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High Energy-Resolution X-rays and Applications in Materials Science: The Case with Inelastic X-ray Scattering

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Abstract content

The advent of tunable, highly intense and bright synchrotron radiation, and technical advances in the last decades have provided an increasingly powerful source for a broad range of spectroscopic tools, including inelastic x-ray scattering (IXS), for materials research. The construction of dedicated facilities that routinely deliver x-ray beams with μm focal size, energy resolution down to ˜meV, and flux on the order of 1010 photons/sec/meV was imperative for the fruitful development of various IXS techniques for the study of lattice dynamics and correlation effects of electrons in many-electron systems. The high penetration depth of hard x-rays offers furthermore unique strength in the study of materials properties under extreme thermal dynamical conditions such as high pressure and extreme temperature. In this presentation, the current status of the IXS techniques will be reviewed and illustrated with examples drawn from high-resolution experiments on a variety of systems, including low-energy charge excitations of a few archetypal materials and materials under the extremes of pressure and temperature. Some perspectives for further developments in the field, particularly in connection with the IXS capabilities planned or being developed at NSLS-II, will also be discussed.

Summary

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