From charge separation to light-driven molecular machines

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Our group has been interested in "*artificial photosynthesis*" for many years as well as in *chemical topology* and "*molecular machines*".

The first part will be devoted to light-induced charge separation in multicomponent transition metal complexes. In particular, we will focus on molecular triads containing a Ru(II) or Ir(III) complex as central photo- and electro-active species and variously metalated porphyrins (Au(III)- or Zn^{2+}-complexed) or other electron donor or acceptor groups at the periphery of the system. Particularly noteworthy is the *long-lived charge separated state* obtained in a non porphyrinic assembly after excitation of the central iridium(III) complex followed by sequential electron transfer [1].

In the second part, we will briefly explain how our group became interested in **catenanes** (interlocking ring systems) and related species, coming from pure inorganic chemistry many years ago. The link to molecular machines will also be discussed and several examples of such compounds will be mentioned.

In the last section, we will focus on light-driven systems which can be set in motion by generating dissociative excited states within ruthenium(II) complexes. We will in particular describe recent work mostly carried out by Marco Frasconi (an Italian postdoctoral researcher) in association with Fraser Stoddart and his team. **M**eso**p**orous **S**ilica Nanoparticles (MPSN) were used as vehicles to transport ruthenium complexes grafted at the surface of the MSNP and able to interact with DNA *via* a classical intercalator ("dppz") once released. Light irradiation of the particles was used as a means for releasing the ruthenium complex, thus allowing it to find DNA and interact with it. In a second step, it was shown that the MPSNs can be loaded by a cytotoxic compound (drug), the pores being later on blocked by a voluminous ruthenium complex. Light irradiation allowed to liberate both the ruthenium complex and the drug in a stepwise process. The potential of this hybrid system will be discussed.

References :

[1] Flamigni, L.; Collin, J.-P.; Sauvage, J.-P. *Acc. Chem. Res*. **2008**, 41, 857-871

[2] M. Frasconi, Z. Liu, J. Lei, Y. Wu, E. Strekalova, D. Malin, M. W. Ambrogio, X. Chen,Y. Y. Botros, V. L. Cryns, J.-P. Sauvage, J. F. Stoddart, *J. Am. Chem. Soc*., **2013**, 135, 11603