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Synthesis of Monodisperse Gold Nanoparticles for Plasmonics

S. Marguet,[1*] J. Caron,[1] A. Habert,[1] M. Khaywah,[1]

[1] NIMBE, CEA, CNRS, Université Paris-Saclay, CEA Saclay 91191 Gif-sur-Yvette, France

Abstract:

Our research activities concentrate on the **synthesis and assembly of gold nanoparticles** for plasmonics that is a rapidly growing discipline at the interface of physics, chemistry and biology with promising applications.

We use a seed-mediated growth method of **colloidal chemistry** to synthesize gold nano- and micro-particles of **controlled shape and size**. This morphology control provides a fine tuning of the plasmon resonance wavelength and of the local field enhancement factor**.** Compared to top-down materials, these gold particles of **high crystalline quality** offer **better surface-confinement** of the electromagnetic field.

The figure illustrates some of the monodisperse gold NPs and gold nanohybrids we have been synthesized . Contrary to spherical and rod-shaped NPs that are commercially-available, other shapes such as nanocubes, nanotriangles and micro-plates with tunable sizes are only produced in our lab and in few laboratories worlwide, mainly in Asia. **Triangles** are of particular interest **for ultrasensitive sensing,** and **plates (hexagonal or triangular)** are very attractive **for the construction of original plasmon-based optical devices** due to their large atomically flat facets. At the present time, the synthesis of highly uniform triangles and plates still required purification steps that render them difficult to produce.

Our research is made in collaboration with various research teams expert in the different field of plasmonics and aims at providing appropriate materials to study enhanced-photochemistry, enhanced-spectroscopy and nanosources of light. In the future, we are eager to widen the application range of these NPs to sensors and metamaterials through new expected collaborations.

Keywords: gold nanoparticles, gold nanoplates, gold microplatelets, spontaneous self-assembly , plasmonic applications.

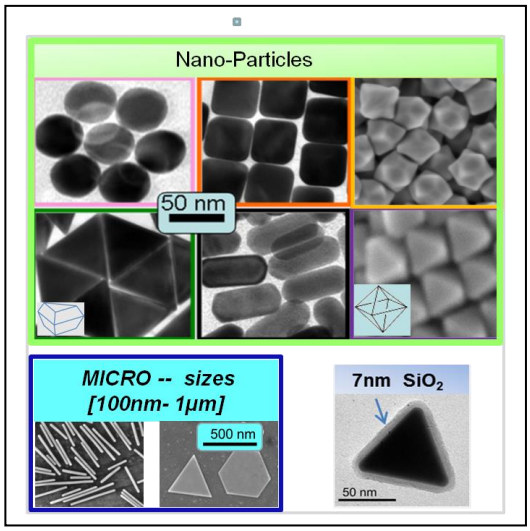

Figure 1: illustration of the monodisperse gold NPs and gold nanohybrids we are able to synthesize with tunable sizes and thicknesses. Top to bottom, left to right:

- **Gold Nanoparticles**: perfectly spherical spheres, cubes, stars, triangles, rods, octahedra,

-**Gold Wires and Microplates** [100nm-1µm] Plates with triangular- or hexagonal shape,

- **Gold-silica (Au@SiO2) nanohybrids.**

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E. Le Moal et al. (2013) "An electrically excited nanoscale light source with active angular control of the emitted light," *Nano Lett.* 13, 4198-4205

M. Haggui et al. (2012)_"Spatial Confinement of Electromagnetic Hot and Cold Spots in Gold Nanocubes", *ACS Nano.* 6(2) , 1299-1307