tion process at a strain rate of 10-3 s-1. The NC alloys demonstrated very high values of strength and ductility. The true stress-true strain curves exhibit a larger strain hardening effect and larger uniform deformation in Pd-Ag alloys than in pure Pd. We relate this enhanced behavior to a decreased SFE in the alloys: the lower the SFE, the more difficult is the cross slip and climb of split dislocations, which leads to greater dislocation storage and, ultimately, to increased strain hardening. The dimpled structure of fracture surfaces in the alloys will also be discussed in relationship to these findings.

MM 29.5 Wed 15:00 H 0111

New approach to design the strain hardening ability in nanostructured materials. (exchanged with MM 30.1) — •Lilia Kurmanaeva[1], Yulia Ivanisenko[1], Jürgen Markmann[2], Jörg Weissmüller[1,2], Ruslan Z. Valiev[3], and Hans-Jörg Fecht[4] — [1]Institute für Nanotechnology, Forschungszentrum Karlsruhe, Karlsruhe, Germany — [2]Universität des Saarlandes, Saarbrücken, Germany — [3]Institute of Phisycs of Advanced Materials, Ufa, Russia — [4]Institute of Micro and Nanomaterials, University of Ulm, Ulm, Germany

The recent past has seen an increasing interest in studies of mechanical properties of nanostructured materials(NSM), since new methods of continuous processing of bulk NSM using severe plastic deformation were developed. NSM demonstrate superior hardness and strength, but often a limited ductility due to poor strain hardening(SH) ability. In present paper we suggest a simple method to increase the SH ability of NSM by decreasing the stacking fault energy(SFE). The microstructure and mechanical properties of nanocrystalline Pd and Pd-x%Ag(x=5,10,20,40) alloys were investigated. Additions of Ag strongly decrease the SFE of Pd. The initially coarse grained samples were processed by high pressure torsion, which resulted in formation of homogeneous ultrafine-grained structure. The increase of Ag contents led to the decrease of the resulted grain size. Consequently, the samples with larger Ag contents demonstrated the higher values of strength properties. The uniform elongation had also increased, and tensile curves exhibited larger SH. Thus we have obtained a combination of high strength and good ductility in nanostructured Pd-Ag alloy.

MM 30: Mechanical Properties II

Time: Wednesday 15:45–17:00 Location: H 0111

MM 30.1 Wed 15:45 H 0111

Tensile tests of magnetron sputtered nanocrystalline palladium (exchanged with MM 29.5) — •Anna Castrup[1,2], Sebastian Gottschalk[1], Horst Hahn[1,2], Rudolf Baumbusch[3], Patric Gruber[3], and Oliver Kraft[3] — [1]Institute of Nanotechnology, Forschungszentrum Karlsruhe GmbH, P.O. Box 3640, D-76021 Karlsruhe, Germany — [2]Institute for Materials Science, Thin Films Division, Darmstadt University of Technology, Petersenstr. 23, D-64287 Darmstadt, Germany — [3]IZBS, University of Karlsruhe, Kaiserstr. 12, 76131 Karlsruhe, Germany

Nanocrystalline Pd films of 1 μm thickness were prepared by rf magnetron sputtering on Kapton substrates. The films were sputtered by use of nanoscale multilayer technology with individual deposition layer thicknesses ranging between 1 and 20 nm at various sputter conditions. The resulting grain size and texture were characterized using TEM and conventional XRD measurements. Tensile tests were performed ex-situ as well as in-situ in a synchrotron diffractometer. Peak form analysis reveals intrinsic and extrinsic stacking fault density and twin density, which depend on the applied strain rate. Considered deformation mechanisms are: grain boundary sliding, grain rotation and the formation of stacking faults. It is investigated whether the formation of these defects is reversible after relaxation.

