

MM 17: Postersession I

Time: Monday 18:00–20:00

Location: Poster E

MM 17.1 Mon 18:00 Poster E

Microstructural characterization of hydrogen induced cracking in TRIP-assisted steels by EBSD — ●AURÉLIE LAUREYS, TOM DEPOVER, ROUMEN PETROV, and KIM VERBEKEN — Department of Materials Science and Engineering, Ghent University (UGent), Technologiepark 903, B-9052 Ghent, Belgium

The present work evaluates hydrogen induced cracking in a TRIP-assisted steel with a complex multiphase microstructure, containing ferrite, bainite and retained austenite. When deformed, the retained austenite transforms to martensite and each structural constituent demonstrates a different behavior in the presence of hydrogen. The goal of this work is to understand the response of the hydrogen saturated multiphase structure to a mechanical load. Tensile tests on notched samples combined with in-situ electrochemical hydrogen charging were performed. The tests were interrupted at a stress just after reaching the tensile strength, since hydrogen induced cracks were found to form after reaching the tensile strength. Such interrupted tests allowed to study hydrogen induced crack initiation and propagation in the material. The microstructure of the samples was characterized by means of scanning electron microscopy (SEM) and electron backscatter diffraction (EBSD). A correlation was found between the occurrence of martensite, which is known to be very susceptible to hydrogen embrittlement, and the initiation of hydrogen induced cracks. The latter were located on the surface in specific high-stressed regions, which were induced due to the presence of the notch.

MM 17.2 Mon 18:00 Poster E

Growth Process of Hydrogen Induced Structures on Gd Films and Islands Observed by STM — ●SARA WANJELIK, SAMUEL KÖNIGSHOFEN, and MATHIAS GETZLAFF — Institute for Applied Physics, University of Düsseldorf

Hydrogen in metals as an area of research has been of great interest for the past decades. On the one hand this is caused by the technical application as hydrogen storage. On the other hand metal hydrogen systems are of great interest from a fundamental point of view. But only few investigations are carried out by imaging techniques with a lateral resolution on the nm-scale. Even less works deal with the initial stage of hydride formation.

Here we present STM measurements on thin Gadolinium films and islands grown on a W(110) surface under ultra high vacuum conditions. On Gd-films two kind of hydrogen induced modifications can be observed: Hydrides and small disc-like islands with a diameter of a few nm and a height of one atomic step. The discs form chains with clearly preferred directions. A triangular shaped structure is observed together with the discs. The growth process of these modifications were studied in detail. Electronic differences of the described structures were investigated by maps of differential conductivity.

Contrary to films islands can be penetrated by hydrogen from the side walls. Therefore, the hydride formation should start from the edges. Another difference to films is that not only a vertical expansion, due to the larger volume of the hydride, is possible but also a lateral.

MM 17.3 Mon 18:00 Poster E

Kinetics of Hydrogen uptake in epitaxial thin films of Niobium — ●NIKLAS TEICHMANN, VLADIMIR BURLAKA, STEFAN WAGNER, and ASTRID PUNDT — Univ. Göttingen, IMP, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany.

Hydrogen located in interstitial lattice sites changes physical properties of the host metal, such as the resistivity or the lattice parameter.[1,2] Even though both physical properties are not linearly coupled to the hydrogen content, strong changes occur upon phase transitions. Therefore, they can be used to determine the concentration change and the onset of phase transition in thin films. In this paper we report on in-situ studies on the kinetics of the hydrogen uptake in thin Nb films (8 nm - 40 nm) with different Pd capping layers (0,2 nm - 20 nm). All experiments are performed without breaking the UHV conditions. Hydrogen is loaded step-wise from the gas-phase. It will be shown that even down to a Palladium capping layer thickness of 2 nm the kinetics of Hydrogen uptake is fast. It is dramatically reduced below that thickness. This effect is attributed to an island-like Pd-layer morphology that arises for the thinnest capping layer thicknesses. Also,

the unloading kinetics is reduced when island-like capping layers are used.

Financial support by the DFG via projects PU131/9-1 and PU131/12-1 is gratefully acknowledged.

