MINI-SYMPOSIUM

CHIMIE SUPRAMOLECULAIRE ET CHIMIE DES BIOMOLECULES : UNE INTERFACE FERTILE

CHEMICAL SPACE DISCOVERY OF BIOACTIVE SMALL MOLECULES AND PEPTIDES

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SELF-ASSEMBLED FOLDAMER NANOSTRUCTURES WITH CONFINED SPACE OR INHERENT POROSITY

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INTEGRATION OF MOLECULAR MOTORS IN OUT-OF-EQUILIBRIUM POLYMER NETWORKS

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ENSCM
8 rue de l'école normale, Montpellier
AMPHI FORCRAND

VOIR CI-DESSOUS POUR LES RESUMES DETAILLES DES PRESENTATIONS

CHEMICAL SPACE DISCOVERY OF BIOACTIVE SMALL MOLECULES AND PEPTIDES

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Chemical space describes the ensemble of all molecules that are possible by assembling atoms through covalent bonds. This concept is particularly relevant in drug discovery, where new molecular entities are constantly needed to develop new drugs addressing unmet medical needs. In our research we design cheminformatics methods for enumerating, mapping and virtual screening the chemical space of small organic molecules and peptides.[1, 2] We then implement these methods to choose, synthesize and test molecules in the laboratory. I will describe applications targeting ion channels,[3] transporters[4] and enzymes,[5] as well as new peptide based antibiotics against multi-drug resistant bacteria.[6]

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There is considerable interest in the development of peptides as self-assembling building units for use in a wide range of applications, including bio-sensing, catalysis, bio-materials and nano-materials.(*1*, *2*) Similarly, foldamers have a huge potential to fabricate both complex and atomically precise structures, with the added benefit of permitting the exploitation of a wider range of building units, thus enabling an increased divergence from nature.(*3*, *4*) However, the design of foldamers with the ability to self-assemble into defined nanostructures in aqueous conditions has proved exceptionally challenging. In this presentation, we will discuss some of our recent efforts towards this goal showing how de novo design and subsequent sequence manipulation of non peptide helical foldamers (aliphatic oligoureas(*5*)) in aqueous solutions may lead to the controllable (at least rationally explicable) formation of diverse protein-like higher-order structures such as compact and extended nanostructures.(*6*) Importantly, these assemblies present valuable structural features (i.e. isolated internal cavities and polar channels) which conceivably could lead to tailored functions.

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Making molecular machines that can be useful in the macroscopic world is a challenging long-term goal of nanoscience. Inspired by the protein machinery found in biological systems, and based on the theoretical understanding of the physics of motion at the nanoscale, organic chemists have developed a number of molecules that can produce work when triggered by various external chemical or physical stimuli. In particular, basic molecular switches that commute between at least two thermodynamic minima and more advanced molecular motors that behave as dissipative units working far from equilibrium when fueled with external energy have been reported. However, the ultimate challenge of coordinating individual molecular motors in a continuous mechanical process that can have a measurable effect at the macroscale has remained elusive until very recently. We will discuss advances developed by our group on artificial molecular machines and involving their mechanical coupling within dynamic polymeric systems. We will show that it is now possible to amplify their individual motions to achieve macroscopic functions in materials. In particular, we will present a dual-light controlled system operating fully out-of-equilibrium, and in which the integrated motions of two types of mechanically active units can be tuned by modulation of frequencies.