MA 25: Magnetic Shape Memory Alloys II (jointly with MM)

Time: Tuesday 13:30–15:00 Location: HSZ 103

MA 25.1 Tue 13:30 HSZ 103

Polycrystalline Ni-Mn-Ga: influence of microstructure and sample shape — •Jan Romberg[1], Martin Pötschke[1], Claudia Hürrich[1], Stefan Roth[1], Bernd Rellinghaus[1], and Ludwig Schultz[1,2] — [1]IFW-Dresden — [2]TU-Dresden

Ni-Mn-Ga ferromagnetic shape memory alloys (FSMAs) show strain up to 10% in magnetic field due to the motion of twin boundaries (MIR - magnetically induced reorientation). But, the large strain is only observed for single crystals. For technical application, polycrystals are of great interest because they are easier to produce und cheaper. But in polycrystals the grain boundaries can hinder twin boundary motion. It is known that in textured polycrystals MIR is possible.

We discuss the influence of microstructure and sample shape on the magnetically induced strain. Furthermore we worked out how to get large and yet textured grains and we developed an optimized mechanical training procedure in order to achieve large strain.

MA 25.2 Tue 13:45 HSZ 103

Cyclic fibre texture in hot extruded $Ni_{50}Mn_{29}Ga_{21}$ — •Robert Chulist[1], Werner Skrotzki[1], Carl-Georg Oertel[1], Andrea Böhm[2], Heinz-Guenter Brokmeier[3], and Thomas Lippmann[4] — [1]Institut für Strukturphysik, Technische Universitaet Dresden, D-01062 Dresden, Germany — [2]Fraunhofer-Institut für Werkzeugmaschinen und Umformtechnik, D-01187 Dresden, Germany — [3]Institut für Werkstoffforschung, GKSS Forschungszentrum Geesthacht, D-21494 Geesthacht, Germany — [4]Institut für Werkstoffforschung, GKSS Forschungszentrum Geesthacht, D-21502 Geesthacht, Germany

The cyclic texture in polycrystalline $Ni_{50}Mn_{29}Ga_{21}$ magnetic shape memory alloy fabricated by hot extrusion was investigated with high-energy synchrotron radiation, neutron diffraction and electron backscatter diffraction. Combination of these techniques reveals that the texture of the hot extruded sample is quite complex. It is composed of components related to the radial direction and rotated around the extrusion axis. Additionally, the dominant texture components change from the centre to the edge of the rod. The recrystallized grains contain a lot of twins with the trace of the twin boundaries preferentially aligned along the extrusion and radial direction showing the cyclic nature of the texture and microstructure, too. The results are discussed with respect to deformation mode, phase transformations, starting grain structure and texture.

MA 25.3 Tue 14:00 HSZ 103

Textured Ni-Mn-Ga as a material for magnetically driven actuators — •Martin Pötschke, Jan Romberg, Claudia Hürrich, Stefan Roth, and Ludwig Schultz — IFW Dresden, Institute for Metallic Materials, P. O. Box 270116, 01069 Dresden, Germany

Ni-Mn-Ga alloys are interesting because of their possible application as magnetic shape memory materials. This effect is caused by the motion of twin boundaries in a magnetic field. Up to now most of the research was concentrated on single crystals. However, the preparation of single crystals is a time consuming and cost intensive process and compositional changes along the growth axis as well as segregations may occur. This is why for technical applications there is a great interest in polycrystals, which are easier to produce. To achieve magnetic field induced twin boundary motion in polycrystals, directional solidification was applied to a 5M Ni-Mn-Ga alloy in order to prepare coarse grained, textured samples. The samples show a <100> fibre-texture. Annealing is necessary for homogenization and stress relaxation. After the annealing the samples showed chemical homogeneity along the sample axis. A two-side mechanical training was applied to decrease the stress, which is necessary to move the twinboundaries. The stress-strain curves for the two training directions show a different behaviour. Also the magnetically inducable stress is different for the two directions. This influences the magnetic-field-induced strain (MFIS). A resettable MFIS was measured in samples with a plate-like geometry.

