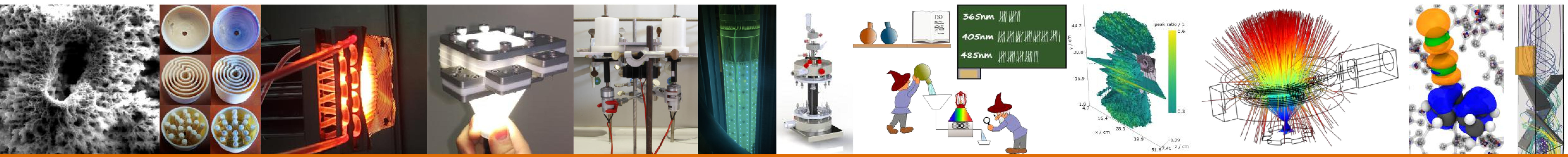
Institute of Chemical Engineering
Photochemical Reaction Engineering



Laboratory of Photochemical Reaction Engineering

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Light-driven reactions are essential for life on earth. Natural photosynthesis stores solar energy as chemical energy and captures around 130 TW of solar energy per year. Photochemical reactions driven by natural as well as artificial light sources have a huge potential to contribute to energy transition and pave the way towards sustainable chemical processes.

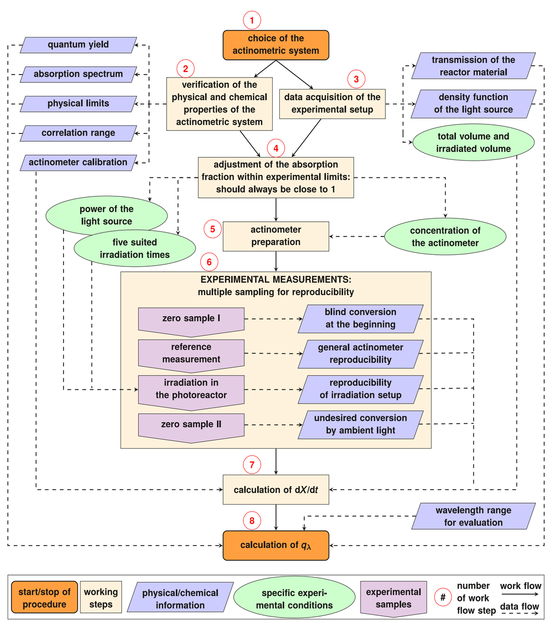
Photoreactions give access to synthetic routes not accessible via thermal paths, leading to products which cannot be synthesized through conventional reactions or to a significant reduction of necessary synthetic steps. Photoreactions meet the principles of green chemistry to improve sustainability of the overall process by increasing atom economy, energy efficiency and prevention of chemical waste. Light is a traceless reagent that is only present as long as irradiation is provided to the reaction compartment and can initiate reactions very selectively when it is monochromatic, providing new adjusting screws to the reaction engineering tool box. Reactions driven by visible light can be costless and the availability unlimited as long as solar light is used.

Conducting photochemical reactions adds an extra complexity to the reaction engineering aspects. The radiation field has to be considered as an additional governing parameter for the design, operation and scale-up of photoreactors. Since the interaction of light with matter is not linear, a thorough understanding of the interaction of the light driven reaction with mass, heat and radiation transfer is key for the development of highly efficient photochemical processes.

The research group "Photochemical Reaction Engineering" headed by Prof. Dr. Dirk Ziegenbalg investigates the unique features and particularities of photochemical reactions. The group works on fundamental investigations, optimization and design of photoreactors as well as photochemical processes. Optimization and design is based on fundamental knowledge of spatial photon fluxes in reactors. By appropriate investigation and understanding of the reaction engineering aspects of the whole process, optimization of photochemical processes on the process level is realized. Micro- and millistructured reactors, *online* analytical methods, additive manufacturing and numerical simulations are applied as tools. By utilizing the unique features of light, the group applies light as tool for the investigation of general reaction engineering topics.

