Holistically Optimized Laboratory XAS Systems

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For the first time, holistically optimized laboratory x-ray absorption spectroscopy (XAS) systems enable XAS measurements of most elements in the periodic table (Z>13) in minutes with energy resolution better than 0.7 eV, approaching capabilities of XAS facilities using bending magnet beamlines at second generation synchrotron light sources. The optimizations include:

- High brightness x-ray source with high thermal conductivity target incorporating diamond substrate, multiple target materials providing smooth spectrum free from characteristic x-ray lines, x-ray source size and shape optimized for using low miller index diffraction planes of cylindrically bent Johannsson crystal analyzers at low-medium Bragg angles, which provides optimal tradeoff between x-ray energy resolution and flux.
- Making use of dispersion of cylindrically bent Johannsson crystal analyzers in both tangential and sagittal directions for efficient use of source x-rays.
- 2D photon counting detector for recording x-rays dispersed by the crystal analyzer in tangential and sagittal directions and rejecting harmonics reflected by a crystal analyzer.

With those options, we have developed laboratory XAS systems operating from 1.7 keV to 25 keV, providing monochromatic x-ray flux over 2*10^7/s, and achieved energy resolution better than 0.7eV. The design and performances of the systems will be presented.