Surface patterning and assembly of DNA Origami structures by electrostatic forces

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The so-called DNA origami method allows a high-parallel and feasible synthesis of latter. DNA origami objects can serve as templates/breadboards, on which objects/hetero-objects of nanometer size can be arranged site specifically and with a resolution of about 1 nm as a possible approach for bottom-up methods for MEMS/NEMS fabrication. This implies, that the assembly, integration and alignment in well-defined assembly structures regarding the DNA origami template dimensions as well as the connection of these discrete nano objects at large scale are new challenging key technologies.
In the recent years scanning probe microscopy (SPM) getting more and more important for nano fabrication techniques and nano patterning. One of these techniques is the so called Nanoxerography (NX), which uses electrostatic forces for attracting polarized or charged particles (see Fig. 1). NX is based on using a conductive Atomic Force Microscopy (AFM) tip during typical Contact Mode measurements and applying a voltage between sample and tip for polarization of the sample surface. After polarization the substrate is drop-coated with a dispersion of desired material. The molecules will be attracted by the charge of substrate and assemble along the charged area.
In our contribution we show results of preliminary steps of AFM-based Nanoxerography for selective deposition by example of PEDOT:PSS – an polyelectrolyte complex, functionalized polymers like METAC and SPMA as a primary stage deposition for a following DNA origami assembling to introduce the challenges of NX with aqueous dispersions. Further a possible process flow for a direct DNA origami deposition out of an aqueous dispersion is presented.
After successful preparation we transfer the NX steps to Electrical-Nanoimprint Lithography[1] (E-NIL) for fabrication in wafer level. Instead of an AFM tip a conductive stamp is used during printing the mold into the substrate for applying a voltage between stamp and substrate for polarization of the pitches. In this way DNA origamis could be assembled selectively, aligned and in large scale in the pitches of the chosen nanostructure of the wafer.

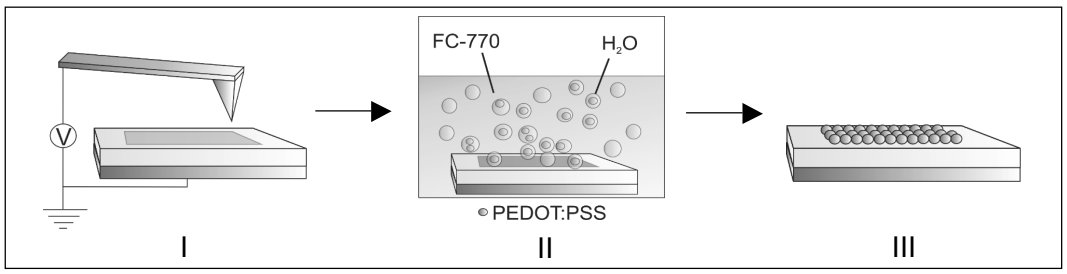

Fig. 1: Sketch of NX process chain for PEDOT:PSS deposition; I charge writing; II attraction; III drying.

1. [1] L. Ressier; Nanotechnology **23** (2012)..