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Controllable emission of quantum dots coupled to magneto-electric Mie-type resonances of subwavelength all-dielectric nanoantennas

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250-word abstract for review

Recent experimental observations of strongly directional light scattering based on interference between electric and magnetic Mie-type modes supported by high-index all-dielectric nanoparticles [1,2] suggest a novel approach towards highly directional nanoantennas [3]. However, previous works so far have concentrated on directional far-field scattering effects, while the direct coupling of nano-emitters to such antennas remains largely unexplored. Here we investigate experimentally and numerically how the emission properties of near-infrared PbS quantum dots (QDs) are influenced by coupling to tailored electric and magnetic modes supported by silicon nanodisks.

In experiment we fabricate silicon nanodisks covered with a thin polymer layer containing QDs. A systematic variation of the nanodisk aspect ratio allows us to tune the spectral positions of the electric and magnetic resonances both with respect to each other and to the QD emission wavelength. We perform micro-photoluminescence (PL) spectroscopy measurements of the coupled system, showing that the QD emission properties are strongly modified by the presence of the silicon nanodisk antennas, and that the spectral PL line shape is strongly dependent on the nanodisk aspect ratio. Our results demonstrate that the role of high-index all-dielectric nanoparticles is not limited to creating highly directional effects, but that they can furthermore significantly modify the emission properties of spectrally matched QDs.

[1] S. Person *et al*., Nano Lett. 13, 1806 (2013).
[2] Y.-H. Fu *et al.*, Nat. Commun. 4, 1527 (2013).
[3] A. E. Krasnok *et al*., Opt. Exp. 20, 20599 (2012).

100-word text summary

Recent experimental observations of strongly directional light scattering based on interference between electric and magnetic Mie-type modes supported by high-index all-dielectric nanoparticles suggest a novel approach towards highly directional nanoantennas. However, the ability of all-dielectric nanoantennas to tailor the emission properties of nanoscale emitters remains largely unexplored. Here we investigate experimentally and numerically how the emission properties of near-infrared PbS quantum dots (QDs) are influenced by their coupling to tailored electric and magnetic Mie-type modes supported by silicon nanodisks, revealing a strong dependence of the QD photoluminescence line shape on the nanodisk geometry.