Hybrid photonic-plasmonic crystals based on self-assembled structures

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The fields of photonic crystals and plasmonics have been actively explored over the past two decades as a means to exert control on light propagation and emission in ways not permitted by conventional materials. While photonic crystals have achieved unprecendent control over the guiding and generation of light, the nanoscale confinement of electromagnetic radiation allowed by metallic nanostructured systems remains unparalleled. Recently, the possibility of combining the two fields in hybrid metallodielectric structures has paved the way to strongly confine electromagnetic radiation while avoiding losses associated with metals [1,2].

We will present recent results regarding the possibility of fabricating hybrid photonic-plasmonic systems by means of self-assembly techniques. In particular, we have studied photonic crystals in the form of 2D arrays of organic spheres containing light emitters, coupled to surface plasmon polariton supporting substrates. Combining numerical simulations and a thorough optical characterization, an in depth understanding of the way light propagates in this kind of structures has been obtained. Beyond a complete study of the optical properties of passive systems[3], the possibility of strongly modifying the spontaneous emission of the internal light sources will be presented [4]. Other aspects of these systems, such as the possibility of fine tuning their optical response by means of a nanometer control of the dielectric components, will be discussed [5].

References

[1] J. Grandidier, S. Massenot, G. Colas des Francs, A. Bouhelier, J.-C. Weeber, L. Markey, A. Dereux, J. Renger, M. U. González, and R. Quidant, Phys. Rev. B **78**, (2008) 245419

[2] R.F. Oulton, V. J. Sorger, V. J. Zentgraf, R.M. Ma, C. Gladden, L. Dai, G. Bartal, X. Zhang, Nature **461**, (2009) 629

[3] J. F. Galisteo-Lopez, M. Lopez-Garcia, C. Lopez, and A. Garcia-Martin, Appl. Phys. Lett. **99**, (2011) 083302

[4] M. López-García, J.F. Galisteo-López, A. Blanco, J. Sánchez-Marcos, C. López and A. García-Martín, Small **6**, (2010) 1757

[5] M. López-García, J.F. Galisteo-López, A. Blanco, C. López and A. García-Martín, Adv. Funct. Mater. **20**, (2010) 4338

Figures

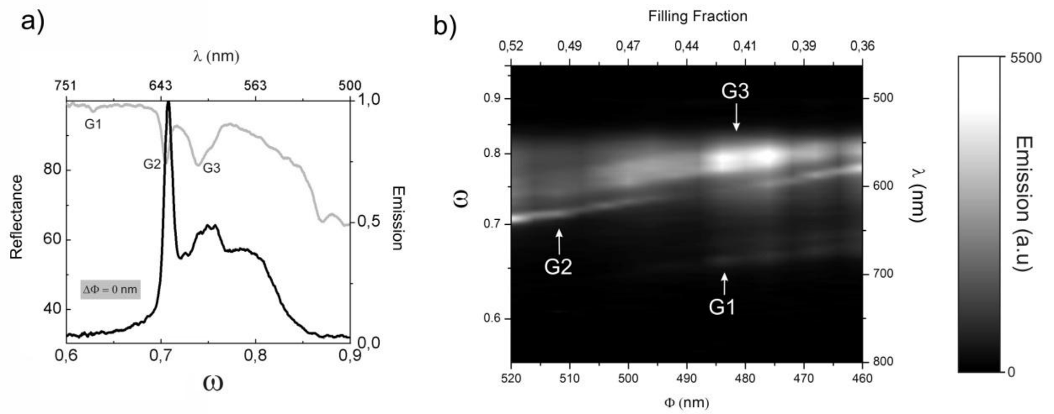

Fig. 1 a) Normal incidence reflectance (grey) and emission (black) for close-packed lattice of red dye dopped PS 520 nm polystyrene spheres on gold substrate. b) Evolution of emission with filling fraction variation. G1, G2 and G3 are the best defined modes shown as dips in reflectance in a)