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Light-driven non-equilibrium operation of artificial molecular pumps and motors

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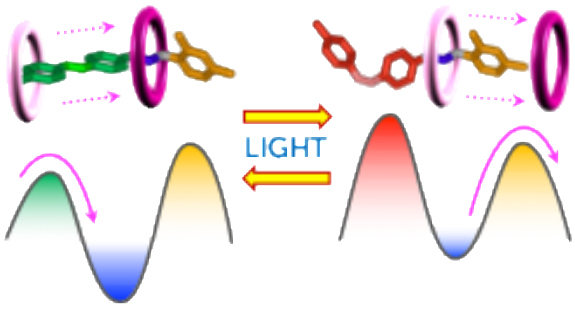
Abstract:

The design, synthesis and investigation of artificial molecular machines has formidably stimulated the creativity of chemists in the past three decades. The directionally controlled motion, activated by energy inputs, of molecular components is key to realize nanometer-scale motors that could perform tasks. By implementing energy ratchet mechanisms with topologically non-trivial molecules, such as rotaxanes and related systems, we have realized prototypes of artificial molecular pumps powered by light. Here we will describe the design and evolution of these devices and discuss the conceptual and pratical challenges associated with the use of light energy to drive chemical systems away from chemical equilibrium. We will also present a new light-driven molecular rotary motor capable of inverting the preferred direction of rotation upon changing the color of light. Besides the interest for fundamental science, synthetic molecular machines and motors have the potential to bring about radical innovation in catalysis, materials science, energy conversion, robotics and medicine.



A light-driven molecular pump based on a pseudorotaxane structure.

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