

DNA-grafted supramolecular polymers: synthesis, self-assembly and potential applications

Yuliia Vyborna¹, Robert Häner*¹

¹ Department of Chemistry and Biochemistry, University of Bern Freiestrasse 3, CH-3012 Bern, Switzerland.

Email: yuliia.vyborna@dcb.unibe.ch

Recent advances in DNA nanotechnology led to the development of biocompatible functional materials targeting different applications, including delivery, precise scaffolding, computation, etc. However, a standard toolbox of building blocks used by chemists is largely limited to canonical nucleobases. To further develop the functional potential of synthetic DNA systems, the use of sequence-specific DNA-polymer conjugates has emerged as an exciting alternative approach. Herein, we demonstrate the synthesis and self-assembly properties of monodisperse DNA-pyrene polyphosphate oligomers as essential units for DNA-grafted supramolecular polymers. Such systems become increasingly important for the creation of dynamic and stimuli-responsive materials.

The unique self-recognition properties of oligonucleotides laid the foundation of modern DNA nanotechnology. Over the last two decades, man-made DNA assemblies led to the development of numerous biocompatible functional materials, including drug carriers, nanorobots, and scaffolding platforms. A standard toolbox of building blocks used by chemists in the field is largely limited to four units – A, G, C, T. To further develop the functional potential of synthetic DNA systems, the use of DNA-chromophore conjugates emerges as an exciting approach.

Following our previous findings, we demonstrate herein the synthesis of the DNA-pyrene oligomers and the temperature-induced self-assembly of these conjugates into DNA-grafted supramolecular polymers. (see Figure 1). Such systems become increasingly important for the creation of dynamic and stimuli-responsive materials targeting various applications such as delivery and precise scaffolding.

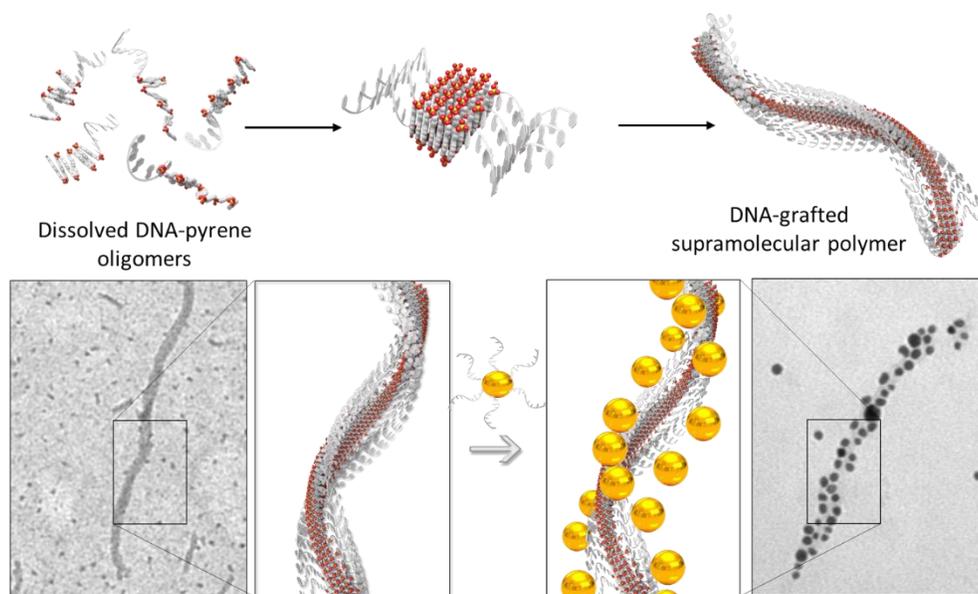


Figure 1. Schematic representation of the self-assembly of molecularly dissolved pyrene-DNA hybrids (top) into 1-dimensional DNA-grafted supramolecular polymers. Mixing of the pre-annealed polymers with DNA modified gold nanoparticles at 20 °C results in the arrangement of the NPs along the edges of the self-assemblies through hybridization of the complementary DNAs (bottom).

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