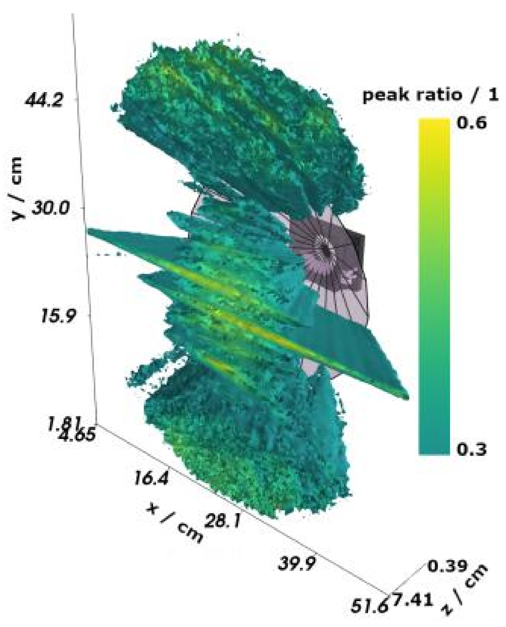
Characterization, Development and Optimization of Photoreactors

- development and application of actinometric methods for intensified photoreactors



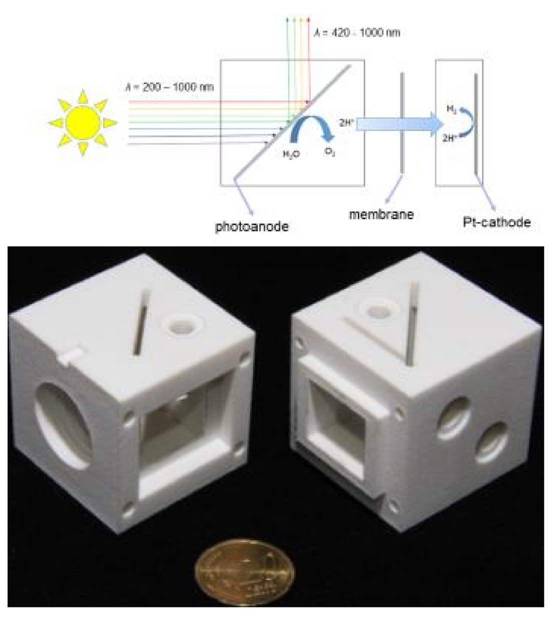
10.1007/s41981-019-00072-7
10.1002/cptc.202100122
10.1002/ceat.201500498
10.1002/cptc.201800106

