EE213: Microscopic Nanocharacterization of Materials
Spring 2012
Homework #1
Due: April 26, 2012

1. Below are shown schematic profiles of three different samples to be viewed in an SEM with an Everhart-Thornley detector. Beneath each profile, sketch the signal you would expect to detect as the incident electron beam is scanned across the sample from left to right. Do this for two different incident beam energies of: A) 5 keV and B) 20 keV.

The incident beam has a diameter or 1nm and the ET detector is on the right side of the page. EXPLAIN the key features of your “line scan” plot using your knowledge of the physical interactions that occur. Be as quantitative as you can.
2. The center to center distance from one pair of double lines to the next pair in the secondary image shown below is 50 nm. It has been taken with an Everhart-Thornley detector and the image has been inverted (i.e., black means high intensity, white means low intensity). Beneath the image is a line scan across the image at right angles to the lines, (the higher the peak, the greater the signal)
A. Sketch a topographic profile of the sample. Explain.
B. Where is the location of the detector? Explain.
3. Consider the KL\textsubscript{2}L\textsubscript{3} transition in Aluminum.
   A) What is the energy of the KL\textsubscript{2}L\textsubscript{3} Auger electrons?
   B) What is the energy of the corresponding X Ray that could be emitted as a result of the L\textsubscript{2} electron filling the K shell hole upon K shell ionization?
   C) What is the ratio of the probability of a KL\textsubscript{2}L\textsubscript{3} Auger electron from Aluminum to that of the K\alpha XRay?

4. Shown on the next page is a differential Auger electron spectrum obtained using a cylindrical mirror analyzer and 5keV electron incident normal to a sample surface that consists of an Aluminum wire deposited on a silicon substrate as shown below.

   ![Diagram](image)

   A. Which peak corresponds to Aluminum? Explain.
   B. What are the major processing contaminants on the surface? (ie the 3 other peaks). Explain.
   C. What are the relative concentrations of these major contaminants relative to Aluminum? Use any method you wish to get at the answer, but you must explain what you use and make a best estimate of your error.