

Alternative approaches for enhancing plasmonic sensor performance

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Abstract

Strong light localization within metal nanostructures occurs by collective oscillations of plasmons in the form of electric and magnetic resonances. The high susceptibility of such localized surface plasmons (LSP) to refractive index changes has made it an excellent platform for rapid and label-free sensing, particularly in the development of low-cost sensing platforms in the visible spectrum. However, the linear relationship between sensitivity and resonance wavelength indicates that sensitivity decreases for shorter wavelengths. In this thesis, alternative plasmon resonance mechanisms are explored to address the challenges of plasmonic sensing in the visible frequency range. The numerical and experimental investigation of the magnetic-type LSP resonance is contrasted with the electric-type used in conventional LSP-based sensing. The role of geometry, especially height, on the resonance mechanisms is studied, in which it is found that higher aspect ratio structures, realized by a cost-effective electrodeposition process, support hybridized waveguide-type modes which far outperform typical planar resonance mechanisms both in sensitivity and in figure of merit (FOM). Furthermore, the practical implications of the work are discussed.