AKE 3: Solar and Hydrogen Technology, Fuel Cells

Time: Monday 16:45–17:30 Location: H45

AKE 3.1 Mon 16:45 H45

A Systematic Study on the Deposition of μm Thick $CuInS_2$ Spray ILGAR Layers — •Christian Camus, Daniel Abou-Ras, Nicholas Allsop, Wolfgang Bohne, Sophie Gledhill, Iver Lauermann, Martha Christina Lux-Steiner, Jörg Röhrich, and Christian-Herbert Fischer — Hahn-Meitner-Institut Berlin, Glienicker Str. 100, D-14109 Berlin

The Spray Ion Layer Gas Reaction (ILGAR) is a new non-vacuum process, well suited for roll-to-roll production. In the first step of the process a metal salt solution is sprayed onto a heated substrate. The resulting solid layer is converted to the metal sulfide by H_2S. Both steps are repeated until the desired thickness is achieved. Recently In_2S_3 buffer layers for highly efficient $Cu(In,Ga)(S,Se)_2$ solar cells have been deposited by this method. Now we have significantly extended the process and enabled the deposition of copper containing compounds, such as $CuInS_2$. By aerosol preheating, temperature optimization and the use of appropriate precursor-salts, the deposition rate has been increased from 3nm/cycle up to 35nm/cycle in order to achieve μm thick films needed for solar cells. However, in addition to $CuInS_2$, In_2O_3 was also detected, which was strongly reduced by H_2S-postanealing. Nevertheless, XPS-, ERDA-, SEM- and EDX-measurements still revealed some structural and chemical inhomogeneities. Thus several approaches like a reducing atmosphere were tested to further improve the layer quality. Working solar cells have been produced with these $CuInS_2$ absorber layers. Their optimization with respect to photovoltaic performance is in progress.

AKE 3.2 Mon 17:00 H45

Hydrogen Permeability of Nb Membrane Annealed Under Ultra High Vacuum — •Helmut Takahiro Uchida[1], Yoshihiro Yamazaki[2], Atsunori Kamegawa[3], Hitoshi Takamura[3], Junichi Koike[3], Masuo Okada[3], Astrid Pundt[1], and Reiner Kirchheim[1] — [1]Institut für Materialphysik, Göttingen, Germany — [2]California Institute of Technology, California, USA — [3]Department of Materials Science, School of Engineering, Tohoku University, Sendai, Japan

In this research, hydrogen permeability of Pd-free Nb membrane using hydrogen annealing process by ultra high vacuum equipment was investigated. Pure Nb (99.85 percent) was used as membrane. The hydrogen permeation experiment was carried out in the temperature range of 773-1173K, and the H_2 pressure range of 1-3.5 atm in the inlet side. Hydrogen flux and hydrogen pressures in the inlet side and outlet side of chamber were measured using mass flow meter and capacitance manometer, respectively. Hydrogen permeability was determined by Fick's first low.

Effects of annealing conditions and heat treatment under hydrogen atmosphere on hydrogen permeability were investigated. It is supposed that the surface oxidation of Nb is reduced by the hydrogen annealing. Moreover, it is found that the value of hydrogen permeability becomes almost equivalent to the theoretical value when the sample preparation was optimized by an extension of the evacuating time. The best hydrogen permeability is obtained in metal membranes using the annealing under ultra-high vacuum and pure hydrogen atmosphere.

AKE 3.3 Mon 17:15 H45

Synthesis and Magnetic Properties of Porphyrin-based Electrocatalysts for the Oxygen Reduction in a Fuel Cell — •Ulrike Ingrid Koslowski[1], Sebastian Fiechter[1], Klaus Lips[1], Irmgard Abs-Wurmbach[2], Jan Behrends[1], Gerrit Schmithals[1], and Peter Bogdanoff[1] — [1]Hahn-Meitner-Institut Berlin GmbH, Glienicker Str. 100, D-14109 Berlin — [2]Technische Universität Berlin, Straße des 17. Juni 135, D-10623 Berlin

International research efforts have been made to find alternative catalysts instead of platinum for the ORR in fuel cells. N_4-metallomacrocycles are well known as materials for the reduction of oxygen. Heat treatment of these materials impregnated on carbon black results in highly active catalysts [1].

We would like to introduce a new preparation technique: By using a foaming agent (such as iron oxalate) during the decomposition of the porphyrin a highly porous carbon matrix is formed in situ with integrated catalytic centres [2].

For both preparation methods (impregnation and using a foaming agent) only a diluted number of catalytic centres are formed in the carbon matrix. It is assumed that these centres are transition metal ions coordinated by nitrogen in graphene type layers. We suppose that there are also differences in the structure of both catalytic systems.

To compare and to characterise these methods Electron Paramagnetic Resonance (EPR) and 57Fe Mössbauer spectroscopic (MS) experiments were performed. Additional measurements will illustrate the differences of the macroscopic structure of both materials. [1] Top. Curr. Chem. 1976, 61, 133 [2] J. New. Mat. Electrochem. Sys. 2004, 7, 85