TT 15: Superconductivity: Poster Session

Time: Tuesday 14:00–18:00 Location: Poster B

TT 15.1 Tue 14:00 Poster B

Superconducting MgB_2 films with introduced artificial pinning centers — •Anatoli Sidorenko[1,2], Vladimir Zdravkov[1], Andrei Surdu[1], Günter Obermeier[3], Christoph Frommen[4], Stefan Walheim[4], Thomas Koch[2,4], and Thomas Schimmel[2,4] — [1]Institute of Electronic Engineering and Industrial Technologies ASM, Kishinev MD2028, Moldova — [2]Institute of Applied Physics, University of Karlsruhe, D-76128 Karlsruhe, Germany — [3]Institute of Applied Physics, University Augsburg, 86159 Augsburg, Germany — [4]Institute of Nanotechnology, Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany

High quality superconducting magnesium diboride films were prepared using DC-magnetron sputtering and post annealing in Mg vapor within a specially designed Nb reactor. The influence of embedded gold nano particles on resistive transition broadening in external magnetic field has been investigated. The transition broadening in strong magnetic fields could be explained by the change of the effective dimensionality of superconductivity nucleation in magnesium diboride, because of the dimensional crossover of fluctuations.

The work was supported by the BMBF project 01/007 Superconducting Magnesium Diboride Films for Techical Application, and the project Poziţionarea forţei de pinning si creşterea curentului critic in MgB_2 si applicatiile technice.

TT 15.2 Tue 14:00 Poster B

Carbon doping as an effective way of changing the superconducting properties of MgB_2 — •Marko Herrmann[1], Wolfgang Häßler[1], Margitta Schubert[1], Wolfgang Gruner[1], Manfred Ritschel[1], Bernhard Holzapfel[1,2], and Ludwig Schultz[1,2] — [1]IFW-Dresden, Institute for Metallic Materials, P.O. Box 270116, D-01171 Dresden, Germany — [2]Dresden University of Technology, Department of Physics, D-01062 Dresden, Germany

Up to now, carbon doping is the only reliable way to enhance the superconducting properties of MgB_2 significantly. Precursor powders of carbon-doped and undoped MgB_2 were prepared by mechanical alloying. This very effective preparation method imparts an enormous quantity of energy to the material and produces a partially reacted, nanocrystalline powder with enhanced reactivity. The high reactivity of the milled powders promotes the formation of MgB_2 at reduced temperatures around 600°C to 650°C. Very high critical current densities of J_c = 1.1 x 10^6 A/cm^2 in self-field at 4.2 K and critical fields B_{c2} = 15.5 T at 10 K of undoped bulk samples of mechanically alloyed precursors were measured. In comparison to results of other in-situ preparation techniques this values exceed most of the superconducting properties by far and even keep up with results on optimized carbon doped samples reported so far. Starting from this high performance powders a comparison of promising carbon dopants will be presented. We show the influence of these dopants on the lattice parameter, the superconducting transition, critical field and critical current density of the bulk samples.

TT 15.3 Tue 14:00 Poster B

Film growth and anisotropic behaviour of the critical field in epitaxial $Lu_xHo_{1-x}Ni_2B_2C$ thin films — •Tim Niemeier, Ruben Hühne, Ludwig Schultz, and Bernhard Holzapfel — IFW Dresden, P.O. Box 270116, 01171 Dresden

The research on Rare Earth Nickel Borocarbides has led to a number of new conclusions about superconductivity, particularly in regard to the interdependency with magnetic influences. Recently, it was concluded by *Wälte et al.* from specific heat measurements and thermodynamic simulations that $LuNi_2B_2C$ provides a non-magnetic corresponding partner of $HoNi_2B_2C$ [1].

Complementary to single crystal growth, we use pulsed laser deposition for the sample preparation. In the past, particularly the anisotropy of the upper critical field could be successfully measured using thin film samples [2]. We prepared epitaxial thin films of alloys of $Lu_xHo_{1-x}Ni_2B_2C$ for different x for the investigation of the transition temperature and the upper critical field. Especially we discuss the anisotropic behaviour above as well as below the magnetic ordering temperature known from $HoNi_2B_2C$ providing numerical fitting results for different simple models.

[1] Wälte, A: Doctoral thesis, TU Dresden 2007

[2] Wimbush, S. C., L. Schultz, and B. Holzapfel: Angular anisotropy of the upper critical field in YNi_2B_2C. Physica C 408-10 (2004): 83-84.

TT 15.4 Tue 14:00 Poster B

Electrical properties of thin $YBa_2Cu_3O_{7-x}$ films with embedded gold nano clusters — •Sebastian Engmann, Uwe Schinkel, Veit Grosse, Christoph Becker, Alexander Steppke, Frank Schmidl, and Paul Seidel — Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena, Helmholtzweg 5, D-07743 Jena

High temperature superconducting devices such as magnetometers or gradiometers are usually made from a single thin film, although each part of the device needs to fulfill special requirements. These are for example a low flux noise in antenna structures and a low contact resistance to the bonding pads. These requirements can be achieved by embedding gold nano clusters in thin films of $YBa_2Cu_3O_{7-x}$ (YBCO), since they can act as flux pinning centers and they increase contact area to the film.

We present studies on the formation of gold nano clusters during the pulsed laser deposition of thin YBCO films in dependence on the gold film thickness. We verified the high crystalline quality of the films by measuring Rocking curve widths. Size and distribution of the gold clusters were determined from AFM measurements. We compare the superconducting and noise properties of bridge structures and gradiometers with devices made of conventional YBCO films.

TT 15.5 Tue 14:00 Poster B

Preparation and Characterization of $YBa_2Cu_3O_7$/$PrBa_2Cu_3O_7$ Superlattices — •Ayman El Tahan, Gerhard Jakob, and Hermann Adrian — Institute of Physics, University of Mainz, 55099 Mainz

High T_c superconductor/insulator superlattices offer the possibility to create artificial superconductors with variable strength of the interlayer Josephson coupling. We want to investigate the interlayer coupling strength by measuring the transport properties perpendicular to the layers.

