A novel method for conducting X-ray fluorescence experiments

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The CSIRO Mineral Resources X-ray technologies group develops industrial X-ray analysis instruments designed to measure concentrations of precious and base metals, such as gold, platinum, nickel and copper in mineral ore. The most common X-ray analysis technique for in-situ analysis industry applications is X-ray Fluorescence (XRF).

In a typical XRF experiment, the elements in the sample are excited with a continuum of bremsstrahlung X-rays between 5 and 50 keV (the output of an average X-ray tube) to ensure all atoms in the sample are excited simultaneously. The characteristic fluorescence X-rays emitted from the sample can then be detected simultaneously by a detector and used to determine the elemental composition of the sample.

This study has evaluated a non-conventional approach to the X-ray fluorescence technique. The approach involves selectively exciting each element within a sample in a sequence of measurements, controlled by varying the X-ray energy output of the X-ray tube. Rather than exciting the sample with the whole bremsstrahlung spectrum, the sample will be measured continuously with different energy exciting X-rays at different times. When using an X-ray tube, this can be established by cycling the tube voltage as a function of time. The resulting fluorescence response of the sample will also be measured as a function of time and used to determine the elemental composition of the sample.

We have measured various samples to evaluate whether the proposed novel alternative method of X-ray fluorescence analysis can be used to accurately determine the elemental composition. In this paper we will show that the technique can be used in a variety of cases to determine the concentration of transition metal elements. Finally, we will make and discuss a comparison of the new method and the traditional X-ray fluorescence method.