DOCTORAL THESIS

Active textured metallic microcavity

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Active Textured Metallic Microcavity

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Abstract

The control of the spontaneous emission of light can be achieved by placing the emitter in a suitable optical environment. Microcavity that has inherent photonic band structure within exhibits unique optical characteristics. Based on electron-beam lithography, we have successfully created a two-dimensional wavelength-scale periodic texture on one of the cavity mirrors with nanometer precision. The periodic lateral structure enables the Bragg scattering to occur. By performing the angle-resolved photoluminescence (ARPL) and transmission (ARTR) measurements, we mapped out the photonic modes inside the cavity and observed that the emitter radiated through the accessible photonic modes. In asymmetric structured sample, the waveguide mode inside the cavity split up at the Brillouin zone edge and bandgap was formed. The Bragg scattering mediated the coupling between the photons and surface plasmon (SP) in the metal/dielectric interface. The SP coupling dispersion curves for both ARTR and ARPL results were observed. We found that the air/silver interface SP dominant and there are enhancement in transmission/PL intensity where the photon wavevector and photonic energy matched with the SP. The simulations for photonic band structure and the surface plasmon coupling were performed and they are in good agreement with results. Careful tailoring of the photonic lattice parameters allows us to tune the emission characteristic of the microcavity. The present study shows that the 2-D patterned metallic microcavity has the potential in application such as super bright LED and also fundamental emission study of luminescent materials.

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