XRF: Capabilities for Analytical Problem Solving

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X-ray fluorescence is a powerful analytical tool for characterizing a wide array of materials ranging from geological to biological to commercial products to nanoparticles to radioactive materials. All of these samples have several things in common: 1) the person with the problem wants to know what elements are present, 2) they want to know how much of those elements are present, and 3) they want it done quickly, with the highest accuracy and precision and for as low a cost as possible. This presentation will highlight the use of both conventional XRF instrumentation as well as specialized XRF instruments to address these 3 key issues in solving analytical problems. Wavelength dispersive XRF (WDXRF) is the industrial workhorse for quantitative analyses, primarily for process control characterization. However, due to sample presentation restrictions, WDXRF is not as flexible in solving analytical problems outside the programmed routines of the process laboratory. Energy dispersive XRF (EDXRF) offers a more flexible avenue for solving a myriad of problems both qualitative and quantitative. While EDXRF does not have the spectral resolution of WDXRF, EDXRF offers more rapid qualitative analysis capabilities. This is particularly apparent when using spatially resolved XRF instruments or micro X-ray fluorescence (MXRF) devices. These instruments rely on special optics to spatially restrict the X-ray beam impinging on the sample, allowing for highly selective spatial analyses of samples. The spot size of the probe beam varies and can range from 5 micrometers to a couple of millimeters. Such flexibility in spatially interrogation of the sample offers a wide capability in sample characterization. The primary advantage of MXRF is the ability to convey a solution to the analytical problem with qualitative elemental map instead of just quantitative numbers. The power of an elemental image immediately invokes the human visual capability of quickly discerning the spatial distribution of an analyte in a sample. In addition to MXRF there is confocal MXRF where 3D elemental images can be created of specimens to provide nondestructive elemental characterization of analytes below the surface. Finally specialized doubly curved crystal (DCC) optics offers high sensitivity and highly selective analytical capabilities not found with any other instrumentation. Examples of these instruments and their application to solving analytical problems will be presented.