

Time-resolved Structural Science

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Time-resolved structural methods (electron and X-ray based) from femtoseconds to nanoseconds have witnessed impressive developments over the past ten to twenty years. New schemes have been implemented at synchrotrons, but also disruptive developments of new sources of electron and X-ray pulses, both table-top and at large scale facilities (specifically, X-ray free electron lasers), have largely driven the developments. I will dwell on examples in time-resolved X-ray and electron diffraction of various systems, before discussing results obtained using X-ray spectroscopy. X-ray absorption spectroscopy is sensitive to the electronic and geometric structure around specific elements via its XANES and EXAFS features. Over the past twenty years, my group and I have implemented time-resolved X-ray absorption spectroscopy, first in the picosecond time-domain, then the femtosecond domain, specifically for the study of solution-phase (bio)chemical and nanostructures. I will present and discuss examples of the structural dynamics of molecules in solution, proteins in physiological media and nanoparticles in solution. I will finally dwell on the current developments enabled by X-ray Free electron lasers, which hold great promise of deeper insights and specificity into chemical processes.