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Tech Tip: Ion Beam Induced Low Energy Electrons

Analyzer Performance

Using an ion induced low energy peak can be invaluable when troubleshooting analyzer performance. The peak occurs at about 20 to 50 eV in kinetic energy (KE) and the size of the peak is directly related to both the alignment of the ion beam with the analyzer as well as the amount of ion current.

Checking XPS Performance

Set up an alignment for a range of zero to 100 eV KE. The eV range in binding energy depends on which anode energy you have selected in the software. Most systems use a Mg anode, so the energy would be 1250 to 1150 eV.

1. Using a blank sample mount, position a sample at the focal point of the analyzer.
2. Look under the Hardware Properties menu for XPS and note the x-ray anode type.
3. Set up an alignment with the following parameters:
   - upper limit = 1480 eV if Al is the anode, 1250 eV if Mg is the anode.
   - lower limit = 1390 eV if Al is the anode, 1150 eV if Mg is the anode
   - eV per step = 0.5 (or the closest selection to 0.5)
   - time per step = 20 ms
   - pass energy = 100 eV (or closest available value to 100)
4. Start the alignment and turn on the ion gun (no raster). You should have a low energy peak at around 20 to 50 eV KE.
5. If necessary, reduce the ion gun beam current to prevent the detector from saturating. (You can increase the condenser lens setting or reduce the emission current in order to reduce the ion beam current).

If you do not get the peak, then you probably have a problem with the analyzer or analyzer electronics. If you do get the peak, then the analyzer and electronics are probably OK. (This is a very useful technique for isolating a low signal XPS problem between the analyzer and the x-ray source.)

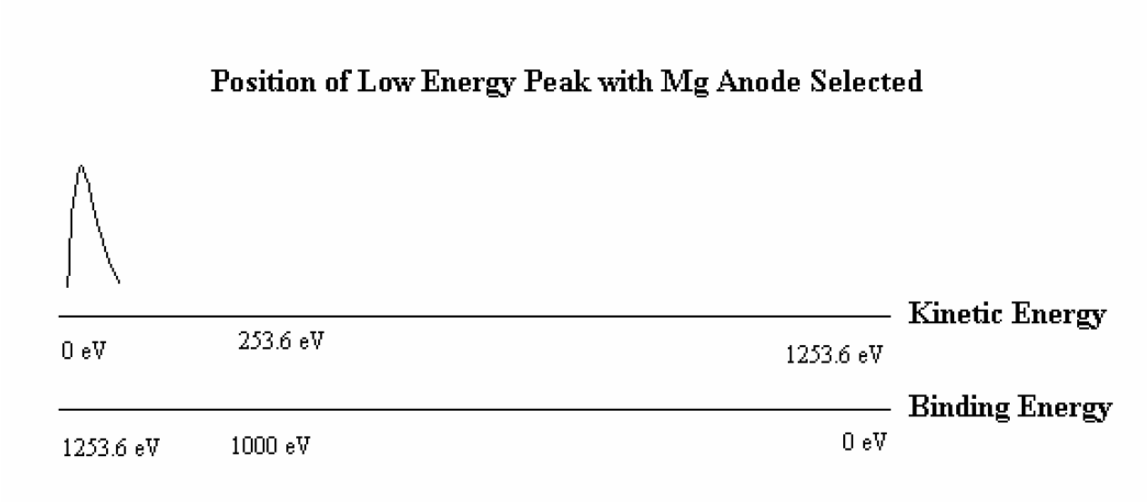

Figure 1. Low Energy Ion Peak

Checking AES Noise Level

Analyzer noise (noisy data) can be caused by many factors:

- Poor contact between the inner and outer cylinder terminating ceramics
- Analyzer control
- Electron multiplier supply
- Electron gun control or electron gun high voltage supply

This technique will help isolate analyzer noise by determining if it is related to the electron gun, which in turn would be caused by the electron gun control or electron gun high voltage supply.

Overview

This procedure uses both the electron gun and ion gun as a source to generate low energy electrons. By comparing the relative noise levels, you can determine if the problem is related to the electron beam only, or both beams. If it is related only to the electron beam, then the problem is in the electron gun control or electron gun high voltage supply. If both the electron and ion beams are noisy, then the problem is either the analyzer control, the multiplier supply, or poor contact in the analyzer. The analyzer control and electron multiplier supplies can be tested for noise using the appropriate calibration procedure.

Procedure

Set up an alignment with these parameters:

- Lower Limit = 0 eV
- Upper Limit = 100 eV
- eV per step = 1
- time per step = 20 ms

1. In AugerScan, go to the Multiplier Properties dialog box and uncheck the Auto EMS box. This will keep the computer from trying to automatically set the electron multiplier voltage.
2. In AugerScan, go to the Hardware Properties dialog box and make sure the input is VF1.
3. With the electron beam on and set up for a normal elastic peak, start the acquisition and manually adjust the 32-100 CMA electron multiplier until you have a maximum count rate of approximately 100 Kcps. You will see a low energy peak around 20 to 50 eV depending on your sample.
4. Use the yellow cycle stop button to end the alignment and then save the file.
5. Blank the electron beam and turn on the ion gun. Do not use any raster.
6. Start the acquisition and manually adjust the 32-100 CMA electron multiplier until you have a maximum count rate of approximately 100Kcps.
7. Use the yellow cycle stop button to end the alignment and then save the file.

