Micro-Focused Pink Beam For Time-Resolved X-Ray Emission Spectroscopy

MING-FENG TU, ANDRE AL HADDAD, GILLES DOUMY, STEPHEN SOUTHWORTH, ANNE MARIE MARCH, YOSHIKI KUMAGAI, DONALD WALKO, LINDA YOUNG, CHRISTOPH BOSTEDT, Argonne National Laboratory — X-ray emission spectra (XES) in the valence-to-core (vtc) region offer direct information on occupied valence orbitals. They emerge as a powerful tool for the ligand identification, bond length, and structural characterization. However, the vtc feature is typically two orders of magnitude weaker than $K\alpha$ emission lines, making it hard to collect, especially for transient species. To overcome the difficulty, pink beam excitation capability was demonstrated recently at Sector 7 of the Advanced Photon Source. A water-cooled flat mirror rejects higher harmonics, and beryllium compound refractive lenses (CRLs) focus the reflected fundamental beam (pink beam) to a $40\mu m \times 10\mu m$ elliptical spot at sample target that matches the laser spot size used for photoexcitation. With an X-ray flux of $10^{15}$ photons per second, non-resonant XES spectra were taken on iron(II) ferrocyanide and on photoexcited iron(II) tris(2, 2′-bipyridine). We could reproduce previous measurements with only a fraction of the acquisition time, demonstrating the ability to measure high quality spectra of low concentration species.

Work was supported by the U.S. Department of Energy, Office of Science, Chemical Sciences, Geosciences, and Biosciences Division

Ming-Feng Tu
Argonne National Laboratory

Date submitted: 26 Jan 2018

Electronic form version 1.4