Unisense microsensors in water splitting studies

Hydrogen and oxygen microsensors for direct and real-time detection of dissolved gas in photocatalytic/electrochemical studies

H_2 and O_2 sensor characteristics:

- Direct gas and liquid phase measurements
- Real-time data - no need for GC or MS
- Detection range <50 nM to saturation
- Response time in seconds
- Customizations available
- Simple two-point calibration

Unisense microsensors are widely used in photocatalytic and electrochemical studies looking at the development of either H_2, O_2, or both gases. The sensors can be mounted directly in the reaction vessel, e.g. an H-cell, with standard or customized sensors from Unisense. This will allow for fast and real-time measurements with no need for slower, and error prone detection methods.

Selected microsensor applications:

Hydrogen evolved from light-driven water splitting at the surface of a semiconductor material

Jonathan Kampmann and coworkers from the University of Munich have used a Unisense H_2-NP low range microsensor to detect the nanomolar concentrations of hydrogen evolved from light-driven water splitting at the surface of a semiconductor material. They used a covalent organic framework (COF) as photoelectrode and the material was held at a potential of 0.4 V versus a reversible hydrogen electrode. During light illumination, the generated charge reduced water in the cuvette and hydrogen was produced and detected continuously with the H_2 microsensor (Figure 1).

You can read more in the article by Sick et al. (2018) Oriented Films of Conjugated 2D Covalent Organic Frameworks as Photocathodes for Water Splitting. J. Am. Chem. Soc. 2018, 140, 2085-2092.

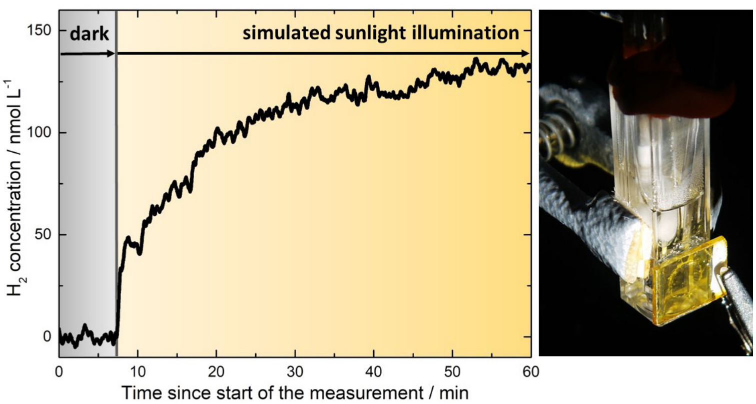
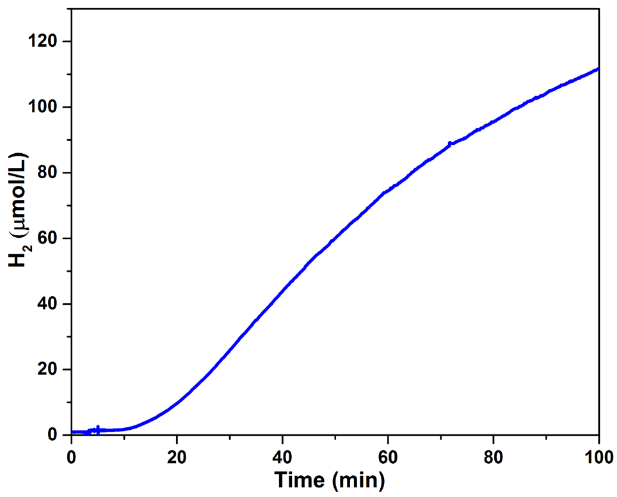


Figure 1. *Microsensor measurement of the H_2 produced when the sample was illuminated with sunlight (left). H_2-NPLR microsensor in the cuvette containing the active semiconducting material (orange substrate) and water (right).*

Data and photo kindly provided by Jonathan Kampmann.

Hydrogen production upon illumination of a polymer dot catalyst

Dr. Haining Tian and his research group from Uppsala University have been investigating the potential of organic semiconducting polymer dots (Pdots) to serve as a photocatalyst in light-driven hydrogen production from water splitting. In the experiment the researchers used a H_2-NP low range sensor with a detection limit of 50 nM to pierce through the lid of a cuvette and then measure the hydrogen evolution in an aqueous solution containing Pdots (Figure 2). The researchers showed that the Pdots worked very well as photocatalysts for light-driven water splitting.



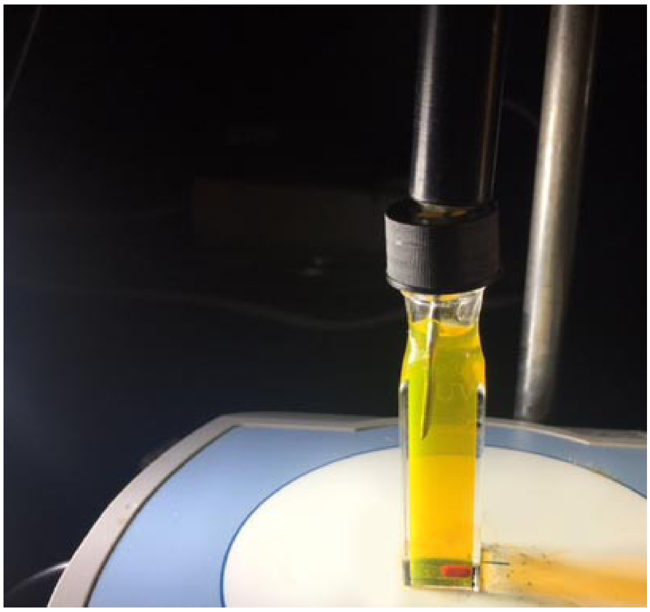


Figure 2. *H_2 generation over time measured with the Unisense H2-NPLR microsensor (left) and experimental setup showing the hydrogen microsensor pierced through the lid into the sample measuring the H_2 generation (above).*
Data and photo kindly provided by Dr. Haining Tian.

For further reading please see the article: Wang et al. (2016) Organic Polymer Dots as Photocatalysts for Visible Light-Driven Hydrogen Generation. Angew. Chem. Int. Ed. 2016, 55, 12306.

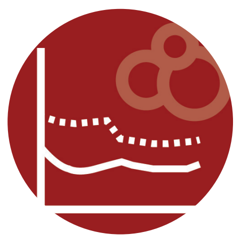
Suggested products

Sensors

Amplifiers

Single or MultiChannel UniAmp

Software



SensorTrace Logger

Related publications

Salomao et al. (2019) Photoelectrochemical hydrogen production from water splitting using heterostructured nanowire arrays of Bi_2O_3/BiAl oxides as photocathode. Solar Energy Materials and Solar Cells 2019.

Alqathani et al. (2019) Heteroepitaxy of GaP on silicon for efficinet and cost-effective photoelectrichemical water splitting. J. Mater. Chem. A,7, 8550-8558.

Tian et al (2018) Hydrogen evolution by a photoelectrochemical cell based on a Cu20-ZnO-[FeFe] hydrogenase electrode. J. Photochem. Photobiol. A Chem., Vol 366, 27-33.

Sherman et al. (2016) A Dye-Sensitized Photoelectrochemical Tandem Cell for Light Driven Hydrogen Production from Water, J. Am. Chem. Soc. 138, 16745-16753.