Photocatalytic reactor design for time and space resolved multi-spectroscopic analysis integration

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Light-driven catalytic systems and their molecular components, specifically the photosensitizer and the catalyst, are known to suffer from degradation due to irradiation or harsh reaction conditions. The underlying mechanisms and kinetics are not yet well understood and investigation attempts often rely on invasive, destructive, and *ex situ* analysis techniques. Previous studies have shown that using *in situ* multi-spectroscopic analytical platforms with IR-ATR and Raman integration[1] can enable online monitoring of reaction and degradation products with high temporal resolution[2]. However, reaction engineering concepts are not commonly considered during the design of such platforms, which can lead to uncharacterized and unfavorable reaction conditions and consequently, contribute to accelerated system degradation and challenging data comparability. As part of the CataLight CRC/TRR 234 project C2, this work aims to combine reaction engineering and spectroscopic insights to generate high quality reproducible data in order to generate understanding and ensure comparability of different light-driven systems. The focus lies on the development of characterized homogeneous and membrane reactors optimized for multi-spectroscopic analyses under both batch and flow conditions. Generated knowledge on degradation can also give an insight into possible repair and self-regulating mechanisms.

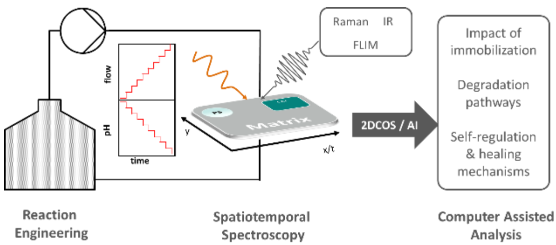

Figure 1: Key objectives overview: combining reaction engineering concepts with spectroscopic insights for generation of high quality data for 2DCOS and ML applications.

[1] S. Klingler *et al.*, Angewandte Chemie (International ed.) 2023, 62 (44), DOI: 10.1002/anie.202306287.

[2] S. Klingler *et al.*, ACS measurement science au 2022, 2 (2), 157–166. DOI: 10.1021/acsmeasuresciau.1c00048.