DNA-templated fabrication of nanoarrays on hard condensed matter

Martin Sajfutdinow, Christoph Schneider, David M. Smith

Fraunhofer Institute of Cell Therapy and Immunology IZI, Perlickstraße 1, 04103 Leipzig, Germany

During the last decades, numerous techniques for the production of molecular arrays with nanometer-scale resolution on surfaces, e.g. electron beam lithography, AFM nanolithography or others, have been developed. Mostly, the available techniques are not readily scalable to high-throughput processes, are expensive, or require high fidelity equipment and much expertise.

Nanometer-scale (< 100 nm) structures that are programmed to self-assemble out of DNA strands [1], have recently gained popularity for patterning of molecules. They can be precisely decorated with nearly any type of molecules down to a single-nanometer spatial resolution. Numerous studies on plasmonic and multi-enzymatic systems template on DNA structures have been published in the last decade [2]. Nevertheless, the structures are not suitable for creating large (micrometer-scale) arrays with high resolution.

A first study has shown [3], that DNA brick-based technology can be applied to form micron-scale DNA crystals with predicted patterns and nanometer-scale resolution (Fig 1). Although they can be decorated with gold particles with a high yield, the array uniformity depends on basic properties of the underlying DNA structure. Low salt conditions, high pH and temperature inconsistency as well as detergents can negatively affect the quality of array patterns.

This poster will present a versatile method of how DNA nanostructures, in particular micrometer-scale DNA crystals, might be applied to quickly "print" molecular arrays with nanometer-scale resolution directly onto prefunctionalized, hard condensed matter surfaces (Fig 2), thereby minimizing issues arising from the instability of DNA nanostructures in unfavorable conditions. This could offer a new basic technique for the fabrication of multi-enzymatic biosensors, plasmonic crystals and oligomers, DNA nanoarrays for high-throughput sequencing and genotyping as well as nanocircuits. Preliminary results for AFM and SPR characterization will be shown.

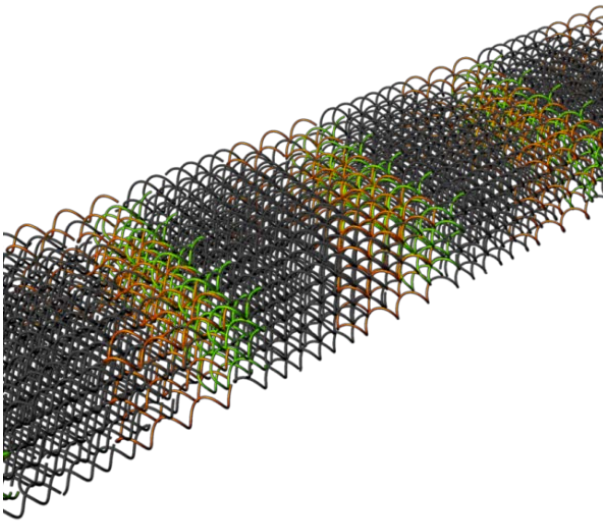

***Fig1** Animation of 1D DNA brick-based crystal*

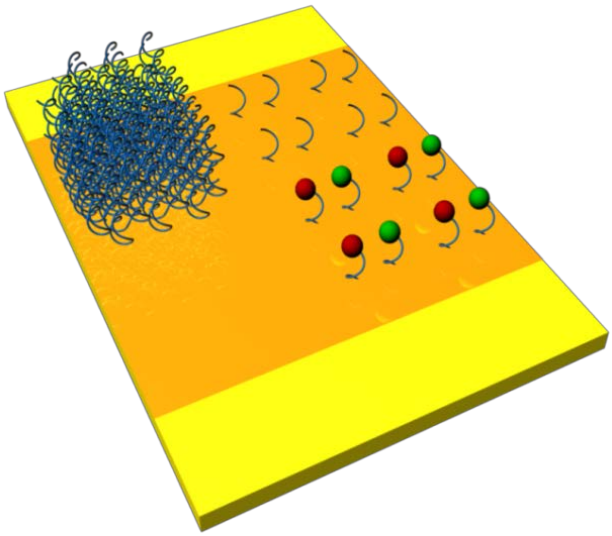

***Fig 2** Schematic printing procedure*

[1] N. C. Seeman, Nature 421 (2003) 427-431. P. W. K. Rothemund, Nature 440 (2006) 297-302.
[2] J. Fu et al. JACS 134 (12) (2012) 5516-5519. A. Kuzyk et al., Nanotechnology 20, 235305 (2009).
[3] Y. Ke et al. Nature Chemistry 6 (2014) 994-1002.