Our presented films are prepared from stoichiometric targets by high pressure sputter deposition in pure oxygen atmosphere. As substrates we used (100) oriented $SrTiO_3$ and $LaAlO_3$. Using x-ray diffraction we confirmed the c-axis oriented epitaxial growth of the superlattices. The superlattice quality is determined by comparison to simulated diffractograms using the program SUPREX. AC magnetic susceptibility was used for characterization of the critical temperature for our $YBa_2Cu_3O_7$ samples and $YBa_2Cu_3O_7$/$PrBa_2Cu_3O_7$ superlattices.

Financial support by the MWFZ Mainz and the government of Egypt is gratefully acknowledged.

TT 15.6 Tue 14:00 Poster B

Synthesis and characterisation of superconducting and magnetic properties of $RuSr_2Gd_{1-x}Y_xCu_2O_8$ — •Johannes Krämer, Eugenio Casini, and Hans F. Braun — Physikalisches Institut, Universität Bayreuth, D-95440 Bayreuth

It is well known that the formation of RuRE1212 (RE = rare earth) under ambient pressure is strongly affected by the size of the rare earth ion. The 1212 structure type forms just with RE = Gd, Eu and Sm. Under high pressure, the synthesis has been successful with the smaller elements Tb - Er and Y [1]. Under ambient conditions, the phase has been reported in solid solution systems $RuSr_2Gd_{1-x}RE_xCu_2O_8$ with RE = Dy - Er, Yb and Lu up to a maximum content of $x = 0.7$ [2].

In our work we investigated the partial substitution of Gd with the non-magnetic rare earth Yttrium. The samples were characterised using x-ray powder diffraction, scanning electron microscopy (SEM) and ac-susceptibility measurements. We observed a dependence of the superconducting transition temperature T_c as well as the lattice parameters on the Yttrium content. However, single-phase samples were not obtained.

[1] L.T. Yang et al., J. Solid State Chem. 177 (2004) 1072

[2] M. Abatal et al., Physica C 408-410 (2004) 185

TT 15.7 Tue 14:00 Poster B

Effect of variable Ru content on superconducting and magnetic properites of $RuSr_2GdCu_2O_8$ — •Manuel Kempf, Eugenio Casini, and Hans F. Braun — Physikalisches Institut, Universität

Bayreuth, D-95440 Bayreuth

We have investigated the effect of a variation of the Ru content in $RuSr_2GdCu_2O_8$ (RuGd1212) on sample properties as for example shifts of the superconducting and magnetic transition temperatures T_c and T_m and the presence of phases in equilibrium with RuGd1212. The procedure of sample preparation can strongly affect the magnetic and superconducting properties of RuGd1212. Due to the relatively high volatility of the Ru-oxides at temperatures around 1000°C, a Ru loss can arise during calcination of the starting materials, the preparation of the Sr_2RuGdO_6 precursor and the final sintering process of RuGd1212.

The starting composition for our RuGd1212 was a mixture of CuO and Sr_2RuGdO_6 in the stoichiometric ratio 2:1. Samples were sintered in an O_2/Ru-oxide gas flow with variable Ru content. An increase of the Ru concentration in the gas mixture leads to a decrease of T_c and an increase of T_m. In sample areas exposed to the gas flow, additional phases coexisting with RuGd1212 were observed at higher Ru-oxide partial pressure. Thus, sintering of RuGd1212 in O_2/Ru-oxide gas flow with variable partial pressure of Ru-oxide controls the loss or increase of Ru in RuGd1212. The different Ru contents in RuGd1212 result in changes of T_c and T_m. This is compatible with the results of experiments where Ru is partially substituted by Cu.

TT 15.8 Tue 14:00 Poster B

Elektromechanische und thermische Charakterisierung von Bi-2223 Hochtemperaturbandsupraleitern bei kryogenen Temperaturen — •Philipp Keller[1,2], Michael Schwarz[1], Klaus-Peter Weiss[1], Reinhard Heller[1] und Sonja Schlachter[1] — [1]Institut für Technische Physik, Forschungszentrum Karlsruhe — [2]Kirchhoff-Institut, Universität Heidelberg

Um den Energiebedarf der Menschen auch in Zukunft befriedigen zu können, sind neue Wege in der Gewinnung, der Speicherung und dem Transport nutzbarer Energien erforderlich. Hierbei spielen Supraleiter und vor allem die im Jahre 1986 entdeckten Hochtemperatursupraleiter eine zunehmend wichtige Rolle. Um diese jedoch technisch nutzen zu können, müssen die Supraleiter in einer der Anwendung angepassten Form gefertigt und physikalisch charakterisiert werden. Am Beispiel von Bi-2223 Bändern für die Anwendung in supraleitenden Stromzuführungen wurden typische Größen wie der kritische Strom Ic unter äußerer mechanischer Spannung, sowie die thermischen Eigenschaften, speziell die thermische Leitfähigkeit und die Längenausdehnung, untersucht. Somit kann der Einfluss der Leiterparameter (z.B. supraleitendes Material, Matrixmaterial, Füllfaktor) bestimmt und die gewünschten Eigenschaften des Bandsupraleiters durch den gezielten Einsatz entsprechender Materialien optimiert werden, was letztendlich die technische Anwendung ermöglicht. Ein tiefer gehendes Verständnis wird durch eine FEM-Modellierung der elektrischen, thermischen und mechanischen Eigenschaften eines Bi-2223 Bandleiters und deren Vergleich mit den durchgeführten Messungen gebildet.

TT 15.9 Tue 14:00 Poster B

In-plane anisotropy of the spin excitation spectrum in strongly underdoped $YBa_2Cu_3O_{6+x}$ — •Daniel Haug[1], Vladimir Hinkov[1], Benoît Fauqué[2], Philippe Bourges[2], Yvan Sidis[2], Alexandre Ivanov[3], Chengtian Lin[1], and Bernhard Keimer[1] — [1]Max-Planck-Institut für Festkörperforschung, Stuttgart, Germany — [2]Laboratoire Léon Brillouin, CEA-CNRS Saclay, France — [3]Institut Laue-Langevin, Grenoble, France

The spin excitation spectrum of the optimally doped and moderately underdoped high-temperature superconductor $YBa_2Cu_3O_{6+x}$ is dominated by the so-called resonance peak for excitation energies between 30 and 40 meV (depending on the oxygen content x) that sets in abruptly below T_c. Here we report measurements on arrays of untwinned single crystals in the strongly underdoped regime in which the situation is very different: Spectral weight is shifted towards low energies and evolves smoothly through T_c. The spectrum exhibits a peak below ∼10 meV which shows a spontaneous onset of a strong anisotropy in the a-b-plane defined by the CuO_2 layers. This phenomenon matches the symmetry properties of a nematic liquid crystal, a new symmetry-broken electronic phase that coexists with high-temperature superconductivity in strongly underdoped cuprates.

