ALS Beamline 10.3.2: a versatile hard X-ray microprobe on a bending magnet

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Beamline 10.3.2 is a hard X-ray microprobe used primarily for environmental, geological, and materials science work, though it is also used for many other types of investigation. It provides a probe of 1.5-15μm size in the energy range 2.4-17.5keV (SK-UL_3). The major techniques supported are micro X-ray fluorescence mapping (μXRF), point monochromatic micro X-ray diffraction (μXRD) and micro X-ray absorption spectroscopy (μXAS). The beamline is designed to use the limited brightness of the bending magnet source to full advantage, allowing μXAS data of quality which is often superior to that obtained from the same sample on undulator-fed beamlines. In addition, the beamline supports a number of "specialty" techniques such as chemical-state mapping, QuickXAS and fluorescence tomography.

Several scientific applications of this beamline will be discussed, in a wide variety of fields. The combination of multiple techniques (μXRF, μXAS and μXRD) will be emphasized to demonstrate how one can get the most information by using them together rather than separately. For instance, chemical-state mapping can be used to survey a sample, after which μXAS and μXRD can be used to verify the nature of individual particles found via mapping.

Capabilities which are now expected of new microprobes include continuous scanning over the sample (not step-and-repeat), the availability of μXRD, and a suite of analysis software and databases with which to understand the data as it's being acquired. In addition, flexibility around the sample area to put in special sample environments such as a total electron yield detector, a cold stage, or an in-situ reaction cell is increasingly important.

"Soft" features not generally listed on the specification sheet can nonetheless be very important. These include user-friendliness of the data-taking software and skilled beamline staff who can assist at all stages of a project from proposal submission to deep analysis to paper writing.

Finally, there are some speculative ideas which might be implemented on a new beamline. These include micro-SAXS mapping to probe the distribution of natural nanoparticles, correlated with composition, and micro powder diffraction phase mapping, which has been done before but now becomes truly practical due to increased flux and fast detectors. It should be possible to use the microprobe as a condenser stage for a TXM, which would enable a large range of additional experiments.