

Novel characterization methods of the ultrafast electronic and structural dynamics in nanomaterials

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The past ten years have witnessed a revolution in science with the advent of X-ray free electron lasers (XFEL) and table-top sources of short-wavelength radiation. XFELs in particular provide pulses of ultrashort time duration, high fluxes, high coherence, polarization control, etc., which allow novel methods to be implemented. Among these are photon-in/photon-out methods such as X-ray emission spectroscopy (XES), resonant Inelastic X-ray scattering (RIXS), or non-linear X-ray optical methods. In my presentation, I will discuss the use of ultrafast Angle-resolved Photoelectron spectroscopy (ARPES), X-ray absorption spectroscopy (XAS), XES and RIXS to probe the charge carrier and structural dynamics, as well as transport phenomena in (nano)materials such as transition metal oxides and perovskites. I will finish by presenting the state-of-the-art of X-ray studies and give an example of hard X-ray transient grating non-linear spectroscopy, as well as subsequent developments.