Single molecule contact printing for fabrication of nano-arrays

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Nanostructures self-assembled from DNA, e.g. DNA origami [1], have become an important tool for arrangement of targets such as particles, fluorophores and proteins [2] to study their distance and pattern related characteristics. To push the superiority of nanometer precise arrangement to more advanced applications we developed a nanofabrication process called *single molecule contact printing*. It applies DNA origami structures comparable to stamps to transfer patterns of functionalized molecules on pre-activated surfaces (Fig. 1). This approach overcomes the limits of DNA origami that are solely stable under stringent conditions and was successfully used to position DNA, proteins and also gold nanoparticles on gold surfaces (Fig. 2).
Currently the technology is limited on printing on bare gold surfaces and unspecific binding of target particles and molecules restricts applicability, too. New strategies and preliminary results of printing on glass surfaces as well as reducing background signals will be presented.
One of the numerous conceivable applications is the arrangement of multiple enzymes on surfaces since it was shown, that minimization of distance between enzymes in cascades increase systems overall activity [3]. Our numerical analysis indicate, that large area decoration of those enzymes on preprinted binding spots could control ratio, distance and homogeneity with significant and strong effect regarding multi-enzymatic systems such as biosensors and biofuel cells.

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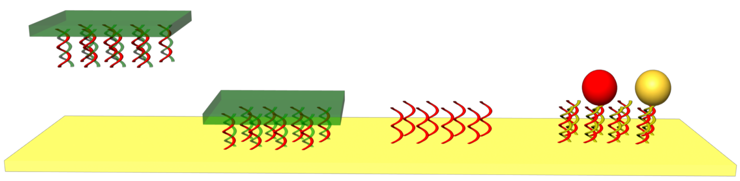

Fig. 1: Progress of Single Molecule Contact Printing (from left to right)

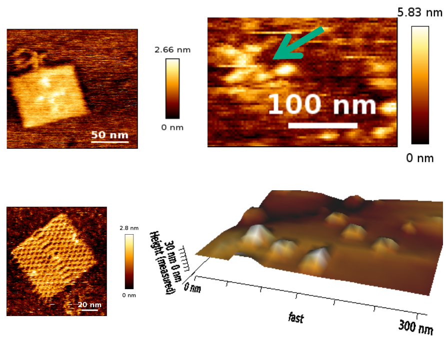

Fig. 2: Printed patterns used to arrange biotinylated DNA and Streptavidin (top: cross) and 15 nm gold nanoparticles (bottom: 3 particles particles in a row)

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[2]. A. Kuzyk et al., Nanotechnology 20 (2009), 235305. G. Acuna et al., ACS Nano 6 (4) (2012), 3189-3195. B. Saccà et al., Angewandte Chemie 49 (49) (2010), 9378-9383.
[3] J. Fu et al. JACS 134 (12) (2012) 5516-5519: