New photosensitizer for light driven water oxidation

- New metal-containing porphyrin compounds
- Good alternative for rare and expensive metals used for nature inspired catalysis
- Higher oxidation potentials than existing photosensitizers
- Can be used for photoanode fabrication in water splitting dye-sensitized photoelectrochemical cells

Background

Researchers from the University of Amsterdam (UvA), Prof. A.M. Brouwer and H.C. Chen MSc, have managed to use abundantly available, cheap metals in compounds for Nature Inspired Catalysis/Artificial Photosynthesis. Currently at the heart of the catalysts used in these processes are mostly rare and expensive metals. The light sensitive photosensitizer invented by the UvA researchers contains abundantly available and cheaperer metals. It can be used for visible light-driven water oxidation (i.e. capturing light and producing electrons to split water) in a neutral phosphate buffer solution.

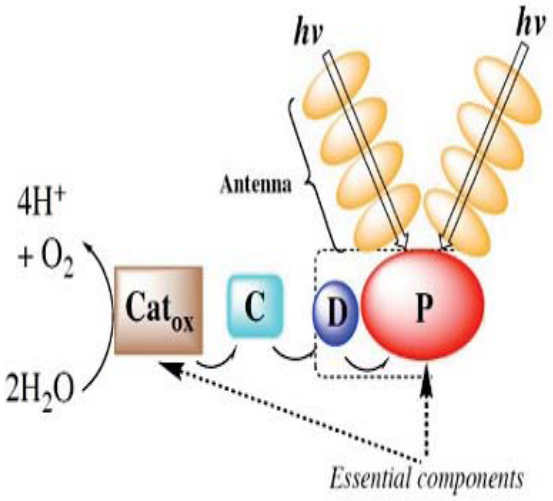

Fig 1. Schematic view of water oxidation; P, Photosensitizer; D, Electron donor; C, Electron carrier; Cat_{ox}, Water-oxidation catalysts.

The technology

A currently widely used photosensitizer for visible light-driven water oxidation is based on poly(bipyridine) ruthenium complexes e.g. $Ru(bpy)_3^{2+}$.

Better photostability

These poly(bipyridine) ruthenium complexes, however, extremely rapidly photo-decompose and photo-bleach in a neutral phosphate buffersolution. Our invantion, a photosensitizer of the metelloporphyrin type, has shown to be more photostable in a neutral phosphate buffer than $Ru(bpy)_3^{2+}$.

Higher oxidation potential

It has also shown to have a robust photosensitizer performance for light-driven water-oxidation, because of the higher oxidizing power, which activates a wide range of (water-oxidation) catalysts.

Great photo-capture ability

Moreover, $Ru(bpy)_3^{2+}$ has very poor absorption ability in the visible-light range. Our metalloporphyrin photosensitizer can definetely have a better photo-capture ability than the current standerd photosensitizer. It can extend the absorption wavelength to 600 nm for performing light-driven water-oxidation. Consequently, it can show comparable photocapture wavelength as the currently longest absorbing of inorganic semiconductor photocatalyst material Ta_3N_3 for water-oxidation.

Requirements met for commercial fabrication

Our photosensitizer meets all the requirements needed as an ingredient for commercial fabrication of an artificial leaf, which are a simple procedure, high synthesis yield and accessibilty of all materials used. This is the first step to the future of light-driven artificial photosynthesis, the ultimate source of energy for biofuel production. Artificial photosynthesis can also provide raw materials and electricity generation. These are all possible implementation options.

What are we looking for?

Our long-lived photostable photosensitizers with intense visble light absorption and high formal potential which can initiate photocatalytic water oxidation in concentrated neutral phosphate buffer solution is just an ingredient of a complete system.

The University of Amsterdam is looking for a partner that is willing to jointly develop a complete system based on the new photosensitizer.

Inventors

- **Prof. A.M. (Fred) Brouwer,** Department of Spectroscopy and photonic materials, University of Amsterdam
- **H.C. (Hung-Cheng) Chen MSc,** University of Amsterdam

Key publications

H.C. Chen, D.G.H. Hetterscheid, R.M. Williams, J.I. van der Vlugt, J.N.H. Reek & A.M. Brouwer (2015). Platinum(II)-porphyrin as a sensitizer for visible-light driven water oxidation in neutral phosphate buffer. Energy & Environmental Science, 8 (3), 975-982. doi: 10.1039/c4ee03302g

Want to know more?

Contactperson: Willem Fokkema
Business development manager
Email: w.t.fokkema@uva.nl