MM 30.2 Wed 16:00 H 0111

Fe-based composite materials with improved mechanical properties — •Katarzyna Werniewicz[1,2], Uta Kühn[1], Norbert Mattern[1], Jürgen Eckert[1], Ludwig Schultz[1], and Tadeusz Kulik[2] — [1]IFW Dresden, P.O. Box 270116, D-01171 Dresden, Germany — [2]Warsaw University of Technology, Faculty of Materials Science and Engineering, Warsaw, Poland

Following a previous study by the authors two new compositions $(Fe_{89.0}Cr_{5.5}Mo_{5.5})_{91}C_9$ and $(Fe_{89.0}Cr_{5.5}Mo_{5.5})_{83}C_{17}$ have been developed with the aim of improving the ductility of $Fe_{65.5}Cr_4Mo_4Ga_4P_{12}C_5B_{5.5}$ bulk metallic glass (BMG). In contrast to the alloys in that study, the recently prepared Fe-based materials are Ga-free. It was expected that the variations in the composition will lead to the changes in the phase formation and, hence, in the mechanical response of the investigated alloys. It was recognized that in-situ formed Fe-based composites show superior plasticity ($\epsilon_{pl} \approx 37\%$) for the alloy with lower C content and ($\epsilon_{pl} \approx 4\%$) for the alloy with higher C content compared to monolithic glass ($\epsilon_{pl} \approx 0.2\%$). Furthermore, on the basis of present as well as previous investigations it has been shown that the Ga addition is beneficial for the plasticity of these Fe-based alloys. It was observed that the $(Fe_{89.0}Cr_{5.5}Mo_{5.5})_{83}C_{17}$ alloy exhibits a significantly smaller fracture strain ($\epsilon_f \approx 5\%$) compared to its Ga-containing counterpart ($\epsilon_f \approx 16\%$). Therefore, it can be concluded that appropriate alloying additions are crucial in enhancing the mechanical properties of the complex Fe-based materials developed here.

MM 30.3 Wed 16:15 H 0111

Mechanical Characterisation of a human tooth with a structured filling material — •Ferenc Molnar[1], Frank Richter[1], and Norbert Schwarzer[2] — [1]Chemnitz University of Technology, Solid State Physics, 09107 Chemnitz, Germany — [2]Saxonian Institute of Surface Mechanics, Lieschow 26, 18569 Ummanz, Germany

New materials for dental use must have mechanical properties comparable to those of the surrounding biological material. To investigate a structured filling material consisting of hard nanometer-sized grains in a tough matrix with high local resolution we have applied the method of nanoindentation. Therefore a cross-section of the tooth has been prepared and depth sensing indentation measurements were performed. Using the UNAT device (Universal Nanomechanical Tester, Asmec GmbH) with a Berkovich indenter an array of totally about 3200 measuring points with a spacing of 75 microns were created covering the essential parts of the tooth including filling, dentine and dental enamel regions. Young's modulus and hardness have been determined for each point of this array to obtain laterally resolved data of these mechanical properties. In addition, we have evaluated the yield strength of the filling material applying the effective indenter approach of Schwarzer [J. Phys. D: Appl. Phys., 37 (2004) 2761-2772]. The filling shows quite homogeneous behaviour to the external load but at smaller scales the microstructure gains more influence. Values of hardness and Young's modulus for particular measuring points being by a factor of two or three bigger than the average could be correlated by optical microscopy to single extraordinary large grains in the matrix.

MM 30.4 Wed 16:30 H 0111

Simulation der ersten Phasen der Materialermüdung durch ein granulares Modell — •Judith Fingerhuth[1], Matz Haaks[1], Gunter Schütz[2] und Karl Maier[1] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Rheinische Friedrich-Wilhelms-Universität Bonn, Nußallee 14-16, D-53115 Bonn — [2]Institut für Festkörperforschung, Forschungszentrum Jülich, D-52425 Jülich

Basierend auf der Idee des zellulären Automaten werden die ersten Phasen der Ermüdung eines Metalls vor der Initiierung von Mikrorissen mit einem mesoskopischen Modell simuliert. Der Kristall wird dabei als regelmäßige Anordnung von Kristallkörnern betrachtet, deren komplexe, individuelle Eigenschaften durch die skalaren Parameter Korngröße, Orientierung und Schädigung (mittlere Versetzungsdichte pro Korn) repräsentiert werden. Die Schädigung eines Korns wird aus der plastischen Verformung, der pro Verformungszyklus dissipierten Energie und Schädigung der Nachbarkörner berechnet. In einer eindimensionalen Implementierung wurde das Verhalten von Nickel im einachsigen Zug-Druck-Versuch teilweise wiedergegeben. Es werden nun die Ergebnisse einer realistischeren 2D-Implementierung vorgestellt.

MM 30.5 Wed 16:45 H 0111

Vorhersage des Ermüdungsbruchs an vordeformiertem Karb-