4th International Symposium on
Energy Challenges & Mechanics
- working on small scales

11-13 August 2015
Aberdeen, Scotland, UK

Catalyst design for efficient water electrolysis

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Accepted for publication on 24th March 2015

Electrochemical reactions play a significant role in major present industrial applications (chlorine production) as well as the future concepts of energy storage that rely on the conversion of electrical energy into chemical energy carriers (hydrogen production via water splitting). The economy of these processes is determined by the efficiency of the employed catalytic electrodes. State-of-the-art catalysts of electrolysis cells often require significant amounts of Platinum, Ruthenium or Iridium [1]. Limited availability and high prices of these metals demand their efficient utilization.

Effects related to the mass transport of reactants and produced gases as well as electron transport can play a considerable role in the catalyst operation at high current densities. Introducing controlled porosity into catalytic coatings can significantly improve the performance of electro-catalysts and decrease electrochemical overpotentials for e.g. OER catalysts [2]. However, the targeted optimization of the pore system of electrolysis catalysts remained so far unexplored.

I will present concepts and examples for the design of catalytically active electrode coatings for the electrochemical evolution reactions of oxygen (OER) and hydrogen (HER). Control over pore size and pore connectivity is achieved employing micelles of amphiphilic block-copolymers as pore templates. Colloidal synthesis routes provide access to active nanoparticles with tunable particle size and core-shell structure. The developed synthesis routes establish control over structure, composition and material crystallinity, which enables the assessment of fundamental structure-activity relationships in electro-catalytic reactions.

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Keywords: water electrolysis, oxygen evolution, hydrogen evolution, catalyst design