



Applications of plasmonic and dielectric nanoantennas in nanophotonics

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Optical nanoantennas based on metallic nanostructures enable the controlled focusing of light from the far field to highly confined volumes below the diffraction limit, and furthermore form the basis of implementations of metamaterials and metasurfaces operating in the optical regime of the spectrum.

Upon excitation of the plasmon oscillation, parts of the energy get dissipated via electron/hole pair formation, leading ultimately to dissipation into phonon modes. Here, we show how the vibrational frequencies of these modes can be controlled on the nanoscale, at the level of an individual nanoantenna. This is achieved via pinning certain parts of the antenna stronger to the substrate, utilizing oxide bar layers. Comprehensive finite element modelling combined with degenerate fs pump probe spectroscopy allows us to determine the ratio of the amplitudes of the underlying vibrational normal mode, demonstrating the tailoring. We believe that this work could be the start of a new avenue for control over electromagnetic - acoustic coupling in optical metasurfaces.

We further demonstrate the mapping of plasmonic hot spots using super-resolution far-field fluorescence spectroscopy, including a de-coupling of enhanced absorption and emission processes. The crucial role of the latter in determining the position of the emitter with respect to the antenna will be elucidated. Finally, we will present applications of dielectric nanoantennas for surface-enhanced spectroscopies, including antennas operating via localized surface phonon-polarion modes.