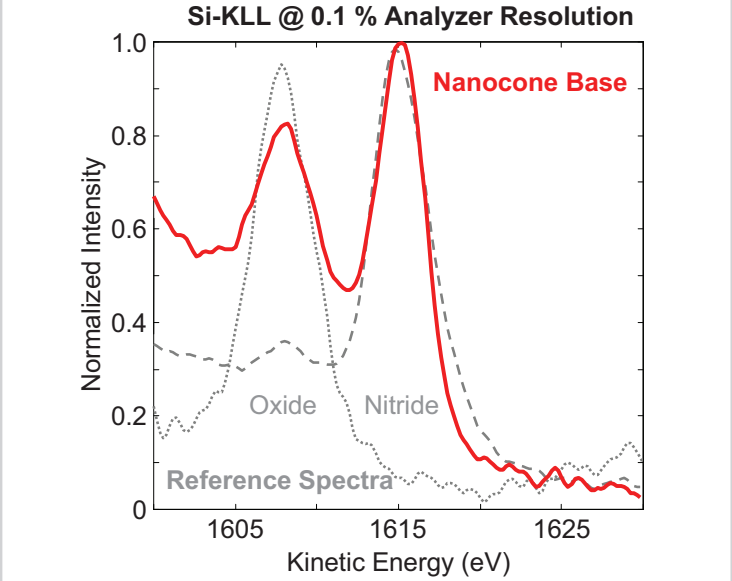
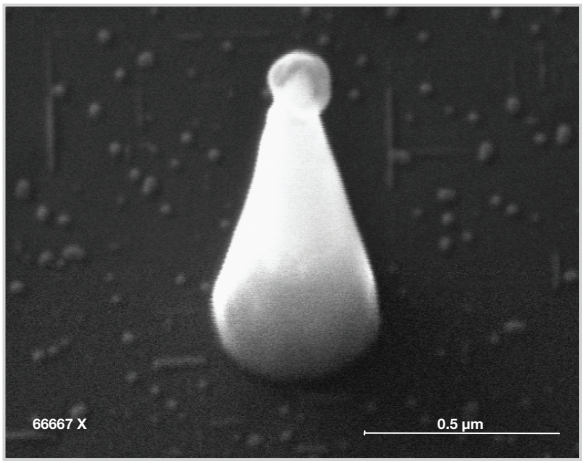


Figure 2: HR spectra from the nanocone base (red), and reference spectra of Si oxide and Si nitride (gray).

SE Image of Nanocone



Auger Map Color Overlay: Fe, N

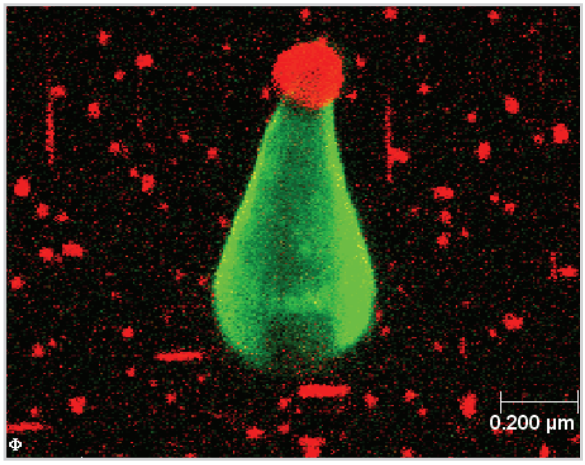


Figure 1. SEI image of nanocone and color overlay display of N KLL (green) and Fe LMM (red) maps from a nanocone grown on a Si wafer. 3 nm diameter Fe-Pt seed particles are clearly visible on the Si wafer substrate.

The HR option preserves the wide range of collection angles, the high sensitivity, and the coaxial geometry of the cylindrical mirror analyzer (CMA) which enables mapping without artifacts caused by sample topography. The HR option provides enhanced spectral chemical analysis capability for the PHI *700*, *690,* and *680* Auger instruments. (PHI *680* instruments require CE electronics configuration.)

