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ADVANCED PHOTON SOURCE

LERIX: Pinning Down the q in XRS

Nineteen measurements are better than one—especially if one is using nonresonant x-ray Raman scattering (XRS) techniques to study certain low-Z elements. The problem is that XRS yields a low cross section, making measurement at differing momentum transfer q values tedious and time-consuming, because the instrumentation usually must be repeatedly retuned or realigned for the different q levels. Obviously, the ability to measure XRS simultaneously at many different values of q would be a boon for researchers using XRS and would improve counting statistics. An instrument capable of doing just that—the lower energy resolution inelastic scattering (LERIX) spectrometer—has been developed by a research group from the University of Washington; Argonne; the University of California, Davis; the New Jersey Institute of Technology; and the NJ-XRSTECH Company, and made available to APS general users.

LERIX (photo above) is a multielement spectrometer consisting of 19 analyzers arranged in a semicircle and mounted in an aluminum frame. An incident x-ray beam enters horizontally from one side of the base to focus on the sample enclosure at the center of the semicircle. At each end of the base is a gas ionization chamber for measuring the incident and transmitted energy of the x-ray beam. The arrangement of the analyzers allows the simultaneous measurement of XRS from the sample ranging from the low-q dipole limit to a high-q multipole limit near backscattering. Surrounding the sample enclosure at the center of the semicircle are 19 NaI scintillation detectors. The sample enclosure, like the area inside the semicircle between the sample and the analyzers and detectors, is filled with He to reduce air scattering. The instrument was carefully designed to minimize background signal from stray x-ray scattering. For example, with nearly 10^{13} photons/s incident on the sample, there are typically only a few-photons-per-second of stray background counts at each detector.

Numerous experiments have been carried out to demonstrate instrument versatility. These include measurements (at the XOR/PNC 20-ID beamline) of both the LiC_6 and the Li-metal oxide electrode materials in Li-ion batteries; of the isomers of a carborane molecule, which may be a novel component in future cancer therapies; and of carbon "nano-onions," which have been proposed to be an important constituent of interstellar dust. Preliminary results for the first two LERIX general user groups have included clean data on boron-carbide ceramics used for coatings of industrial tools and on silicon-oxide glasses for improved solar cell technology. LERIX promises to allow high-energy, nonresonant IXS experiments with a great deal of versatility and adaptation to the needs of individual users. It opens the door to the further development of XRS as a powerful research technique for the 21st century.

— Mark Wolverton

See: T.T. Fisher et al., "Multielement spectrometer for efficient measurement of the momentum transfer dependence of inelastic x-ray scattering," Rev. Sci. Instrum. **77**, 063901 (2006) DOI: 10.1063/1.2204581

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At the Advanced Photon Source, our door is open to experimenters from all scientific disciplines whose research requires the highest brilliance hard x-ray beams in the Western Hemisphere.
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Information on access to beam time at the APS is at http://www.aps.anl.gov/user/beamtime/get_beam.html or contact Dr. Dennis Mills, DMM@aps.anl.gov, 630/252-5680.

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