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Improved Dynamic Analysis Method for Quantitative High Definition XFM Element Imaging using Maia

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Projection of quantitative element images from fluorescence data collected on the XFM beamline of the Australian Synchrotron equipped with a Maia detector and real-time processor uses the Dynamic Analysis (DA) method in the GeoPIXE software. It uses matrix transformations to achieve least-squares fitting of pixel spectra in X-ray fluorescence imaging and tomography at up to ~3 x 10^7 events per second in the FPGA processor for real-time imaging or ~2-8 x 10^6 on a desktop, which typically corresponds to about 10^4-10^5 pixels per second. At least initially, it assumes uniform sample composition, background shape and constant model X-ray relative intensities. Our present approach is to then apply an iterative matrix (composition) correction. But this does not account for changing background shape and X-ray relative intensities evolving spatially with significant changes in composition.

A new method, applied in a second pass, uses an end-member phase decomposition obtained from the first pass, and DA matrices determined for each end-member, to re-process the event data with each pixel treated as an admixture of end-member terms. This approach better tracks spatially complex samples as encountered in geological and environmental research while still benefiting from the speed of DA. The decomposition and DA matrices can be applied to a series of samples with similar content. This paper describes the method and illustrates how the enhanced accuracy of spectral deconvolution improves imaging of challenging materials.

Keywords or phrases (comma separated)

XFM imaging, Maia detector, Fluorescence, SXRF, quantitative analysis

Summary

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