

Femtosecond X-ray Experiments: new observables for chemical dynamics studies

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Time-resolved X-ray methodologies allow measuring electronic and geometric structure changes. X-ray emission spectroscopy is sensitive to electronic changes, such as oxidation and spin states, while X-ray Absorption Fine Structure tools deliver information about the local geometric structure around the selected absorbing atom. Combining these tools with forward scattering in one single setup allows extracting simultaneous information about the local to rather global structural changes occurring in the reacting system.

We will present some case examples, for which picosecond and femtosecond X-ray pump-probe experiments deliver new insight into evolving dynamic processes, including reactive high-valent iron compounds and a class of spin transition systems. This will be preceded by an introduction about the information content of those X-ray techniques.

Finally, all these tools can be combined into one single experimental setup, and the Femtosecond X-Ray Experiments (FXE) Instrument at the European XFEL will allow just this, and its operation has just started in 2017. We will present the current status of this new instrument at the only worldwide existing high repetition rate hard X-ray free electron laser together with some early results.