Towards Reliable Fabrications of Qdot-Nanopatterns on DNA Origami

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The central goal of nanotechnology is to control and organize matter at the nanometer scale. Organizing metallic nanoparticles in a controlled manner is of great interest in nanoelectronics and nanophotonics/plasmonics. For this purpose, DNA origami, a particular type of DNA nanostructures, has been used to generate various geometries with molecular precision [1] and direct the aseembly of other nanoscale components as a template to build more complex, functional devices. In recent years, conjugates of nanoparticles and DNA origami have been used to build a variety of nanoarchitectures, but still with limited success. [2] To achieve reliable yields of such nanostructures, however, it is important to understand the interplay of factors affecting the binding of nanoparticles to DNA origami.

In this work, we monitor binding of streptavidin-coated quantum dots to biotinylated DNA origami using AFM imaging analysis. We show that the speed and the yield of the binding are controlled by valency at the binding location, biotin linker length, and the organization and spacing of the binding locations on DNA template. In addition, we have determined forward and backward reaction rate coefficients through analysis of time course data and it provides us physical insight into these types of self-assembly processes.

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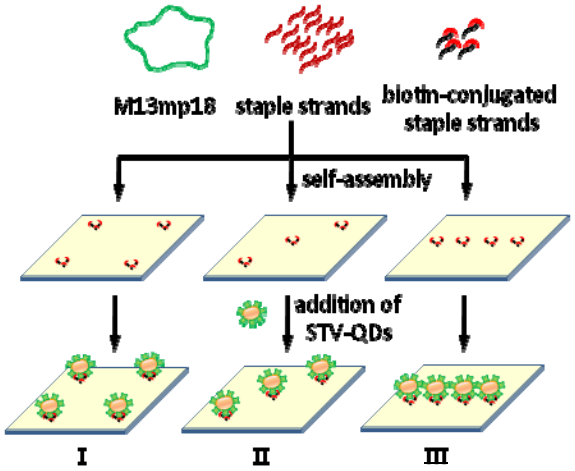

Figure 1. Schematic representation of the fabrication process of quantum dot-nanopatterns on DNA origami templates. The group of three biotin-conjugated staple strands was located at predetermined each binding site to capture streptavidin (STV)-conjugated quantum dots (QDs) on higher efficiency of binding. The distance of adjacent binding sites was controlled as 50 nm (I), 35 nm (II), and 22 nm (III).