

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

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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 pathway complexity in a temperature-induced self-assembly of the DNA-pyrene oligomers. Thermodynamically favoured DNA-grafted supramolecular polymers assemble into metastable networks through hybridization between DNA sticky ends followed by the subsequent re-assembly into individual DNA-grafted polymers through monomer exchange (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.

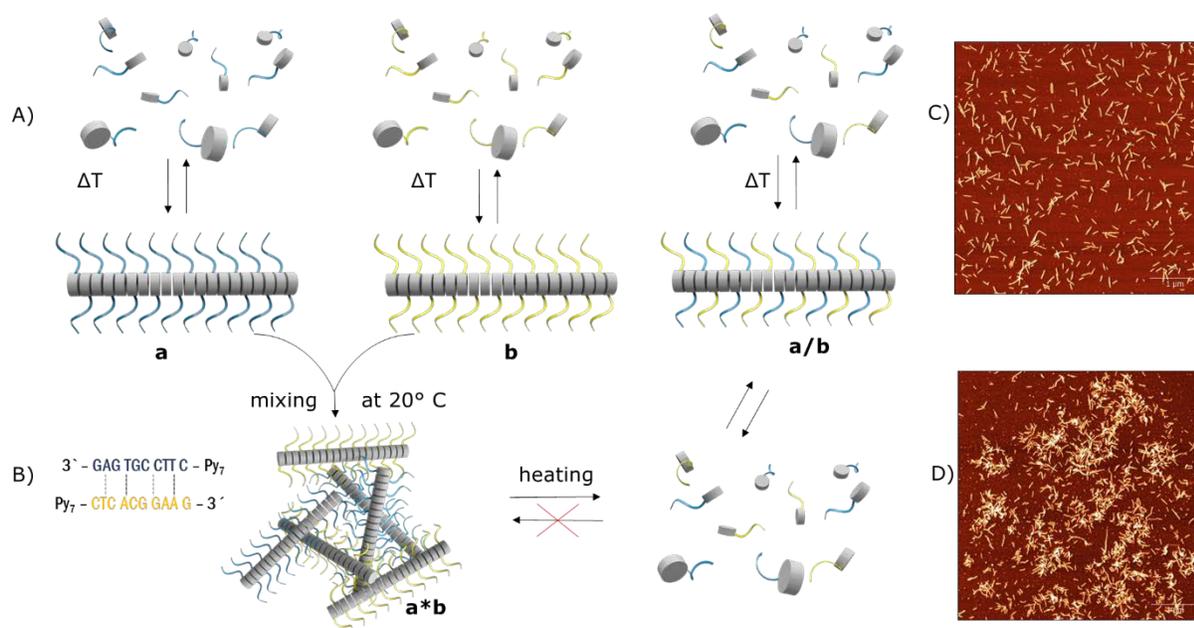


Figure 1. Schematic representation of the self-assembly of molecularly dissolved pyrene-DNA hybrids (A) into 1-dimensional DNA-grafted supramolecular polymers a/b, a and b. Mixing of the pre-annealed SPs a and b at 20 °C results in the formation of the networks a*b via hybridization between complementary DNA strands (B left). This scheme also shows irreversible rearrangement of the networks into dual-component SPs a/b through the disassembly upon heating (B). AFM images of the DNA-grafted SPs a/b formed from co-assembled pyrene-DNA oligomers (C) and DNA interconnected networks formed from separately pre-annealed SPs a and b (D).

(1) E. Mattia, S. Otto. *Nature Nanotech.* 10, 111-119 (2015)

(2) Y. Vyborna, M. Vybornyi, A. Rudnev, R. Häner, *Angew. Chem. Int. Ed.*, 54, 7934-7938 (2015)