High-density photo- and magneto-active hybrid core-shell nanoassemblies

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The tremendous development of organic electronics has brought neat organic materials, in particular small molecules, to the front stage. Although such small organic molecules have been combined to inorganic layers, their use as a real platform for hybrid nanoparticles has scarcely been envisaged. Such design strategy contrasts with the "classical" one where inorganic nanoparticles are grafted with functional organic molecules. It advantageously provides nanoassemblies with high density of inorganic nanoparticles (plasmonic or superparamagnetic). Novel synergetic optical or dipolar magnetic properties can thus be obtained owing to mutual nanoparticle coupling, which can be harnessed for data storage or bioimaging applications. We have developed a top-down assembling process conducting to reverse scaffolds (nanospheres, nanorods) made of a photoactive organic core (photochromic, fluorescent) surrounded by inorganic nanoparticles [1]. Two strategies were explored: i- the first method consisted in complexing pre-formed gold nanoparticles by a thiol-containing organic core while the second method involved progressive growth of gold seeds on the core itself. In both cases, clear coating with gold nanoparticles of the central platform was revealed by TEM imaging. In the case of direct complexation, SERS effects were evidenced and could be tuned upon changing the distance between the photochromic core and the gold nanoparticles (Fig. 1a-b) [2]. Surprisingly, no hot spots appeared despite the close vicinity of the self-assembled gold nanoparticles. In the case of seed-induced growth, electrostatic interactions were evoked to explain the appearance of sharp gold nanostructures instead of a continuous shell of gold nanoparticles, displaying a broad LSPR band in the near infrared range (Fig. 1c).

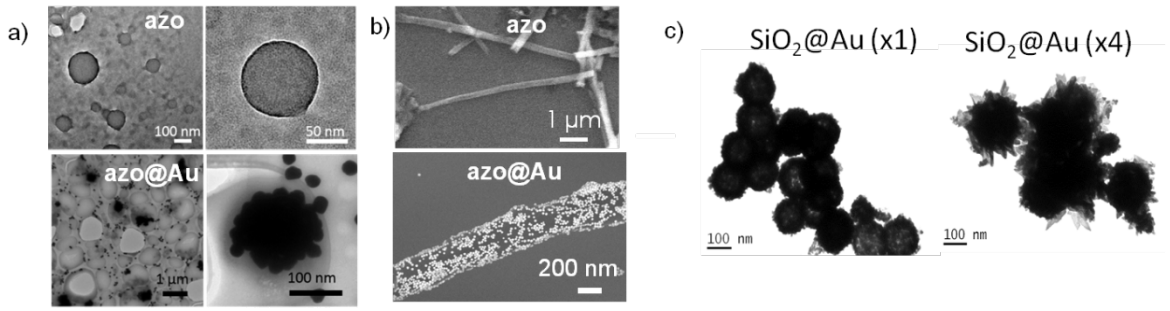

Fig. 1: a) TEM imaging of organic photochromic nanospheres coated with Au NPs. b) SEM imaging of organic photochromic nanorods coated with Au NPs. c) TEM imaging silica nanoparticles coated with Au NPs as a function of the gold seed concentration (×1 or ×4).

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