NST-002

Scattering characteristics of metal and dielectric optical nano-antennas

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Optical resonances of metallic or dielectric nanoantennas enable to effectively convert free-propagating electromagnetic waves to localized electromagnetic fields and vice versa. Plasmonic resonances of metal nanoantennas extremely modify the local density of optical states beyond the optical diffraction limit and thus facilitate highly-efficient light-emitting, nonlinear signal conversion, photovoltaics, and optical trapping. The leaky-mode resonances, or termed Mie resonances, allow dielectric nanoantennas to have a compact size even less than the wavelength scale. The dielectric nanoantennas exhibiting low optical losses and supporting both electric and magnetic resonances provide an alternative to their metallic counterparts. To extend the utility of metal and dielectric nanoantennas in further applications, e.g. metasurfaces and metamaterials, it is required to understand and engineer their scattering characteristics.

At first, we characterize resonant plasmonic antenna radiations of a single-crystalline Ag nanowire over a wide spectral range from visible to near infrared regions. Dark-field optical microscope and direct far-field scanning measurements successfully identify the FP resonances and mode matching conditions of the antenna radiation, and reveal the mutual relation between the SPP dispersion and the far-field antenna radiation. Secondly, we perform a systematical study on resonant scattering properties of high-refractive-index dielectric nanoantennas. In this research, we examined Si nanoblock and electron-beam induced deposition (EBID) carbonaceous nanorod structures. Scattering spectra of the transverse-electric (TE) and transverse-magnetic (TM) leaky-mode resonances are measured by dark-field microscope spectroscopy. The leaky-mode resonances result a large scattering cross section approaching the theoretical single-channel scattering limit, and their wide tuning ranges enable vivid structural color generation over the full visible spectrum range from blue to green, yellow, and red. In particular, the lowest-order TM01 mode overcomes the diffraction limit. The finite-difference time-domain method and modal dispersion model successfully reproduce the experimental results.

Keywords: optical nanoantenna, scattering, plasmonic, Mie resonance

NST-003

Nanoparticle plasmonics: from single molecule chemistry to materials science

김지환

서울대학교 화학과

I will present my research group's recent investigation on how the localized plasmon of a nanoparticle interacts with another plasmon, and with nearby molecules. First, I will demonstrate the use of scattering-type scanning near-field microscopy (s-SNOM) to directly visualize the capacitive / conductive coupling in dimeric nanoparticles and heterometallic nanorods. Second, I will talk about the use of gap-plasmons to locally induce photochemical reactions, and to follow chemical kinetics of individual organic molecules using the gap-plasmons. As a last topic, I will talk about the use of near-field coupling between a scanning probe and graphenes to visualize / identify the stacking domains (e. g., ABA versus ABC-type stacking in triple layer) hidden in multilayer graphenes.

Keywords: plasmonics; single-molecules; SERS