- development and application of 2D and 3D radiometric methods



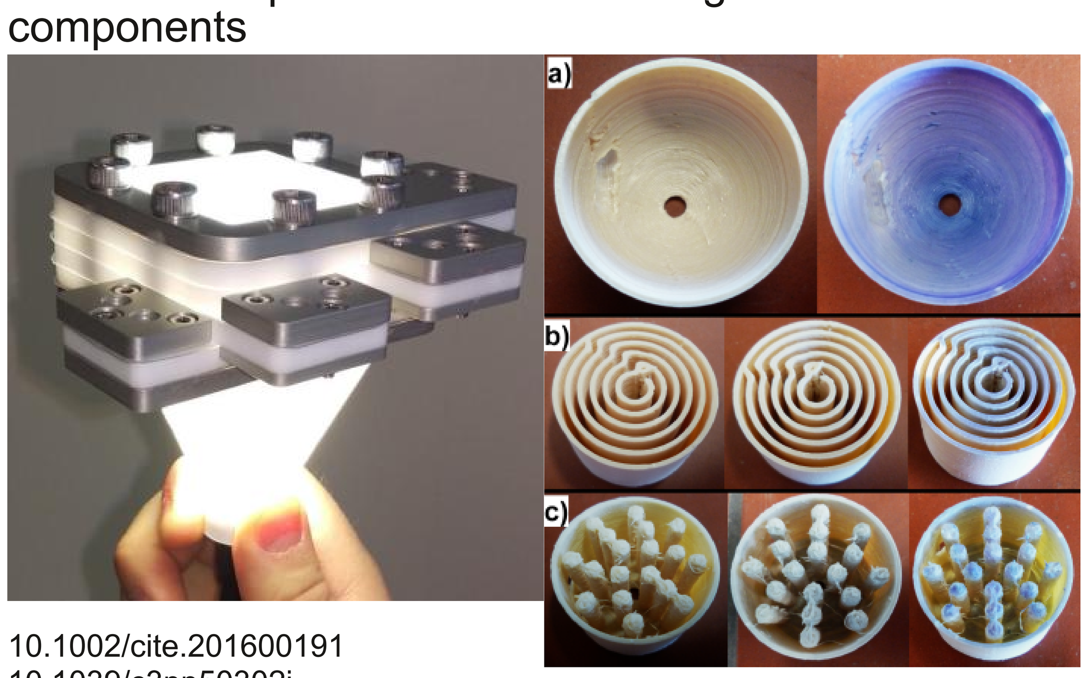
10.1039/D0RE00456A
10.1039/D0RE00457J

- advanced reactor concepts for utilization of polychromatic light



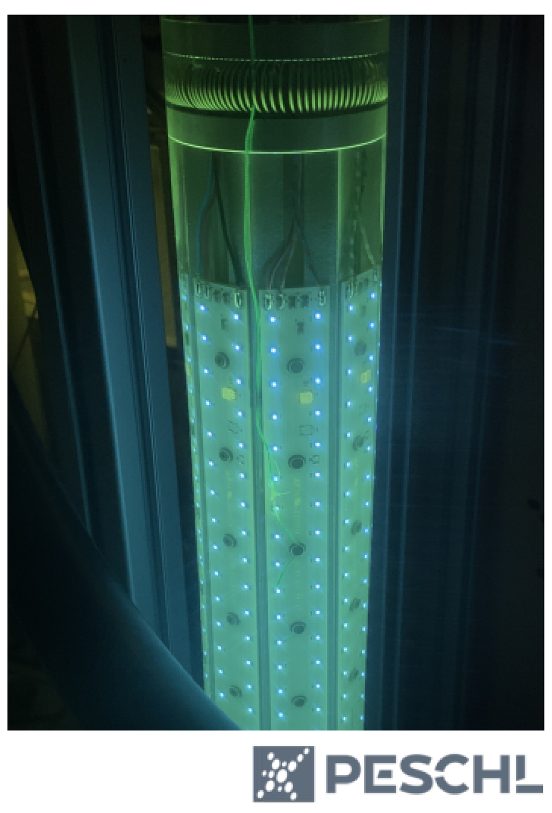
10.1002/chem.201602709

- customized photoreactors and integration of active components



10.1002/cite.201600191
10.1039/c3pp50302j

- advanced fluid cooling of LEDs



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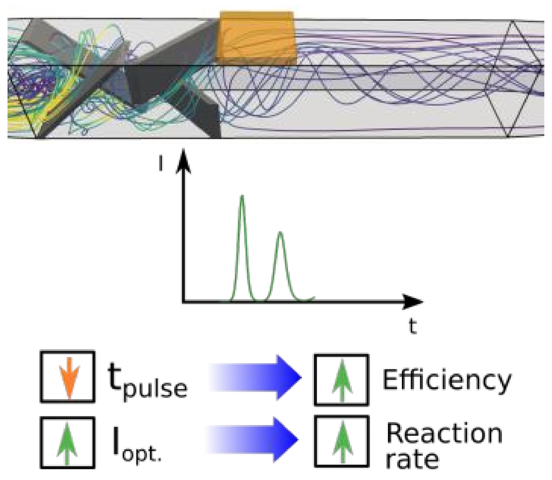
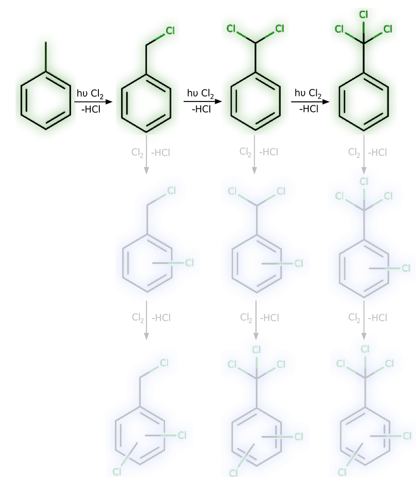
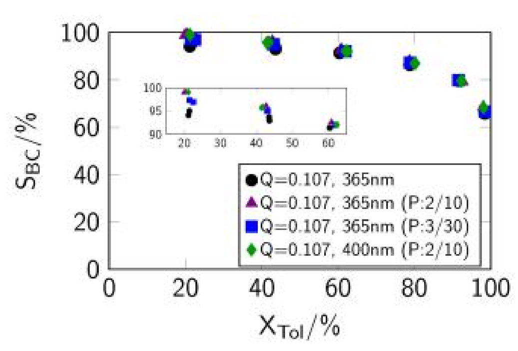
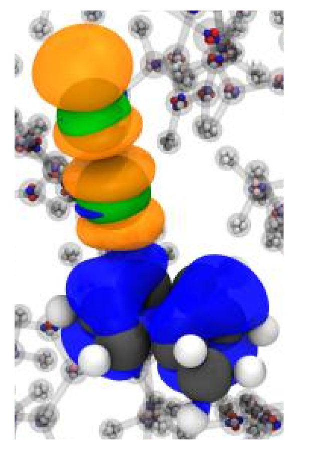
Optimal Reaction Control

