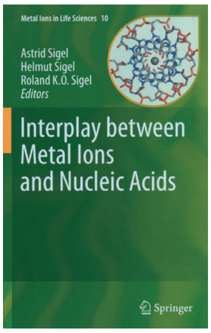
Interplay between Metal Ions and Nucleic Acids



Interplay between Metal Ions and Nucleic Acids
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Bioinorganic chemistry is an exciting branch of chemistry with applications in new materials (including sensors and tissues), health (diagnosis and therapy), energy supplies (generation and storage), biological function, evolution, and beyond. The Sigel volumes are always a reliable way of keeping abreast of this rapidly expanding field. This one is no exception.

The focus here is on metal ion–nucleic acid interactions, both in the solid state and in solution, on single nucleic acids themselves through to oligonucleotides, and high-molecular-weight DNA. Not only are binding interactions described, but also oxidative damage (Chapter 7) and DNA-based catalytic reactions (Chapters 8 and 9). In Chapter 12 metal interactions with peptide nucleic acids (PNA) are reviewed. These provide opportunities to introduce new functions into DNA. The stability of PNA-DNA conjugates, for example, can be greatly increased by Zn^{2+} or Ni^{2+} binding.

There are many good chapters. I will comment further on just a few.

As a reference work Chapter 2 is very valuable: the X-ray crystal structures of metal ion complexes with nucleotides and oligonucleotides reported after 1994, including bonding patterns for A-RNA and A/B/Z-DNA fragments that form duplexes. Topical too is Chapter 4, although concise, on G quadruplexes by Campbell and Neidle. G quadruplexes are usually stabilized by Na^{+} or K^{+} binding to the C6O atoms of G in a central channel, a feature which distinguishes them from other types of nucleic acid structures, and important to the function of human telomeres and cell division.

As noted by Zambelli et al. in Chapter 5, metal-dependent gene regulation is a new frontier in bioinorganic chemistry, and its understanding requires a full grasp of metal ion coordination chemistry, molecular biology, biochemistry, cell biology, structural biology and a range of physical methods—a challenge indeed. Metal sensor systems involving for example Mn, Fe, Co, Ni, Cu, As, and Hg are discussed. In Chapter 9, Garcia-Fernandez and Roelfes review applications of DNA as a scaffold and chiral ligand for enantioselective transition-metal catalysis, mainly Lewis acid catalysis. Here second coordination sphere interactions provided by DNA are of critical importance.

Can DNA be used as a molecular wire (Chapter 10)? Yes, made easy by artificial modification of the DNA bases and doping the interior with stacks of metal ions such as Ni^{2+}, Cu^{2+}, Ag^{+}, or Hg^{2+}, perhaps finding eventual use in nanoelectronic devices.

This book is a good read and all bioinorganic chemists might wish it was on their shelves—not only for research, but as a resource for undergraduate teaching. Alas it is probably too expensive for most personal pockets, but I am sure bioinorganic chemists and others with an interest in the role of metal ions in biological systems will urge their libraries to buy it.

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