Research Axis: Emerging Photonics and Materials

Experimental Investigation of Plasmonic Superradiance in Au-Fluorophore Nanohybrids

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Among the devices demonstrated during the last decade in the development of nanoplasmonics, one can notice the nanolaser proposed by Noginov *et al.* [i] in 2009 based on the surface plasmon amplification by stimulated emission of radiation (SPASER) introduced by Bergman and Stockman [ii] in 2003. This device consists in a strongly doped silica shell acting as a gain medium around a gold core. To gain insight into the way the coherent surface plasmon modes build-up in this system, it is of interest to consider the mechanism of plasmonic superradiance proposed by Pustovit and Shahbazyan to describe cooperative emission by a finite ensemble of emitters located near a metal nanoparticle [iii].

From this theoretical work we wish to study experimentally the emission of emitters (organic dyes or quantum dots) grafted onto a silica shell acting as a spacer with respect to a gold nanosphere. Using ensemble and single particle spectroscopy we estimate the fluorescence properties of the whole nano-hybrid to study the evolution of the collective light emission as a function of wavelength, amount of coupled emitters and distance to the plasmonic resonator. Here we present preliminary evidence of the plasmonic superradiance from the ensemble study of different concentrations of organic dyes grafted onto plasmonics nanoparticles.

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[i] M. A. Noginov, G. Zhu, A. M. Belgrave, R. Bakker, V. M. Shalaev, E. E. Narimanov, S.Stout, E. Herz, T. Suteewong, U. Wiesner, Nature 460, 1110-1112 (2009).
[ii] D. J. Bergman, M. I. Stockman, Phys. Rev. Lett. 90, 027402 (2003).
[iii] V. N. Pustovit, T. V. Shahbazyan, Phys. Rev. B 82, 075429 (2010).