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Active plasmonic nanostructures

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Abstract:

In principle, the surface plasmon polaritons, at the planar metal/dielectric interface, cannot be excited by incident light. However momentum transfer from incident light to Surface Plasmon Polaritons (SPPs) inside the light line can be achieved by adding a periodic structure at the interface. The lattice wave vector can compensate the difference between incident light and surface wave momentum and satisfy momentum matching requirement. Two methods are commonly used to achieve this goal: first, using prism and second, surface engineering using different array apertures at the metal/dielectric interfaces.

In this thesis, the ruled grating pattern at the metal/dielectric interface using conventional photolithography technique was fabricated. The dimension of ruled grating pattern is proportional to expanding/collimating system in the interference set-up. In fact, a large area grating can be utilized for many optoelectronic applications with greater efficiency. In this work, large area grating pattern, 10×10 mm^2, on top of the microcavity structure was integrated that permitting cavity mode-SPP coupling. Hence, Rabi-like splitting was observed from the hybrid plasmonic microcavity. The splitting was created from the coupling of cavity mode with the surface plasmon polariton mode; anti-crossing was observed alongside the modal conversional channel on the reflection light measurement.

In following, it was experimentally explored the effect of using organic fluorescent molecules inside the hybrid plasmonic microcavity. Accordingly we integrated large area ruled metal grating onto photonic microcavity and assessed the cavity mode-SPP coupling with reflectivity measurement. We got much more grounded modal coupling in presence of florescent molecules within photonic cavity. The anti-crossing was detected with enormous Rabi-like splitting energy at 280 meV in the strong coupling regime. Besides we compared the coupling strength of plasmonic microcavities with various cavity lengths to explore the absorption impact.

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