The PHI *700* HR option is a modification to the sample stage, electronics and software which allows continuous adjustment of the analyzer energy resolution. For Auger transitions with a kinetic energy (KE) greater than 1000 eV, the analyzer energy resolution can be adjusted from 0.5 % to 0.1 %. For Auger transitions with kinetic energies less than 1000 eV, the maximum available analyzer resolution (AR) is given by the equation: AR = (0.5 * 100 / KE) %.

Typical Auger analysis begins with secondary electron imaging, followed by high sensitivity elemental analysis and imaging at 0.5% analyzer energy resolution. For a majority of samples, elemental maps indicate different surface chemical environments simply by the spatial coincidences of various chemical elements. High energy resolution Auger spectra can be used to confirm the chemistry indicated by the maps. Figure 3 shows the enhanced Auger chemical spectroscopy available with the PHI *700* HR option at 0.1 % analyzer energy resolution compared to the higher sensitivity 0.5% standard energy resolution mode. The relative quantities of Al metal and Al oxide are more clearly resolved in the higher energy resolution mode.

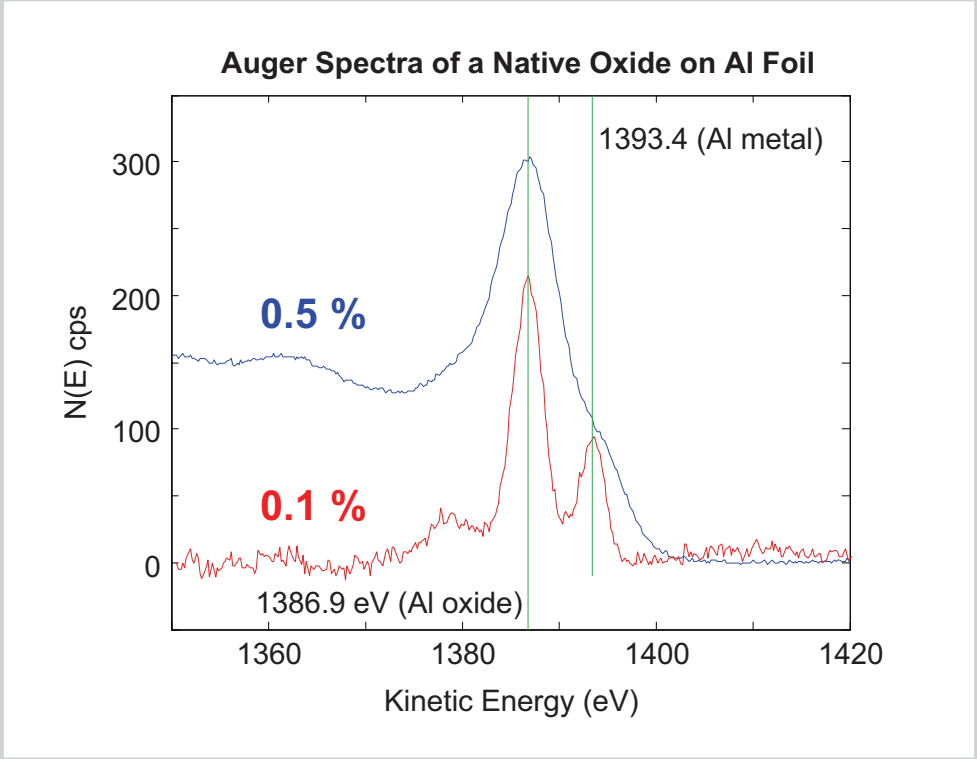


Figure 3. Auger KLL spectrum of a native oxide on Al foil collected using a PHI CMA operating at 0.5 % and 0.1 % energy resolution, after background subtraction.

Physical Electronics
18725 Lake Drive East,
Chanhassen, MN 55317
952-828-6200
www.phi.com

ULVAC-PHI, Inc.
370 Enzo, Chigasaki,
Kanagawa, 253-8522, Japan
81-467-85-4220
www.ulvac-phi.co.jp

PHYSICAL ELECTRONICS