Upconversion in water and its application to "green" transformations of recalcitrant compounds

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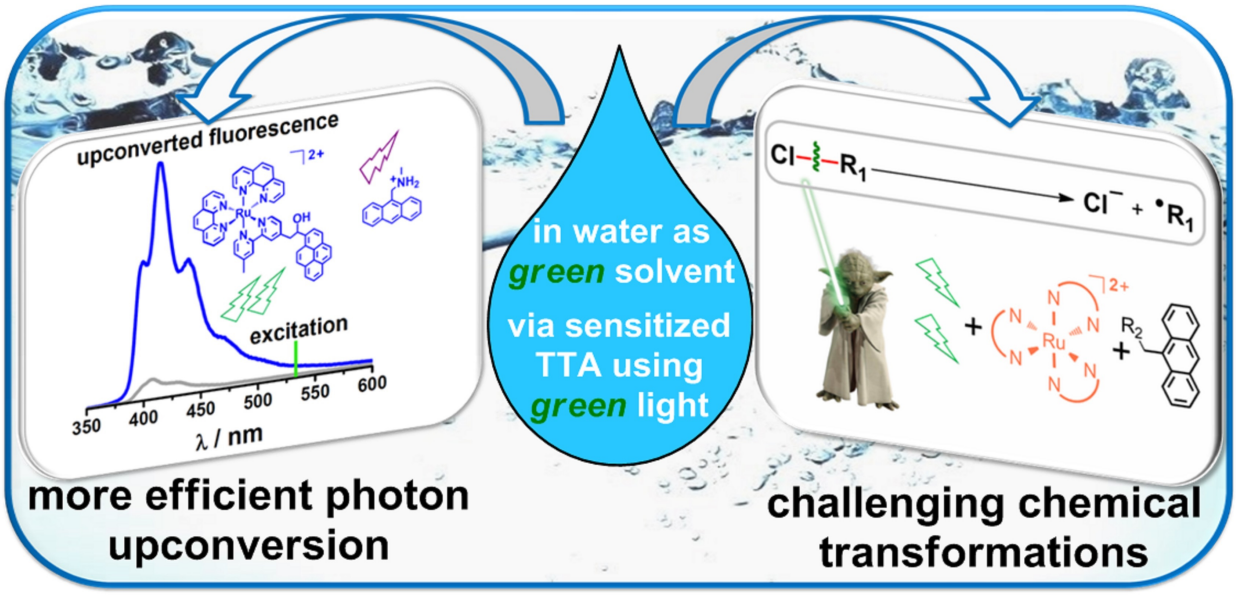
Sensitized triplet-triplet annihilation (TTA) upconversion is a promising mechanism for solar energy harvesting and the energy pooling of two visible photons to initiate transformations of otherwise unreactive molecules.[1] However, current applications of that mechanism are practically completely limited to organic solvents and self-assembled systems.[2,3] Combining water-soluble ruthenium complex-pyrene dyads with particularly long-lived excited states as sensitizers and highly fluorescent commercial anthracenes as acceptors / annihilators, we were able to achieve green-to-violet upconversion with unprecedented quantum yields in pure water. Compared to the only known system exploiting sensitized TTA in homogeneous aqueous solution,[4] we improve the overall photon upconversion efficiency by a full order of magnitude and present the very first example for a chemical transformation on laboratory scale via upconversion in water.[5] Specifically, we found that a thermodynamically challenging carbon-chlorine bond activation can be driven by green photons from an inexpensive continuous wave light source in the presence of dissolved oxygen. Our new approach might thus be important in the context of cleaning water from toxic chloro-organics, as well as for sustainable photochemistry in the most environmentally friendly solvent.



[1] C. G. López-Calixto et al., *Appl. Catal., B*, **2018**, *237*, 18-23.
[2] T. N. Singh-Rachford, F. N. Castellano, *Coord. Chem. Rev.*, **2010**, *254*, 2560-2573.
[3] V. Gray et al., *Coord. Chem. Rev.*, **2018**, *362*, 54-71.
[4] K. A. El Roz, F. N. Castellano, *Chem. Commun.*, **2017**, *53*, 11705-11708.
[5] C. Kerzig, O. S.Wenger, *Chem. Sci.*, **2018**, DOI: 10.1039/c8sc01829d.