A New Tool for Cultural Heritage: High Speed, Simultaneous XRD-XRF Mapping with the Color X-ray Camera

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The Color X-ray Camera (CXC) [1] is a unique imaging spectrometer capable of recording both the position and energy of each X-ray event on the detector. This enables the simultaneous collection and analytical separation of both X-ray fluorescence and X-ray diffraction [2]. When combined with a micro focused X-ray source, the CXC can create X-ray maps of heterogeneous materials with mapping dwell times as low as 10 ms per point. In this relatively short measurement time, a full X-ray spectrum with an energy resolution of 145 eV at Mn Kα is recorded along with a diffraction pattern with an angular range of approximately 150° 2θ. Figure 1 shows the results from the analysis of a multi-mineral mount. A 100 µm X-ray beam was scanned over a mount containing samples from 100 different minerals, many of which are common pigment materials. In the 500 ms per point dwell time, a diffraction pattern and fluorescence spectrum were recorded by the CXC, and these two data sets were further analyzed to separate out the minerals themselves, allowing for positive identification. This rapid material identification technique can be very useful for cultural heritage applications, such as in the analysis of mineral-based pigment samples.

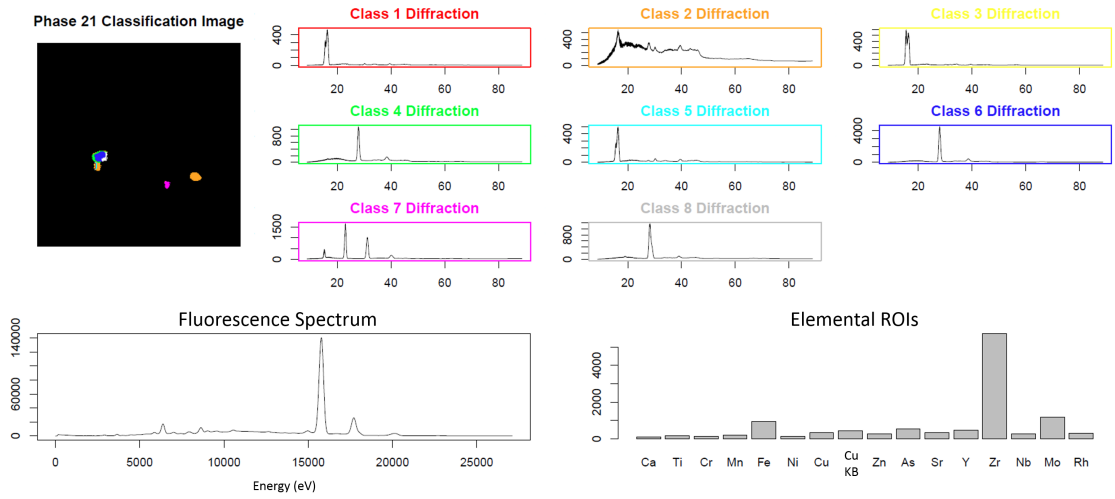

Figure 1: Diffraction patterns and fluorescence spectra from an analysis of a multi-mineral mount. Of the over 100 minerals analyzed in the map, four showed the presence of Zr. These minerals differ significantly in their diffraction patterns, making identification of the materials possible with a single, 500 ms measurement at each point.

References:
[1] Scharf, O., Ihle, S., Ordavo, I., *et al*, Compact pnCCD-based X-ray camera with high spatial and energy resolution: A color X-ray camera, Analytical Chemistry, **83** (2011), p. 2532:2538.
[2] Leitenberger, W., Hartmann, R., Pietsch, U., *et al*, Application of a pnCCD in X-ray diffraction: a three-dimensional X-ray detector, Journal of Synchrotron Radiation, **15** (2008), p. 449:457.