

2 Objectives

As indicated above, Fe_2O_3 is a promising candidate for the oxidative half-reaction of water splitting, which has been the topic of several studies. Nevertheless, distinct deficits in catalytic activity and a systematic relation between catalytic current and surface area are still issues which need to be addressed.

Therefore, this thesis focuses on the electrocatalytic water oxidation with nanostructured Fe_2O_3 electrodes in a phosphate buffer at pH 7. Anodized aluminum oxide (AAO) is chosen as the template for the nanostructures, which is then coated with the catalyst by means of atomic layer deposition (ALD).

The effect of surface area enhancement on the water oxidation efficiency is studied for pore elongation. Here, the optimal system is to be determined in which the maximum catalytic turnover and the related highest overall current density can be achieved.

Linked to system optimization, is the problem of low conductivity of the catalyst surface. For this purpose, the basic nanostructured Fe_2O_3 system is compared with electrodes with underlying conductive layers. Platinum or aluminum doped zinc oxide (AZO), which are deposited by galvanic plating or ALD, respectively, are chosen as underlying layers.

Furthermore, the influence of post-deposition annealing of the Fe_2O_3 surface under O_2 or N_2 atmosphere is investigated with respect to changes in morphology and chemical composition.

In addition to the electrode preparation procedure, methods used are steady-state electrolysis, electrochemical impedance spectroscopy (EIS) for distinction of the different electrochemical processes, scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS) for structural and elemental surface analysis, respectively.

This work shall therefore serve to optimize the Fe_2O_3 electrode performance and to gain a better understanding of the structural changes and electrochemical reactions taking place with respect to the future application of Fe_2O_3 electrodes for solar water splitting.

Electrochemical Water Oxidation at Iron(III) Oxide

Electrodes

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Oxidation Efficiency

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