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Synchrotron x-ray spectromicroscopy for trace chemical speciation at sub-20 nm resolution

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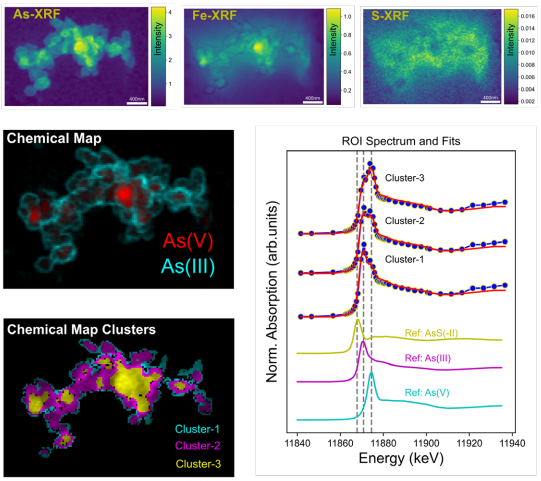

The advancement of hard x-ray nano-XANES for chemical speciation at nanoscale spatial resolution will be discussed in this presentation. The combined understanding of chemistry and morphology at high spatial resolution is a significant goal across various scientific disciplines. Hard x-ray nanoprobes have been developed at modern synchrotron light sources to probe elemental and chemical state information (spectromicroscopy) of samples within complex heterogeneous environments at nanoscale. In this presentation, I will elaborate on the development and applications of hard x-ray nano-XANES established at the hard x-ray nanoprobe beamline (HXN) at NSLS-II. We successfully reported sub-50 nm nano-XANES at photon energies ranging from 6 to 12 keV, suitable to study first row transition metal speciation. Our latest achievement is the development of sub-20 nm nano-XANES at incident energies from 12 to 18 keV, using multilayer Laue lenses (MLL) as the focusing optics. The application of nano-XANES in the oxidation of single-particle pyrite and arsenopyrite, correlating chemical state imaging with nano-XRF mapping will be discussed next. The oxidation state changes of Fe and As in intermediate phases during mineral oxidation are characterized using nano-XANES chemical imaging. In addition, the morphology changes of As, S, and Fe are correlated with chemical speciation elucidated the of mechanism oxidation. This presentation will also discuss the versatility of nanoscale x-ray spectromicroscopy in environmental and geochemistry sample systems.