Plasmonically enhanced light-matter interaction

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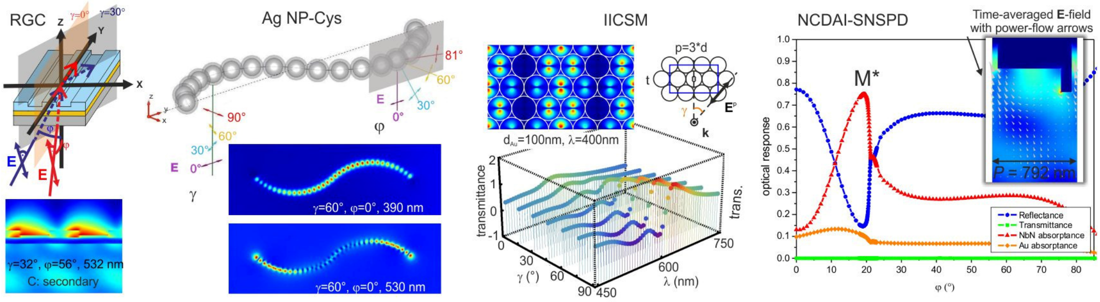
Characteristic far-field and near-field phenomena accompanying excitation of propagating surface plasmon polaritons and localized plasmons were studied by finite element method and by experimental surface plasmon resonance spectroscopy. It was proven that the optical responses as well as the near-field distribution can be controlled by optimizing the structure of various architectures supporting plasmonic modes and by tuning the direction of polarized light illumination. On bimetal films covered by wavelength-scaled periodic fused silica and polymer gratings the analogy between energy and momentum gaps was demonstrated. It was shown that the origin of double resonance minima in reflectance is simultaneous excitation of two different eigenmodes on the grating with **E**-field maxima along the valleys and hills. The multilayer parameters (modulation depth, fill-factor, profile) were varied to enhance sensitivity achievable via bio-sensing platforms based on periodic structures [1]. On two-dimensional arrays of bio-functionalized noble metal nanoparticle aggregates appearance of double peaked spectra was explained by excitation of collective resonances in the UV and visible region. It was shown that the near-field distribution originating from co-existent antenna-like eigenmodes and from strongly squeezed grating coupled guided modes can be precisely tailored by the illumination direction. Appearance of resonator modes accompanied by large **E**-field enhancement and tuning methods with potential to enhance sensitivity in aggregates-based bio-sensing were demonstrated [2]. A novel integrated lithography was developed, which is based on the combination of laser-based interference and colloid sphere lithography. It was demonstrated that by varying the wavelength, angle of incidence and relative orientation of interference patterns with respect to colloid sphere monolayers four independent structure parameters can be tuned. Variation of periodicity as well as distance, size and fine structure of nano-objects makes four degrees of freedom in spectral engineering achievable. Complex structures composed of wavelength-scaled arrays of nano-objects can be fabricated, which ensure enhanced sensitivity and specificity in bio-detection [3]. Versatile sub-wavelength and wavelength-scaled periodic plasmonic patterns were integrated into superconducting nanowire single photon detectors. It was demonstrated that by applying appropriately designed nano-resonator-, deflector-, double-deflector and trench-arrays the achievable absorptance as well as the polarization contrast can be maximized via localized and propagating modes, which are efficiently coupled in optimal integrated detector configurations [4].



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