Topography-Controlled Alignment of DNA Origami Nanotubes on Nanopatterned Surfaces

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Abstract

Since its discovery, DNA origami technique [1] has attracted considerable attention from various research fields. By this technique, it has become possible to generate complex 2D and 3D DNA nanostructures with any desired shape. Quasi-one dimensional DNA nanostructures hold particularly great promise as scaffolds for nanoelectronic device fabrication. However, the fabrication of functional nanoelectronic devices from such DNA nanostructure templates requires their controlled arrangement and orientation on a conventional substrate. In the past, various techniques have been employed to control the alignment of immobilized DNA nanostructures on different surfaces [2], [3]. However, most techniques rely on lithographic pre-patterning and often also a chemical functionalization of the substrate.

In this work, we demonstrate a compelling alternative approach to generate ordered arrays of DNA nanotubes on topographically patterned surfaces. To this end, we combine two bottom-up techniques for nanostructure fabrication, i.e., DNA origami self-assembly and self-organized nanopattern formation on silicon surfaces during ion sputtering [4], thus avoiding the necessity of lithographic processing or chemical modifications. The self-alignment of the six-helix-bundle (6HB) DNA origami nanotubes is purely driven by electrostatic interactions with the nanorippled Si/SiO2 surface during adsorption. By tuning the pattern dimensions to match the dimensions of the DNA origami nanotubes, we obtain an alignment yield of 70% [5].

References

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