Materialwissenschaftliches Seminar des Instituts für Werkstoffforschung / Materials Science Seminar of the Institute of Materials Research 2014		Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung
Datum / Date	Vortrag / Presentation	Gastgeber / Host:
1 Jahreshälfte / 1. Half Year 2014		
Vorträge jeweils um 10 Uhr, HZG-Hörsaal / Talks regularly at 10 am, HZG lecture Hall		
13.2.	Prof. Dr. Rainer Birringer, Universität des Saarlandes	Dr. J. Markmann
2 pm, Nobel-pavillon	**Nanocrystalline metals go ductile under shear deformation** M. Grewer, C. Braun, A. Leibner, R. Birringer Universität des Saarlandes, FR7.2 Experimentalphysik, 66041 Saarbrücken, Germany Shear compression specimens (SCS) of IGC-prepared nanocrystalline PdxAu1-x (grain size <10 nm) alloys have been fabricated to become deformed under dominant shear and superimposed compression to large plastic strains (ε > 20 %). Taking stress strain curves at different strain rates and temperatures allowed us to extract the shear activation volume, strain- rate sensitivity and activation energies as a function of plastic strain, respectively. We also present TEM and in-situ diffraction and deformation data to identify the microscopic processes that are carriers of strain in the different deformation regimes. The SCS geometry permits to vary the normal stress (pressure) component acting on active slip planes. Analysis of the pressure-dependent deformation behavior then enables to determine the pressure activation volume and the Mohr-Coulomb friction coefficient. We discuss in which manner thermal activation parameters and knowledge of microstructural evolution during deformation can be combined to discriminate between the plethora of just possible deformation scenarios and the relevant mechanism that contribute to overall strain. In fact, we find that at the low end of the nanoscale the deformation behavior of nanocrystalline fcc alloys is governed by shear shuffling across the core region of grain boundaries. Other striking similarities with the generic deformation behavior observed in metallic glasses will also be addressed.	
6.3.	Dr. Leyun Wang (WME)	Dr. E. Lilleodden
	Study of deformation twinning in Ti by EBSD and Laue microdiffraction Twinning is an important mechanism for the room temperature plastic deformation of hexagonal close packed metals. In Ti, the most active twinning mode is $\{10\bar{1}2\}<\bar{1}011>$ (T1). Through extensive EBSD characterization, it was found that many T1 twins nucleated from grain boundaries through a strain transfer process: dislocations gliding on a prismatic slip system stimulated twin nucleation in a neighboring grain. This type of slip enhanced twin nucleation, the so-called S+T mechanism, requires a good crystallographic alignment between the active prismatic slip system in one grain and the stimulated twinning system in the neighboring grain, represented by a high strain transfer parameter m'. The value of m' dictates which twinning system will be activated in an S+T event and suggests at which grain boundaries S+T will occur in a polycrystal. Twins that jointly formed from a grain boundary (T+T) was also investigated. Similar to S+T, high m' was often found between the two activated twinning systems in T+T, which could explain why T+T usually occurs at grain boundaries with relatively low disorientation angle (<30°). The second part of this talk focuses on the $\{\bar{1}\bar{1}21\}<11\bar{2}6>$ twinning mode (T2). Associated with a high twinning shear, T2 twins usually display irregular twin boundaries and could lead to microcracks in the neighborhood. Interaction between matrix <c+a> dislocations (**b=**	

