Capillary Force Assembly of colloidal nanostructures for optical biosensors

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Colloidal Nanostructures (CNs) are considered as potential building blocks in the research field of nanoscience. To introduce those CNs into useful devices, rapid and lowcost assembly techniques have to be developed to overcome colloidal Brownian motion and localize precisely the colloid position on a surface. In this practical work, we present a new Assisted-Capillary Force Assembly (A-CFA) method developed in a microfluidic cell to build deterministic assembly of nanostructures quickly and efficiently (Fig. 1.). This technique is based on the control of the dewetting of the colloidal solution above a patterned surface by substrate temperature modification and air suction flow. The influence of those two parameters on the assembly process will be explained.

After fabrication of a patterned substrate using lithography technique, A-CFA will be conducted to assemble dielectric or metallic micro/nanostructures of predefined geometry. Possibility of the A-CFA in term of photonic component fabrication (Fig. 2.(a) and (b)) and biological applications (Fig. 2.(c)) will be discussed.
In a second part, optical characterizations (micro-spectroscopy and intensity mapping) will be performed on two kinds of structures, chosen for their unique optical properties: gold dimers as ultrasensitive biosensor and polystyrene bead chains as optical waveguide in the visible.

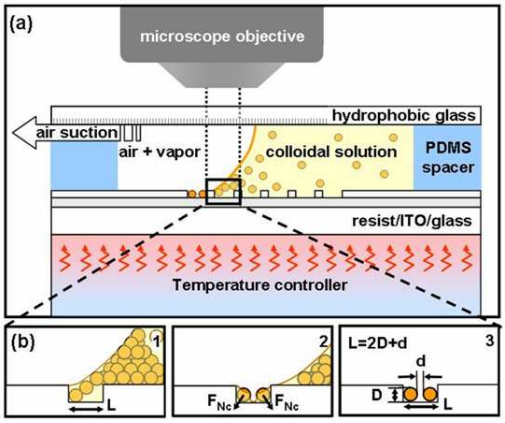

Fig. 1 – (a) Assisted-assembly set-up. **(b)** Schematic view of the assembly principle: colloidal deposition and capillary separation into micro or nano-holes.

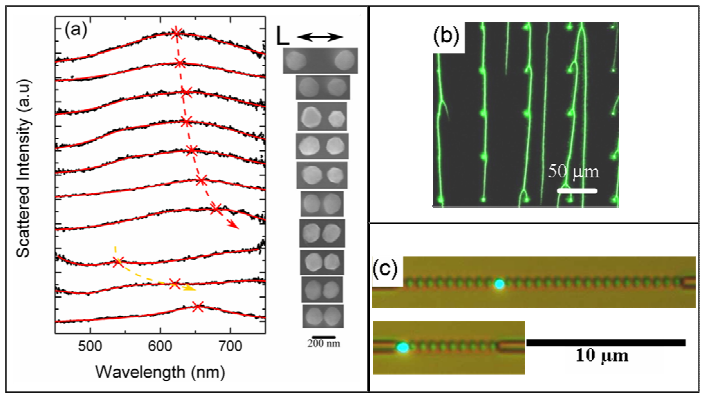

Fig. 2 – (a) Scattering spectra of gold dimers with various interspaces. **(b)** DNA assembly and stretching into a periodic array. (**c**) Chains of dielectric microspheres with their own local emitter.

[1] T. Pinedo et al., JVST B. 26(6) (2008)., T. Pinedo et al., Microelectron. Eng. **86** (2009) 1089.
[2] M. Gordon and D. Peyrade, App. Phys. Lett. 89 (2006) 053112
[3] O. Lecarme et al. App. Phys. Lett. **98**, 083122 (2011)
[4] O. Lecarme et al., J. Vac. Sci. Technol. B **28** (2010)