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Hyperspectral X-ray Imaging

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We are developing a chemical imaging capability ("Hyperspectral X-ray Imaging") for microscopic samples based on ultra-high-resolution x-ray emission spectroscopy with large transition-edge sensor microcalorimeter arrays in the scanning electron microscope. By combining microcalorimeter arrays with hundreds of pixels, high-bandwidth microwave frequency-division multiplexing, and fast digital electronics for near real-time data processing, our goal is to enable practical chemical speciation analysis using small-laboratory instrumentation rather than synchrotron beamlines. Our focus is on mapping the detailed chemical form of microscopic particles containing materials from the nuclear fuel cycle. Their detailed chemical form is a crucial link to material origin, history, and behavior in the environment. In combination with developing the instrumentation to obtain high-quality x-ray emission spectra on such samples, we are working to develop a validated theory capability to interpret fine structure in the spectra and better understand fundamental properties of actinide chemical bonding. We will present our approach to developing the Hyperspectral X-ray Imaging capability, recent results from a 128-pixel microcalorimeter array at LANL and the 16-pixel STAR Cryoelectronics MICA-1600 spectrometer, and the path to high-throughput chemical mapping.

Less than 5 years of experience since completion of Ph.D

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Student (Ph.D., M.Sc. or B.Sc.)

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