Abstract for an Invited Paper for the NWS09 Meeting of The American Physical Society

## **Optical antennas for nanoscale imaging and spectroscopy: probing matter on its natural time and length scales** MARKUS RASCHKE, University of Washington

The natural time- and length-scales of the elementary excitations in matter define a new regime of ultrafast vibration 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 what became known as scattering-type near-field optical microscopy. I will discuss several examples of linear and nonlinear spectroscopic imaging in the visible and infrared spectral region providing direct access to the molecular vibrational dynamics in organic nanocomposites, the ultrafast electronic decoherence of plasmonic nanostrucutres, or the phase behavior of complex materials such as transition metal oxides. I will also discuss new concepts for the rational design of nanoconfined light sources for spectroscopy and imaging.