Designer DNA for Biomedical and Nanotechnology Applications

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DNA with precise user-defined sites for modification would play an important role in nanotechnology and as bio-molecular carriers. The heat-cool cycle extension of oligo "seeds" produces long DNA of controlled base pair composition.[1] It is also possible to incorporate modified nucleotides to produce a wide range of functional DNA, shown in Figure 1. We aim to investigate two model systems; DNA scaffolds as biological carriers and DNA:metal coordination polymers.
Click chemistry was performed with alkyne-modified DNA and azido-fluorescein and purified using QIAGEN PCR purification columns. Metal addition was performed by the titration of Au^{+}, Cd^{2+} and Au^{3+} with thiolated-DNA followed by UV-Vis and IR spectroscopy, atomic force microscopy and fluorescence microscopy for the characterisation of the products.
Synthesis of modified DNA was successful, with modifications situated at user-defined positions, see Figure 1. Click chemistry, between the azido-fluorescein and the alkyne modified DNA, shows a potential route to conjugate biomolecular carriers with their cargo. Titration of Au^{+}, Ni^{+}, Cd^{2+} and Au^{3+} with thiolated-DNA outlines the binding ratios of 3:1, of thio-group to M^{n+}, affording control over metal deposition to the DNA.
This method is an efficient and reliable approach for user defined adaptations of site specific DNA modification demonstrated by azide-modified fluorophores, or thio-binding metal ions. Further developments could lead to the design of specific carrier molecules for biological applications and coordination polymers, useful in nanotechnology.

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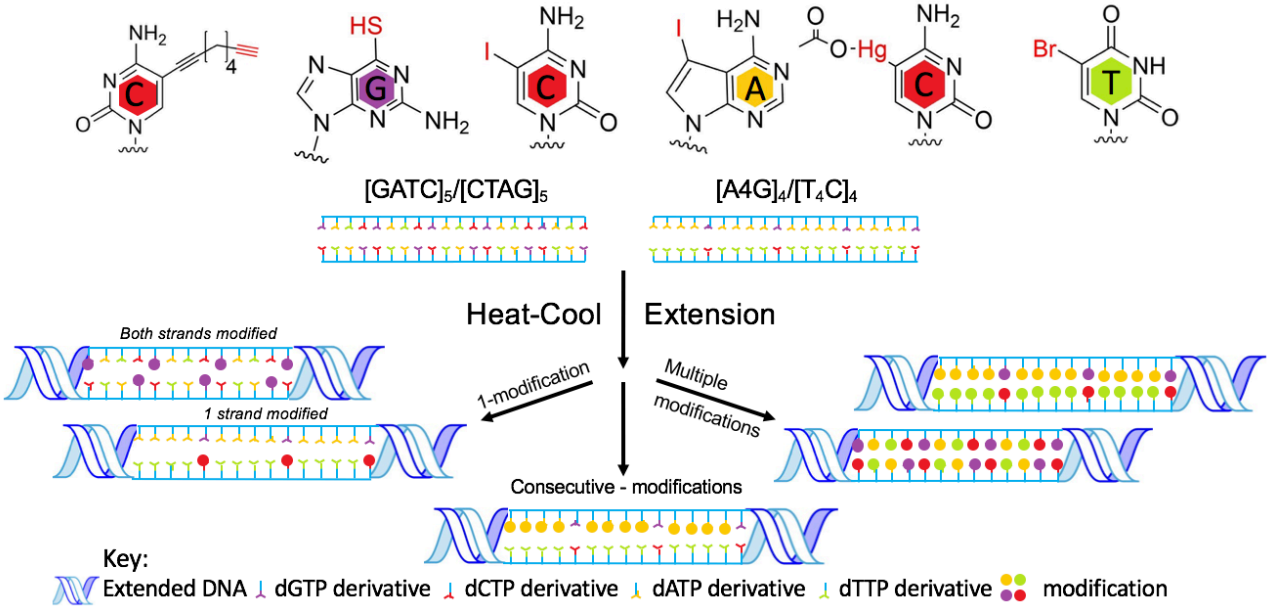

Fig. 1: DNA extension by heat-cool cycles to produce modified DNA with single or multiple modifications on one or both strands.

[1] C. J. Whitfield et al., Angewandte Chemie 54 (2015) 8971.