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	$\frac{1}{3}[\bar{1}2\bar{1}3]$) and a $(\bar{1}\bar{1}21)[11\bar{2}6]$ twin was investigated by slip trace characterization, electron backscattered diffraction and Laue microdiffraction. The combined results from this work on twin nucleation and slip-twin interaction provide valuable guidelines for appropriately simulating twinning in crystal plasticity models.	
10.4.	Dr. Robert Maaß, Universität Göttingen	Dr. Erica Lilleodden
	Fast and furious: shear-band dynamics in metallic glasses Bulk metallic glasses (BMG) are known to deform via shear localization and structural softening. This mode of deformation results in a quasi-brittle failure and undercuts their potential for engineering solutions. Shear-localization is confined to the nm-scale and results in intermittent flow that has very short operating timescales. With the aim of improving room temperature malleability of BMGs, this talk focuses on understanding and eventually controlling shear-band dynamics. Shear-band dynamics will be divided into an initiation, propagation, and arrest phase, each providing insights on the fundamental mechanisms at play. It will be shown that i) shear-band initiation is a dilatational process reaching a volume expansion similar to values attained near the glass transition temperature [*Phys. Rev. Lett.* **107**, 185502 (2011)], and ii) that the transition between serrated and non-serrated flow is directly linked to the propagation velocity of shear-bands [*Acta.Mater.* **59**, 3205, (2009)]. Subsequently, the question “Why do shear-bands stop?” will be addressed in detail, and discussed on the basis of stop-and-go experiments. Here, time- and temperature-dependent stress decays and stress overshoots are observed. The view of an activated shear band being a shear-softened planar layer is adapted, and the findings are discussed with respect to stick-slip phenomena that arise in boundary lubrication processes of nanoscopically confined liquids. This framework provides access to characteristic time scales, which are in agreement with those obtained in earlier work on shear-band propagation kinetics, and reveals first insights into how shear-bands arrest during inhomogeneous plastic flow [*Appl. Phys. Lett.* **100**, 071904 (2012)].	
20.5.	Peter Hähner, EC Joint Research Centre, Institute for Energy and Transport, Petten, The Netherlands	Prof. Swantje Bargmann
11 a.m.	**Small Punch creep testing: experimental practice and theoretical challenges** With the miniature small punch (SP) testing techniques a range of material properties can be evaluated, in particular, creep properties of high temperature alloys. The main benefit of the SP creep testing is the reduced amount of test material needed, for instance for screening purposes, for virtually non-invasive testing of large components or for testing of neutron irradiated material. However, the SP test is multi-axial in nature and the stress state and deformation response in the thin specimen disc is complex. The interpretation of SP test results is challenging and simplified transformation equations to acquire representative values for comparison with uniaxial creep results are being debated. Under these circumstances, the repeatability and reproducibility of SP creep tests deserve particular attention, in order to distinguish experimental uncertainties from systematic methodological uncertainties. In this presentation SP creep test data is discussed with reference to the European SP testing Code of Practice (CEN CWA 15627) with suggestions for improvements in the testing equipment, temperature control, puncher geometry, loading details and post-test examination routines. The main material used for the present	

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	work is a ferritic-martensitic grade 91 steel results of which are compared to uniaxial creep results from the public domain. Recent advances in improving the theoretical understanding with regard to the correlation between SP creep and uniaxial creep property determination are presented.	
5.6.	Jun.-Prof. Dr.-Ing. Andreas Heynr, Otto von Guericke University, Magdeburg	Dr. Frank Feyerabend
	From phenomenon towards method, electrochemical noise from corrosion processes In the early 70s of the last decade two scientists (Iversion and Tyagai) could show charge fluctuations during corrosion of metals in aqueous solutions by means of simple measuring techniques and assigned them to certain corrosion processes. This was the birth of the so called electrochemical noise analysis (ENA). Towards an established method it was and it is still a long way, because the understanding of relevant corrosion mechanisms (source of the signals) is of major importance as well as knowledge and experience, how to measure and analyze the signals in an appropriate way. In this lecture the phenomenon and the measuring techniques will be considered and some selected successful application from own research will be explained. These examples range from basic examinations, short-term studies and corrosion monitoring.	

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4.9.	Prof. Andrew M. Minor, Lawrence Berkeley National Laboratory, USA	Prof. Erica Lilleodden
	Quantitative in situ nanomechnical testing and mapping of local stress and strain in a TEM Recent progress in both in situ and ex situ small-scale mechanical testing methods has greatly improved our understanding of mechanical size effects in volumes from a few nanometers to a few microns. Besides the important results related to the effect of size on the strength of individual nanostructures, the ability to systematically measure the mechanical properties of small volumes through quantitative mechanical probing allows us to test samples that cannot easily be processed in bulk form, such as a ion-irradiated materials or single crystals of very specific alloys. This talk will describe our recent results from in situ TEM nanomechanical testing that provide insight into small scale plasticity in lightweight alloys, including size effects in Mg and solute effects in Ti. In addition to the in situ TEM results, the incorporation of new techniques such as such as dislocation tomography, digital image correlation and the mapping of local and transient strain using a high speed direct electron detector will be presented.	
2.10.	N.N.	N.N.
6.11.	N.N.	N.N.
4.12.	N.N.	N.N.