# Design of plasmonic & photonic structures using *Smart Force*

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Synthesized micro-nanoparticles in solutions show remarkable optical properties. Especially, they have the capabilities to resonantly scatter or absorb the light, to locally enhance the electromagnetic (EM) field or to induce quantum effects. Thus, they are promising building blocks for making new photonic/plasmonic components for direct application in the fields of health, micro-electronics and energy. For example, structured Au nanoparticles has been already successfully used to create ultrasensitive sensor for diagnostic, localized therapy tools, single emitter nano-antennae or transparent solar cells. However getting the quintessence of photonics requires a fine adjustment of the nanostructure's shape and placement. Capillary force assembly (CFA) has proven to be one of the most promising techniques to create shape controlled nanostructures from micro-nanoparticles in aqueous solution [1-2].

In this work, we show that thermodynamic CFA on patterned substrates (fig. 1), using a *Smart Force* device, can be used to position in a deterministic way particles in solution independently of their size, shape or nature.

Next, as a first example of the interest of the technique in the field of plasmonics, we present the optical properties of fabricated Au dimers and 3D Au nanoclusters. Plasmonic coupling [3] in single dimers is observed (fig. 2a) and the resulting EM enhancement is experimentally observed through photoluminescence amplification on quantum-dot-decorated dimers. On 3D structures, collective propagation modes [4] are revealed from two-photon luminescence (TPL) measurements (fig. 2b).

As a second example, we demonstrate the possibility to make precise broad-band localized light source (fig. 3a) and photonic nanojet waveguides (fig. 3b) by organizing polystyrene (PS) nano and microparticles.

Finally we will discuss about the potential of the thermodynamic CFA to work at the interface between optics and biology.

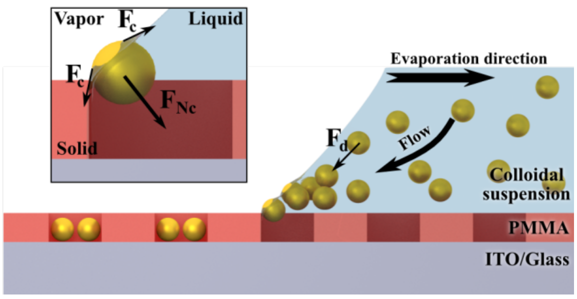


Figure 1 - Capillary Force Assembly (CFA) principle.

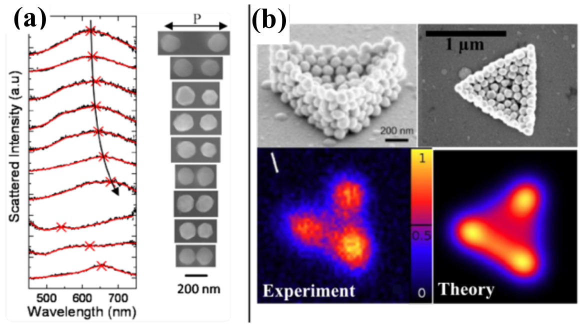


Figure 2 - (a) Scattering spectra of single dimers with decreasing gap and corresponding SEM images. (b) Images of a 3D triangular cluster and its experimental and theoretical TPL intensity map.

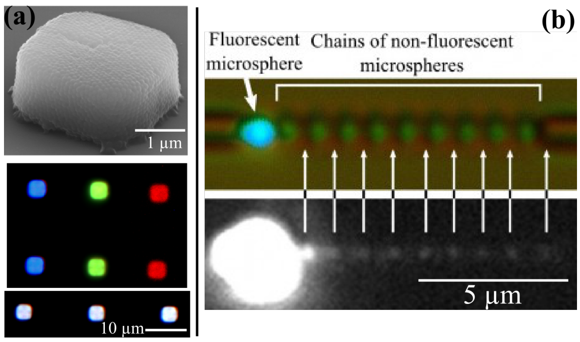


Figure 3 - (a) SEM image of a 3D opal of 100 nm fluorescent PS spheres and corresponding fluorescent micrograph using blue, green, red dyed-doped PS spheres and the mixture of the 3 colors. (b) Optical micrograph of a 1µm-microsphere based waveguide with its own emitter shown under white and fluorescent illumination.

**References:**

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