Quartz-based flat-crystal resonant inelastic x-ray scattering spectrometer (RIXS) with sub 10 meV energy resolution

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High energy-resolving power of a spectrometer is crucial to address topical science in the fields of condensed matter physics and materials science. Few meV energy resolutions of hard x-ray inelastic scattering spectrometers are typically achieved by matching the x-ray energy to the desired Bragg backscattering reflection of spherically diced Si analyzer. The resonant character of resonant inelastic x-ray scattering (RIXS) prevents such tuning of the x-ray energy and the best achievable energy-resolution of spherically diced Si analyzer is in the range of few tens of meV. In this presentation, we introduce a Quartz-based flat-crystal RIXS spectrometer, which can provide sub-10 meV energy resolutions for L-edges of 5d elements. We constructed the 4 meV RIXS spectrometer for the L_3-edge of Ir element (11.215 keV) and achieved 9.7 meV total energy resolution with 8.9 meV bandpass incident x-rays. Furthermore, for the first time, the new spectrometer allows efficient polarization analysis in a RIXS measurement without loss of energy resolution. The capabilities of the instrument are demonstrated by first measuring longitudinal acoustical and optical phonons in diamond for calibrating the energy scale, followed by recording magnon spectra at the magnetic zone center in $Sr_3Ir_2O_7$. A polarization analysis with high efficiency and no loss in energy resolution completes a characterization of the new instrument. Preliminary measurements on Sr_2IrO_4 and Na_2IrO_3 will be presented.