ID28 - Inelastic Scattering II

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Synopsis

Beamline ID28 is dedicated to the study of phonon dispersion in condensed matter at momentum transfers, Q, and energy transfers, E, characteristic of collective atom motions. Inelastic X-ray scattering (IXS) is therefore closely related to inelastic neutron scattering (INS) techniques, and consequently largely shares the scientific questions addressed in fields ranging from life science to materials research. IXS is particularly suited for the study of disordered systems such as liquids and glasses in a Q,E-range inaccessible to INS and of samples only available in very small quantities (<< 1 mm3) and/or submitted to very high pressures (up to 100 GPa). The beamline characteristics are as follows:

- Incident photon energy: 13840, 15817, 17794 and 21747 eV.
- Energy resolution of 7.0, 5.5, 3.0 and 1.5 meV.
- Energy transfer: 0 – 200 meV
- Momentum resolution: typically 0.03 nm^{-1} (can be further improved by slits).
- Momentum transfers from 1 – 100 nm^{-1}.
- Five momentum transfers are recorded simultaneously.

Scientific Applications

Determination of the phonon dispersion, or more generally, of the high-frequency (THz) collective dynamics, allows to access various material properties such as sound velocities, elastic constants, interatomic force constants, phonon-phonon interactions, phonon-electron coupling, dynamical instabilities, relaxation phenomena etc. Applications of inelastic X-ray scattering from phonons on ID28 can be roughly divided into three categories:

- Phonon dispersion in crystalline materials, only available in very small quantity, or otherwise incompatible with inelastic neutron scattering techniques: (High-temperature superconductors, large bandgap semiconductors , actinides)
- Determination of the high-frequency collective dynamics in disordered systems: (Hydrogen-bonded liquids, liquid metals, molten salts, glass formers, quantum liquids, biological materials)
- Phonon dispersion under extreme conditions of very high pressure (up to 100 GPa): (geophysically relevant materials, metals, liquids)

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