MM 48 Mechanische Eigenschaften IV

Zeit: Dienstag 16:30–17:45 Raum: TU H111

MM 48.1 Di 16:30 TU H111

Dislocation processes in a peak to overaged γ'-strengthened nickel base alloy studied by in situ TEM tensile tests — •Dietmar Baither[1], Volker Mohles[2] und Eckhard Nembach[1] — [1]Institut für Materialphysik, Universität Münster, Wilhelm-Klemm-Strasse 10, 48149 Münster — [2]Institut für Metallkunde und Metallphysik, Rheinisch-Westfälische Technische Hochschule, 52056 Aachen

The commercial nickel base alloy NIMONIC PE16 is strengthened by nanoscale spherical coherent precipitates of the γ'-intermetallic phase Ni_3(Al, Ti). Maximum strength is attained in the peak-aged state. In the transition range to the overaged state, the strength is reduced as the interaction process between dislocations and precipitates changes.

Thin foils of NIMONIC PE16 were stretched inside a TEM and the dislocation processes were observed under full load. It was found that dislocations overcome the γ'-precipitates by a combination of bypassing and shearing. Due to the $L1_2$-long range order of the γ'-precipitates two dislocations with identical Burgers vectors form a pair and glide together. The leading dislocation bypasses the γ'-precipitates and leaves Orowan loops behind. The trailing dislocation first forces the loops to shear the γ'-precipitates before it shears the precipitates itself. The dislocation configurations observed in situ in the TEM are compared with those obtained in computer simulations.

MM 48.2 Di 16:45 TU H111

Versetzungsbildung im zweiphasigen Karbonstahl C45E — •Matz Haaks, Torsten Staab und Karl Maier — Helmholtz Institut für Strahlen und Kernphysik, Nußalle 14-16, 53115 Bonn

Positonen-Annihilationsspektroskopie ist eine etablierte Methode zum Nachweis der Versetzungskonzentration über die an die Versetzung gebundenen assoziierten Leerstellen. Die Doppler-Verbreiterung der Annihilationslinie liefert dabei Information über die Konzentration der Gitterfehler. Die Analyse des Hochimpulsteils der Annihilationsstrahlung liefert eine zusätzliche Information über die chemische Umgebung des Zerstrahlungsorts. Bei einer mehrphasigen Legierung kann so bestimmt werden, in welcher Phase die Versetzungsbildung während einer plastischen Verformung hauptsächlich stattfindet. Der Karbonstahl C45E weist nach langsamem Abkühlen aus der Lösungsglühung ein feinkörniges Gefüge mit 40 % Ferrit (α-Phase) und 60 % Perlit auf. Ein Vergleich zwischen den Hochimpulsteilen von zugverformtem C45E und Graphit bzw. α-Eisen zeigt, daß eine Zunahme der Versetzungsdichte zum größten Teil in der kohlenstoffarmen α-Phase stattfindet.

MM 48.3 Di 17:00 TU H111

Interaction of screw dislocations with coherent twin-boundaries in fcc metals — •Zhao-Hui Jin[1], Karsten Albe[1], and Horst Hahn[2] — [1]TU Darmstadt, Institut für Materialwissenschaft, Petersenstr. 23, D-64287 Darmstadt — [2]Forschungszentrum Karlsruhe, Institut für Nanotechnologie, D-76021 Karlsruhe

The concept of the generalized stacking fault (GSF) energy, which is generally considered to be crucial for understanding nucleation of lattice dislocations, is re- examined for various FCC metals. In this paper we study the scenario of a pure screw dislocation that starts moving towards an elementary coherent twin boundary. In order to carry plasticity further away the dislocation has to cross the twin boundary and change to a different glide plane, where it moves on. This is equivalent to a renucleation process of the dislocation, which has to be activated against constrictions of the pre-existing twin boundary. Be means of molecular dynamics simulations we can identify a crystallographically unexpected behaviour of this crossing process in Ni, Cu and Al. From the GSF energy and the driving force acting on the dislocation we can estimate the nucleation thresholds and explain the nature of bifurcated slips either into the twin lattice or along the twin plane.

MM 48.4 Di 17:15 TU H111

On the strengthening effect of precipitates with a negative stacking fault energy — •Volker Mohles — Institut für Metallkunde und Metallphysik, RWTH Aachen, 52056 Aachen

Recent atomistic computer simulations (Embedded Atom Method) by Wirth and Shim have revealed that the interaction between a dislocation and a coherent cobalt precipitate in a copper matrix differs strongly from all expectations. In literature, the interaction is described by the size mismatch (coherence stress). But the quoted simulations showed that another effect is at work in addition: while a first partial dislocation moves, it creates a stacking fault in the copper matrix. But inside the particles it actually moves the cobalt atoms near the glide plane to the more favourable hexagonal positions. The second partial cutting through the particle will restore the unfavourable cubic face centred arrangement. This effect can be described by a negative stacking fault energy inside the particles. In the present talk, the impact of this effect on the particle's strengthening effect is worked out by dislocation dynamics simulations.

MM 48.5 Di 17:30 TU H111

Investigations on the Portevin-LeChâtelier effect in Al-Mg metal-matrix composites — •Hanno Dierke[1], Stephanie Graff[2], and Hartmut Neuhäuser[1] — [1]TU Braunschweig, Inst. f. Metallphysik und Nukleare Festkörperphysik, D-38106 Braunschweig — [2]Centre des Materiaux, Ecole Nationale Superieur des Mines de Paris, F-91000 Evry

Due to their low weight and high mechanical strength AlMg alloys provide a large variety of applications as material for lightweight construction. However, the practical benefit is limited due to instabilities and inhomogeneities caused by correlated movement of dislocations during plastic deformation (PLC effect). By addition of unshearable obstacles the formation of dislocation avalanches may be prevented or at least reduced.

The metal-matrix composite (MMC) AA5754 with 2 or 5 vol% Al_2O_3 showed hardly any influence of the particles added. This could be explained by an inhomogeneous distribution of the particles during manufacturing of this MMC.
Further investigations have been performed using AA6061 as matrix material, as well as numerical modelling of the MMCs in cooperation with the Ecole des Mines, Paris.