Color Routing and Coherent Perfect Absorption by Controlling the Phase in Plasmonic Metasurfaces

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Following Huygens'principle, the signal we perceive from a plasmonic system is determined by the phases of the different nanostructures that compose the system. This phase controls the spatial radiation distribution as well as the spectral response of the system. Actually, even the field scattered by a simple plasmonic particle exhibits a phase shift of pi when the exciting frequency goes through the plasmon resonance. In this presentation, we will show that it is possible to significantly expand the range of phase shifts by using more complex nanostructures, especially those that support Fano resonances. By composing a metasurface with such complex nanostructures fabricated in silver, we are able to control the scattered light and channel different colors into different directions. The relation between the bandwith of the effect and the geometry of the atoms composing the structure will be investigated in detail. In a second series of experiments, we will show that by controlling the phase of two beams incident on the plasmonic system, we can tune the absorption in the system from 18% to 96%, reaching nearly coherent perfect absorption. When this condition is met, the near-field in the metasurface is dramatically increased, which can lead to a very significant enhancement of the Raman signal for molecules on the metasurface.