DS 20: Amorphous Thin Magnetic Films

Time: Wednesday 15:45–17:30 Location: GER 37

Topical Talk DS 20.1 Wed 15:45 GER 37

Amorphous magnetostrictive thin films for sensor applications — •Eckhard Quandt — Lehrstuhl für Anorganische Funktionsmaterialien, Institut für Materialwissenschaft, Technische Fakultät, Christian-Albrechts-Universität zu Kiel, Kaiserstr. 2, 24143 Kiel

Magnetron sputtered amorphous FeCoBSi thin films are attractive for different sensor applications due to their softmagnetic properties, their high piezomagnetic coefficient and their good high frequency properties.

The presentation describes mainly the dependency of the magnetic properties of FeCoBSi films on strain. Vibration sample magnetometer (VSM), Kerr-effect, magneto-optical indicator film (MOIF) techniques, and high frequency permeameter measurement data obtained with special test jigs are discussed in view of applications as remote interrogated stress sensors or as multiferroic magnetic field sensor.

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Topical Talk DS 20.2 Wed 16:15 GER 37

Thermodynamic stability and crystallization of amorphous thin magnetic films — •Ulrich Herr[1], Andreas Grob[1], Mohammad Mujeebuddin[1], Xiaoxi He[1], Senthilnathan Mohanan[1], Rolf Diebolder[2], and Raimund Hibst[2] — [1]Institut für Mikro- und Nanomaterialien, Universität Ulm, 89081 Ulm — [2]Institut für Laseranwendungen in der Medizin und Meßtechnik, Universität Ulm, 89081 Ulm

The thermodynamic stability of thin films is strongly affected by the presence of surfaces and interfaces. We present results of the stabilization of FeZr films on different substrates. The initially amorphous films undergo a crystallization at a critical thickness, which depends on the thermodynamic driving forces. The crystallization occurs spontaneously at room temperature and can be monitored by changes of the magnetic and mechanical properties of the films. The results demonstrate the importance of the structural mismatch at the film-substrate interface for the stabilization effect. In the second part we report on crystallization of thin amorphous CoFeB films which are of interest for application in TMR devices with MgO tunnel barriers. The annealing treatment necessary for the crystallization may lead to unwanted interdiffusion and degradation of device properties. The intention of our study is to limit the interdiffusion by pulsed heating with nanosecond laser pulses. The progress of the crystallization is monitored by measurements of electrical resistivity, magnetic properties and structural investigation by X-ray diffraction. The effect of CoFeB film thickness and laser intensity on the crystallization process has been investigated.

Topical Talk DS 20.3 Wed 16:45 GER 37

Magnetism in FeZr-based multilayers – stability, coupling, dimensionality — •Andreas Liebig[1], Panagiotis Korelis[2], Gabriella Andersson[2], Hans Lidbaum[3], Klaus Leifer[3], and Björgvin Hjörvarsson[2] — [1]Inst. of Physics, TU Chemnitz, Chemnitz, Germany — [2]Dep. of Physics, Uppsala University, Uppsala, Sweden — [3]Dep. of Engineering Sciences, Uppsala University, Uppsala, Sweden

We present a study on the magnetism of FeZr-based multilayers with either insulating or metallic interlayers, using MOKE and SQUID magnetometry. The structure was determined using X-ray reflectivity as well as HR-TEM and the chemical composition was determined by RBS.

A brief overview over the $Fe_{91}Zr_9/Al_2O_3$ system, where the interplay between dewetting and phase separation leads to the formation of nanocrystallites at the interface, will be given. For $Fe_{90}Zr_{10}/Al_{70}Zr_{30}$ multilayers, however, the formation of a nanocrystalline phase can be excluded from structural and magnetic measurements. Therefore, these can be used as a prototype to study magnetic coupling phenomena in amorphous systems in low dimensions. The interlayer exchange coupling over the $Al_{70}Zr_{30}$ turns out to be negligible, and the ordering temperature scales therefore only with the thickness of the magnetic layers. Above the apparent ordering temperature a phase with exceedingly high magnetic susceptibility is found. Similarities to the hypothetic Aharony-Pytte phase of infinite magnetic susceptibility are discussed, and a conceptual model for the transition is given.

DS 20.4 Wed 17:15 GER 37

Long range order on atomic scale induced at CoFeB/MgO interfaces — •Gerrit Eilers[1], Marvin Walter[1], Kai Ubben[1], Henning Ulrichs[1], Michael Seibt[2], Andy Thomas[3], Günter Reiss[3], and Markus Münzenberg[1] — [1]I. Phys. Inst., Universität Göttingen — [2]IV. Phys. Inst., Universität Göttingen — [3]Physics Department, Bielefeld University

Magnetic tunnel junctions (MTJs) based on amorphous (a-) CoFeB / crystalline (c-)MgO / a- CoFeB trilayers have been of great interest in research just recently. Due to their high tunnel magneto resistance (TMR) they are a promising candidate spin torque MRAM devices. For future writing concepts like current induced magnetic switching MTJs with thin barriers are necessary to provide sufficient high current densities. Therefore, the quality of the interfaces is of great significance and should be optimized on the nano-scale. The a-CoFeB / c- MgO interface has been studied by means of quantitative high resolution transmission electron microscopy (HRTEM) from atomic to micrometer length scales with increasing annealing temperatures. On the micron scale crystallisation is governed by nucleation processes. On the atomic scale a long range order is induced by the MgO interface, explaining the high TMR values >100% even for not fully crystallized CoFeB/ MgO/ CoFeB tunnel junctions. We compared the subnanometer atomic order induced at the interface with a simulated HRTEM data set generated by a multislice method from a two dimensional atomic distribution function.

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