TT 15.10 Tue 14:00 Poster B

Energy gap and asymmetry of coherence peaks in 123 cuprate superconductors and their T_c dependence — •Pintu Das[1,3], Michael R. Koblischka[1], Thomas Wolf[2], and Uwe Hartmann[1] — [1]Institute of Experimental Physics, University of Saarland, 66041, Saarbruecken, Germany — [2]Forschungzentrum Karlsruhe GmbH, Institute of Solid State Physics, 76021 Karlsruhe, Germany — [3]Max Planck Institute of Chemical Physics of Solids, Nöthnitzer Str. 40, 01187 Dresden, Germany

The energy gap in conventional superconductors is directly proportional to the transition temperature. In high-T_c cuprate superconductors, scanning tunneling spectroscopy (STS) and angle resolved photoemission studies have often shown that the underdoped samples which have low T_c values exhibit very large energy gaps giving rise to a high value of the coupling ratio ($2\Delta/k_BT_c$). This has been mostly observed for $Bi_2Sr_2CaCu_2O_{8+\delta}$. In this work, we observe from the STS experiments on $NdBa_2Cu_3O_{7-\delta}$ single crystal samples that the average energy gap increases with the decrease of T_c. For a moderately underdoped sample the coupling ratio is found to be as high as 18. We also observed an asymmetry in coherence peaks which is minimum in the case of optimally doped (highest T_c) samples. The observed T_c dependence of the asymmetry suggests that it is related to the number of electrons and holes.

TT 15.11 Tue 14:00 Poster B

STM based inelastic electron tunneling spectroscopy on $NdBa_2Cu_3O_{7-\delta}$ — •Pintu Das[1,2], Michael R. Koblischka[1], Helge Rosner[2], Thomas Wolf[3], and Uwe Hartmann[1] — [1]Institute of Experimental Physics, University of Saarland, 66041, Saarbruecken, Germany — [2]Max Planck Institute of Chemical Physics of Solids, Nöthnitzer Str. 40, 01187 Dresden, Germany — [3]Forschungzentrum Karlsruhe GmbH, Institute of Solid State Physics, 76021 Karlsruhe, Germany

Inelastic electron tunneling spectroscopy (IETS) is a very powerful tool to detect collective excitations in conducting materials. Due to inelastic excitation by tunneling electrons, a very weak kink is usually observed in dI/dV curves at the bias voltage corresponding to the excitation energy. In IETS on s wave superconductors, phonon modes (ω_{ph}) were observed at energies given by $E = \Delta + \hbar\omega_{ph}$, where Δ is the energy gap. Recently IETS using scanning tunneling spectroscopy (STS) has been used to detect a bosonic mode in $Bi_2Sr_2CaCu_2O_{8+\delta}$ [1]. In the STS data obtained on $NdBa_2Cu_3O_{7-\delta}$ single crystals, we observed peaks in d^2I/dV^2 curves beyond the coherence peaks from which collective excitation energies of ∼ 23 meV and ∼ 34 meV have been found for the samples with T_c of 93.5 K and 95.5 K respectively. Band structure calculation shows that there is no structure in the density of state at the observed energies which thus supports the presumption that the observed kinks in dI/dV curves are due to inelastic scattering of electrons.

[1] Lee et al., Nature **442**, 546 (2006).

TT 15.12 Tue 14:00 Poster B

Magic doping fractions in Bi2201 — •Lenart Dudy, Alica Krapf, Beate Müller, Olaf Lübben, Helmut Dwelk, Christoph Janowitz, and Recardo Manzke — Humboldt-Universität zu Berlin, Institut für Physik, Newtonstr.15, D-12489 Berlin, Germany

One interesting feature in the hole doped cuprates is the depression of the superconducting transition temperature at certain hole doping fractions. The 1/8 depression in $La_{2-x}Sr_xCuO_4$(LSCO) [1] is widely accepted, and can be interpreted in terms of static stripes [2] - but also by a structural tetragonal-orthorhombic (LTT-LTO) phase transition [3]. In our view the structural interpretation can be ruled out, as additional to 1/8 other fractional depressions were deduced for LSCO (i.e. at 1/16; 3/32; 1/8; 3/16) [4]. But these fractions may also violate the stripe picture, as they can not be interpreted by a static one-dimensional arrangement of holes in the CuO_2-plane but by a two-dimensional one. Despite one controversial report [5] in the Bismuth cuprates the knowledge of the existence or non existence of such fractions is very poor. We will show that also in the one-layer Bismuth cuprate the depressions at certain hole doping fractions exist which are equal to the fractions found by [4]. This may point to a generality of magic doping fractions in the cuprates.

[1] A. R. Moodenbaugh et al., Phys. Rev. B 38, 4596 (1988)
[2] D.L. Feng et al., Journ. of Phys. and Chem. of Solids 67, 198 (2006)
[3] J. Zhao et al., Supercond. Sci. Technol. 18, 966 (2005)
[4] S. Komiya et al., Phys. Rev. Lett. 94, 207004 (2005)
[5] W.L. Yang et al., Phys. Rev. B 62, 1361 (2000) 1

TT 15.13 Tue 14:00 Poster B

STM investigated characteristics of Pb-Bi2201 in dependence of the lead content — •Olaf Lübben, Lenart Dudy, Alica Krapf,

Helmut Dwelk, Christoph Janowitz, and Recardo Manzke — Institut f. Physik, Humboldt-Universität zu Berlin, Newtonstr. 15, 12489 Berlin

The single layered superconductor $Bi_{2-y}Pb_ySr_{2-x}La_xCuO_{6+\delta}$ ($x = 0.4$) around optimal doping has been investigated by scanning tunneling microscopy (STM). Continuously changing the amount of lead showed a fascinating structural development and revealed new modulations in the BiO layer.

