

Ultrafast Near-Field-Controlled Dynamics and Disintegration of Isolated Nanoparticles

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When the wavelength of a driving laser becomes comparable to the characteristic dimensions of a nanostructure, highly complex near-field distributions can emerge. The spatial structure of these fields as well as the magnitude of the associated field enhancement are governed by the size, geometry, and optical properties of the target. Previously such near-field effects have successfully been exploited to achieve controlled electron emission from nanostructures such as silica nanoparticles and nanotips. However, to which extent laser heating and in particular the ensuing atomic dynamics can be controlled through such tailored near-fields remains an important question. We addressed this in a series of studies with increasing near-field complexity utilizing the coherent diffractive imaging technique in laser-pump/X-ray-probe experiments at XFEL facilities. The unprecedented access to the expansion dynamics of isolated, laser-driven nanosystems in such experiments enables us to directly probe the influence of structured near-fields on ultrafast energy deposition and material response. Here, we present the results of this ongoing collaborative effort between experiment and theory.