MM 9: Functional Materials II - Oxides and Alloys

Time: Monday 11:45–12:45 Location: IFW A

MM 9.1 Mon 11:45 IFW A

Magnetic characterization and 3D-imaging of epoxy-based magnetocaloric composites — •Bruno Weise[1], Barbara Pulko[2], Konstantin Skokov[3], Jaka Tušek[2], Oliver Gutfleisch[3], Anja Waske[1], and Jürgen Eckert[1,4] — [1]IFW Dresden, Institute for Complex Materials, Dresden, Germany — [2]University of Ljubljana, Faculty of Mechanical Engineering, Ljubljana, Slovenia — [3]TU Darmstadt, Department of Materials Science, Darmstadt, Germany — [4]Institute of Materials Science, Dresden University of Technology, Dresden, Germany

Epoxy-based magnetocaloric composites of La-Co-Fe-Si with different fractions of active material were produced and characterized. Their magnetic properties, as well as the temperature- and field-dependent specific heat capacity (c_p) were determined. For comparison, a sintered La-Co-Fe-Si and a Gadolinium sample, which is a benchmark material for magnetocaloric materials, was measured. From the specific heat, entropy change ΔS and temperature change, ΔT was calculated and compared with magnetic measurements (ΔS^M) and direct measurements (ΔT^{direct}). Furthermore by using Computed Tomography (CT) exact volume fractions of the active magnetocaloric material, the epoxy and the porosity were studied. We will discuss the magnitude of the magnetocaloric effect with respect to the active magnetic material and the role of the porosity.

MM 9.2 Mon 12:00 IFW A

Interface-related phenomena in coupled direct and inverse magneto-caloric materials: A first-principles study — •Biswanath Dutta, Tilmann Hickel, and Jörg Neugebauer — Max-Planck-Institut für Eisenforschung GmbH, D-40237 Düsseldorf, Germany

A combination of different magneto-caloric materials in a single system gives rise to new phenomena that can be highly relevant for applications. Within this study, we investigate the physical properties of systems containing Ni-Mn-Ga and Ni-Mn-Sn, which show direct and inverse magneto-caloric effect respectively. X-ray diffraction experiments indicate that their combination in a layered structure significantly changes the structural properties of both phases. We have investigated the underlying mechanisms for this observation using density functional theory. On the one hand, our calculations reveal that the atomic magnetic moments get modified near the interface implying that interfaces influence transition temperatures and entropy changes. On the other hand, we have carefully investigated strain contributions, interlayer diffusion as well as defect formation such as vacancies. Our calculated results show clear indications for Ga diffusion into Ni-Mn-Sn, thereby modifying the chemistry of the alloy. We discuss these results in the framework of lattice expansion and vacancy formation for various species and have used them to explain the experimental observations.

MM 9.3 Mon 12:15 IFW A

Recent progress in development of Fe-Pd ferromagnetic shape memory films and foils for biomedical applications — Y. Ma[1], A. Arabi-Hashemi[1], A. Landgraf[1], U. Allenstein[1,3], M. Zink[3], and •S.G. Mayr[1,2,3] — [1]Leibniz-Institut für Oberflächenmodifizierung e.V. Leipzig — [2]Translationszentrum für regenerative Medizin — [3]Fakultät für Physik und Geowissenschaften, Universität Leipzig

Due to their excellent biocompatibility, Fe-Pd based ferromagnetic shape memory alloys are highly promising materials for use as actuators or sensors in biomedical applications. Yet, their application within these areas has been hampered by unresolved issues, including i) synthesis as freestanding single-crystals in the desired fct martensite phase, ii) optimization for a martensite temperature located sufficiently above body temperature, iii) activation of twin boundary motion and iv) mechanical coupling to cells. The present contribution will review recent progress in coping with challenges i)-iv), employing molecular beam epitaxy for single crystal synthesis, ion beam irradiation for tuning martensite transformation, film-lift-off by a tailored etching approach, followed by functionalization with biomolecules for interfacing to cells. In doing so, we particularly focus on the physical understanding, how synthesis parameters affect resulting properties and functionality.

MM 9.4 Mon 12:30 IFW A

Electrical and magnetic properties of Fe-based bulk metallic glass with minor Co and Ni addition — •Hyo Yun Jung — IFW Dresden, Institute for Complex Materials, D-01069 Dresden, Germany

Effect of minor Co and Ni alloying on soft magnetic properties and electrical resistivity (ρ) of Fe75.5C7.0Si3.3B5.5P8.7 (at.%) bulk metallic glass (BMG) has been investigated. Within examined compositional range (Co and Ni up to 4 at.%), the saturation magnetization (Ms) and ρ of the alloy continuously decrease with increasing Co and Ni contents, while the Curie temperature (Tc) and initial permeability of the alloy increase. Comparing the effect of Co and Ni additions, the alloys with Co addition have much higher Tc and Ms than the alloy with Ni addition. The present results suggest that minor addition of Co can provide better effectiveness to enhance the magnetic softness of Fe-based BMGs than minor Ni addition.