Special attention has been given to the "inhomogeneous" background modulation. It is suggested, like in [1], that this background is not just caused by electronic reasons, but has structural origin. Because of the short range of this modulation it could influence the electronic structure of the CuO_2 plane and the charge transfer between this plane and the carrier reservoir (BiO-SrO). In this context the question arises if a "good" and a "bad" background with respect to superconductivity exists.

[1] H. Mashima et al., Phys. Rev. B **73**, 060502 (2006).

TT 15.14 Tue 14:00 Poster B

Possibility of hole density modulation in highly overdoped Bi(Pb)-2201 single crystals: XAS measurements — •Ariffin Ahmad Kamal, Beate Müller, Rüdiger Mitdank, Lenart Dudy, Helmut Dwelk, Alica Krapf, Christoph Janowitz, and Recardo Manzke — Institut für Physik, Humboldt-Universität zu Berlin

The polarization i.e. angular dependence of the relative intensity of the satellite peak and the main peak of the CuL_3 edge of highly overdoped Bi(Pb)-2201 single crystals was studied by XAS. The spectrum near the CuL_3 edge displays the interaction of the Cu atom with the oxygen localized holes. The relative intensity of the satellite peak and the main peak, which gives the value and distribution of the hole content, has been measured by varying the angle of the electrical field vector E of the synchrotron light within the ab-plane. We have found that the relative intensity of the satellite peak and the white line of highly overdoped Bi(Pb)-2201 single crystals is polarization dependent. The modulation shows that the maximum occurs at nearly 60^0 intervals. This suggests the hole density being distributed with some form of periodicity.

TT 15.15 Tue 14:00 Poster B

The nature of the sharp peak — •Beate Müller, Lenart Dudy, Helmut Dwelk, Alica Krapf, Christoph Janowitz, and Recardo Manzke — Humboldt-Universität zu Berlin, Institut für Physik, Newtonstr. 15, 12489 Berlin

In the high-T_c cuprates the excitations investigated by photoemission in the antinodal direction are incoherent. Only at low temperatures a quasiparticle like excitation, the so-called sharp or superconducting peak, emerges. Mainly the sharp peak is interpreted as a coherent excitation marking e.g. a dimensional crossover [1] but it was also seen as the signature of superfluid density [2,3] or the consequence of the coupling to the magnetic resonance mode [4]. The distinction between the different approaches is the definition of the sharp peak as a consequence of a change in lineshape of the band theory derived excitations or as an additional excitation. In our opinion ARPES measurements at different photon energies point towards the sharp peak being an additional excitation. From this point of view it is possible to reevaluate the various models.

[1] T. Valla, P. Johnson, Z. Yusof, B. Wells, Q. Li, S. Loureiro, R. Cava, M. Mikami, Y. Mori, M. Yoshimura, Nature 417, 627 (2002)

[2] R. H. He, D. L. Feng, H. Eisaki, J.-I. Shimoyama, K. Kishio, and G. D. Gu, Phys. Rev. B 69, 220502 (2004)

[3] D. Feng, D. Lu, K. Shen, C. Kim, H. Eisaki, A. Damascelli, R. Yoshizaki, J.-i. Shimoyama, K. Kishio, G. Gu, Science 289, 277 (2000)

[4] M. Eschrig and M. R. Norman, Phys. Rev. Lett. 89, 277005 (2002)

TT 15.16 Tue 14:00 Poster B

Probing the superconducting state via Andreev bound states in $(La,Ce)_2CuO_4$ — Michael Wagenknecht[1], •Sebastian Scharinger[1], Dieter Koelle[1], Reinhold Kleiner[1], Siegfried Graser[2], Nils Schopohl[2], Boris Chesca[3], Aiko Tsukada[4], Sebastian T. B. Goennenwein[5], and Rudolf Gross[5] — [1]Physikalisches Institut – Experimentalphysik II and Center for Collective Quantum Phenomena, Universität Tübingen, Germany — [2]Institut für Theoretische Physik, Universität Tübingen, Germany — [3]Department of Physics, Loughborough University, United Kingdom — [4]NTT Basic Research Laboratories, Atsugi-shi, Japan — [5]Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften, Garching, Germany

We present quasiparticle tunneling data of $(La,Ce)_2CuO_4$ thin film bicrystal junctions. The differential conductance in the superconducting state shows a pronounced zero bias conductance peak (ZBCP). This peak is attributed to zero energy surface Andreev bound states due to the d-wave symmetry of the order parameter in this electron doped cuprate. Such bound states are closely related to the macroscopic phase coherence of the superconducting state. Hence the ZBCP due to these bound states must disappear at or below the upper critical field $B_{c2}(T)$. By following the disappearance of the ZBCP in the $B-T-$phase diagram we find a lower bound for $B_{c2}(0) \approx 25\,\mathrm{T}$ which is higher than values reported previously for any electron doped cuprate. Following this observation we suggest a modified $B-T-$phase diagram with a larger region of superconductivity, leaving less room for a possible pseudogap phase.

TT 15.17 Tue 14:00 Poster B

Dynamical spin susceptibility in different phases of the electron-doped cuprate superconductors — •Jan-Peter Ismer[1], Ilya Eremin[1], Enrico Rossi[2], and Dirk Morr[3] — [1]MPI für Physik komplexer Systeme, Dresden — [2]University of Maryland, College Park, USA — [3]University of Illinois at Chicago, USA

We present a study of the dynamical spin susceptibility in the electron-doped cuprate superconductors. We show that the resonance peak observed recently in $Pr_{0.88}LaCe_{0.12}CuO_{4-\delta}$ represents rather an effect of the magnetic coherence than a bound state seen in the hole-doped counterparts. We further analyze some aspects of the peculiar behavior of the spin excitations in the presence of the spin density wave (SDW) instability in $d_{x^2-y^2}$-wave superconducting state ($T_N \ll T_C$). We find that the spin resonance will show a remarkable temperature dependence in contrast to the hole-doped cuprates.

