応用物理学会学術講演会予稿のタイトル

Capacitive-mediated strong coupling in terahertz plasmonics metafilms

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Recently, the study of ultrastrong light-matter coupling has gained increased interest due to its potential application in optoelectronics, plasmonics and circuit quantum electrodynamics. One common way to achieve strong coupling is to place an emitter near or inside an optical cavity. In contrast to microcavities, where the light field is confined by two metallic layers or dielectric mirrors, an alternative approach to achieve strong coupling is provided by metamaterials (MMs) in which the confinement is provided by the evanescent field of localized plasmons**.** This has led to the demonstration of strong-coupling regime with a number of quantum systems including phonons [1], intersubband transitions [2] and cyclotron resonances [3]. In addition, resonant coupling leads to light–matter hybridization into two normal modes with an energy separation known as the vacuum Rabi splitting (VRS).

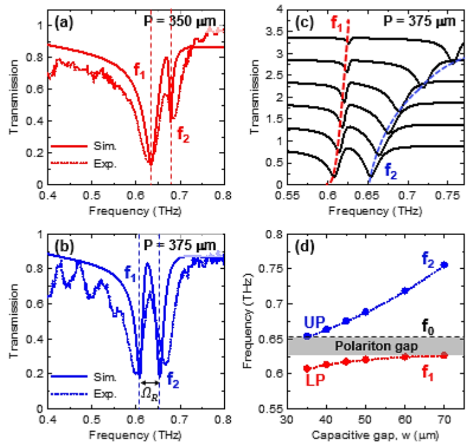

Fig. 1. (a)-(b) Simulated (solid line) and measured (dashed line) transmission spectra of the CSRRs array for P = 350 μm and 375 μm, respectively. (c) The transmission spectra for different values of the capacitive gap width *w*, when P = 375 μm. From bottom to top, *w* = 35, 40, 45, 50, 60 and 70 μm, respectively. (d) The simulated resonance position of the excited eigenmodes extracted from the spectra.

In this work, we investigate a THz planar metamaterial and observe the excitation of a polaritonic state as well as a VRS with a coupling strength of ~21%. Strong splitting results in the formation of a forbidden frequency gap that can be evaluated as a transparency window caused by the hybridization of two eigenmode (Figure 1). The physics of the transparency window is analogous to the lattice induced transparency effect [4] in which there are limited demonstrations in the literature of strong coupling due to cavity-cavity interactions. Further, we show that by increasing the capacitive gap width of the MM unit cell, we increase the overall capacitance of the MM and demonstrate an anti-crossing behavior; a key signature to strong-light matter coupling.

References:

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