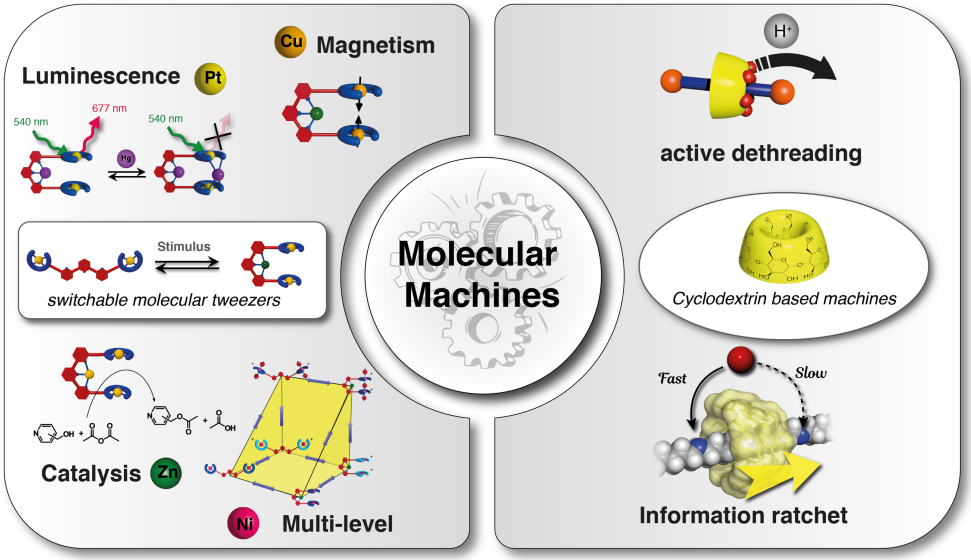
Functional molecular machines: from switchable molecular tweezers to cyclodextrin-based information ratchets

Guillaume VIVES

Institut Parisien de Chimie Moléculaire, Sorbonne Université, 4 Place Jussieu, 75005, Paris, France.
guillaume.vives@sorbonne-universite.fr

In recent years, molecular machines[1] have attracted increasing interest for their ability to control motion at the molecular level. However, artificial systems are far from achieving the complexity of natural systems and harnessing their properties to perform useful functions remains a major challenge.
We have developed an innovative approach to control physical or chemical properties at the molecular level by exploiting the mechanical motion of molecular tweezers. We have designed a family of switchable molecular tweezers based on a terpyridine ligand functionalized by metal-salen complexes that can be controlled by a coordination stimulus. Drastic modulation of luminescence,[2] magnetic[3] or even catalytic[4] properties has been achieved using Pt(II), Cu(II) and Zn(II)-salen, respectively. A remarkable six-level system[5] obtained by combining ion-triggered mechanical motion with the redox activity of Ni(II)-salen complexes will be presented.
In parallel, we have developed cyclodextrin based rotaxanes to exploit the conical shape of CD for its controlled motion. To obtain a motor, a critical point is the development of molecular ratchets and in particular the so-called information ratchet, where information is given to a reaction center to kinetically bias the system and induce unidirectional motion. Until now, the only given information was the relative positions of the motor components. We have recently shown that in a rotaxane the cyclodextrin induces a kinetic bias depending on its position and orientation.[6] This new class of information ratchet mechanism that opens up new possibilities for the design of molecular machines will also be highlighted.



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