Towards Bioactive Supramolecular Assemblies: Molecular Design, Metals and Light

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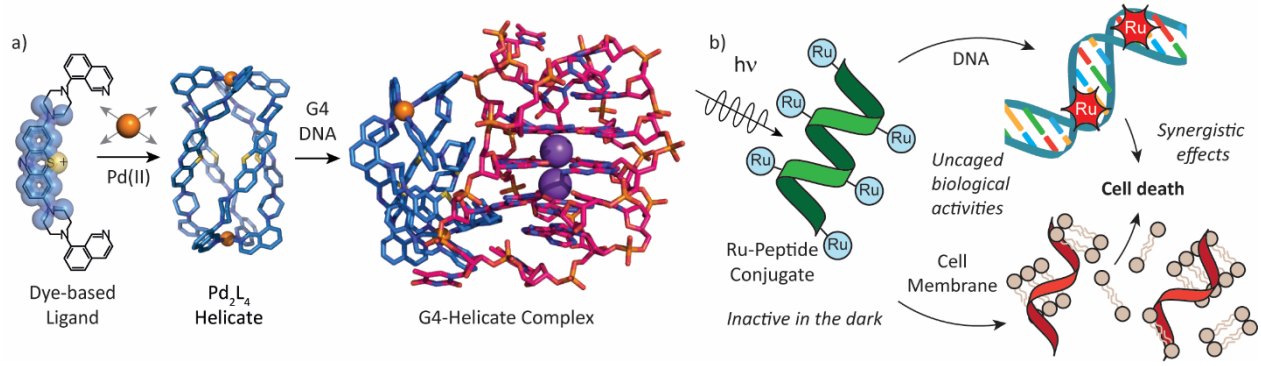
Molecular cavities are central to many biological functions and have inspired the development of artificial host–guest systems capable of selectively binding and protecting molecules within confined spaces. Coordination cages, in particular, offer predictable self-assembly and, when appropriately functionalized, allow reversible encapsulation, making them attractive for applications such as sensing, catalysis, and controlled drug delivery. Their promise in biological contexts arises not only from their ability to shield cytotoxic agents and release them in response to specific stimuli, but also from their three-dimensional shapes, which more closely mimic protein–protein or protein–DNA recognition motifs than traditional small molecules. This structural complementarity enables fine control over binding affinities and specificities. However, the reliance on rigid aromatic ligands and labile metal nodes often results in poor water solubility, limited stability under physiological conditions, and loss of structural integrity at low concentrations, hindering their translation to biomedical contexts. The Supramolecular Bioinorganic Chemistry Laboratory aims to address these challenges by developing biocompatible metal-based architectures designed to function as next-generation supramolecular therapeutics.

In this talk, I will highlight key achievements from my academic journey that have shaped the research vision of the newly established Supramolecular Bioinorganic Chemistry Laboratory in Strasbourg. I will discuss the design of dye-based coordination cages for chiroptical recognition of small molecules and G-quadruplex DNA (Fig a), as well as the development of ruthenium–peptide conjugates for photoactivated chemotherapy (Fig b).



Key references:

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