Raman spectroscopy´s role in understanding photocatalytic systems

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In light of the growing demand for energy resources and the constrained supply, renewable energy represents a prospective and sustainable solution. In this context, the utilization of solar energy via novel photocatalytically active materials represents a promising avenue of research. The development of new photocatalysts necessitates the utilization of analytical techniques that can be employed in situ, with the objective of elucidating the underlying photocatalytic processes that occur following exposure to light at the molecular level. A comprehensive grasp of photochemical reactivity is a fundamental prerequisite for regulating photocatalytic activity and implementing novel repair mechanisms at the molecular or material level, for instance.

Here, we will show that Raman spectroscopy is an effective method for analyzing photocatalytic processes at the molecular level. We are investigating in operando photo-catalytic activity for homo- and heterogeneous systems. Processes such as degradation of the photosensitizer, optimization, and stability of the system are investigated. The impact of dynamic irradiation on water oxidation catalysis was investigated with the objective of elucidating the underlying limitations in artificial photosynthesis and developing strategies to circumvent deactivation pathways. Furthermore, the binding conditions of photocatalysts integrated into matrices such as polymers have been investigated. For the analysis of the observed Raman spectra tailored 2D correlation analysis routines have been developed.

Acknowledgements

Financial support from the German Science Foundation in the framework of SFB/TRR 234 CATALIGHT is acknowledged.