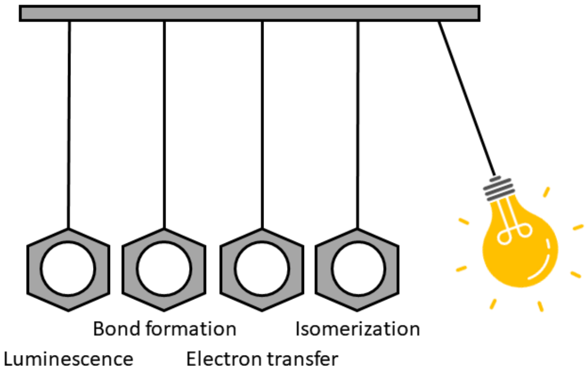
New Modes of Reversible Photochemistry

Tomáš Slanina

Institute of Organic Chemistry and Biochemistry, Czech Academy of Sciences, Flemingovo nám. 2, 160 00, Prague, Czech Republic
email: tomas.slanina@uochb.cas.cz

The classical approach for achieving photochemical reversibility is the use of photoswitches. These molecules can be interconverted between two forms by the light of different wavelengths. Formally, two forms of a photoswitch are the products of photoisomerization (e.g., electrocyclization or isomerization). While this strategy has been utilized in many applications, such as smart materials [1], photopharmacology [2] and molecular electronics [3], we believe that many other modes of photoinduced reversible systems are possible (see figure below).



We combine redox and photochemical processes to selectively manipulate photoswitches and develop novel systems capable of reversible transformation upon irradiation. We focus on (i) programmable gated photoswitches, such as fulgides [4] and diarylethenes, (ii) photoinduced manipulation with electrons ("electron ping-pong") and (iii) reversible formation and cleavage of covalent bonds between two molecules ("catch-and-release" strategy) [5-6]. We also reversibly modulate the luminescence of molecular systems by the light of a specific wavelength.

While these approaches diversify in terms of potential applications, the fundamental design principles are analogic to the development of photoswitches, namely optimization of wavelength orthogonality, quantum yields, dark stability and photostationary state composition. Combined, these next-generation reversible photochemical systems broaden the scope of photoactivatable molecules [7] applied in chemical biology, molecular electronics, photovoltaics, and material chemistry.

References

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