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Novel light emission engineering using III-V dielectric metasurfaces

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All-dielectric metamaterials consist of arrays of high-index, subwavelength-size Mie resonators have been attracting much attentions recently because they strongly interact with both electric and magnetic fields and therefore enable manipulation of the electromagnetic permittivity and permeability. Great success has been achieved in nonlinear optical processes, ultrathin optical components and advanced wavefront engineering using dielectric metamaterials. However, most of the work has been done using silicon, which is not an efficient light emitter. To overcome this, our group recently demonstrated III–V semiconductors based dielectric metamaterials using monolithic fabrication technique that allow for full integration with optoelectronic functionality. In this talk, I will show that we engineer the photoluminescence of light emitters that are epitaxially grown inside the dielectric metamaterials. We design and fabricate two different kinds of structures: symmetry-broken Fano resonator arrays and regular nano-cylinder resonator arrays. With both designs, we observe large enhancement of the photoluminescence intensities, wide spectral tuning as well as significant modification of far-field emission patterns. Our demonstration of active dielectric metasurfaces with enhanced and tunable PL paves the road for new ways to study light matter interaction and for using metasurfaces for tailoring the spectrum and beam shape of quantum emitters.