Switching light Intensity to Change the Outcome of a Chemical Reaction

Chemical reactions are often quite sensitive: the products they yield can be manipulated by altering the pressure, temperature, or the type of catalyst used. Photocatalysts (light-driven catalysts) with tailor-made properties are often used to control the yield and type of products obtained from a light-driven photochemical reaction. But studies have shown that even playing with the type of light source and how it hits the reacting mixture can decide the outcome of photochemical reactions. However, the conventionally used metal photocatalysts used are quite expensive and sometimes even toxic.

Thus, to overcome these limitations, we have been looking into more eco-friendly reactions that respond to change in the wavelength of the light. In this study, instead of using two differently colored light sources, the researchers used a single blue LED light source with adjustable light intensity to tune a photochemical reaction.

In this study, a photocatalytic system consisting of a continuous-wave (CW) laser of 447 nm working at 1 W was collimated to a spot smaller than 1 mm^2 using a lens. Along with "Irsppy," a water-soluble catalyst to carry out the reactivity investigations for dehalogenation and isomerization reactions.

We found that this setup was able to obtain two different main products from the same substrate under identical reaction conditions, because the amount of light hitting the photosensitive chemicals could dictate the reaction rate and intermediates or pathways of a photochemical reaction.

These results indicate that this cost-effective and novel irradiation intensity modulation technique could be used for a range of lab-scale photoreactions, with three substrate classes resulting in high product yields and exceptional selectivity.

Our study paves the way for better, more efficient photocatalytic reactions that yield valuable products, which can be designed and controlled by just switching the intensity of light.

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Authors: Christoph Kerzig and Oliver S. Wenger

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Corresponding author e-mails: christoph.kerzig@unibas.ch, oliver.wenger@unibas.ch

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