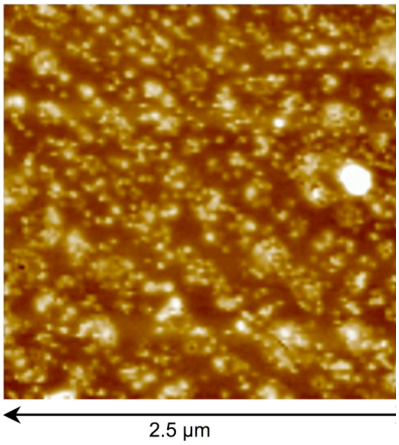
Decoration of liquid crystal defects for gold nano-particles self-assembly

E. Lacaze[a], H. Sellame[a], H. Ayeb[a], E. Audras[a], T. Sadoun[a], J. Grand[b], J. Aubard[b], S. Truong[b] & N. Felidj[b]

a Institut des Nano-Sciences de Paris (INSP), UMR-CNRS 7588, Université Pierre et Marie Curie-Paris 6, 140 rue de Lourmel, 75015 PARIS, France
b Laboratoire Interfaces, Traitements, Organisation et Dynamique des Systèmes , Université Denis Diderot-Paris 7, 15, Rue Jean de Baïf, 75205 PARIS cedex 13, France

Gold nanoparticles (NPs) exhibit unique optical properties arising from localized surface plasmon resonance (LSPR). LSPR can be tuned by changing the surrounding refractive index or by modifying the interactions between NPs. Among others, 1D coupled NPs systems, strongly anisotropic, are of particular interest. Mixing NPs with liquid crystals (LCs) presents the added value of the LC optical anisotropy, thus providing new means of tuning LSPR, e.g. with an electric field or with light polarization[1]. However, a well-defined orientation of the LC around the NPs is needed, though being difficult to realize. This can be achieved by self-assembly of NPs, previously obtained at the cholesteric LC/air interface[2], or using LCs as nano-synthesizers[3]. Here, we show that patterns of LC defects can force self-assembly of NPs.

Using smectic oily streaks on a crystalline substrate[4], first we show that chains are created at the boundaries between oriented oily streaks domains. This demonstrates that in smectic phases also, the most favourable location for NPs is at the area of zero liquid crystal order[5]. Second we show that, in absence of grain boundaries, NPs ribbons, are formed, straight up to several tens of micrometers. This suggests that, in addition to the grain boundaries, the substrate/LC interface is a favourable area, on which the LC anchoring induces alignment of the NPs with a particularly well defined LC orientation around.



These results open up the route for a fine and handy tuning of NPs optical properties but also for a variety of NPs self-assemblies based on the existing panel of LC defects patterns. These results are consequently of interest in the frame of metamaterials also.

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