# Electrodeposited zinc oxide nanorods ALD-coated with iron oxide: their photocatalytic and photoelectrochemical properties

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Using  the energy available in sunlight to produce fuels, such as hydrogen, could provide society with an environmentally friendly form of energy.
The major challenge for research into this field is to identify a material that can maintain its chemical stability while supplying high current densities.

In this work, we combined two commonly available semiconductors. Separately, each material has serious drawbacks, but by tailoring the morphology of the composite some of the drawbacks could be alleviated.

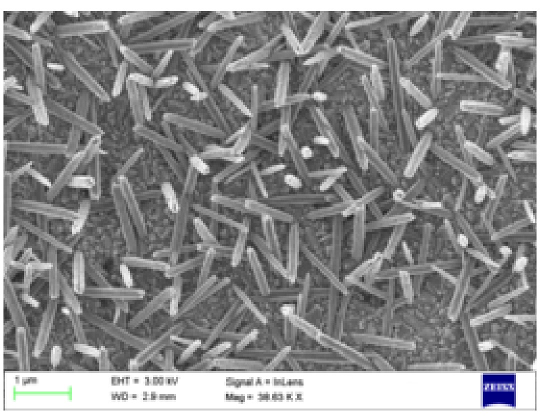
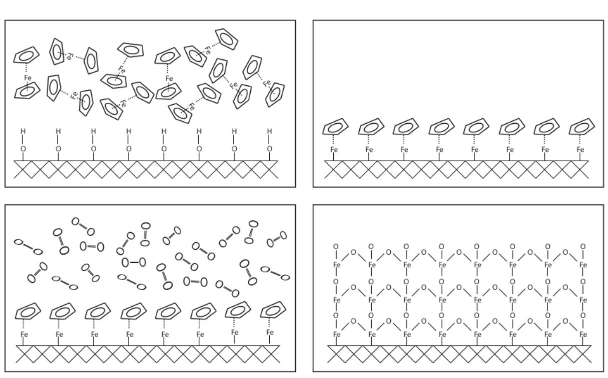


*Illustration 1: Electrodeposited ZnO nanorods, grown on fluorine-doped tin oxide in an aqueous bath.*

To improve and tune the optical properties of the photoanode, electrodeposited ZnO nanorods were coated with varying thickness of conformal iron oxide films deposited using the ALD (atomic-layer deposition) technique.

Iron oxide was deposited on ZnO nanorod samples in a Picosun ALD reactor using a ferrocene precursor at a chamber temperature of 450 °C. Film thickness was varied by controlling the number of reactive cycles, from 35 to a 100 cycles, corresponding to 2 – 20 nm.



Due to the thinness of the iron oxide film compared to the thickness of the substrate float glass, optical methods were unable to resolve the signal from the iron oxide film. The same effect also complicated x-ray fluorescence and x-ray diffractometry measurements.

To help identify the phase of the deposited iron oxide film, we resorted to XPS, which is a surface-sensitive technique, which did indicate the presence of hematite on the surface of the photoanode.

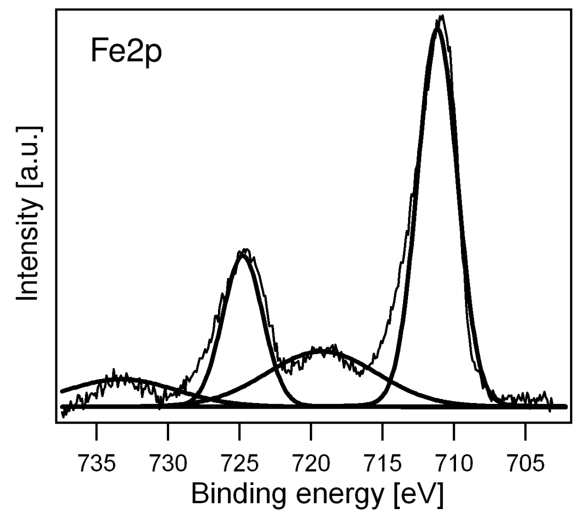



*Illustration 2: Fe 2p spectra of iron oxide/zinc oxide nanorod/FTO anode on a float-glass substrate, indicating the presence of hematite.*

Characterization results with respect to the photocatalytic and photoelectrochemical performance of the composite photoanode will be presented.

The samples were furthermore characterized using spectroscopical and spectroelectrochemical techniques. Additionally, electron microscopy showed that the iron oxide film was conformal to the substrate for the deposited thicknesses.

This work will also discuss the effect of tuning the thickness of the iron oxide layer towards the material's optical and photoelectrocatalytic properties.