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Controlling spontaneous emission rates of quantum dots with plasmonic nanopatch antennas THANG HOANG, GLEB AKSELROD, CHRISTOS ARGYROPOULOS, JIANI HUANG, DAVID SMITH, MAIKEN MIKKELSEN, Center for Metamaterials and Integrated Plasmonics, Duke University — The radiative processes associated with quantum emitters can be strongly enhanced due to intense electromagnetic fields created by plasmonic nanostructures. Here, we experimentally demonstrate large enhancements of the spontaneous emission rate of colloidal quantum dots coupled to single plasmonic nanopatch antennas. The antennas consist of silver nanocubes (75 nm) coupled to a gold film separated by a thin polyelectrolyte spacer layer ($\sim$1 nm) and core-shell CdSe/ZnS quantum dots ($\sim$6 nm). By optimizing the size of the nanopatch antenna, the plasmonic mode is tuned to be on resonance with the quantum dot emission. We show an increase in the spontaneous emission rate by a factor of 880 (Purcell factor) and a 2300-fold enhancement in the total fluorescence while maintaining a high radiative quantum efficiency of $\sim$50 %. The nanopatch antenna, as demonstrated here, offers highly directional and broadband radiation that can be tailored for emitters from the visible to the near infrared, providing a promising approach for the spontaneous emission control of single quantum emitters.

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