TT 15.18 Tue 14:00 Poster B

Raman spectroscopy study of the pyrochlore superconductors KOs_2O_6 and $RbOs_2O_6$ — •Ana Maria Racu[1], Joachim Schoenes[1], Zbigniev Bukowski[2], and Janusz Karpinski[2] — [1]Institut für Physik der Kondensierten Materie, TU Braunschweig, Germany — [2]Laboratorium für Festkörperphysik, ETH Zürich, Switzerland

The discovery of superconductivity in the pyrochlore oxides KOs_2O_6, $RbOs_2O_6$ and $CsOs_2O_6$ has attracted much interest due to their unusual properties. Crystallographic studies proposed two different structures whithin the centrosymmetric $Fd\bar{3}m$ and the non-centrosymmetric $Fd\bar{4}3m$ [1] space groups. Both reveal a very special feature: the alkali atom is situated in an oversized Os-O cage. It is believed that the anharmonic rattling of the alkali atom in the cage strongly influences the electronic structure and the superconductivity [2]. We performed Raman measurements on single crystals of KOs_2O_6 and $RbOs_2O_6$. The experimental results are compared with a factor group analysis for the two proposed crystal structures. The number and the symmetry of the observed modes is compatible with the centrosymmetric space group. In the low energy range we observe a mode which is strongly dependent on the alkali atom. Its energy corresponds to one of the fine structures observed in KOs_2O_6[3] in the photoemission spectra. We attribute this low energy mode to the Raman active rattling vibration of the K and Rb atoms.

[1] Schuck et al., PRB 73, 144506 (2006)
[2] Hiroi et al., J. Phys. Soc Jpn. 74, 3400 (2005)
[3] Shimojima et al., PRL 99, 117003 (2007)

TT 15.19 Tue 14:00 Poster B

Superconductivity on the Border of Weak Itinerant Ferromagnetism in UCoGe — N. T. Huy[1], A. Gasparini[1], D. E. de Nijs[1], Y. Huang[1], J. C. P. Klaasse[1], T. Gortenmulder[1], A. de Visser[1], •A. Hamann[2], T. Görlach[2], and H. v. Löhneysen[2,3] — [1]Van der Waals-Zeeman Institute, University of Amsterdam, Valckenierstraat 65, 1018 XE Amsterdam, The Netherlands — [2]Physikalisches Institut, Universität Karlsruhe, D-76128 Karlsruhe, Germany — [3]Forschungszentrum Karlsruhe, Institut für Festkörperphysik, D-76021 Karlsruhe, Germany

We report the coexistence of ferromagnetic order and superconductivity in UCoGe at ambient pressure [1]. Magnetization measurements show that UCoGe is a weak ferromagnet with a Curie temperature $T_C \approx 3\,\mathrm{K}$ and a small ordered moment $m_0 \approx 0.03\,\mu_B$. Superconductivity is observed with a resistive transition temperature $T_s \approx 0.8\,\mathrm{K}$ for the best sample. Thermal-expansion and specific-heat measurements provide solid evidence for bulk magnetism and superconductivity. The

proximity to a ferromagnetic instability, the defect sensitivity of T_s, and the absence of Pauli limiting, suggest triplet superconductivity mediated by critical ferromagnetic fluctuations.

[1] N. T. Huy et al., PRL 99, 067006 (2007)

TT 15.20 Tue 14:00 Poster B

Electronic and structural properties of two novel Palladium-based Heusler superconductors. — •Jürgen Winterlik, Gerhard H. Fecher, and Claudia Felser — Institut für Anorganische und Analytische Chemie, Johannes Gutenberg - Universität, 55099 Mainz, Germany

This work reports the two novel superconducting Heusler compounds Pd_2ZrAl and Pd_2HfAl. Magnetization and resistance measurements were carried out to verify their transitions to the superconducting states. The compounds exhibit transition temperatures of 3.2 K for Pd_2ZrAl and 3.4 K for Pd_2HfAl. From their behavior in external magnetic fields, it was determined that both compounds are type II superconductors. Similar to the half-metallic ferromagnets, the superconducting Heusler compounds follow an electron counting scheme based on theoretical considerations, the van Hove scenario. As found from *ab initio* calculations, the superconductivity can be explained by a valence instability at the L-point, that has been used as design criterion.

TT 15.21 Tue 14:00 Poster B

Superconductivity, magnetic order and intermediate valence in the new platinum germanium skutterudites $M\mathbf{Pt_4Ge_{12}}$ (M = Sr, Ba, La, Ce, Nd, Pr, Eu) — •Roman Gumeniuk, Michael Nicklas, Helge Rosner, Walter Schnelle, Ulrich Burkhardt, Andreas Leithe-Jasper, and Yuri Grin — Max-Planck-Institut für Chemische Physik fester Stoffe, Dresden, Germany

In the new germanium-platinum compounds with the filled-skutterudite crystal structure $M\mathrm{Pt_4Ge_{12}}$ superconductivity was observed for the non-magnetic cations $M = Sr^{2+}$, Ba^{2+}, La^{3+} and for Pr^{3+} which has a singlet crystal field ground state [1,2]. The isostructural compound with cerium shows no superconductivity above 0.45 K but displays intermediate valence. With the cations Nd^{3+} and Eu^{2+} magnetic order is found at temperatures below 1.8 K. Interestingly, from Curie-Weiss fits to magnetic susceptibility data much stronger antiferromagnetic interactions could be inferred.

[1] R. Gumeniuk *et al.* Phys. Rev. Lett. submitted. ArXiV 0710.1413v1.
[2] W. Schnelle *et al.* Talk, this conference.

TT 15.22 Tue 14:00 Poster B

Unusual Property of Spin Dynamical Susceptibility and its Effect on Superconductivity in Non-centrosymmetric Systems — •Tetsuya Takimoto and Peter Thalmeier — max planck institute for chemical physics of solids, dresden

Recently, non-centrosymmetric superconductors like $CePt_3Si$ attract much attention. For centrosymmetric system, Hubbard model consisting of hopping term and on-site interaction term will be a minimal model. In addition to these terms, the model hamiltonian of non-centrosymmetric system involves Rashba-field term, by which inversion symmetry is broken. In order to study effect of the Rashba-field on relation between spin fluctuation and superconductivity, we calculate spin dynamical susceptibility in the system. It is shown that unlike centrosymmetric system, spin dynamical susceptibilities show unusual momentum dependences, which is induced by Rashba-field. In order to explain these unusual features, group theoretical consideration is carried out. We will discuss its effect on superconductivity.

