MM 74: Structural Materials (Steels, light-weight materials, high-temperature materials)

Structural Materials II

Time: Friday 11:15–12:15 Location: H 0106

MM 74.1 Fri 11:15 H 0106

Structure and Properties of Al Alloys Produced by Friction Stir Processing — •Maximilian Gnedel[1], Amanda Zens[2], Ferdinand Haider[1], and Michael Friedrich Zaeh[2] — [1]Chair for Experimental Physics I, University of Augsburg, Universitätsstraße 2, 86159 Augsburg, Germany — [2]Institute for Machine Tools and Industrial Management, Technical University of Munich, Boltzmannstraße 15, 85748 Garching, Germany

Friction Stir Processing (FSP) can be used to locally modify properties in materials such as aluminum. Furthermore, the composition of the alloy can be changed by this technique. Intermixing specific micrometer-sized metal powders helps to optimize both the microstructural stability during subsequent heat treatment, as well as the mechanical properties in general. This work provides insights into the properties of an AA1050 aluminum matrix with dispersed copper and iron particles added through FSP. The characteristics examined include the grain structure, the microhardness and the formation of intermetallic phases. Suitable processing parameters were found to produce homogenous aluminium samples containing spherical particles with an average diameter of several micrometers. X-Ray computed tomography examination confirmed a consistent distribution in the welding direction. Etching and electron microscopy investigation revealed a unique grain structure and intermetallic layers formed during the process, which yielded a remarkable change in microhardness in comparison to FSPed aluminium without additive particles. Future studies will help to understand the properties of such non-equilibrium alloys.

MM 74.2 Fri 11:30 H 0106

Impact of Microstructure and Geometric Length Scales on Miniaturized Tensile Tests of Advanced Steels — •Jonas Finn Kutschmann[1], Thomas Pretorius[2], Andreas Offergeld[2], Friederike Emeis[1], Niklas Nollmann[1], and Gerhard Wilde[1] — [1]Institute of Materials Physics, Westfälischen Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 10, D-48149 Münster — [2]thyssenkrupp Steel Europe AG, Kaiser-Wilhelm-Straße 100, D-47166 Duisburg

In this work the mechanical properties of advanced steels are characterized by a miniaturized tensile test and compared to the results of other mechanical testing methods. The eleven steel raw materials were provided by thyssenkrupp and the miniaturized specimens were cut with a dog-bone shape contour. For one type of steel the dimensions were severely changed to verify an occurring specimen size effect. The influences of the geometric length scales were investigated by microstructural analysis using EBSD.

The tensile test results were correlated to Vickers hardness measurements, average grain size and thyssenkrupp database values for the ultimate tensile strength. Some steels reproduce the macro-scale results well in miniaturized testing whereas others show a significant drop in the performance. The overall performance of the miniaturized tensile tests were evaluated by the ultimate tensile strength and the fracture strain for one type of steel by varying the geometrical dimensions. The results suggest the inclusion of the standard deviation of the grain size distribution for a more independent evaluation of the specimen size effect.

MM 74.3 Fri 11:45 H 0106

Advanced microstructural characterization of nanoprecipitates in nickel-based superalloys — Robert Lawitzki[1], Salman Ul-Hassan[1], Lukas Karge[2], Julia Wagner[1], Michael Hofmann[2], •Ralph Gilles[2], and Guido Schmitz[1] — [1]Universität Stuttgart, Institut für Materialwissenschaft — [2]TU München, FRMII

Nickel-based superalloys are high performance alloys that can be found in high temperature structural applications like aero and land-based gas turbine engines. Most important for the mechanical properties of these alloys is the presence of nanoprecipitates. The addition of elements like Al, Ti or Nb and a suited heat treatment are the requirement for their controlled precipitation. Finding the optimum heat treatment depends on the solubility of the nanoprecipitates and often requires associated studies by electron microscopy of small samples in the micrometer scale.

In this contribution, we present results of the microstructural characterization of differently heat treated nickel-based superalloys Inconel 718, which were further characterized by small angle neutron scattering (SANS). Information about the morphology - obtained by electron microscopy - and about the composition - obtained by atom probe tomography - of nanoprecipitates, are used as input parameters to simulate the SANS data. The obtained models give information about the volume fraction and size of precipitates in the mm-scale and can be further used for in situ neutron experiments during heat treatment or plastic deformation on bulk samples.

MM 74.4 Fri 12:00 H 0106

Defect Imaging Using the Positron-Microbeam of the CDB Spectrometer at NEPOMUC — •Thomas Gigl, Lukas Beddrich, Marcel Dickmann, Benjamin Rienäcker, Mathias Thalmayr, Sebastian Vohburger, and Christoph Hugenschmidt — Heinz Maier-Leibnitz Zentrum (MLZ) and Physik Department E21, Technische Universität München, Lichtenbergstr. 1, 85748 Garching, Germany

The Coincidence Doppler Broadening Spectrometer (CDBS) at the positron beam facility NEPOMUC was upgraded with a beam brightness enhancement system in order to enable CDB spectroscopy with improved spatial resolution. The positron is transported in a newly designed μ-metal shielded optically column comprising several electrostatic lenses, magnetic compensation coils, and beam monitors. The new brightness enhancing device is integrated in the electrostatic beam guiding system and basically comprises a beam focusing unit and a Ni(100) foil of 100 nm thickness working as transmission remoderator. For high resolution measurements the positron beam is first focused onto the Ni remoderation foil before it is accelerated up to 25 keV onto the sample. In order to estimate the beam diameter at the sample position spatially resolved DB measurements have been performed. Without remoderator a lateral resolution of 200 μm is obtained. Using the brightness enhancement system the beam spot could be reduced to 33 μm. Benefiting from the improved resolution of the CDBS *upgrade*, defect spectroscopy on various light metal alloys has been performed recently.