A bent Laue spectrometer for x-ray Raman and Compton scattering studies

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Abstract

We are developing an IXS spectrometer optimized at 20 - 30 keV x-ray region. The spectrometer consists of a bent Laue analyzer and a large-area multi-channel scintillation detector. The commissioning has been successfully made and many experiments are being performed. Two examples of the applications will be discussed.

I. X-ray Raman studies under high pressure.

An advantage in X-ray Raman scattering is the transition matrix transforming from dipolar to multipolar as momentum Q increases. Nonetheless, it is sometimes hampered to measure a spectrum at low-Q or a small scattering angle if the sample includes heavy elements. The reason is that the transmission geometry is often restricted for such samples due to the short penetration length and thus one need to attempt the reflection geometry, being mostly problematic if the sample has poor surfaces or is in a complicated environment, typically in high pressure apparatus. The bent Laue spectrometer is advantageous in such cases because one can use higher energy x-rays having much longer penetration length.

II. Ultra high-resolution Compton studies

The typical Compton scattering studies are performed at a 0.1 a.u. or 0.2 A-1 momentum resolution using 100 keV x-rays. If the energy decreases down to 10 keV, one can easily get a higher instrumental resolution by an order of magnitude but the actual resolution is limited due to the final states effect. In order to overcome the problem we need to increase the x-ray energy with maintaining the resolution of E/dE=5000 - 10000. The possibility of such ultra-high resolution Compton studies will be discussed along with several experimental data.

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