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Multipole X-ray Spectroscopy Using Non-resonant X-ray Raman Scattering TIM FISTER, GERALD SEIDLER, ADRIENNE BATTLE, University of Washington, JULIE CROSS, ALBERT MACRANDER, Advanced Photon Source, QING QIAN, TREVOR TYSON, New Jersey Inst. of Technology, UNIV. OF WASHINGTON COLLABORATION, ADVANCED PHOTON SOURCE COLLABORATION, NEW JERSEY INST. OF TECHNOLOGY COLLABORATION — The information obtained by non-resonant inelastic x-ray scattering, commonly known as non-resonant x-ray Raman scattering (XRS), has both similarities and key differences when compared with that obtained by traditional x-ray spectroscopies such as from XAFS measurements. In the dipole limit ($qa \ll 1$), the matrix elements for XRS is proportional to that for x-ray absorption spectroscopy but with the direction of the momentum transfer playing the role of the polarization vector. However, XRS measurements at high q can often go beyond the dipole limit—leading to “forbidden” multipole excitations. This q -dependence can help separate various contributions to the local density of states, providing new information on the symmetries of a material. A primary drawback to XRS is its low cross-section, which is compounded measurements at multiple values of q are needed. In response, we have built a multi-element apparatus to measure up to 10 values of q simultaneously. We apply this instrument to a range of problems, including the valence-band exciton in LiF and the L - and M -edges of transition metals, transition metal oxides, and several minerals for the purpose of prototyping future measurements under high pressure.

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