Compare the two files to determine whether or not they have similar amounts of noise. In the examples shown below, the electron gun (Figure 2) as a source exhibits more noise than the ion gun (Figure 3) as a source. In this instance, the problem was isolated to a noisy emission supply in the 20-610 high voltage supply on a 600 system.

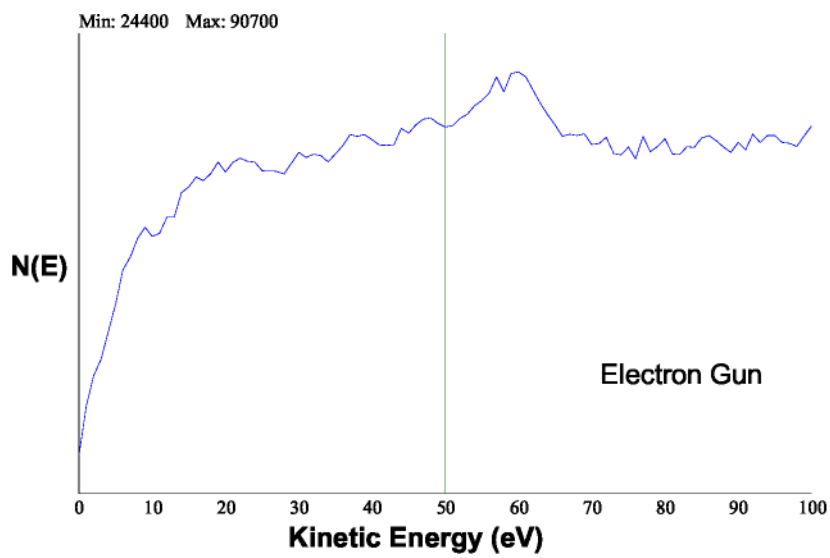

Figure 2.

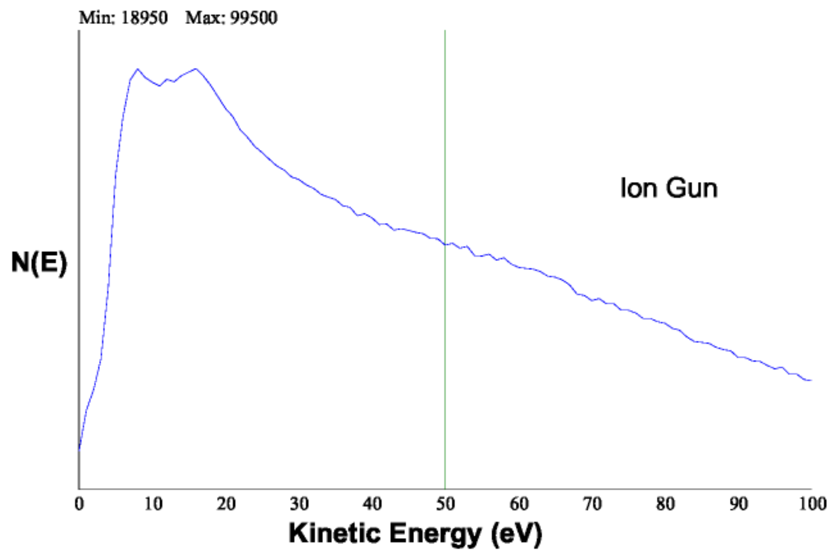

Figure 3.

Ion Gun Alignment

On systems that do not have scanning electronic guns for TV imaging, you can use the low energy peak to center the ion beam with respect to the analyzer focal point.

AES Ion Gun Alignment Procedure (for non-scanning AES)

1. Using a blank sample mount, position a sample to the focal point of the analyzer (elastic peak).
2. Set up an alignment with the following parameters:
   - lower limit = 0 eV
   - upper limit = 100 eV
   - time per step = 20 ms
3. In the Multiplier Properties dialog box, un-check the Auto EMS Box.
4. In the Hardware Properties dialog box, make sure the input is V/F 1.
5. On the 32-100, set the CMA multiplier switch to analog and make sure the potentiometer is fully CCW.
6. Start the alignment and turn on the ion gun (no raster).
7. Slowly turn up the 32-100 CMA multiplier supply (or the 20-075 multiplier supply if you have an older system) until you have about a 100 Kcps peak at 20 to 50 eV. This should occur at no more than 2000 V on the multiplier (5.0 on the 32-100 potentiometer).
8. Finally, adjust the X and Y position of the ion gun for maximum signal. The ion gun is now aligned to the focal point of the analyzer

XPS Ion Gun Alignment Procedure:

1. Using a blank sample mount, position a sample at the focal point of the analyzer.
2. Look under the Hardware Properties menu for XPS and note the x-ray anode type.
3. Set up an alignment with the following parameters:
   - upper limit = 1480 eV if Al is the anode, 1250 eV if Mg is the anode.
   - lower limit = 1390 eV if Al is the anode, 1150 eV if Mg is the anode
   - eV per step = 0.5 (or the closest selection to 0.5)
   - time per step = 20 ms
   - pass energy = 100 eV (or closest available value to 100)
4. Start the alignment and turn on the ion gun (no raster). You should have a low energy peak at around 20 to 50 eV KE. (see Figure 1)
5. If necessary, reduce the ion gun beam current to prevent the detector from saturating. (You can increase the condenser lens setting or reduce the emission current in order to reduce the ion beam current).
6. Finally, adjust the X and Y position of the ion gun for maximum signal. The ion gun is now aligned to the focal point of the analyzer