SURFACE-ORDERING OF NANOPARTICLES USING WRINKLED SURFACES FOR TEMPLATING

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The ordered deposition of nanoparticles on macro-scale surfaces is of considerable interest both for fundamental science and from an application point-of-few. If it is achieved, nanoparticle characteristics like anisotropic electronic / optical properties or stimulus sensitivity could be transferred to macroscopic objects. As well, new properties should arise from collective effects.

Controlled wrinkling provides a low cost approach towards controlling nanoparticle deposition on surfaces which can be upscaled relatively simple. Wrinkling occurs when thin sheets are compressed in-plane due to mechanical buckling instability. Under suitable conditions, amplitude and wavelength of wrinkles can be controlled and adjusted between 150 nm and many 10s of micrometers. Thus substrates can be topographically structured.

We report on recent experiments in which we have used wrinkled surfaces for template assisted self assembly of colloidal particles on micron [1] and nano-scale [2]. As well, topographical patterns can be translated into chemical patterns using microcontact printing [3]. Finally wrinkles can be used to produce nanochannels, in which particles and other objects can be assembled in confined geometry by a drying process. Thus complex geometries for particle aggregates can be achieved, like the pyramidal structures shown in figure 1. We discuss perspectives of such structures for applications in Surface Enhanced Raman Scattering (SERS).

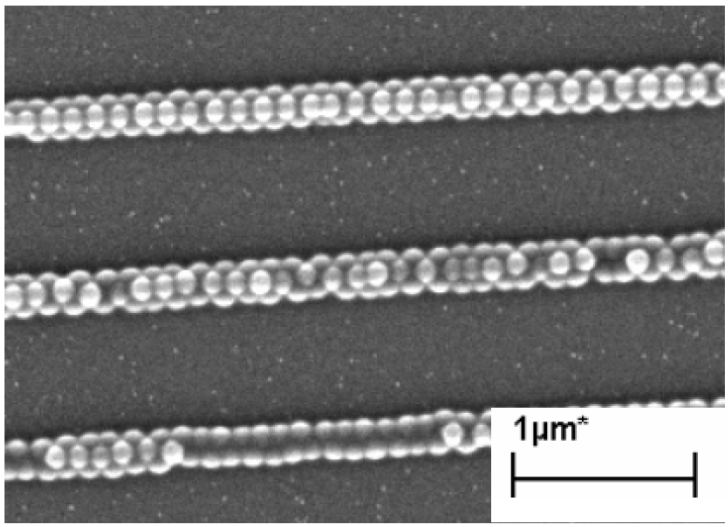

Figure 1: Scanning electron microscopy image of structures formed by wrinkle-confined drying of colloidal suspensions. Particles cluster in double rows and / or pyramidal type arrangements.

Literature :

[1] Lu C, Möhwald H and Fery A. Soft Matter 2007; 3: 1530-1536.
[2] Horn A, Schoberth HG, Hiltl S, Chiche A, Wang Q, Schweikart A, Fery A and Böker A. Faraday Discussions 2009; 143:
[3] Pretzl M, Schweikart A, Hanske C, Chiche A, Zettl U, Horn A, Böker A and Fery A. Langmuir 2008; 24: 12748-12753.