MM 34: Mechanical Properties and Alloy Design: e.g. Light-Weight, High-Temperature, Multicomponent Materials II

Time: Wednesday 10:15–11:30 Location: C 230

MM 34.1 Wed 10:15 C 230

influence of spinodal decomposition on mechanical properties and oxidation resistance of self-passivating WCrY alloy (SMART) for a fusion power plant — •Jie Chen[1], Elena Tejado[2], Andrey Litnovsky[1], Jesus Gonzalez-Julian[3], and Martin Bram[1] — [1]Forschungszentrum Jülich GmbH - Institut für Energie- und Klimaforschung, D-52425 Jülich, Germany — [2]Universidad Politécnica a de Madrid - Departamento de Ciencia de Materiales-CIME. E-28040 Madrid, Spain — [3]RWTH Aachen University - Institute of Mineral Engineering, 52074 Aachen, Germany

Self-passivating Metal Alloys with Reduced Thermo-oxidation (SMART) with a composition of W-11.4wt%-0.6wt%Y is considered as a promising plasma-facing material in fusion power plants. In the present work, the as-sintered SMART material, fabricated via ball milling and field-assisted sintering, is annealed at 1000°C for different amount of time to trigger spinodal decomposition. With 100 hour annealing, the material is characterized by submicron Cr-rich phases with 69.2at% Cr and W-rich matrix phase. The 100h-annealed alloy is significantly softened (HV1011) compared to the as-sintered state. The three point bending tests have been done from room temperature up to 1100°C and it is found that annealed specimens show both higher strength and fracture toughness at all tested temperatures. The oxidation resistance of annealed samples has also been investigated at 1000°C under synthetic air with 70% relative humidity. Details of the work will be given in this contribution.

MM 34.2 Wed 10:30 C 230

Investigation of Age-Hardened AlCu Alloys with Coincidence Doppler Broadening Spectroscopy — •Leon Chryssos and Christoph Hugenschmidt — Heinz Maier-Leibnitz Zentrum (MLZ), Technical University of Munich, Lichtenbergstr. 1, 85748 Garching, Germany

The positron in matter acts as a defect sensitive probe. Coincidence Doppler Broadening Spectroscopy (CDBS) is sensitive to open volume defects and to the elemental signature at the positron annihilation site. In contrast to other positron annihilation techniques, this enables the analysis of vacancy-solute complexes in solids and precipitates in the host matrix. In age-hardened AlCu alloys Cu-rich clusters are responsible for a significant improvement of the strength of the material. In this presentation, CDBS was used to investigate the Cu cluster formation in such alloys, especially after solution annealing and quenching. Combined with our new analysis software and ab-initio calculations this gives detailed insights into the studied materials.

MM 34.3 Wed 10:45 C 230

The Defect Distribution in the Near-Surface Region in Al alloys Studied by Positron Annihilation Spectroscopy — •Lucian Mathes[1], Vassily Vadimovitch Burwitz[1], Adrian Langrehr[1], Christoph Springl[1], Bastian Veltel[1], Emma Huntley[3], Andreas Wagner[2], Maik Butterling[2], Eric Hirschmann[2], Maciej Oskar Liedke[2], and Christoph Hugenschmidt[1] — [1]Heinz Maier-Leibnitz Zentrum (MLZ), TU München — [2]Helmholtz-Zentrum Dresden-Rossendorf, Institute of Radiation Physics — [3]Durham University

We have examined defects in pure and technical Al alloys on the atomic level using Positron Annihilation Spectroscopy. The influence of polishing (down to 40 nm OP-S) and heat treatment (T4 and T6) is explored in the near-surface region up to 6 μm in depth. We have determined the vacancy distribution by means of depth-resolved Doppler-broadening spectroscopy (DBS) using the slow positron beam at TUM. Further, we have characterized the defect type by depth-resolved Positron Annihilation Lifetime Spectroscopy (PALS) performed at the pulsed slow positron facility MePS at pELBE (HZDR).

MM 34.4 Wed 11:00 C 230

Structural Characterisation of Nanoporous Copper — •Prabhu Prasad Biswal[1], Samuel Graf[2], Marlene Eichlseder[3], Fernando Gustavo Warchomicka[3], Fabio Blaschke[4], Maximilian Fuchs[1], Eduardo Machado Charry[1], Alexander Bottaro[1], Karin Zojer[1], Roland Resel[1], and Eva-Maria Steyskal[2] — [1]Institute of Solid State Physics, Graz University of Technology — [2]Institute of Materials Physics, Graz University of Technology — [3]Institute of Materials Science, Joining and Forming, Graz University of Technology — [4]Institute of Chemical Engineering and Environmental Technology, Graz University of Technology

Nanoporous metals are metals with features in the pore structure in the range of 100 nm or less. Nanoporous copper (np-Cu) has recently attracted attention as an alternative to nanoporous gold or platinum. Our np-Cu is prepared by in-situ alloying of aluminium and copper using a 3D laser printer, followed by annealing at 530° C, and a subsequent de-alloying process to remove aluminium. The structural properties of the prepared Al-Cu alloy and np-Cu, including morphology, crystal structures, and chemical composition were systematically compared using X-ray diffraction and X-ray fluorescence spectroscopy; scanning electron microscopy provides surface topography and composition. In addition, the pore size distribution and internal surface area of np-Cu are quantified using micro-computed tomography and mercury intrusion porosimetry. After de-alloying, domains retain their spatial position and extension while their composition changes.

MM 34.5 Wed 11:15 C 230

Experimental investigation on early precipitation reactions in Al-Cu alloys — •Johannes Berlin, Fabian Miller, and Ferdinand Haider — Chair for Experimental Physics I, University of Augsburg, Universitätsstraße 1, 86159 Augsburg (Germany)

Due to their excellent strength-to-weight ratio, heat-treatable Al-Cu alloys have been widely used since their invention. Although the hardening precipitates in these alloys are well-known, the early stages of formation and decomposition are still topic of ongoing research. Based on state-of-the-art scanning transmission electron microscopy, single Cu atoms can be imaged and natural ageing in form of Guinier*Preston zone formation accelerated by excess vacancies can be investigated. Scanning transmission electron microscopy is used to investigate the influence of different parameters, such as thermal history and the addition of trace elements, on early-stage precipitation in Al. In addition, resistivity, DSC and hardness measurements are performed to evaluate the temper state of the specimens. A better understanding of the mechanisms of precipitate formation and precipitate growth in these alloys could make it possible to further fine-tune material properties.