Dynamic and Functional DNA Nanotechnology:

From the Design of an Artificial Rotatory Nanodevice towards Chimeric Nanoreactors Mimicking Enzymes

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Abstract:

DNA nanotechnology has shown a great potential to construct complex assemblies using the addressability and structural features of DNA. During the last decade, emerging applications of these nanoarchitectures as molecular sensors, mechanical nanodevices or as platform to assemble different enzymes or nanoparticles have been reported.[1] Our research focus is based on the use of DNA interlocked architectures to construct different nanodevices with programmed mobility through their mechanical bonds.[2] In particular, we designed an engineered protein which specifically binds to a DNA catenane consisting of two double stranded interlocked DNA rings, and promotes the controlled and unidirectional rotatory motion of one of the rings with respect to the other. This biohybrid structure can perform as DNA walker when implemented on a predefined DNA path with several steps, by re-using the product material generated during the enzymatic activity of such protein. Finally, future directions and prospects based on the use of DNA nanostructures to build up catalytic active sites or binding pockets, similar to the ones found in proteins, by using chemically modified nucleobases, will be discussed.

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[2] (a)Ackermann, D.; Schmidt, T. L.; Hannam, J. S.; Purohit, C. S.; Heckel, A.; Famulok, M. *Nat. Nanotechnol.* **2010**, *5*, 436-442. (b) Lohmann, F.; Ackermann, D.; Famulok, M. *J. Am. Chem. Soc.* **2012**, *134*, 11884-11887. (c) Lohmann, F.; Valero, J.; Famulok, M. *Chem. Commun.* **2014**, *50*, 6091-6093. (d) Lohmann, F.; Weigandt, J.; Valero, J.; Famulok, M. *Angew. Chem. Int. Ed.* **2014**, *53*, 10372-10376.

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