

**Abstract****Electronic structure studies by hard X-ray absorption and emission spectroscopy**

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The electronic structure can be studied element-selectively by inner-shell X-ray spectroscopy where an incident photon creates a hole in a core level of the electron shell. It is often desirable to use X-rays with energies above 5 keV (hard X-rays) with sufficient penetration depth to perform experiments in extreme (e.g. high pressure) or *in-situ* conditions (e.g. for catalysis). This lecture will provide an introduction to hard X-ray absorption (XAS) and emission spectroscopy (XES) and its sensitivity to various aspects of the electronic structure (oxidation and spin state, covalency, ligand identification, magnetic coupling). The X-ray emission after resonant excitation (RXES or resonant inelastic X-ray scattering (RIXS)) increases the sensitivity of XAS-XES and allows studying the core hole effect in detail. Examples will be given from applications in materials science, catalysis and coordination chemistry. Recent results in ultra-fast spectroscopy will be discussed.

- [1] P. Glatzel and U. Bergmann, "*High resolution 1s core hole X-ray spectroscopy in 3d transition metal complexes - electronic and structural information*", *Coord. Chem. Rev.* **249** 65-95 (2005).
- [2] F.M.F. de Groot and A. Kotani, *Core Level Spectroscopy of Solids*. Advances in Condensed Matter Science, ed. D.D. Sarma, G. Kotliar, and Y. Tokura. Vol. 6. 2008, New York: Taylor and Francis.