LOW-POWER MONOCHROMATIC FOCUSED BEAM XRF SYSTEMS USING DOUBLY CURVED CRYSTALS

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Doubly curved crystals based on Bragg diffraction (DCC) have unique x-ray optical properties for x-ray spectrometry and spectroscopy applications. A DCC optic can provide point-to-point focusing monochromatic beams based on low-power x-ray tubes. The energy of the beam can be Rh Lα, Cr Kα, Cu Kα, W Lβ, Mo Kα or Ag Kα line. The total flux of the beam is in a range of 10^8 to 10^{10} photons/sec and with the number dependent on the energy and the focal spot size. The lower the energy, the higher the flux a DCC can deliver. The smaller the beam size, the lower the flux. The focal spot of the beam is in a range of 50μm to 300μm. In this talk, the x-ray optical properties of a DCC will be reviewed

The focused beam from the DCC optic is the physical basis of monochromatic micro x-ray fluorescence (MMXRF) analysis using a low-power tube. MMXRF maps for bone section and brain tissues will be shown and discussed.

A doubly curved crystal optic can also be used as a fixed channel wavelength-dispersive element for collection of fluorescent x-rays. Although a revolved logarithmic DCC does not provide point focusing, it can be designed to have a large solid angle. Small spot monochromatic wavelength-dispersive XRF (MWDXRF) system was successfully developed for a specific application. The MWDXRF system used a DCC optic coupled with a low-power tube for small spot monochromatic excitation. One or more DCC optics were used to collect fluorescence x-rays from a sample. Unprecedented signal/background ratio was achieved for the MWDXRF method. The MWDXRF technique has been successfully applied for low level sulfur analysis in fuel. In this talk, the optical configuration of MWDXRF will be discussed. Minimum detection limits and repeatability for S in oil measurements will be discussed.

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