MM 35: Phase Transitions I

Time: Thursday 10:15–11:15 Location: H 0107

MM 35.1 Thu 10:15 H 0107

Magnetostrain in polycrystalline 5M Ni50Mn29Ga21 — •Uwe Gaitzsch, Martin Pötschke, Claudia Hürrich, Stefan Roth, Bernd Rellinghaus, and Ludwig Schultz — IFW Dresden, P.O. Box 270116, D-01171 Dresden, Germany

Magnetic shape memory alloys have been investigated due to the coupling of magnetic and mechanical properties. By moving twin boundaries in the martensitic state, magnetic-field-induced strain (MFIS) of at maximum 10 % can be achieved. So far, MFIS has only been shown in single crystals. To provide a suitable polycrystalline mircostructure, directional solidification was employed to get a coarse-grained, textured sample. These samples were heat treated for chemical homogenization and stress relaxation. In Ni50Mn29Ga21 samples with 5M crystal structure could be prepared. Structural characterization and texture investigations have been performed using X-ray diffraction techniques. Cubic samples were cut erosively from the ingots to allow for mechanical training via cyclic compression along different axes. One of the sample axes was along the direction of solidification. The training leads to a reduction of the twinning stress by over an order of magnitude as compared to an untrained sample. At the same time the mechanical strain could be increased to the crystallographic limit of 1- c/a. After training in a modified Instron testing machine their magnetic-field-induced strain was measured. By appropriate training up to 1 % of MFIS could be achieved in polycrystalline samples.

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MM 35.2 Thu 10:30 H 0107

Controlling the microstructure in NiMnGa alloys — •Martin Pötschke, Franziska Thoss, Uwe Gaitzsch, Stefan Roth, Bernd Rellinghaus, and Ludwig Schultz — IFW Dresden, Helmholzstr. 20, 01069 Dresden

NiMnGa alloys have gained large research interest because of their possible application as magnetic shape memory materials. This effect is caused by the motion of twin boundaries in a magnetic field. So far, this effect has only been demonstrated in single crystals. However, the preparation of single crystals is a time consuming and cost intensive process and compositional changes along the crystal axis as well as segregations may occur. This is why for technical applications there is a great interest in polycrystals. To extend this effect to polycrystals, directional solidification was applied in order to prepare coarse grained, textured samples. The martensitic transformation temperature which strongly depends on the composition was monitored by DSC, and it is shown that the chemical homogeneity along the sample axis is improved in likewise treated samples. The preferred solidification-induced growth direction was determined by EBSD. Additional annealing steps which are necessary to further improve the chemical homogeneity, coarsening of grains, and stress relaxation effect the texture. Investigations on the texture development during annealing are discussed.

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MM 35.3 Thu 10:45 H 0107

Ferromagnetic shape memory alloy Mn_2NiGa: — •Guodong Liu and Claudia Felser — Institute of Inorganic and Analytical Chemistry, Johannes Gutenberg - University, 55099 Mainz

The structure, martensitic transformation and magnetic properties of $Mn_{25+x}Ni_{50-x}Ga_{25}$ ($x = 0 \cdots 25$) alloys were detailedly investigated. It was found that these alloys favour the Hg_2CuTi-type structure instead of the conventional Cu_2MnAl-type structure. All the samples go through a martensitic transformation on cooling. The transformation temperatures (TM) of the samples with $x > 12.5$ are different from the conventional electron concentration rule. The stoichiometric Mn_2NiGa exhibits a TM of around room temperature and a lattice distortion as large as 21.3% upon the martensitic transformation and has a quite high Curie temperature of 588 K. Excellent two-way shape memory behavior and magnetic-field-controlled effects were observed in Mn_2NiGa single crystals. The electronic structures of Mn_2NiGa were calculated by the first-principle method. The results show that Mn_2NiGa alloy is ferrimagnetic due to antiparallel but uncompensated magnetic moments of Mn atoms at different sublattices in austenite. Furthermore, is shown for off-stoichiometric samples that additional Mn atoms substituting Ni atoms in Ni_2MnGa have the same magnetic behavior as Mn in the Mn_2NiGa phase, which explains the dependence of the magnetization on the Mn composition. (Goudong Liu acknowledges the support by the Institute of Physics, Chinese Academy of Sciences in Beijing and the fellowship by the Humboldt Stiftung.)

MM 35.4 Thu 11:00 H 0107

Dynamic observation of ac field induced twin boundary motion in bulk NiMnGa — •Ryan Yiu Wai Lai, Jeffrey McCord, Rudolf Schaefer, and Ludwig Schultz — Leibniz-Institute for Solid State and Materials Research, P.O.Box 270116, Dresden D-01171, Germany

A study of actuating performance in bulk NiMnGa magnetic shape memory single crystals at various frequencies is presented. A dynamic actuation experimental setup with the ability to apply mechanical stress and alternating magnetic field perpendicularly is developed in cooperation with time-resolved microscopy. Reversible twin boundary motion activated in the frequency range up to 600Hz is directly observed. The maximum field induced strain increases with actuation frequency. Strain hysteresis curves show a pronounced dependency on actuation frequency. The mechanism of the frequency response will be discussed in detail. Funding through the DFG priority program SPP1239 is gratefully acknowledged.