Editorial: DNA-based nanoarchitectures and nanomachines

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The emerging area of DNA-based architectures and machines promises exciting opportunities and will impact on the future of DNA structures in nanobiotechnology.

Nucleic acids (DNA and RNA) represent exciting biomolecules that nature has optimized over billions of years. Not only do they function uniquely as carriers of the genetic information to translate their structures into proteins; nucleic acids, and particularly DNA, also show promise as functional biomolecules for applications in materials science and nanotechnology.

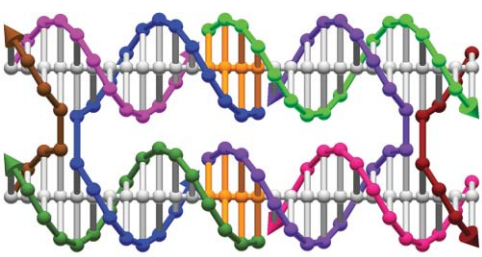
Important chemical and structural information exists in the DNA chains. This includes specific Watson–Crick, H-bonded interactions that lead to organized helical double strands[1] or to the self-assembly of nucleic acids to other structural motifs such as G-quadruplexes.[2] The duplex structure of DNA allows specific intercalation to form helical structures, whereas the negatively charged phosphate units permit the association of ions to form DNA wires.[3]

The interaction of enzymes such as polymerase, ligase or endonucleases with DNA enables the replication, covalent ligation or sequence-specific scission of DNA, thus providing nano-tools to manipulate and mould the DNA structures. These unique features of DNA, together with the availability of synthetic nucleotides or DNA analogues[4] and automated techniques to synthesise substantial quantities of nucleic acids, pave the way to use DNA and its analogues as powerful functional building blocks in materials science.

In recent years there have been several significant advances in using nucleic acids as units for constructing ingenious two- or three-dimensional nanostructures with designed compositions, shapes and geometries.[5,6] These efforts yielded not only artistic architectures such as DNA tiles[7] and triangle arrays[8] but also led to 'bottom-up', DNA-templated nanocircuitry[9] and devices.[10]

Furthermore, the information stored in DNA allows its application as an active dynamic biomolecule that duplicates functions of machines. The sequence-specific hybridization, scission and ligation of DNA enable the controlled targeting of nucleic acids, their specific scission and vectorial translation on a 'DNA track'. In addition, DNA structures that mimic machine functions such as tweezers,[11] walkers[12] or gears[13] have been made. These scientific advances are not only of intellectual value, but have important future practical implications. Ultrasensitive DNA detection schemes[14] or nanotransporter units[15] have already been made and their value as sensors or drug-release systems explored.

This themed issue in *Organic & Biomolecular Chemistry* brings together a collection of articles dedicated to the emerging area of 'DNA-based nanoarchitectures and nanomachines'. Collectively, these articles illustrate recent advances in the field and highlight a promising and diverse future. For example, the *Perspective* article by Jean-Louis Mergny from the Laboratoire de Biophysique, at the Muséum National d'Histoire Naturelle in Paris, France, provides an insight and overview of nanostructures involving quadruplexes.[16] In addition, the series of papers in this themed issue represents the latest results in the field, written by leading scientific authorities.



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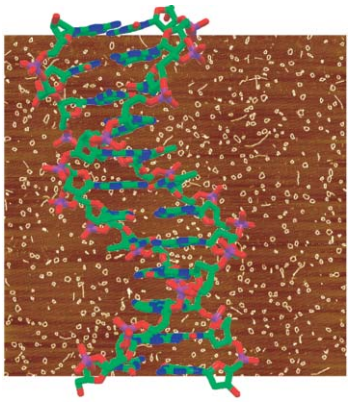

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The editors would like to thank the authors for their contributions and enthusiasm to participate in this effort. We hope that the readers will enjoy reading these articles and appreciate the exciting

opportunities and future impact of DNA structures in nanobiotechnology.

Vikki Allen, Editor,
Organic & Biomolecular Chemistry

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