Design and Operation of Light Driven Supramolecular Pumps

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Natural and artificial autonomous molecular machines operate by constantly dissipating energy coming from an external source (fuel) to maintain a non-equilibrium state. The in-depth study of these dissipative states is highly challenging as they exist only as long as energy is provided.[1]

The use of light as a fuel is highly desirable as one can have high spatiotemporal control, no waste products, and it is intrinsically renewable. We reported on a series of supramolecular pumps capable of using light energy to shift a closed reaction network away from (local) thermodynamic equilibrium thanks to an energy ratchet mechanism.[2] Upon light irradiation the system constantly dissipate energy to sustain a state away from thermodynamic equilibrium. Moreover, transit of the ring along the axle occurs in a directional fashion and the cycle is travelled clockwise with a net reaction rate. Overall, this class of pumps operates transducing light energy, harvested by the photochemical steps, into chemical energy by shifting the equilibrium of self-assembly reactions.[3]

In this talk the structural, kinetics, and energetic aspects of this family of supramolecular pumps will be discussed along with the advancements of the analytical techniques required to reach an unprecedented insight in the non-equilibrium behavior of (photo)chemical reaction networks.

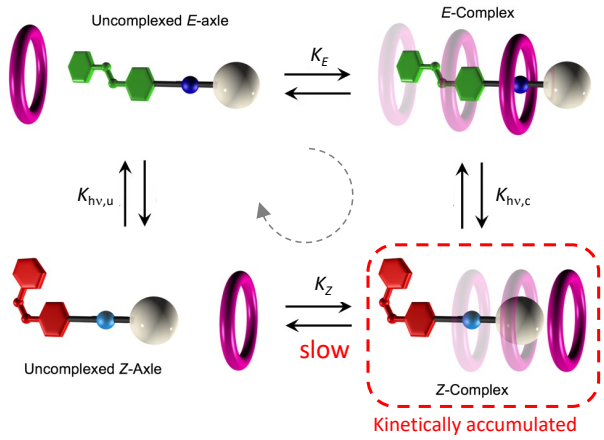

Figure 1. Closed reaction cycle travelled clockwise by the pump during operation (dashed arrow). Z-complex is kinetically accumulated away from its (local) equilibrium concentration.

References:

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