- imposed unsteady irradiation to enhance performance and efficiency





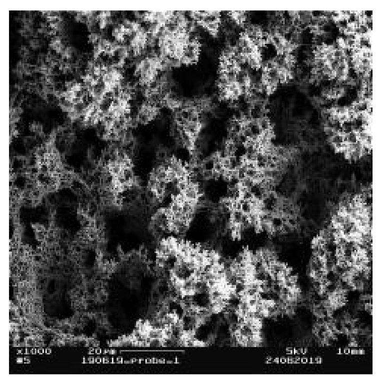




10.1007/s41981-021-00174-1
10.1002/cptc.202100084
10.1002/slct.201800289

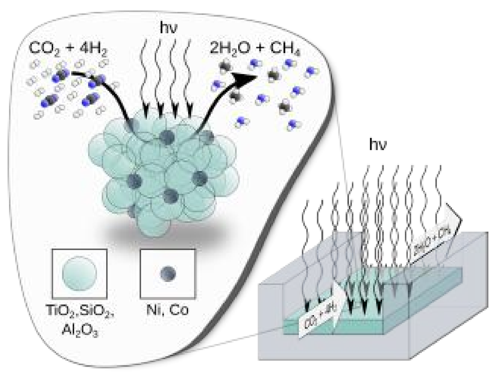
10.1039/d0re00366b
10.1039/d0re00263a
10.1016/j.flowmeasinst.2017.12.012

- reaction engineering of photocatalytic reactions

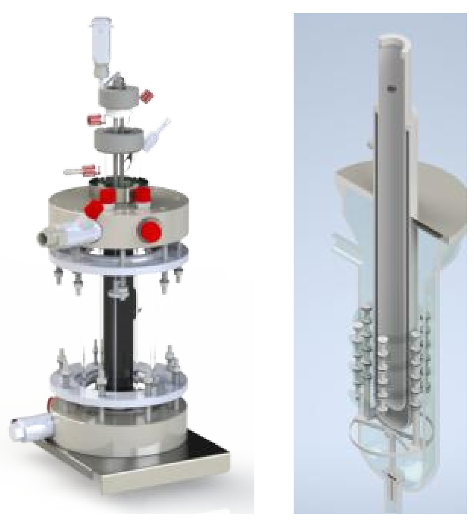


10.1002/cptc.202100084
10.1016/j.solidstatesciences.2020.106212
10.1016/j.solidstatesciences.2018.02.005

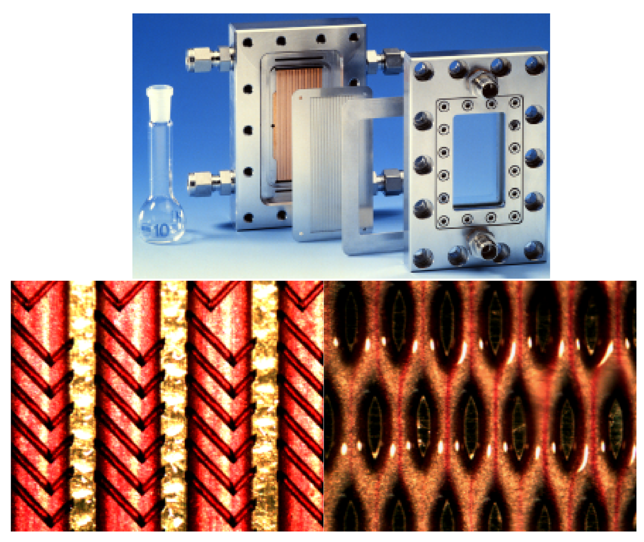
- influencing selectivity and performance of thermal reactions with light



