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Self-assembly of DNA: creating novel materials

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DNA has become very attractive as scaffold for functional molecules on the nanometre scale.1 The sequence specific insertion of modified nucleotides using automated DNA synthesis allows for the creation of new designer molecules with a wide range of potential applications. We have established a general synthetic route to incorporate chromophores and metal complexes into oligo-deoxynucleotides (ODNs) site specifically via solid phase synthesis. We have thus attached the so far largest number of porphyrin based chromophores into DNA, giving access to a multiporphyrin array of approximately 10 nm in length.2 The spectroscopic data and structure calculations indicate the formation of a stable helical array in the single strand porphyrin-DNA. The π-stack of the porphyrins leads to strong electronic interaction between the chromophores. A zipper array with induced stability and energy transfer properties has recently been realised, providing access to the first reversible photonic wire based on a DNA scaffold.3
In this seminar, I will elaborate on the basic concepts to create novel materials based on both natural and modified DNA. The concepts will be underlined with specific examples from our laboratory, which include highly sensitive sensors,4 DNA switches,5 self- assembled polymer-ODN systems,6 and DNA origami.7 Embedded will also be discussions on spectroscopic methods to analyse the systems. The scope and limitations will also be highlighted.

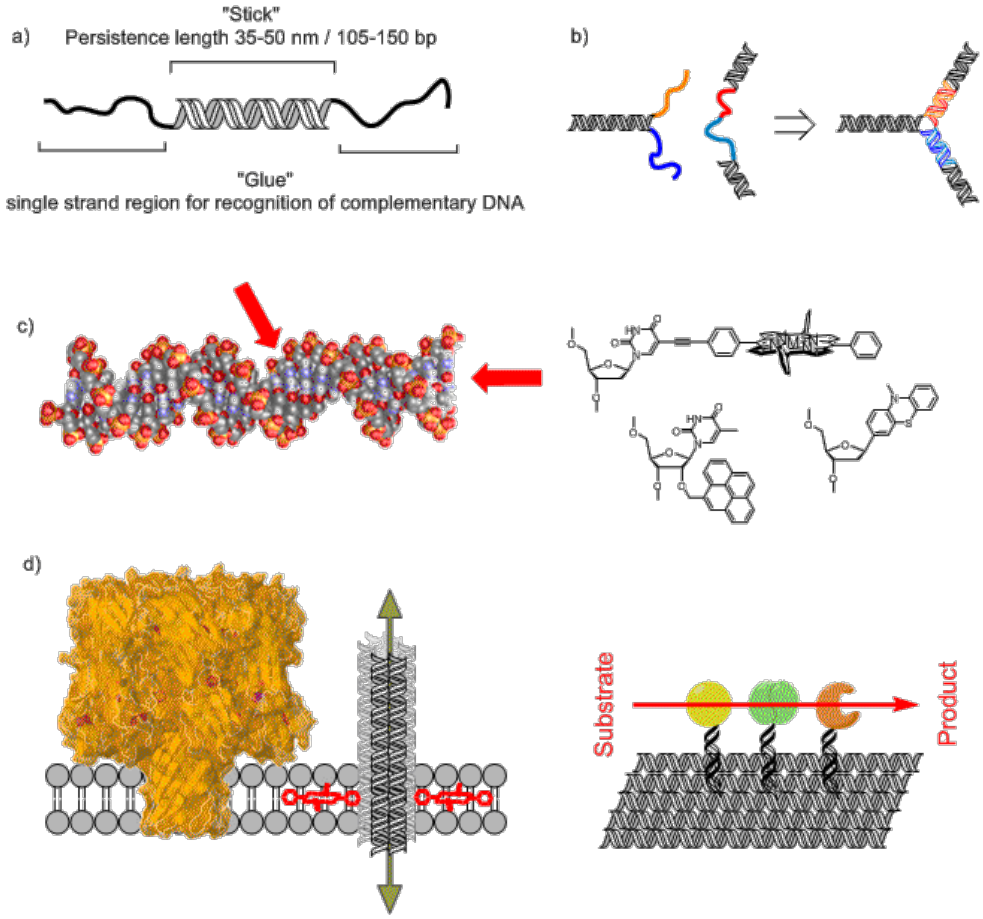

Figure representing some the topics to be discussed. a) Schematic representation of DNA as stick and glue molecule. b) Concept of constructing DNA assemblies by recognition of complementary strands. c) Sites of modification in DNA: internal and terminal, with examples of internal tailored modifications. d) Applications of modified DNA: a DNA origami nanopores mimicking transmembrane proteins, and a DNA origami assembled enzyme cascade.

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