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Purcell factors exceeding 1,000 in directional and efficient plasmonic nanoantennas GLEB AKSELROD, CHRISTOS ARGYROPOULOS, THANG HOANG, CRISTIAN CIRACI, CHAO FANG, JIANI HUANG, DAVID SMITH, MAIKEN MIKKELSEN, Center for Metamaterials and Integrated Plasmonics, Duke University — To move nanophotonic devices such as nano-lasers, ultrafast LEDs, and single photon sources into the practical realm, a challenging list of requirements must be met, including directional emission, room temperature and broadband operation, and high radiative quantum yield, while having a large spontaneous emission rate. To achieve these features simultaneously, a platform is needed in which the various decay channels of embedded emitters can be fully understood and controlled. In this work[1] we show that all these device requirements can be satisfied by a plasmonic nanoantenna with emitters embedded in the nanoscale gap ($\sim$ 10 nm) between a metal film and a silver nanocube. Fluorescence lifetime measurements on ensembles of emitters reveal Purcell factors exceeding 1000 while maintaining high quantum yield (> 0.5) and directional emission (84% collection efficiency). Using angle resolved fluorescence measurements, we independently determine the orientations of emission dipoles in the nanoscale gap. By incorporating this information along with the three-dimensional spatial distribution of dipoles into simulations, we predict the emission dynamics in excellent agreement with experiment.

[1]Akselrod et al., *Nature Photonics* **8**, 835-840 (2014).

Gleb Akselrod
Center for Metamaterials and Integrated Plasmonics, Duke University

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