High-Resolution Inelastic X-ray Scattering of Materials of Geophysical Interest

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Inelastic X-ray scattering (IXS) has progressively arisen as one of the major spectroscopic tools with the advent of bright X-ray sources of 3rd generation. It offers the unique opportunity to investigate the phonon or electronic properties *in situ*, at various conditions of pressure and temperatures, and is thus very well suited to the study of the composition and dynamics of the Earth and planetary interiors.

The elasticity and the sound wave anisotropy of hcp-metals, namely iron and cobalt have been investigated at high-pressure by very high resolution (meV) IXS. I will address the case of hcp-iron, the main constituent of the Earth's inner core, and report the direct experimental determination of the anisotropy in the propagation of longitudinal acoustic waves in textured sample above 100 GPa. Hcp-cobalt, here chosen a proxy for iron, has also been studied with the advantage to be available as single crystals, thus making the determination of the full elastic tensor possible at high pressure.

The electronic and magnetic properties of minerals under extreme conditions of pressure or temperature can also be studied through X-ray emission spectroscopy (XES) in the fluorescence regime. We measured the spin state of iron in the main constituent of the Earth's lower mantle, *i.e.* the iron-bearing magnesium silicate perovskite $(Mg,Fe)SiO_3$, by studying the Kβ emission line to pressures exceeding 140 GPa. Geophysical implications for both the anisotropy of propagation of acoustic waves in the Earth's core and the physical properties of the lowermost mantle will be discussed.

Keywords: geophysics, inelastic x-ray scattering, high-pressure