Self-Assembly of DNA Origami Nanostructures on Lithographically Patterned Surfaces

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One of the current goals of nanotechnology is coupling techniques for self-assembly of molecular nanostructures with conventional microfabrication techniques. Merging these so called “bottom-up” and “top-down” fabrication methods would enable the production of nanostructures that have the addressability and registration required for integration into functional devices.

Biological nanostructures, particularly those based on DNA, have been shown to be good candidates for this type of component assembly. The nature of the complementary Watson-Crick base-pairing allows construction of complex nanostructures,[1] and the same synthetic techniques can be used to make functionalized 2D structures through the inclusion of attachment sites that can bind smaller objects such as nanoparticles[2]. Collections of these small DNA structures have also been demonstrated to selectively bind to patterned regions of chemically treated surfaces.[3]

In this contribution we describe methods for the placement and self-assembly of arrays of a new type of DNA nanostructure—DNA origami[4]—on lithographically patterned templates. DNA origami have dimensions on the order of 100 nm and can be synthesized with complex arbitrary shapes in high yield, making them excellent candidates for site-specific placement and alignment of nanostructures on patterned semiconductor surfaces. AFM imaging results will be described on planar chemically patterned surfaces and topographically patterned surfaces fabricated using either electron-beam or optical photo resist based lithography. We will also describe the results of direct e beam patterning of SiO2 surfaces. Results from surface selectivity studies and surface characterization measurements will be presented. The placement of individual triangular DNA nanostructures with excellent site selectivity and alignment will be demonstrated.

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