TT 15.23 Tue 14:00 Poster B

Theory for cooper pairing in non-centrosymmetric superconductors — •Ludwig Klam and Dirk Manske — Max Planck Institute for Solid State Research, Heisenbergstrasse 1, 70569 Stuttgart, Germany

With the discovery of superconductivity in the non-centrosymmetric heavy Fermion compound $CePt_3Si$ by E. Bauer *et al.* a new field of research has developed. Since in this compound the order parameter is – due to a large antisymmetric spin-orbit coupling – a superposition of a spin singlet and spin triplet state, many new interesting properties have been observed. The pairing interaction giving rise to this mixed parity order parameter can be parameterized, and depending on the strength of the different interaction contributions we explore the phase diagram and the nodal structure.

We use a Green's function approach in order to calculate response and transport functions such as the Knight shift and the spin susceptibility. Furthermore we investigate the role of the band-structure obtained from LDA calculations and use a parametrization for the so-called β-band of $CePt_3Si$ in order to compare our numerical results to the experiments.

TT 15.24 Tue 14:00 Poster B

Contribution of the surface dipole to deformation of superconductors — Pavel Lipavsky[1,2], •Klaus Morawetz[3,4], Jan Kolacek[4], Ernst Helmut Brandt[5], and Michael Schreiber[3] — [1]Faculty of Mathematics and Physics, Charles University, Ke Karlovu 3, 12116 Prague 2, Czech Republic — [2]Institute of Physics, Academy of Sciences, Cukrovarnická 10, 16253 Prague 6, Czech Republic — [3]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [4]Max Planck Institute for the Physics of Complex Systems, Noethnitzer Str. 38, 01187 Dresden, Germany — [5]Max Planck Institute for Metals Research, 70506 Stuttgart, Germany

The interaction of the ionic lattice with the superconducting condensate is treated in terms of the electrostatic force in superconductors. It is shown that the surface dipole supplies the force responsible for the volume difference of the normal and superconducting states. Assuming this mechanism we argue that the usual parametrization of the theory of deformable superconductors should be revisited.
arXiv:0708.3760

TT 15.25 Tue 14:00 Poster B

The nonadiabatic regime in optically excited BCS superconductors — •Thomas Papenkort[1], Vollrath Martin Axt[2], and Tilmann Kuhn[1] — [1]Institut für Festkörpertheorie, Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster — [2]Institut für Theoretische Physik III, Universität Bayreuth, 95440 Bayreuth

We have calculated the coherent dynamics of a BCS superconductor excited by short laser pulses using the density matrix formalism in mean field approximation. For very short pulses a nonadiabatic regime emerges in which the superconductor is put into a state with nonvanishing quasiparticle coherences. For such states the modulus of the BCS order parameter performs a damped oscillation in time. It turns out that this oscillation cannot be measured by means of pump-probe spectroscopy as only its temporal mean is reflected in the spectra. However we will show that this drawback can be overcome by using two coherent pump pulses.

TT 15.26 Tue 14:00 Poster B

Pump-probe spectra and nonlinear dynamics of BCS superconductors — Thomas Papenkort[1], •Norina Richter[1], Vollrath Martin Axt[2], and Tilmann Kuhn[1] — [1]Institut für Festkörpertheorie, Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster — [2]Institut für Theoretische Physik III, Universität Bayreuth, 95440 Bayreuth

We present numerical calculations of the reaction of a BCS superconductor to short laser pulses. Starting from the BCS ground state, a laser pulse decreases the modulus of the order parameter, $|\Delta|$. The intensity dependence of this shift depends strongly on the temporal width of the laser pulse. It may be measured using pump-probe spectroscopy: $|\Delta|$ ist directly linked to the energy gap of the superconductor which in turn is clearly visible in the absorption spectra. If the probe pulse precedes the pump pulse, an oscillation is superimposed on the spectrum and both the gap before and after the pump pulse can be seen. After very short pump pulses $|\Delta|$ does not remain constant but instead oscillates. The time dependence of this oscillation is in very good agreement with exact results obtained for the dynamics of a BCS system without external driving following a sudden change into a nonequilibrium state.

TT 15.27 Tue 14:00 Poster B

Microwave conductivity of superconducting aluminum films — •Katrin Steinberg and Martin Dressel — 1.Physikalisches Institut, Universität Stuttgart, Pfaffenwaldring 57, 70550 Stuttgart, Germany

BCS-Superconductors show a coherence peak in real part of the conductivity below the energy gap. We investigated the development of the coherence peak in thin aluminum films with different mean free path. Microwave measurements of the complex conductivity were done in a range from 45 MHz to 40 GHz down to 1.2 K. The temperature and frequency dependence of the coherence peak gives information about

the quasiparticle scattering and coherence effects in a superconductor.

TT 15.28 Tue 14:00 Poster B

Investigation of proximity systems with very low temperature STS — •Wolz Michael, Debuschewitz Christian, Kunej Vojko, and Scheer Elke — Fachbereich Physik, Universität Konstanz, 78457 Konstanz

We have investigated the superconducting proximity effect of double layer superconductor (S)- normal metal (N) systems with a very low temperature STM with high energy resolution. We used the BCS-superconductor Al. We have measured the density of states (DOS) for different thicknesses of the N-layer and for different N-materials (Au, Ag and Pd). The DOS of the Pd samples show a strong suppression of the superconuctivity in comparison to the Au and Ag samples. A possible explanation for that could be the strong electron-spin fluctuation coupling in Pd [2]. Our experimental data were fitted with a theoretical model of Belzig et al. [1] to check the dependence of the DOS on the interface quality and on the coherence lengths in N and S.

