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Spin wave propagation in permalloy thin films is investigated, both in the frequency and the time domain. Different configurations of two coplanar waveguides used as emitter and receiver of spin waves are presented. Using a broadband vector network analyzer we measure the spin wave eigenfrequencies in the frequency domain. In a further experiment the transmission of pulsed induced spin waves in the time domain is detected using a digital sampling oscilloscope. All measurements are performed at room temperature with an external field applied in different directions. We discuss the data in the light of the spin wave propagation based on dispersion relations of permalloy thin films. We acknowledge financial support through the German excellence cluster "Nanosystems Initiative Munich".

MA 40.92 Fri 11:00 P1A

**Effect of a DC current on the magnetization dynamics in spin-valve nanocontacts** — •Abdelghani Laraoui[1], Florin Ciubotaru[1], Helmut Schultheiss[1], Alexander Serga[1], Sebastian Hermsdörfer[1], Maarten van Kampen[2], Liesbet Lagae[2], Britta Leven[1], Andrei N. Slavin[3], and Burkard Hillebrands[1] — [1]Fachbereich Physik and Forschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany — [2]IMEC, Kapeldreef 75, Leuven, Belgium — [3]Oakland University, Rochester, Michigan, USA

We have studied the magnetization dynamics in spin-valve nanocontact devices under the influence of an applied microwave ac and dc current by means of Brillouin light scattering (BLS) microscopy. To obtain an idea of the possible modes of spin waves that can be excited, the 80 nm point contact was subjected to an ac current of varying frequencies and powers. The BLS spectra of the extended Py free layer of the spin-valve stack were recorded at a fixed position near to the point contact (˜ 200 nm) and for various amplitudes of an external magnetic field. Strong nonlinear spin waves are excited with the ac current and discussed within the framework of three magnon scattering. In the presence of a dc current the efficiency of the direct excited modes is enhanced. This effect can be explained by both spin transfer torque and Oersted field effects. In addition, the threshold properties for nonlinear spin-waves (non-integer modes) excitation are mainly controlled by the Oersted field created by the dc current injected through the nanocontact. Support by EU-MRTN SPINSWITCH (MRTN-CT-2006-035327) and by the Deutsche Forschungsgemeinschaft (SPP1133).

MA 40.93 Fri 11:00 P1A

**Anisotropy dependence of domain structure and magnetization dynamics in magnetic thin film elements** — •Claudia Patschurek, Jeffrey McCord, Rainer Kaltofen, Rudolf Schäfer, and Ludwig Schultz — IFW Dresden, Inst. f. Metallische Werkstoffe, Helmholtzstr. 20, 01069 Dresden

Patterned multilayered samples of polycrystalline Ni81Fe19 and amorphous Co60Fe20B20 with and without a 5 nm MgO interlayer were deposited under an applied field using dc magnetron sputtering. While the total stack thickness of 80 nm was kept constant, the thickness ratio of the individual layers was systematically varied in order to achieve a linear change of magnetic anisotropy. Static and dynamic properties were investigated by quasi-static magnetometry and pulsed inductive microwave magnetometry (PIMM).

Magneto-optical Kerr microscopy studies reveal that the patterning leads to the formation of characteristic, anisotropy-dependent non-Landau closure domain structures in the non-laminated elements, while no anisotropy dependence is obvious for the domain structure of laminated thin film elements. Irregular contributions to the effective field and thus the dynamic magnetic response, originating from the domain structures, were identified.

MA 40.94 Fri 11:00 P1A

**Tunnel magnetoresistance and spin dependent shot noise in carbon nanotube quantum dot in the Kondo regime** — •Stanislaw Lipinski and Damian Krychowski — Institute of Molecular Physics, Polish Academy of Sciences, Poznan, Poland

The out of equilibrium transport properties of carbon nanotube quantum dot coupled to ferromagnetic electrodes are studied by means of the non-equilibrium Green functions using equation of motion method. Polarization of electrodes introduces the spin dependence of tunneling rates and exchange splitting of the dot level. We point out on the possibility of achieving giant values of tunnel magnetoresistance in the Kondo range and discuss a prospect of gate control of this quantity. Change of the gate enables a control of the value and sign of polarization of conductance. For parallel orientation of polarizations of electrodes a significant decrease of the Fano factor is observed for gate potentials corresponding to vanishing exchange splitting. The exchange induced Kondo satellites reflect in the bias or gate dependences of spin resolved Fano factors.