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MA 25.4 Tue 14:15 HSZ 103

Atomically resolved surface structure of (100)-oriented thin epitaxial Ni-Mn-Ga films. — •Aleksej Laptev[1], Philipp Leicht[1], Mikhail Fonin[1], Yuansu Luo[2], and Konrad Samwer[2] — [1]Fachbereich Physik, Universität Konstanz, 78457 Konstanz — [2]I. Physikalisches Institut, Georg-August-Universität Göttingen, 37077 Göttingen

Epitaxial off-stoichiometric Ni-Mn-Ga films were deposited on MgO(100) substrates by dc magnetron sputtering. After appropriate cleaning steps in ultra high vacuum conditions the (100)-oriented film surface was studied at room temperature by means of scanning tunneling microscopy (STM). In the austenitic state well-ordered surface exhibiting predominantly Mn-Ga termination was observed. After a transformation of the sample to the martensitic state upon a high temperature annealing step the martensitic surface was investigated at room temperature. On a larger scale STM images show a zig-zag shaped surface topography due to the formation of twin boundaries [1]. A second corrugation feature is found on every second side of twin lamellae originating from the modulated nature of martensites. The irregularly-spaced corrugation lines and the observed atomic structure on both sides of the twin variants support the stacking approach of the modulated superstructure proposed within the model of adaptive martensites [2]. This work was supported by BMBF-Projects MSM-Sens 13N10061 and 13N10062.

[1] J. Buschbeck et al., *Acta Mater.* **57**, 2516-2526 (2009)
[2] S. Kaufmann et al., *Phys. Rev. Lett.* **104**, 145702 (2010)

MA 25.5 Tue 14:30 HSZ 103

Electronic structure, magnetic and transport properties of the Heusler shape memory alloy Mn_2NiGa. — •C. G. F. Blum[1,2], S. Ouardi[1], G.H. Fecher[1], S. Wurmehl[2], B. Buechner[2], B. Balke[1], S. Ueda[3], K. Kobayashi[3], and C. Felser[1] — [1]Institute of Inorganic and Analytical Chemistry, Johannes Gutenberg - University, Mainz, Germany — [2]Institute of Solid State Research, IFW Dresden, D-01171 Dresden, Germany. — [3]NIMS Beamline Station at SPring-8,National Institute for Materials Science, Hyogo 679-5148, Japan.

Magnetic shape memory based on Heusler compounds have received increasing interest, due their potential use for actuator and sensor applications. The single crystals Mn_2NiGa were grown by the optical floating zone method using a image furnace with vertical setup under a purified argon atmosphere. The both cubic (austenite) and tetragonal (martensite) phases of the sample were determined using temperature dependence powder x-ray diffraction XRD. The effect of martensitic transitions on the magnetic and transport properties of the compound was investigated by measuring the saturation magnetization, electrical resistivity $\rho(T)$, the Seebeck coefficient $S(T)$ and magnetoresistance R_M. All measurements detect clear signatures of the martensitic transition around room temperature with a thermal hysteresis up to 30 K. The electronic structures of the martensitic as well the austenitic phase were investigated using bulk-sensitive hard X-ray photoelectron spectroscopy (HAXPES).

MA 25.6 Tue 14:45 HSZ 103

Phase transformations and mechanical properties of freestanding single crystalline $Fe_{70}Pd_{30}$ thin films — •Y. Ma[1,2], F. Szillat[1,2], D. Manova[1], S. Mändl[1], J. W. Gerlach[1], and S. G. Mayr[1,2] — [1]Leibniz-Institut fuer Oberflaechenmodifizierung — [2]Translationszentrum fuer Regenerative Medizin und Fakultaet fuer Physik und Geowissenschaften, Universitaet Leipzig, 04318 Leipzig

Ferromagnetic shape memory alloys have attracted significant scientific interest recently due to their high potential for actuators in microsystems. Recently, freestanding single crystalline $Fe_{70}Pd_{30}$ thin films became available, which can be transformed to the desired fct phase by annealing treatment [1]. We show, that by raising the deposition temperature to 850 °C or higher, room temperature single crystal fct Fe-Pd films are readily prepared without post-annealing treatment. Scanning electron microscopy and atom force microscopy images reflect the twin structure of martensite. The transformation temperature from fct martensite to fcc austenite at about 53 °C was confirmed independently by temperature dependent x-ray diffraction and magnetization measurements. The films were released from the substrates by chemically dissolving the MgO, while the crystal structure, phase and composition of these films are kept intact. The Young's modulus of as prepared and freestanding Fe-Pd films was determined by nanoindentation with a Berkovich tip in quasi continuous stiffness

method.

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[1] T. Edler and S. G. Mayr, Adv. Mat. (in press, 2010).