A Fluorescence-Based Screening Protocol for the Identification of Water Oxidation Catalysts

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Invited for this month's cover is the group of Joost Reek at the University of Amsterdam. The image shows a screening approach for the identification of molecular catalysts for chemical oxidation of water, which is based on oxygen-sensitive fluorescence-quenching using an OxoDish.
The Full Paper itself is available at 10.1002/cssc.201500558.

What prompted you to investigate this topic?

The research is part of the program of the BioSolar Cells consortium, in which eight Dutch universities joined forces and collaborate with various industries. One of the main objectives is to develop efficient solar-fuel devices—or so-called artificial leafs—from labscale to demo-devices that can split water into oxygen and hydrogen using sunlight. As catalysis is one of the main pillars for light-driven water splitting, we investigate the working principles of molecular catalysts for both water oxidation and proton reduction with the goal to make robust and efficient catalysts for incorporation into devices. For sustainable water oxidation, robust and efficient catalysts are needed that consist of abundant materials. High-throughput screening can speed up the identification and further development of such catalysts, and this has lead to the investigation that is reported in this work. We show that the OxoDish is a versatile tool to facilitate the quick evaluation of potential molecular water oxidation catalysts. Several catalysts were found, even based on first-row metals, that formed oxygen under the applied conditions.

Who are the collaborators in this research?

In this particular project, we teamed up with InCatT B.V., a company specialized in high-throughput catalyst research, who helped us to develop a fast identification tool especially suitable for water oxidation catalysis. Interestingly, the company now also uses the new tool to evaluate complexes for other oxidation-type catalysis and as such the collaboration was also very fruitful for InCatT B.V.

What do you consider exciting developments in the field?

In our strategy we try to develop a solar-fuel device based on dye molecules and molecular catalysts that, driven by sunlight, split water into oxygen and hydrogen. This is currently becoming a hot topic, and there are several studies in which new water oxidation catalyst are reported based on Fe, Cu, Ir, Co, Mn, and Ru. Putting all components together to make a working device is challenging, but recent work of Licheng Sun and co-workers showed for the first time a system with two connected electrodes coated with molecular components that could split water using solar simulation (DOI: 10.1021/jacs.5b04856). It will still be a long way before high solar-to-fuel efficiencies will be reached, but based on the blue print provided by Nature, photosynthesis, devices based on molecular compounds should have a bright future.

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