MA 40.95 Fri 11:00 P1A

**AC Transport in thin manganite films** — •Sebastian Hühn, Kai Gehrke, Vasily Moshnyaga, and Konrad Samwer — I. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, 37707 Göttingen

We have studied the metal-insulator (MI) transition in perovskite manganite films by means of a.c. electric transport technique. The films of $La_{1-x}Sr_xMnO_3$ (LSMO), $La_{1-x}Ca_xMnO_3$ (LCMO) and $(La_{1-y}Pr_y)_{1-x}Ca_xMnO_3$ (LPCMO) were prepared by a metalorganic aerosol deposition technique. The linear $R_\omega$ and nonlinear 3rd harmonic resistance $R_{3\omega}$ were measured simultaneously as a function of temperature (4-300K), current (1-1000$\mu$A), frequency (1-1000Hz) and magnetic field (0-7T). We show that the MI transition temperature ($T_{MI}$) is frequency dependent. The nonlinear resistance $R_{3\omega}$ is strongly enhanced mostly in the vicinity of $T_{MI}$ and shows a peculiar magnetic field dependance. The results on LPCMO film are compared with LCMO and LSMO and discussed within correlated polarons approach and phase separation scenario.

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MA 40.96 Fri 11:00 P1A

**Electronic structure in mesoscopic systems under finite bias** — •Steven Walczak[1,2], Michael Czerner[2], Christian Heiliger[3], and Ingrid Mertig[2] — [1]Max Planck Institute of Microstructure Physics, D-06120 Halle (Saale), Germany — [2]Institute of Physics, Martin Luther University Halle-Wittenberg, D-06120 Halle (Saale), Germany — [3]I. Physikalisches Institut, Justus Liebig University, D-35392 Giessen, Germany

The understanding of the I-V-characteristics is a key issue in ballistic transport. In particular, the voltage drop within the scattering region depends strongly on the geometry of the system. For example in a tunnel junction one expects a simple linear voltage drop over the barrier but for atomic contacts, nanowires, or molecules the voltage drop is expected to be more complicated. To account for these systems we extend our implementation of the Keldysh formalism in the Korringa-Kohn-Rostoker Green's function method [1]. Furthermore, a real space formulation of the Keldysh equation is used to describe open systems which exhibit broken translational symmetry like atomic contacts or nanowires.

Our extension includes the self-consistent treatment of the system under applied bias using the non-equilibrium density between the chemical potentials of the left and the right lead. The voltage drop within the system is then proportional to the difference of the densities with and without an applied voltage.

[1] C. Heiliger, M. Czerner, B. Yavorsky, I. Mertig, M. Stiles, J. Appl. Phys. 103, 07A709 (2008)

MA 40.97 Fri 11:00 P1A

**Direct measurement of the spin polarization of Co-Fe and Co-Fe-B** — •Savio Fabretti[1], Oliver Schebaum[1], Andy Thomas[1], Günter Reiss[1], and Jagadeesh Moodera[2] — [1]Universität Bielefeld — [2]MIT Cambridge

We investigated the spin polarization of Co-Fe and Co-Fe-B thin films with the Meservey-Tedrow method. Superconductor/insulator/ferromagnet (S/I/F) structures were fabricated using shadow masks and DC- and RF-magnetron sputtering in an automatic sputtering system. The samples have been post annealed in a vacuum furnace. The superconducting electrode consists of $Al_{95}Si_5$ while the insulator is MgO. For optimization of the superconducting tunnel junctions the properties of the Al-Si films on MgO buffer layers have been investigated in dependence of the Al-Si thickness and the annealing temperature. The dI/dV measurements were done in a $^3$He cryostat at a temperature of 0.46K with magnetic fields applied in the range of 2T to 2.8T. Finally, the results were compared with conventional MgO magnetic tunnel junctions with Co-Fe and Co-Fe-B electrodes.

