Light driven Hydrogen Generation: Efficient Iron-based Water Reduction Catalysts

Henrik Junge, Felix Gärtner, Annette-Enrica Surkus, Albert Boddien, Sebastian Losse and Matthias Beller

Leibniz-Institut für Katalyse e.V. an der Universität Rostock

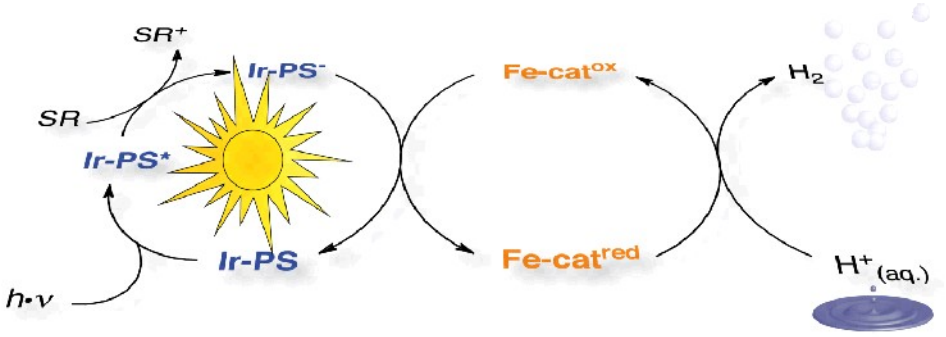
Albert-Einstein-Str. 29a, 18059 Rostock, Germany

Hydrogen is considered to be an attractive energy source, since it can be used in a clean and highly efficient manner in fuel cells. A benign objective is the conversion of the almost unlimited available energy of sunlight into non-fossil based energy carriers like hydrogen. Since the discovery of the Honda Fujishima effect in 1972 photocatalytic water splitting into hydrogen and oxygen has inspired researchers all over the world to develop novel and economic photocatalysts for this reaction. [1]

In order to improve the overall process the two half reactions water oxidation and water reduction can be studied separately employing sacrificial reagents as electron donors or electron acceptors. [2]

We recently demonstrated an efficient light driven water reduction cascade for homogenous reduction of aqueous protons to hydrogen containing an iridium photosensitizer (Ir-PS), iron(0)carbonyls as simple, cheap, readily available and abundant water reduction catalyst (WRC) and triethylamine as sacrificial reagent (SR). [3]

Our system can be driven by Xe-light irradiation either with UV content or with the exclusion of UV light by only the visible part of the light spectrum. All components of the system are essential for catalytic activity. In Addition experiments with D_2O instead of water point out that water is the only source of liberated hydrogen in the reaction.



The highest turn over numbers obtained were 3000 for the iridium photosensitizer and more than 1500 for the iron water reduction catalyst. Thus our system can compete with the established cobalt oxime water reduction catalysts and it belongs to the most active water reduction systems based on iron water reduction catalysts reported so far.

This work is a part of the project “Light2Hydrogen” funded by the BMBF within the programme “Spitzenforschung und Innovation in den neuen Ländern”.

References:

[1] a) Kudo, A.; Miseki, Y. *Chem. Soc. Rev*. **2009**, *38*, 253; b) Osterloh, F. E. *Chem. Mater*. **2008**, *20*, 35.

[2] water reduction cascades: a) Wang, M.; Na, Y.; Gorlov, M.; Sun, L. *Dalton Trans.* **2009**, 6458; b) Tinker, L. L.; McDaniel, N. D.; Bernhard, S. *J. Mater. Chem.* **2009,** *19***,** 3328; water oxidation: Sala, I. Romero, X.; Rodríguez, M.; Escriche, L.; Llobet, A. *Angew. Chem*. **2009**, *121*, 2882; *Angew. Chem. Int. Ed*. **2009,** *48*, 2842.

[3] Gärtner, F.; Sundararaju, B.; Surkus, A.-E.; Boddien, A.; Loges, B.; Junge, H.; Dixneuf, P. H.; Beller, M. *Angew. Chem*. **2009**, *121*, 10147; *Angew. Chem. Int. Ed*. **2009,** *48*, 9962.