EXPERIMENTAL STUDY OF THE ARTIFICIAL OPTICAL MAGNETISM OF PLASMONIC NANOCLUSTERS IN THE VISIBLE RANGE

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Nanochemistry and self-assembly have become promising versatile fabrication methodologies for the production of controlled nanostructures. The versatility of chemical synthesis offers an almost unlimited range of achievable nanoparticles of controlled composition, size, shape, and surface coating. Self-assembly induces spontaneous structures, possibly presenting characteristic sizes at the nanoscale and variable degrees of order.

Among the exciting emerging functional nanomaterials, metamaterials are artificial composites presenting unusual properties of light propagation thanks to a specific structure at a lengthscale smaller than the operational wavelength. The search for meta-properties in the visible domain, which could open the way to technical breakthrough in optics such as hyperlenses and cloaking, is mostly focused on nanostructured plasmonic systems. In this context, chemistry and self-assembly of metallic nanoparticles can lead to interesting structures, in which the localized surface plasmon resonances of the metallic nanoparticles in the visible or near infrared regions, provide specific optical responses.

Plasmonic nano-clusters made of metallic satellites surrounding a dielectric core (so-called “plasmonic raspberries”) are a specific class of 'meta-materials', which are predicted to exhibit artificial optical magnetism and open a path to obtain materials presenting magnetic permeability different from 1. The magnetic response of assembled plasmonic raspberries depends on governing parameters like the sizes (core and satellites), the choice of materials and the number of satellites. Here, we study experimentally suspensions of assembled colloids made of spherical gold satellites distributed around a central silica core, with a global size of 160nm. Scattering cross-sections are measured by a polarization resolved spectroscopic light scattering experiment. We can measure separately the scattering of the electric and magnetic dipoles as they occur along orthogonal directions and with orthogonal polarizations.

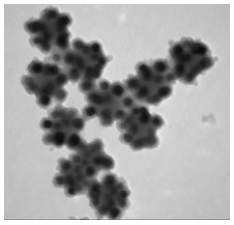

Figure: Transmission electron micrograph of plasmonic raspberries, with a 100nm silica core and 25nm diameter silver satellites.