

STATE-OF-THE-ART, CHALLENGES AND PROSPECTS OF HETEROGENEOUS PHOTOCATALYSIS

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Abstract

Heterogeneous photocatalysis has emerged as an attractive field of research that provides access to a number of useful redox chemistries by means of light-assisted catalysis. However, despite recent advantages in oxidative photocatalysis, reactions of photocatalytic water splitting and CO₂-to-fuel conversion – recognised by the community as a promising way to generate solar fuels – remain a challenge.

In this contribution, I am going to give a general introduction to heterogeneous photocatalysis and overview its current state-of-the-art. I will highlight the existing challenges and give several examples of how these can be addressed by exploring novel material combinations based on the work done in our group.

First, I will introduce you to nanocarbon-inorganic hybrids that take advantage of the extended interface between the two components and facilitate charge separation resulting in enhanced catalytic performance [1, 2] exemplifying CNT-Ta₂O₅ hybrids with different morphologies of the oxide layer [3]. Second, I will discuss a strategy to combine benefits of heterogeneous and homogeneous photocatalysis by a rational assembly of such CNT-metal oxide hybrids with molecular-based catalysts exemplifying one of the most active Ru-based water oxidation complex [4]. Finally, I will talk about the use of inorganic co-catalyst nanoparticles for hydrogen evolution and oxygen evolution reactions and their in situ (de)activation exemplifying most common Pt and several novel non-noble metal co-catalysts. [5]

References

- [1] D. Eder, Chem. Reviews, 2010, 110 (3), 1348-1385.
- [2] C. Shearer, A. Cherevan, D. Eder, Adv. Mater., 2014, 26, 2295–2318.
- [3] A. Cherevan, P. Gebhardt, C. J. Shearer, M. Matsukawa, K. Domen, D. Eder, Energy Environ. Sci. 2014, 7, 791–796.
- [4] J. Creus, R. Matheu, I. Peñafiel, D. Moonshiram, P. Blondeau, J. Benet-Buchholz, J. García-Antón, X. Sala, C. Godard, A. Llobet, Angew. Chem. Int. Ed., 2016, 55, 15382.
- [5] G. Haselmann, D. Eder, ASC Catalysis, 2017, 7 (7), 4668-4675.