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Hybrid polariton bands in an organic-dye-doped nanostructure[1]

RUWEN PENG, KUN ZHANG, WEN-BO SHI, YUE XU, MU WANG, Nanjing University, NATIONAL LABORATORY OF SOLID STATE MICROSTRUCTURES, SCHOOL OF PHYSICS, AND CICAM TEAM — Recently, controlling light-matter interactions by nanostructures has attracted much attention due to both fundamental and practical interest. In this work, we try to achieve multiple polariton bands in organic-dye-doped nanostructures by hybrid coupling among excitons, photons and surface plasmon polaritons(SPPs). We have demonstrated experimentally the hybrid coupling among molecular excitons, SPPs, and Fabry-Perot(FP) mode in a nanostructured cavity, where a J-aggregates doped PVA(polyvinyl alcohol) layer is inserted between a silver grating and a thick silver film. By tuning the thickness of the doped PVA layer, the FP cavity mode efficiently couples with the molecular excitons, forming two nearly dispersion-free modes. The dispersive SPPs interact with these two modes while increasing the incident angle, leading to the formation of three hybrid polariton bands. Besides, we have also experimentally presented multimode photon-exciton coupling in an organic-dye-attached photonic quasicrystal. This work may inspire related studies on hybrid light-matter interactions, and achieve potential applications on multimode polariton lasers and optical spectroscopy. References: 1) K. Zhang et al., Appl. Phys. Lett. 108, 193111 (2016); 2) K. Zhang et al., Opt. Lett. (accepted, 2016).

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