FOXSI
Functional Oxide Surfaces and Interfaces

EINLADUNG

zum Vortrag
von

Univ.-Prof. Dr. Julia Kunze-Liebhäuser

Leopold-Franzens-Universität Innsbruck, Institut für Physikalische Chemie
Austria

Electrochemical Energy Conversion and Storage: Interface Studies at Materials for Application in Electrocatalysis and Battery Research

am

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Technische Universität Wien, Chemie Hochaus
Bauteil BA Hochhaus, GM 3 Vortmann Hörsaal, 02. Stock
1060 Wien, Getreidemarkt 9

Abstract:

Due to enhanced corrosion resistance and possible synergistic effects, transition metal carbides and oxides are interesting substitutes for carbon based catalyst supports in polymer electrolyte membrane fuel cells[1]. TiO_xC_y compact films have been synthesized from anodic TiO_2 on polycrystalline Ti[2], and Pt/TiO_xC_y model electrocatalysts have been employed for the ethanol oxidation reaction (EOR) at elevated temperatures in concentrated H_3PO_4[3]. Compared to Pt catalysts on glassy carbon substrates, Pt/TiO_xC_y exhibits improved chemical stability and significantly enhanced current density during EOR at $0.6V_{SHE}$ and 80°C. It is found that the stability of Pt/TiO_xC_y is influenced by the underlying Ti substrate grains. To understand interdependencies between surface chemistry and structure and electrocatalytic properties, a combined electron backscatter diffraction (EBSD)/ scanning photoelectron microscopy (SPEM) study has been carried out, that enabled us to identify a laterally inhomogeneous surface chemistry of TiO_xC_y compact films that correlates with the crystallographic orientation of the underlying Ti substrate grains. This explains the grain-dependent chemical stability of Pt/TiO_xC_y in H_3PO_4 during EOR. In the area of Li^+-ion batteries, model composite electrodes of self-organized, conductive titania (TiO_{2-x}-C) nanotubes coated with silicon (Si) via plasma enhanced chemical vapor deposition (PECVD) are produced and studied in terms of their lithiation/ delithiation characteristics. The nanotube array provides direct one dimensional electron transport to the current collector, without the need of adding binders or conductive additives. Both components of the composite can be lithiated delivering 120 µAh cm^{-2} total capacity for a film thickness of 1 µm and a Si loading of 10 wt.%. 86 % capacity retention upon 88 cycles at a rate of C/5 and 60 µAh cm^{-2} total capacity at a rate of 10 C are achieved owing to the low lateral expansion and thus good adhesion of the thin Si coating to the TiO_{2-x}-C nanotubes, and due to the formation of a stable solid electrolyte interface (SEI) in ethylene-carbonate (EC), dimethyl-carbonate (DMC), vinylene-carbonate (VC) electrolyte with 1M $LiPF_6$[4].

FWF SFB F45 „Functional Oxide Surfaces and Interfaces (FOXSI)“
Prof. Günther Rupprechter (Speaker), Melanie Schärer (SFB FOXSI Secretary)
Vienna University of Technology, Institute of Materials Chemistry, 1060 Vienna, Getreidemarkt 9, Austria
Tel.:+43-(0)1 58801-165102 - Fax: +43-(0)1 58801-16599
e-mail: grupp@imc.tuwien.ac.at, e-mail: melanie.schaerer@tuwien.ac.at
web: http://foxsi.tuwien.ac.at/

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Prof. Günther Rupprechter (Speaker), Melanie Schärer (SFB FOXSI Secretary)
Vienna University of Technology, Institute of Materials Chemistry, 1060 Vienna, Getreidemarkt 9, Austria
Tel.:+43-(0)1 58801-165102 - Fax: +43-(0)1 58801-16599
e-mail: grupp@imc.tuwien.ac.at, e-mail: melanie.schaerer@tuwien.ac.at
web: http://foxsi.tuwien.ac.at/