The 22nd Holger Erdtman Lecture

Professor Alberto Credi

Center for Light Activated Nanostructures (CLAN), Dipartimento di Chimica Industriale "Toso Montanari", Alma Mater Studiorum - Università di Bologna, and Consiglio Nazionale delle Ricerche, Bologna, Italy.
e-mail: alberto.credi@unibo.it

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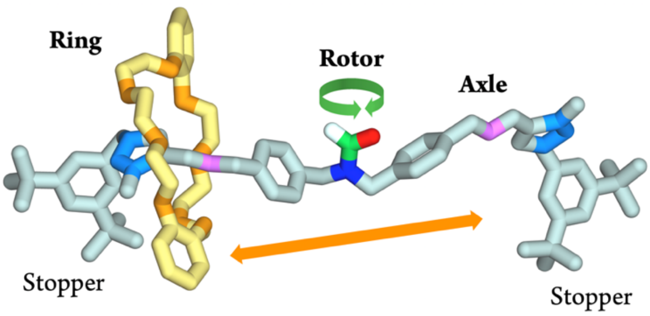
Supramolecular chemistry in action:molecular machines and motors

The construction of molecular scale devices and machines have formidably stimulated the creativity of chemists in the past three decades.[1,2] The interest on this kind of systems arises from their ability to perform a (useful) function in response to chemical and/or physical signals (e.g., light). Mechanically interlocked molecules exhibit appealing structural and functional properties for the construction of nanoscale devices and machines; molecular shuttles based on rotaxanes constitute common examples.[2]

Here I will describe investigations undertaken in our laboratories, aimed at inducing and controlling nanoscale movements in rotaxanes and related species to perform functions such as transmitting motion between sites[3] (see Figure) and activating mechanically chiral structures for enantioselective guest recognition.[4] From a fundamental viewpoint these systems behave as molecular switches under thermodynamic control. Appropriately designed architectures, however, can exploit an energy harvesting process to operate away from thermodynamic equilibrium.[5] Moreover, by exploiting energy and/or information ratcheting effects, directional and autonomous movement of the molecular components can occur.[1,2] We have combined this strategy with a minimalist chemical design to realize artificial nanoscale pumps powered by light[6] and electricity.[7] Besides their interest for fundamental science, these systems have the potential to bring about radical innovation in catalysis, materials science, energy conversion, robotics and medicine.[8]



Welcome!

Division of Organic Chemistry

References:

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[2] M. Baroncini *et al.*, *Chem. Rev.* **2020**, *120*, 200.
[3] S. Corra *et al.*, *Chem* **2021**, *7*, 2137.
[4] S. Corra *et al.*, *J. Am. Chem. Soc.* **2019**, *141*, 9129.
[5] F. Nicoli *et al.*, *J. Am. Chem. Soc.* **2022**, *144*, 10180.
[6] G. Ragazzon *et al.*, *Nat. Nanotechnol.* **2015**, *10*, 70. A. Sabatino *et al.*, *Angew. Chem. Int. Ed.* **2019**, *58*, 14341. J. Groppi *et al.*, *Angew. Chem. Int. Ed.* **2020**, *59*, 14825. S. Corra *et al.*, *Chem. Eur. J.* **2021**, *27*, 11076. M. Canton *et al.*, *J. Am. Chem. Soc.* **2021**, *143*, 10890. S. Corra *et al.*, *Nat. Nanotechnol.* **2022**, *17*, 746.
[7] G. Ragazzon *et al.*, submitted.
[8] S. Corra *et al., Adv. Mater.* **2020**, *32*, 1906064.