

## Nano-Colloidal Arrays on Chemically Patterned Surfaces for Biosensing Applications

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**INTRODUCTION:** Nano-structured functional materials are currently being developed in the still-emerging field of nanotechnology due to promising new or improved optical or electrical properties and its application potential in nanobiotechnological applications. In this work, we report the fabrication of colloidal micro arrays by selectively binding functionalized nano-sized colloidal silica particles on a chemical micro pattern. This approach offers the potential to enhance the sensitivity of current 2D biosensing arrays by decreasing non-specific interactions with bio-molecules while increasing the surface area at distinct spots due to the nano-colloid arrays.

**METHODS:** SiO<sub>2</sub> suspensions with particles sizes of  $41 \pm 5$  nm and  $73 \pm 6$  nm have been used after characterization. Suspensions were buffered at pH = 7.4 with 150 mM NaCl. Particle suspensions were mixed with the polymer solution to coat the particle surface. A centrifugation step was added to remove unadsorbed polymer. The polymer used was poly(L-lysine)-graft-poly(ethylene glycol) (PLL-g-PEG), which consists of a positively charged PLL backbone and PEG chains which are grafted to the backbone and is well known for its protein repellent properties.<sup>1</sup> The substrate patterning technique was developed in our lab and is based on a photoresist lift-off process (Molecular Assembly by Lift-Off (MAPL))<sup>2</sup> (Fig. 1).

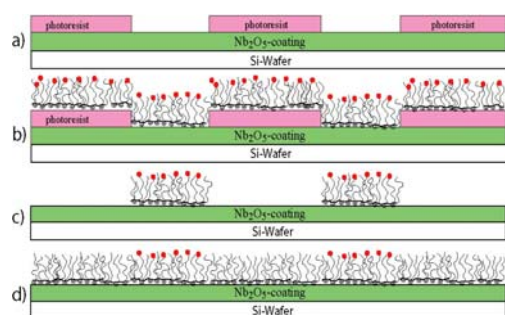


Fig. 1: Overview of the molecular assembly patterning by lift-off technique: a) photoresist pattern b) adsorption of biotinylated PLL-g-PEG polymer c) lift-off process to remove photoresist d) backfilling of the bare niobia with PLL-g-PEG. For more information on this processes see Ref. [2]

**RESULTS & DISCUSSIONS:** With the molecular assembly patterning by lift-off technique (Fig. 1), it is possible to create biotinylated surface patches in a

non-interactive background. Biotin functionalized particles can then be linked onto the active spots via a streptavidin molecule. The background of these patterns has to be rendered non-interactive in order to avoid unspecific adsorption of colloidal particles to the background (Fig. 2).

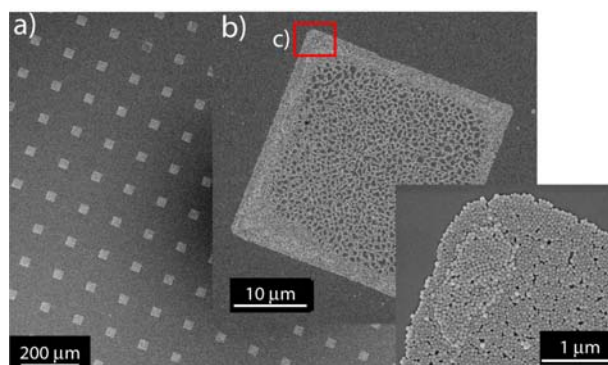


Fig. 1: SEM micrographs showing colloidal arrays obtained by adsorption of PLL-g-PEG-biotin coated 73 nm silica colloids on a MAPL chip. The biotinylated silica colloids were specifically bound to the biotinylated regions of the substrate (see Fig.1). The pattern shows good fidelity (a and b) over a large area. Edge regions of the pattern (c) are sharply confined, but more than a monolayer coverage is often observed as well as depletion effects in center region of the sample (b).

**CONCLUSIONS:** Self-assembly of functionalized colloidal nanoparticles onto chemically patterned substrates was achieved by tailoring the interactions between the functionalized colloid and the surface pattern. The streptavidin-biotin binding system was used to couple the colloidal particles to the surface pattern. Such arrays potentially increase the surface area at given spots without losing the necessary resistance to non-specific adsorption of biomolecules. Such a system could be used to increase the sensitivity of existing biosensing techniques in the future.

**REFERENCES:** <sup>1</sup>S. Pasche et al. (2003) *Langmuir* **19**(22):9216–9225 <sup>2</sup>D. Falconnet et al. (2004) *Advanced Functional Materials* **14**(8):749–756.

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