MA 40.98 Fri 11:00 P1A

**Measurement of the spin polarisation of the current**

**through nanostructured Al/Fe and Nb/Fe point contacts** — •Konstantin Mirlin[1], Samuel Bouvron[1], Michael Marz[1,2], Gernot Goll[1], Christoph Sürgers[1,2], and Hilbert v. Löhneysen[1,2,3] — [1]Physikalisches Institut, Universität Karlsruhe, 76128 Karlsruhe — [2]DFG-Zentrum für funktionelle Nanostrukturen der Universität Karlsruhe, 76128 Karlsruhe — [3]Institut für Festkörperphysik, Forschungszentrum Karlsruhe, 76021 Karlsruhe

Point-contact spectroscopy can be used to determine the spin polarisation $P$ of the current through a S/F point contact. We used this method to study nanostructured Al/Fe and Nb/Fe contacts produced by electron-beam lithography. We measured the differential conductance spectra $G(V) = dI/dV(V)$ of the Nb/Fe contacts in a $^4$He cryostat down to 1.5 K and described the spectra within two different theoretical models, the Mazin model [1] and the Cuevas model [2]. The first one considers the current through the F/S contact as composed of a fully polarised and an unpolarised part. The second one is based on the Landauer-Büttiker formalism with spin dependent transmission coefficients $\tau_{\uparrow(\downarrow)}$ with a single $P = (\tau_\uparrow - \tau_\downarrow)/(\tau_\uparrow + \tau_\downarrow)$. $P$ depends on the contact size and is reduced with increasing contact size, possibly due to spin-orbit scattering in the contact region [3]. This scenario is supported by a larger decrease of $P$ for Nb/Fe contacts compared to Al/Fe contacts, as expected for spin-orbit scattering.

[1] I.I. Mazin, PRL 83(7), 1427 (1999); [2] J.C. Cuevas et al., PRB 69, 140502 (2004); [3] M. Stokmaier et al., PRL 101(14), 147005 (2008)

MA 40.99 Fri 11:00 P1A

**In-situ Preparation and Characterization of Tailored Magnetic Nanocontacts** — Stephen Krzyk, Ajit Patra, •Andre Bisig, Mathias Kläui, and Ulrich Rüdiger — Fachbereich Physik, Universität Konstanz, 78457 Konstanz

It has been shown that magnetoresistance measurements can be used to investigate domain walls spin structure and pinning characteristics [1], and that the type and pinning behavior of domain walls is strongly dependant on the geometry of the investigated structures [2]. So far, the accessible lateral size regime has been limited by the finite resolution of the lithographic preparation process. An innovative approach to overcome this limitation and leading down to atomic size of a contact is the electromigration technique [3].

We use a combination of electron- and focussed-ion-beam lithography to pre-pattern nanoscale ring-structures with notches on a $Si_3N_4$ surface, and Permalloy ($Ni_{80}Fe_{20}$) films are grown on the structures in UHV. Controlled electromigration is used to reduce the size of the notch. By alternating deposition and electromigration, the resistance and correspondingly the cross-section of the notch can be reversibly changed by several orders of a magnitude. In-plane magnetic fields are used to nucleate and move magnetic domain walls in the nanostructure and magnetoresistance measurements are used to probe the influence of the notch geometry on the behavior of the domain wall.

[1] D. Bedau et al., J. Appl. Phys. 101, 09F509 (2007).
[2] M. Laufenberg et al., Appl. Phys. Lett. 88, 052507 (2006).
[3] R. Hoffmann et. al., Appl. Phys. Lett. 93, 043118 (2008).

MA 40.100 Fri 11:00 P1A

**Annealing behaviour of CoFeB/MgO/CoFeB magnetic tunnel junctions** — Sebastian Ringer[1,2], Michael Vieth[2], Ludwig Bär[2], Manfred Rührig[2], and •Günther Bayreuther[1] — [1]Universität Regensburg, 93040 Regensburg, Germany — [2]Siemens AG, Corporate Technology CT T MM1, 91050 Erlangen, Germany

With CoFeB/MgO/CoFeB magnetoresistive tunnel junctions, annealing is commonly used to increase the TMR ratio. The annealing process simultaneously affects the antiferromagnetic pinning layer as well as the tunnel barrier and the ferromagnetic contacts. In particular, the role of diffusion of B into the MgO barrier has been considered recently. By a systematic variation of annealing time and temperature the present study aims to achieve a better understanding of the relevant diffusion processes and an optimization of the annealing procedures. Junctions with a barrier thickness of 1.5 nm showed a TMR ratio of 30% at room temperature before annealing which increased to a maximum value of 150% after annealing for 4 h at 350° C. Measurement of the high resistance state (i.e. for antiparallel magnetizations), the low resistance state (parallel magnetizations) and the TMR ratio versus annealing time at different temperatures allows for the calculation of temperature dependent time constants and activation energies of the processes involved. A comparison of room temperature and low temperature resistance values is used to separate different effects of the annealing process.

