Split Ring Resonators: Flexible and tunable metamaterials, Fano coupling and their applications in Sensing

Split ring resonators (SRRs) are widely used as plasmonics and metamaterials components because they have both the electric and magnetic responses. In this dissertation, by utilizing SRRs as the basic component, we developed a transparent and flexible metamaterials by attaching SRRs onto the polydimethylsiloxane (PDMS). The fabrication method and the sensing application are discussed. Secondly, we demonstrated a tunable and active metamaterial by integrating the SRRs to the phase change material vanadium dioxide (VO₂). Both the electric and magnetic resonance frequency can be tuned simultaneously by controlling the phase of VO₂. This tunability of the optical response can be utilized to manipulate the surface enhanced Raman scattering (SERS) intensity. Furthermore, the magnetic mode of SRRs was used to couple with the electric mode to generate the magnetic mode based Fano resonance. High order magnetic mode based Fano resonance was observed in the split ring resonator/disk nanocavity.

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