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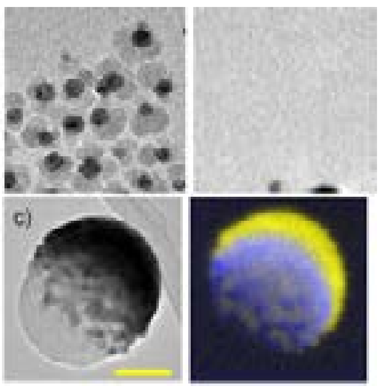
Multifunctional magneto-plasmonic nanostructures for nanotherapies and imaging

Magnetic nanostructures have demonstrated their enormous potential as biomedical nanodevices with both therapeutic and diagnostic activities. One of the most promising application is their use as heat mediators for magnetic fluid hyperthermia, where the nanostructures dissipate heat in the presence of alternating magnetic fields. Similarly, plasmonic nanostructures also exhibit encouraging properties in plasmonic absorption hyperthermia, where plasmonic nanostructures generate heat when irradiated with laser light. Thus, combining both properties in a single entity, i.e., magnetoplasmonic nanostructures, may open new avenues in the design of biomedical nanoplatfoms. Here we present two approaches for the design of magnetoplasmonic nanostructures for biomedical applications using bottom-up and top-down approaches. Magnetic-plasmonic nanoparticles of different sizes and morphologies based on Fe_3O_4 and Au were synthesized by thermal decomposition (bottom-up). This method allows the synthesis of particles with high crystallinity, defined shape and narrow size distribution. Colloidal lithography (top-down) was used to develop magnetoplasmonic nanodomes based on Au and Fe. Both types of structures exhibit appealing magnetic properties at room temperature and clear plasmonic resonances. Hyperthermia measurements show that these nanostructures can be used as heat mediators in magnetic and plasmonic modes. Moreover, the combination or magnetic and plasmonic moieties confers the system additional functionalities like the capability to act as contrast agent for X-Ray Computed Tomography and optical imaging (Au) or as magnetic resonance imaging, MRI (Fe and Fe_3O_4). This combination of properties paves the way to use these hybrid nanostructures as potential theranostic (therapy-diagnostic) agents.



Biography

Borja Sepulveda received his PhD degree in Physics from the Complutense University of Madrid in 2005. His Post-graduate research was carried out at the Microelectronics Institute of Madrid (CSIC). In 2006 he started a two years Postoctoral stay at the Bionanophotonics and Bioimaging group in Chalmers University of Technology (Göteborg, Sweden). In 2008 he joined the Catalan Institute of Nanoscience and Nanotechnology (ICN2) of Barcelona as Research Fellow, where he got a Ramon y Cajal grant in 2009. From 2012, he holds a permanent research position at the ICN2. During his scientific career, he has acquired a highly multidisciplinary experience, focused on the development of photonic and magnetic nanostructures for biomedical and environmental control applications. In particular, he has acquired experience in very diverse fields such as: photonics and nano-photonics, magneto-optics and magneto-plasmonics, nano-fabrication, surface chemistry and microfluidics. He is co-author of more than 50 publications, and the first author of three patents.

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