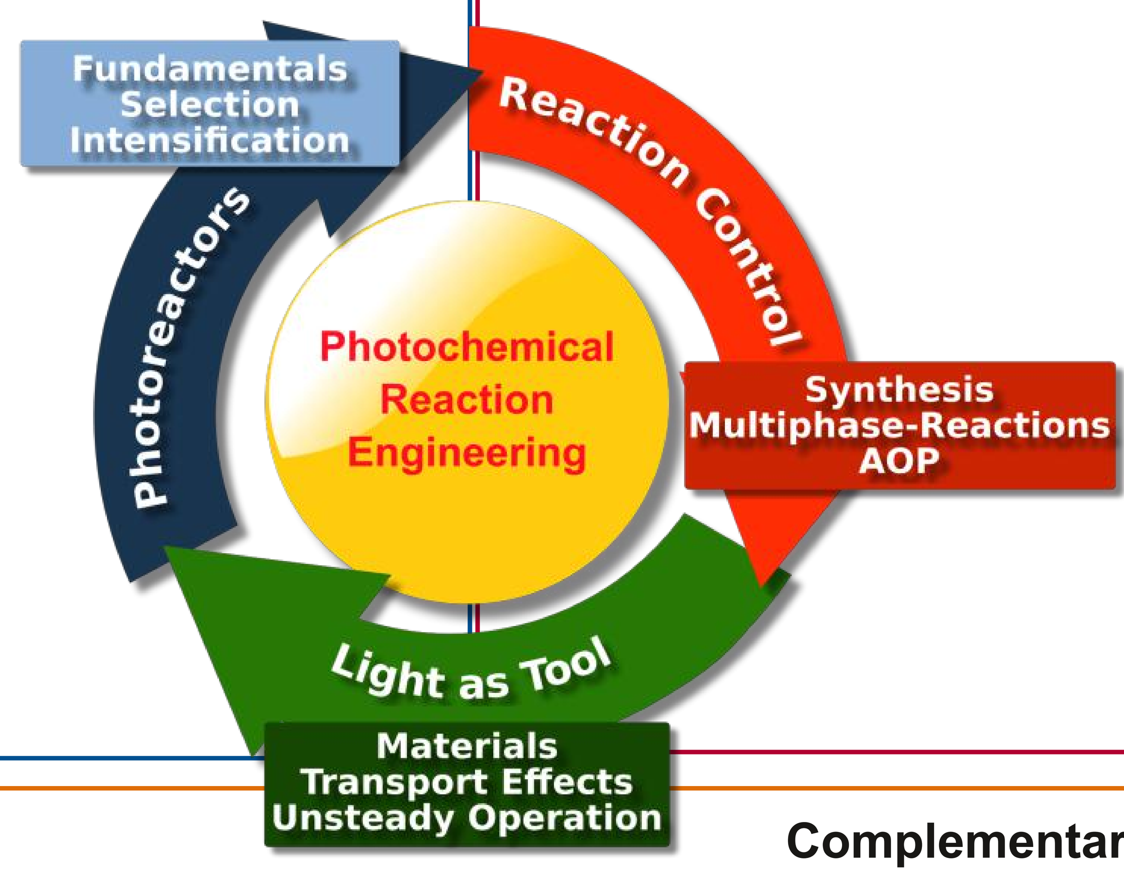
- scale-up concepts for industrial photoreactors



- intensification of multiphase reactions

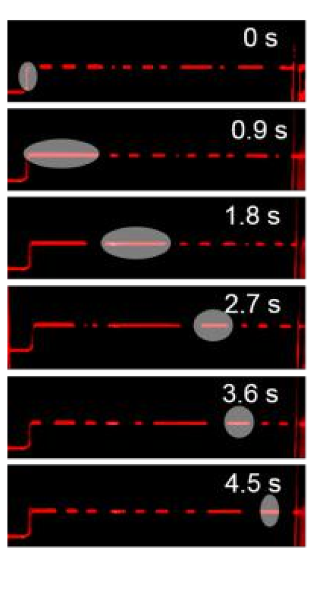


10.1016/j.ces.2010.02.039
10.1016/j.cej.2011.11.014



Light as Tool

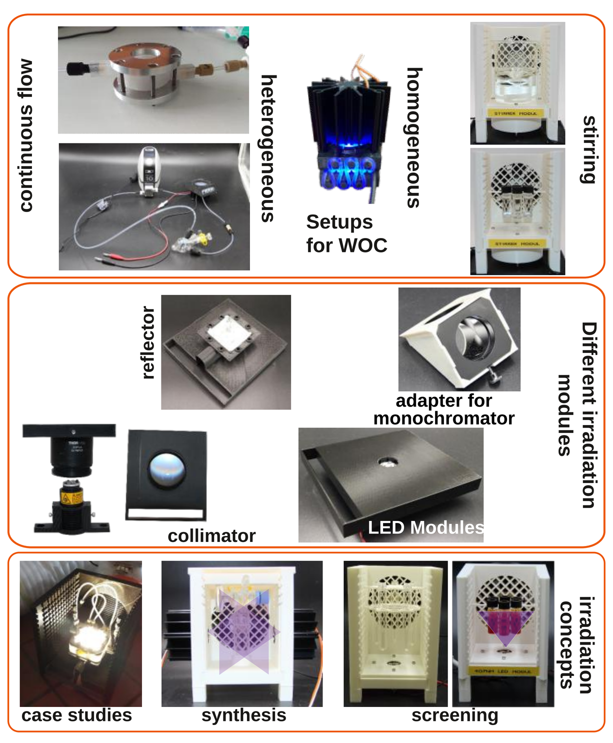
- separation of physical and reactive mass transport



