DNA-origami as Functional Nanodevices

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During the past half century, the nanotechnology has been one of the driving forces of the development, allowing breakthroughs in the fields of medical diagnostics, food industry and pharmaceutical industry [1,2]. In all of these fields, the structural DNA nanotechnology based innovations have shown potential to develop from proof-of-principle concepts into true applications - thanks to the superior properties of DNA such as robust self-assembly, simplicity of its preparation and versatile functionalization schemes [3].

In this context, DNA origami based structures have proven itself to be excellent building blocks for generation of hierarchical nanostructures. In the past few years, these structures have been successfully utilized as optical and electrical nanodevices [4-7] typically employing metallic nanoparticles and biomolecules. In addition, DNA origami based structures have been successfully utilized in label-free detection and multiplexing of several analytes using the principle of Surface Enhanced-Raman Spectroscopy (SERS). However, demand for newer innovations that allow production of universal, cost efficient, tunable and simple to use DNA nanodevices is still broad. Such innovations may include methods to precisely position molecules and nanoparticles to manifest new hybrid-structures or metamaterials with customizable biological, chemical, mechanical, electrical and optical properties.

Our overall aim is to develop DNA origami structures that can act as platforms for precise placement of arbitrary biomolecules and nanoparticles. These platforms could then be utilized in hot electron catalysis [8], chemical or biological sensing, SERS detection of sample at lower concentration down to single analyte level or fabrication of metamaterials with unique optical properties. The future goal would be to manufacture devices ready to use that could be further tailored for user-specified purposes.

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