MA 40.101 Fri 11:00 P1A

**Magnetoresistance and electroresistance in $BiMnO_3$ based tunnel junctions** — •Nicki Hinsche[1], Michael Fechner[1,2], Igor Maznichenko[1], Peter Bose[1,2], Sergei Ostanin[2], Arthur Ernst[2], Juergen Henk[2], Peter Zahn[1] und Ingrid Mertig[1,2] — [1]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, D-06099 Halle, Germany — [2]Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, D-06120 Halle, Germany

The tunneling magnetoresistance (TMR) and electroresistance (TER) of $BiMnO_3$ based tunnel junctions are investigated by means of a combined ab initio and model calculation. The structural relaxation of the barrier material was performed using the VASP package. The electronic structure, and especially the complex band structure of the barrier, are calculated within density functional theory in self-interaction-corrected local density approximation (SIC-LDA) using a KKR multiple scattering scheme. The potential profile in the barrier is determined by the material polarization and the different screening lengths in the electrodes. We assumed a half-metallic and a nobel metal electrode. The influence of the barrier polarization, the $BiMnO_3$ complex band strucure, and the screening properties of the electrodes on the TMR and TER will be discussed.

MA 40.102 Fri 11:00 P1A

**Dielectric Breakdown and inelastic electron tinneling spectroscopy of top pinned and bottom pinned Co-Fe-B/MgO/Co-Fe-B magnetic tunnel junctions** — •Ayaz Arif Khan, Jan Schmalhorst, Karsten Rott, Andy Thomas, and Günter Reiss — Thin films and physics of Nano structures, Department of Physics, Bielefeld university, P. O. Box 100131, 33501 Bielefeld germany.

We present a detailed investigation into the intrinsic tunnel barrier reliability in Co-Fe-B/MgO/Co-Fe-B magnetic tunnel junctions (MTJ). The intrinsic reliability is measured as the ramped breakdown voltage ($V_{bd}$) at room temperature for both positive and negative polarity. The measurements were done for two types of junctions: one set of junctions had exchange biased (pinned) bottom electrodes, one set exchange biased (pinned) top electrodes with an additional artificial ferrimagnet. We found a significant polarity dependence in the dielectric breakdown: top as well as bottom pinned tunnel junctions showed higher breakdown voltage when the top electrode was biased positively compared to negative bias. In contrast to this the differential resistance $\frac{dV}{dI} - V$ spectra revealed an asymmetry for the top pinned junctions which was reversed in comparison to the bottom pinned system. This indicates that both asymmetries have different origins. Additionally the bottom pinned junctions showed in general slightly lower breakdown voltages and stronger magnon excitation in the inelastic electron tunneling $\frac{d^2I}{dV^2} - V$ spectra than the top pinned junctions.Possible reasons for these correlations are discussed.

MA 40.103 Fri 11:00 P1A

**Preparation and characterization of sputtered CoFeB/MgO/CoFeB based TMR magnetic tunnel junctions (MTJs)** — •Neda Sadrifar[1], Senthilnathan Mohanan[1], Sören Selve[2], Ute Kaiser[2], and Ulrich Herr[1] — [1]Institut für Mikro- und Nanomaterialien, Universität Ulm, 89081 Ulm — [2]Materialwissenschaftliche Elektronenmikroskopie, Universität Ulm

MTJs with amorphous aluminum oxide tunnel barrier are currently used in magnetoresistive random access memory (MRAM) and the read heads of hard disk drives. MTJs with crystalline MgO tunnel barrier and body centered cubic (bcc) Fe, Co or CoFe ferromagnetic electrodes are predicted to exhibit over 1000% magnetoresistance due to coherent tunneling of fully spin polarized electrons. MTJs with MgO barrier sandwiched between CoFeB electrodes are recently developed for practical applications and found to have TMR ratios up to 500% at RT. Crystallization of amorphous CoFeB into (001)-oriented bcc structure results in a good lattice matching with (001)-oriented MgO and a very sharp and smooth interface and consequently to highly spin polarized tunneling current and high TMR effect. In this study, CoFeB/MgO/CoFeB-based MTJs were prepared by magnetron sputtering and characterized with respect to their microstructure and roughness by XRD, AFM, SEM and TEM. The main focus is on the effect of underlayers on the morphology of the MTJ stack and formation of (001)-oriented MgO and bcc-CoFeB.

MA 40.104 Fri 11:00 P1A

**Properties of ferromagnetic tunnel junctions with organic**