

Simultaneous XRD-XRF Mapping of Daguerreotypes 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 $K\alpha$ is recorded along with a diffraction pattern with an angular range of approximately $150^\circ 2\theta$. Figure 1 shows the results from the analysis of a Daguerreotype sample measured at the Smithsonian Museum Conservation Institute. A 100 μm X-ray beam (created using the XOS fleX-Beam system) was scanned over a Daguerreotype using the forward scattering geometry (see photograph on left). In the 250 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 diffraction and the fluorescence. This separation is not possible with a single silicon drift detector, but the CXC enables separation of the signals and significant improvement of the resulting X-ray image quality.

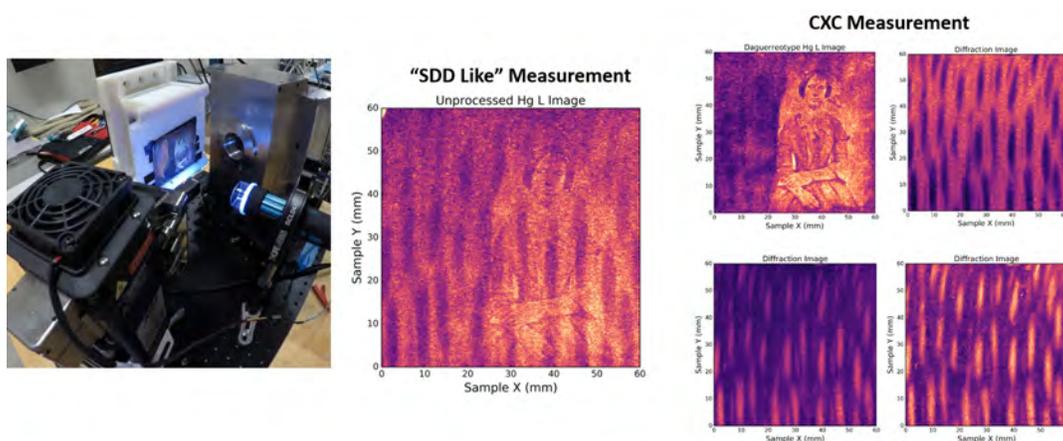


Figure 1: (Left) A photograph of the analytical setup showing the XOS fleX-Beam system and the Color X-ray Camera in the forward scattering geometry with the Daguerreotype sample at the center. (Middle) An unprocessed image where the diffraction and fluorescence signals are mixed. (Right) The result of separating the diffraction and fluorescence using the data from the CXC.

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.