Green Chemistry with Light – From Lab-scale Photochemistry to the Solar Production of Chemicals and Continuous-Flow Photochemical Synthesis

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Common drawbacks of photochemistry are the necessity to use hazardous solvents, energy-intensive artificial light sources or high dilutions. Over the last decades we have developed photodecarboxylations as an efficient access to macrocycles or addition products. Due to the high water-solubility of the starting carboxylates, these reactions can be conducted in aqueous solutions. Large-scale syntheses (<50 g) have also been realised using novel falling-film or circulating loop reactors. The reaction has been furthermore used as a key-step in the synthesis of biologically active target compounds [1]. To overcome the high energy demand of artificial light sources, natural sunlight can be used as a 'free' light source for the production of chemicals [2]. We have realized a number of laboratory- to large-scale solarchemical reactions in direct sunlight. All reactions utilized biomass-derived starting materials and gave complete conversions and excellent yields after short illumination times. The combination of microspace and flow operation is especially advantageous for photochemical transformations. We have thus studied a series of photoreactions under continuous-flow conditions. In all cases examined, the flow reactions gave higher conversions or yields and better product qualities. We have also developed photochemical-thermal tandem processes for multi-step reactions to bioactive compounds *in series* [3]. Parallel photochemical operations have also been conducted in a multicapillary flow reactor and solar exposures in a concentrating trough reactor. Recently, we became also interested in the production of biodiesel through photocatalysis.

Figure 1. Loop reactor, solar CPC-reactor and photochemical-thermal tandem flow-reactor.

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[2] J. S. Wau, M. J. Robertson, M. Oelgemöller *Molecules* **2021**, *26*, #1685.

[3] S. Mumtaz, M. J. Robertson, M. Oelgemöller *Molecules* **2019**, *24*, #4527.