Materials Science Facility at 9-ID Beamline

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Abstract

The future APS-U will enable groundbreaking new capabilities for probing the structural, chemical, electronic, and magnetic properties of matter using X-ray diffraction and scattering techniques. Enhanced beam properties will be particularly important for studies of materials under *in operando* conditions (high pressure, temperature, magnetic field...) where sampling volumes are small and located inside complex environments. With these new-generation beams, the opportunities for transformational breakthroughs in basic and applied science are clear, but the full impact of these capabilities is beyond our imagination at this time.

We propose to develop a materials science oriented beamline, which will combine scattering techniques, namely: ultra-small angle scattering, small-angle scattering (& imaging), and wide-angle scattering, with imaging & tomography, in a "one-stop-shop" facility. Canting the 9-ID beamline (which is partially ready) will provide space for two complementary and independently operated instruments.

On the main line, there will be a totally redesigned USAXS/SAXS/WAXS instrument. This instrument will be dramatically upgraded to provide USAXS/SAXS/WAXS techniques with significantly higher q-resolution and an energy range from 7 keV to 30 keV. This energy range will enable us to support anomalous USAXS in the range of most interest to materials science. During the redesign we will be able to facilitate rapid changes between USAXS/SAXS/WAXS, diffraction enhanced and radiographic imaging and tomography, as well as USAXS-XPCS in the instrument, making it convenient to apply all these techniques together within a single experiment.

On the canted line, we propose developing a multi-detector pinhole SAXS/WAXS camera operating between 20 keV and 30keV. This SAXS camera will provide time resolved capabilities with up to 1 ms time resolution, SAXS imaging, and XPCS capabilities in an energy range of interest in materials science.

With these two beamlines combined, this advanced materials characterization facility will provide urgently needed access to a wide range of scattering and imaging techniques needed for future materials development, while building on the well proven unique capabilities available at the APS today. It will build on a decades old strong user community as well as the experience and expertise of the APS staff.