Position Dispersive X-ray Fluorescence

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The Mineral Resources X-ray Technologies group at CSIRO develops industrial X-ray analysis instruments for the online measurement of the elemental composition and mineralogy of ore. New X-ray analysis instruments are being developed for improved resolution X-ray Fluorescence (XRF) measurements for the analysis of trace elements in complicated samples. This study has evaluated and improved upon a novel approach to the in-situ measurement of high resolution XRF spectra.

Energy dispersive XRF (EDXRF) is ideal for quick measurements as it simultaneously measures a large energy range of the spectra, ideal for the analysis of many elements. However, the detectors used in EDXRF have a poor resolution, of at best 125 eV for the Mn Kα line, preventing the accurate measurement of any fine structure present in the X-ray fluorescence lines. Wavelength dispersive XRF (WDXRF) is able to measure X-ray spectra at an improved energy resolution compared to EDXRF, allowing the measurement of fine structure. It is limited however by the fact that it can only measure one energy at a time, preventing any measurement of time sensitive changes in the spectra. It is apparent that a more suitable method with better energy resolution is required for the real-time measurement of fine structure in X-ray spectra.

Position dispersive X-ray fluorescence (PDXRF) is one novel approach to the simultaneous measurement of X-ray spectra at a significantly improved energy resolution than EDXRF. This novel variation of the WDXRF approach involves the simultaneous dispersing and measuring of a select range of X-ray energies instead of scanning through the energies like in traditional WDXRF. This is achieved using a silicon strip detector, a flat analyzing crystal, a polycapillary tube and a low power X-ray tube. The X-rays are focused by the polycapillary tube onto the sample and then dispersed by the flat analyzing crystal where they are simultaneously detected by different channels onto the strip detector, providing a greatly improved energy resolution. In this study the PDXRF X-ray emission spectra of various elements were measured achieving energy resolutions ranging from 5 to 10eV, a significant improvement over typical EDXRF measurements. This study has also shown that using the PDXRF method the low-intensity satellite lines can be measured and investigated for chemical state analysis of different compounds.

[1] K. Sato, A. Nishimura, M. Kaino, S. Adachi, X-Ray Spectrometry 1(1), 2016, 330-335.

Preference: ORAL