[1] A. Pundt, R. Kirchheim, *Ann. Rev. Mater. Sci.* 2006

[2] K. Nörthemann, & A. Pundt, (2008). Coherent-to-semi-coherent transition of precipitates in niobium-hydrogen thin films. *Physical Review B*, 78(1), 014105.

MM 17.4 Mon 18:00 Poster E

H-Diffusion in Mg-Fe11at% Alloys — ●MAGNUS HAMM, HELMUT UCHIDA, and ASTRID PUNDT — Universität Göttingen, IMP, Friedrich-Hund-Platz 1, 37077 Göttingen

In the last decade Magnesium (Mg) has attracted much interest as a storage material for hydrogen. The reasons are its high reversible hydrogen capacity of up to 7,6 wt% and its high volumetric capacity of 110 kg/m³ [1]. However the slow hydrogen (de)absorption kinetics of Mg and its high desorption temperature provide a significant barrier to Magnesium's commercial use [2]. Iron (Fe) is known to improve the hydrogen uptake rate in Mg [3]. To study the influence of Fe on the kinetics of Mg, 500 nm Mg-Fe alloy films were prepared by Argon-ion-beam sputtering and loaded from the gas phase. The hydrogen uptake was studied in-situ with synchrotron radiation at DESY/Hamburg and ESRF/Grenoble. It will be demonstrated that the diffusion constant, while lower than in pure Magnesium, was orders of magnitude above the recorded diffusion constant of MgH₂. In addition, with the used parameters full loading of the Mg-Fe samples is possible without any sign of a blocking layer. This differs strongly to what was found by H. Uchida et al.[4] on pure Mg films of similar thickness.

Beamtime provided at the DESY/Hamburg and the ESRF/Grenoble is gratefully acknowledged. This project is financially supported by the DFG via Project PU131/9-1 and PU131/10-1.

[1] Dornheim, R. et al., *Scr. Mat.* 56:10 (2007) [2] Bogdanović, B. et al., *J. Alloys Compd.* 282:1-2 (1999) [3] Holtz, R.L. and Imam, M.A., *J. Mater. Sci.* 34:11 (1999) [4] Uchida, H. et al., *Acta Mat.*, accepted

MM 17.5 Mon 18:00 Poster E

Hydrogenography-Study of thin Vanadium-Hydrogen films — ●ANSHU TYAGI, JANTJE SCHOMMARTZ, and ASTRID PUNDT — Universität Göttingen, Institut für Materialphysik, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

In this work, thin Vanadium films of 10 nm - 30 nm thickness, sputter deposited on transparent Glass substrates are examined. These samples are electrochemically loaded with hydrogen while simultaneous measurements of the transmission and reflection are done with a Light microscope. Electrochemical hydrogenography offers the possibility to study the local and the global hydrogen concentration within a defined area of the film and hence gives information on the lateral hydrogen distribution on a micrometer scale. Also the role of nucleation and growth in the hydrogenation of films is analyzed by using a mask technique during film deposition. In-situ Scanning Probe Microscopy studies are additionally performed. The role of the local detachment on the local hydride nucleation is examined by repeated loading experiments.

[1] J. Kürschner, S. Wagner, A. Pundt, *Journal of Alloys and Compounds* 593 (2014) 87-92. [2] L. Mooij, B. Dam, *Phys. Chem. Chem. Phys.* 15 (2012) 2782-2792. [3] J.L. Schommartz, Bachelor Thesis, University of Göttingen, (2014).

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MM 17.6 Mon 18:00 Poster E

Optimized Pd/TiO₂ interfaces for high resolution TEM-EELS in H₂ atmosphere — ●MARIAN BONGERS, CARSTEN NOWAK, and ASTRID PUNDT — Institut für Materialphysik, Georg-August-Universität Göttingen, Germany

Redox reactions on supported metal catalysts exhibit high turnover rates [1, 2]. The used support strongly influences the turnover rate and, therefore, the metal/support interface is expected to be a very important parameter. Atomic resolution STEM and EELS allow to investigate the electronic states at Pd/TiO₂ interfaces, which are expected