10.1002/ceat.201600586

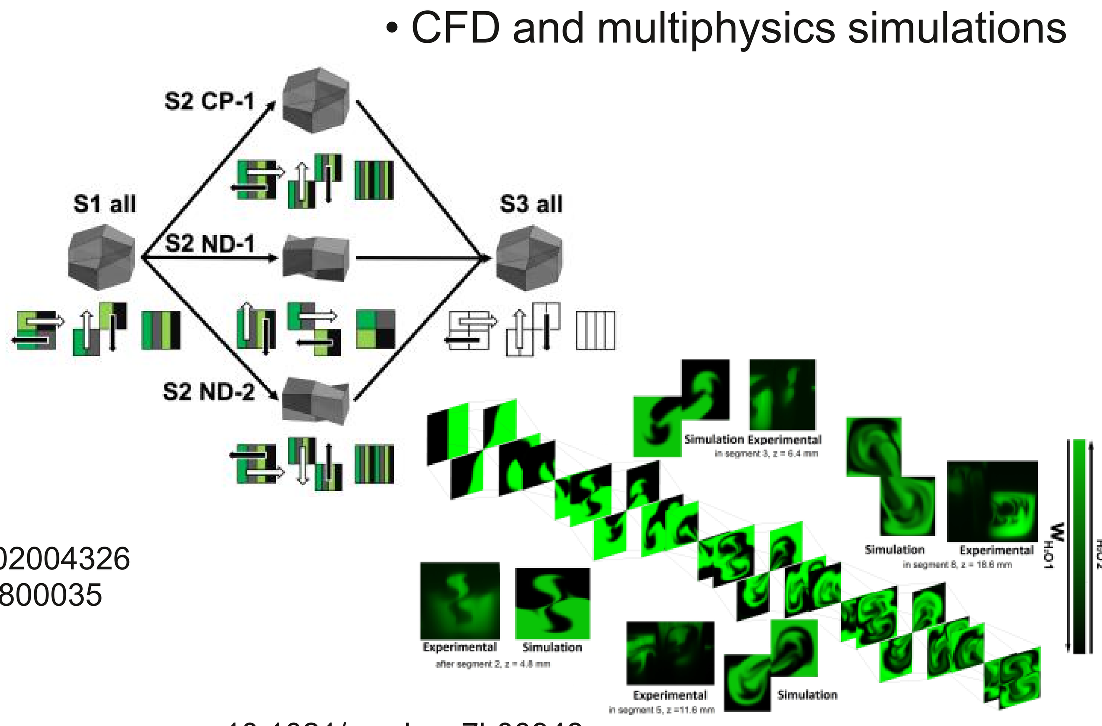
Complementary Research

- 3D printing and rapid prototyping

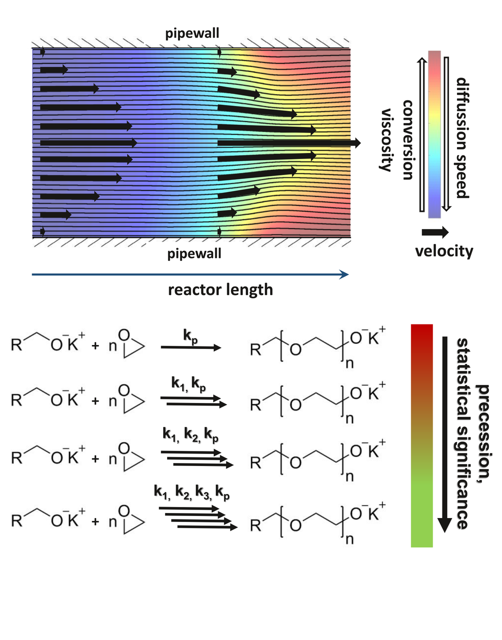


10.1002/chem.202004326
10.1002/cite.201800035

- CFD and multiphysics simulations



10.1021/acs.iecr.7b00948
10.1021/acs.iecr.6b04110



10.1021/acs.iecr.7b00948
10.1021/acs.iecr.6b04110

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https://github.com/photonZfeed/

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