The Wavelength Matters

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Visible-light photocatalysis is a relatively young branch of organic chemistry that quickly became an integral part of the synthetic chemists' toolbox. This results from the synthetic potential of photochemistry that allows unlocking unique reaction pathways unavailable to conventional ground-state reactivity. Photons are used as traceless, sustainable reagents to excite photocatalysts that ultimately induce reactions through energy-, and single electron transfer events with substrates, reagents or co-catalysts under mild conditions. However, most photocatalytic reactions rely on a small set of photocatalysts that are typically activated with high-energy visible-light (<450 nm) to achieve efficient reactions.
The underlying theme of many research activities in the PieberLab is that light is more than just a traceless, sustainable reagent. The energy (and intensity) of photons are overlooked parameters that can be used to gain control over the selectivity and to improve the reproducibility of light-mediated reactions. This, however, requires photocatalysts that broadly absorb over the visible-light spectrum. In this talk, I will give an overview about our research efforts towards new methodologies and photocatalysts that unravel the full potential of light for organic chemistry. I will discuss examples where tuning the irradiation wavelength is crucial to avoid follow-up reactions,[1,2] substrate degradation[1] and the deactivation of co-catalysts.[3] Moreover, I will show that the irradiation wavelength can be used to control the reactivity of a photocatalyst by controlling its excited state oxidation potential.[4] Finally, I will also present our first efforts towards light-mediated cross-couplings that do not require exogeneous photocatalyst.[5]

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