

Dynamics on the nanoscale: optical antennas for imaging with nanometer spatial and femtosecond temporal resolution

The natural time- and length-scales of the elementary excitations in matter define a new regime of ultrafast vibrational and electron dynamics as the dimensions of the medium shrink into the 1 to 100 nm range. To achieve the required femtosecond temporal and nanometer spatial resolution we take advantage of the optical antenna properties of nanoscopic metal tips. They provide the necessary local field enhancement and spatial confinement for so called scattering-type near-field optical microscopy. As examples I will discuss our recent results on the spatially resolved optical response of plasmonic nanocrystals, the nonlinear optical imaging of domain order in multiferroic manganite, and the vibrational dynamics of molecular nanostructures.