Bruker Elemental

Technical Note #1001

Filter, Voltage and Current Selection For Optimum XRF Elemental Group Analysis

In order to obtain optimal spectral information from an XRF spectrometer it is important to control the excitation conditions. This includes control of the X-ray tube current and voltage as well as the excitation filter used. To optimize the excitation conditions for a particular element or group of elements one wants to use filters and tube voltage settings that "position" the X-ray excitation energy impacting the sample just above the absorption edge(s) of the element(s) of interest. The tube current setting allows adjustment of the RAW COUNT RATE in the detector so it is between 1000 and 10,000 (in cases where an SDD is being used the count rate can be as high as 100,000). This application note gives examples of how to optimize excitation for specific elements.

Screening for all Elements (Lab Rat mode):

1. Filter: None
2. Tube Voltage: 40 kV
3. Tube Current:
   a. Highest available current (for non metallic samples)
   b. Lowest available current (for metallic samples)
4. Vacuum: On

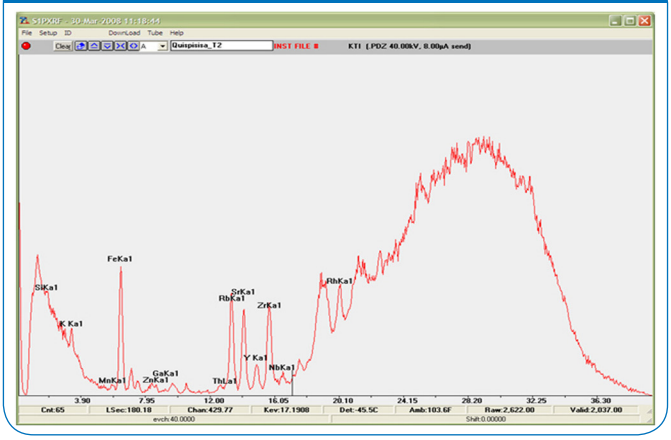
These settings provides excitation for all the X-rays from 1 keV to 40 keV and allow the emitted X-rays to reach the detector thus allowing determination of all the elements from Mg to Pu.

Measurement of Obsidian for higher Z elements (Rb, Sr, Y, Zr, and Nb):

1. Filter: 0.006" Cu, 0.001" Ti, 0.012" Al (green filter)
2. Tube Voltage: 40 kV
3. Tube Current: Highest available current
4. Vacuum: Off

These settings allow all the X-rays from 17 keV to 40 keV to reach the sample thus efficiently exciting the elements from Fe to Mo. These are some of the elements that are key to identifying the origin of the obsidian. There is little or no sensitivity to elements below Fe with these settings (see S1 PXRF-1).

S1 PXRF-1



Measurement of Mg, Al, Si and P to Cu:

Also, L and M lines for the elements that fall between 1.2 and 8 keV.

1. Filter: None
2. Tube Voltage: 12 to 15 kV
3. Tube Current: Highest available current
4. Vacuum: On

These settings allow all the X-rays from the tube up to 15 keV to excite the sample. In particular this allows the Rh L (2.5 to 3 keV) lines from the tube to reach the sample. These are particularly effective at exciting the elements with their absorption edge below 2.3 keV. Note this set up is not good for Cl and S detection, as the scattered Rh L lines interfere with the X-rays coming from these elements.

Measurement of Mg, Al, Si, P, Cl, S, K, Ca, V, Cr, Fe:

Also L and M lines for the elements that fall between 1.2 and 6.5keV.

1. Filter: Ti (blue filter)
2. Tube Voltage: 15 to 20 kV
3. Tube Current: Highest available current
4. Vacuum: On

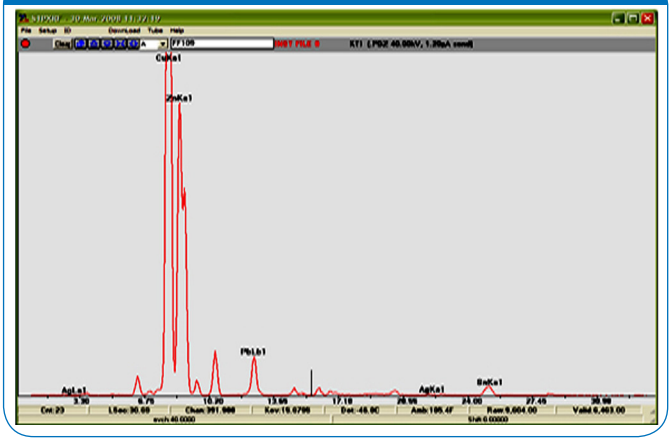
These settings allow X-rays from 3 to 12 keV to excite the sample. In particular this does not allow the Rh L lines from the tube to reach the sample. These Rh L X-rays would interfere with Cl and S analysis. For example, this is a very good set up for measuring Cl on the surface of Fe.

Measurement of metals (Ti to Ag K lines and W to Bi L lines):

1. Filter: 0.001" Ti, 0.012" Al (yellow filter)
2. Tube Voltage: 40 kV
3. Tube Current: 1-5 microamps (monitor the count rate)
4. Vacuum: Off

These settings allow all the X-rays from 12 keV to 40 keV to reach the sample thus efficiently exciting the elements noted above. These are the settings used to calibrate the system for all modern alloys of those elements of those listed in the title of this section. There is little or no sensitivity to elements below Ca with these settings. (S1 PXRF -2).

S1 PXRF-2

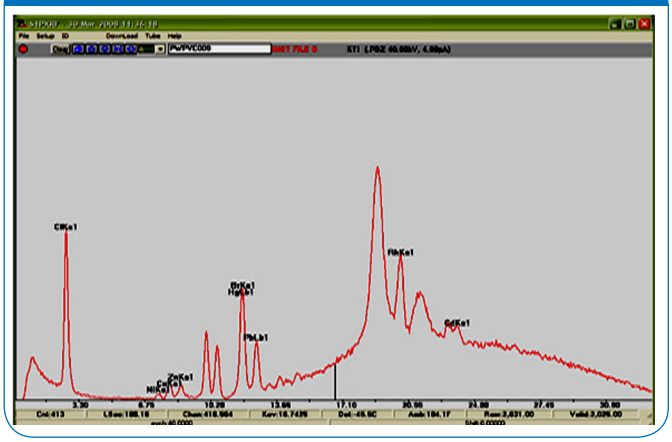


Measurement of Poisons (higher Z elements Hg, Pb, Br, As):

1. Filter: 0.001" Cu, 0.001" Ti, 0.012" Al (red filter)
2. Tube Voltage: 40 kV
3. Tube Current: Highest available current
4. Vacuum: Off

These settings allow all the X-rays from 14 keV to 40 keV to reach the sample thus efficiently exciting the elements Hg, Pb, Br, As. These are some of the key elements that were used to preserve organic based artifacts. There is little or no sensitivity to elements below Ca with these settings (S1 PXRF -3).

S1 PXRF-3



Note: the depth of analysis is very much a function of both the X-ray energy (tube voltage & filter) used to probe the material and the element that is being excited, both are exponential functions dependent on the matrix elements of which the sample is composed

www.handheldxrf.com

Americas

Sales
Billerica, MA · USA
Tel. +1 (978) 663-3660 x1463
hhsales@bruker-elemental.net

Service/Manufacturing
Kennewick, WA · USA
Tel. +1 (509) 783-9850
hhinfo@bruker-elemental.net

Europe / Middle East / Africa

Sales/Service
Bruker Nano GmbH
Berlin · Germany
Tel. +49 (0)30 670 990-0
info-hh@bruker-elemental.com