

New capabilities at accelerator-based light sources include the generation of two-color x-ray pulses with controlled time delay. We present first experiments using two-color double pulses for a spectroscopy experiment in the soft x-ray regime and scattering experiment in the hard x-ray regime. With soft x-rays we studied the x-ray-induced intramolecular dynamics initiated in the XeF<sub>2</sub> triatomic molecule from one site of the molecule to another site with a temporal resolution below 10fs. These experiments allowed us to gain insight into fundamental molecular processes that underlie chemical reactivity and biological processes that typically involve intramolecular dynamics consisting of nuclear motion and the flow of charge and energy across atomic sites. With hard x-rays we investigated the structural dynamics in nanoparticles upon x-ray exposure. We find that the nanoparticle transiently contracts within the first 80 fs following x-ray irradiation before ultimately disintegrating in a rapid hydrodynamic expansion. The contraction can be attributed to the massive x-ray induced electronic excitation that induces a collective change in the bond character of the nanoparticles.