[1] W. Belzig, C. Bruder and G. Schön, Phys. Rev. B 54, 9443 (1996)

[2] T. Konzos et al., Phys. Rev. Lett. 93, 137001 (2004)

TT 15.29 Tue 14:00 Poster B

Geometrical Confinement in Superconducting/Ferromagnetic Heterostructures — •Silvia Haindl[1], Tanya Shapoval[1], Thomas Thersleff[1], Jens Ingolf Mönch[2], Ludwig Schultz[1], and Bernhard Holzapfel[1] — [1]Institute for Metallic Materials, IFW Dresden, PF 270116, 01171 Dresden, Germany — [2]Institute for Integrative Nanosciences, IFW Dresden, PF 270116, 01171 Dresden, Germany

In superconducting thin films, geometrical confinement and thus microstructuring has a strong influence on the nucleation of superconductivity. Additionally, in superconducting/ferromagnetic thin films an influence on the superconducting properties is exerted by the magnetic stray field of the ferromagnet. Superconducting/ferromagnetic heterostructures were prepared by UHV pulsed laser deposition (PLD). Ferromagnetic dots with and without microstructuring were covered by a superconducting thin Nb film. In order to demonstrate the direct influence of the geometrical confinement, a recently developed polishing technique was employed to reduce the thickness of the superconducting layer.

TT 15.30 Tue 14:00 Poster B

Ferromagnet/superconductor heterostructures with different magnetic anisotropies — Niraj Joshi[1,2], Ajay Singh[3], •Christoph Sürgers[1,2], and Hilbert v. Löhneysen[1,2,4] — [1]Physikalisches Institut, Universität Karlsruhe, D-76128 Karlsruhe, Germany — [2]Center for Functional Nanostructures, Universität Karlsruhe, D-76128 Karlsruhe, Germany — [3]Bhabha Atomic Research Centre, Mumbai 400 085, India — [4]Forschungszentrum Karlsruhe, Institut für Festkörperphysik, D-76021 Karlsruhe

In order to explore the interplay between magnetism and superconductivity in ferromagnet (F) / superconductor (S) heterostructures we have investigated various systems with different magnetic anisotropies by measurements of the transition temperature T_c, upper critical field B_{c2}, critical current I_c, and anomalous Hall effect. In the case where F is a Co/Pt multilayer with strong magnetic out-of-plane anisotropy, the superconducting properties of FSF triple layers depend on the relative orientation of the two F layer magnetizations. In a second approach we have modified the magnetic properties of ferrimagnetic $Fe_{1-x}Gd_x$ films in FS bilayers and FSF triple layers by small variations of the concentration x around $x = 0.25$ where the individual magnetizations of the Fe and Gd sublattices are nearly compensated. Finally, we present first magnetization measurements of epitaxially grown Co/Cu multilayers on Nb(110) single crystals in the superconducting and normal state.

TT 15.31 Tue 14:00 Poster B

Andreev reflection measurements using amorphous WC superconducting contact — •Jose Barzola-Quiquia, Michael Ziese, and Pablo Esquinazi — Division of Superconductivity and Magnetism, University of Leipzig, Leipzig, Germany

In this contribution we present point-contact Andreev reflection measurements of Co/ and Cu/tungsten-carbide (WC) contacts. The patterning of the metallic thin films samples was done using e-beam lithography. The tungsten carbide (WC) superconductor tip was grown directly on the investigated sample by decomposition of a metallo-organic vapor (tungsten hexacarbonil) under a focused Ga ion beam (FIB). Measurements were performed in standard four-point configuration with and without applied magnetic field. The experimental conductance-voltage curves were analyzed with the Blonder-Tinkham-Klapwijk theory [Phys. Rev. B 25, 4515 (1982)]. The results highlight the possibilities and advantages of using amorphous WC tips for point-contact spectroscopy of mesoscopic metallic samples.

TT 15.32 Tue 14:00 Poster B

Tunneling transport properties in $(La,Sr)_2CuO_4$ grain boundary Josephson junctions — •Andreas Stöhr[1], Michael Wagenknecht[1], Dieter Koelle[1], Reinhold Kleiner[1], Gennady Logvenov[2], and Ivan Bozovic[2] — [1]Physikalisches Institut - Experimentalphysik II and Center for Collective Quantum Phenomena, Universität Tübingen, Auf der Morgenstelle 14, D-72076 Tübingen, Germany — [2]Brookhaven National Laboratory, Upton, NY, U.S.A.

We investigate tunneling transport properties in thin film grain boundary Josephson junctions (GBJ's) of epitaxially grown $(La,Sr)_2CuO_4$ (LSCO) on bicrystal substrates. These optimally doped LSCO films were made by molecular beam epitaxy producing a very smooth film at the grain boundary. Measurements of the critical current I_c at low magnetic fields B (mT range) are used to characterize the quality of the junctions. Deviations from the ideal $I_c(B)$ pattern enable us to indicate the homogeneity of the GBJ. Measurements of the differential conductance in high magnetic fields (T range) are used to investigate quasiparticle tunneling across the grain boundary. Results are compared to theoretical predictions.

TT 15.33 Tue 14:00 Poster B

Development of Josephson junctions with ferromagnetic barrier — •Dirk Sprungmann, Kurt Westerholt, and Hartmut Zabel — Ruhr-Universität Bochum Experimentalphysik IV, 44780 Bochum, Germany

π-coupled Josephson junctions with ferromagnetic interlayers enjoy an increasing interest in the spin electronic community since they are considered as candidates to be used for quantum bits. In order to investigate π-coupled Josephson junctions it is initially necessary to find a sample design which allows to produce reproducibly high quality Josephson junctions with a low or negligible sub-gap leakage. On our poster we present a sample design with a minimized number of process steps, which allows us to produce a complete sample within six hours. We describe the optimization of the different process steps in the preparation of the SIFS-type junctions, where I and F denote an Al_2O_3 and a ferromagnetic layer respectively.

We acknowledge financial support through SFB 491

TT 15.34 Tue 14:00 Poster B

Fraunhofer pattern of a S-F-S Josephson junction as a function of the magnetization orientation — •Franz Czeschka[1], Sebastian T.B. Goennenwein[1], Rudolf Gross[1], Ruurd S. Keizer[2], Teun M. Klapwijk[2], and Arunava Gupta[3] — [1]Walther-Meissner-Insitut, Garching, Germany — [2]Kavli Institute of NanoScience, Delft, The Netherlands — [3]MINT Center, Tuscaloosa, Alabama

In the last decade the interest in superconductor-ferromagnet hybrid structures has substantially increased due to their potential application in spintronics and quantum computation. Moreover the competing ordering phenomena in superconductors (S) and ferromagnets (F) lead to interesting physical effects.

We have fabricated S-F-S Josephson junctions made of the superconductor NbTiN and the ferromagnet CrO_2. With its high spin polarization and large ferromagnetic domains, CrO_2 is ideally suited for the investigation of magnetization orientation dependent effects in S-F-S Josephson junctions. We have investigated the dependence of the critical current on the magnitude and the orientation of the external magnetic field of $NbTiN/CrO_2/NbTiN$ lateral Josephson junctions, fabricated by e-beam lithography, sputtering and lift-off. We find a strongly hysteretic Fraunhofer pattern with an oscillation period which characteristically changes with the magnetization orientation. We interpret these results in terms of the total magnetic flux $B = \mu_0(H+M)$ in the structure.

Financial support of the German Excellence Initiative via the "Nanosystems Initiative Munich (NIM)" is gratefully acknowledged.

TT 15.35 Tue 14:00 Poster B

Critical current of Nb-$(Nb/Pd_{0.95}Fe_{0.05})$-Nb Josephson junctions — •O. Vávra, W. Meindl, and C. Strunk — Institut für

experimentelle und angewandte

The antagonism of superconductivity and magnetism is investigated by fabricating Nb based Josephson Junction with lateral weak links consisting of Nb-$Pd_{0.95}Fe_{0.05}$ bi-layers with lengths between 200 and 500 nm. The critical current (I_C) of the Nb-$Pd_{0.95}Fe_{0.05}$ bi-layer is found to be significantly reduced by the weak ferromagnetism in the $Pd_{0.95}eFe_{0.05}$ alloy. We have studied the temperature and magnetic field (B) dependencies of the critical current. In magnetic field an irregular supercurrent interference pattern $I_C(B)$ is observed. The shape of the $I_C(B)$ oscillations is similar to that observed for grain boundary junctions between cuprate superconductors. We also investigate the dependence of $I_C(B)$ oscillations on the orientation of the magnetic field.

TT 15.36 Tue 14:00 Poster B

Multi-terminal Josephson Junctions with Ferromagnetic Elements — •Martin Leib and Wolfgang Belzig — Fachbereich Physik, Universität Konstanz, D-78457 Konstanz

The interplay between magnetism and superconductivity in heterostructures has attracted considerable interest since the discovery of the 0-π transition in superconductor-ferromagnet (SF) contacts. Here we investigate the supercurrent in systems of multiple tunnel junctions in the framework of the quantum circuit theory. The considered network consists of two superconducting and two ferromagnetic reservoirs with non-collinear magnetization direction connected by tunnel contacts to a normal metal. We find and interesting interplay between the superconducting phase difference and the relative magnetization angle, which manifests itself in the current phase relation and the critical current.

TT 15.37 Tue 14:00 Poster B

SQUID readout of the magnetic flux states of fractional Josephson vortices. — •Andreas Dewes, Dieter Kölle, Reinhold Kleiner, and Edward Goldobin — Physikalisches Institut-Experimentalphysik II and Center for Collective Quantum Phenomena, Universität Tübingen

We present an experimental study of a direct SQUID readout of the various states of a fractional vortex molecule in a long 0-κ-0 or 0-κ-2κ Josephson junction[1]. The fractional vortices appear at the discontinuities of the Josephson phase that are created by using tiny pairs of current injectors[2,3]. The magnetic field of each vortex is coupled to an integrated DC SQUID placed in front of it. In experiment, we measure the magnetic flux Φ in the SQUID loop as a function of the bias current of the junction I, of the injector current $I_{\rm inj}$ and of the magnetic field H. By changing the bias current of the junction or by modifying the discontinuity $\kappa \propto I_{\rm inj}$ we can induce and observe transitions between all four states of the fractional vortex molecule ($\uparrow\uparrow$, $\downarrow\uparrow$, $\uparrow\downarrow$ and $\downarrow\downarrow$). The readout system is intended to be part of a prospective fractional vortex qubit[4].

[1] E. Goldobin et. al., *Phys. Rev. B* **70**, 174519 (2004).
[2] B. A. Malomed et. al., *Phys. Rev. B* **69**, 064502 (2004).
[3] E. Goldobin et. al., *Phys. Rev. Lett.* **92**, 057005 (2004).
[4] E. Golodbin et. al., *Phys. Rev. B* **72**, 054527 (2005).

TT 15.38 Tue 14:00 Poster B

Spectroscopy of the eigenfrequencies of a fractional Josephson vortex molecule — •Uta Kienzle[1], Tobias Gaber[1], Kai Buckenmaier[1], Konstantin Ilin[2], Michael Siegel[2], Dieter Koelle[1], Reinhold Kleiner[1], and Edward Goldobin[1] — [1]Physikalisches Institut - Experimentalphysik II and Center for Collective Quantum Phenomena, Universität Tübingen — [2]Institut für Mikro- und Nanoelektronische Systeme, Universität Karlsruhe (TH)

Using a pair of tiny current injectors one can create an arbitrary κ discontinuity of the phase in a long Josephson junction (LJJ) [1]. To compensate this discontinuity a κ vortex spontaneously appears [2]. This vortex carries an arbitrary fraction $\propto\kappa$ of the magnetic flux quantum Φ_0 and is a generalization of a semifluxon observed in 0-π LJJs [3]. Such a vortex is pinned at the discontinuity point, but in an underdamped system it is able to oscillate around its equilibrium position with an eigenfrequency [4,5]. In annular LJJs with two injector pairs two coupled κ vortices, forming a molecule, can be studied.

The dependence of the eigenfrequency on temperature and κ of one and two coupled vortices was measured in the range from 300 mK up to 4.2 K. We discuss the results and compare them with simulations based on the perturbed sine-Gordon equation.

[1] E. Goldobin *et al.*, Phys. Rev. Lett. **92**, 57005 (2004)
[2] E. Goldobin *et al.*, Phys. Rev. B **70**, 174519 (2004)
[3] H. Hilgenkamp *et al.*, Nature **422**, 50 (2003)
[4] E. Goldobin *et al.*, Phys. Rev. B **71**, 104518 (2005)
[5] K. Buckenmaier *et al.*, Phys. Rev. Lett. **98**, 117006 (2007)

TT 15.39 Tue 14:00 Poster B

Two dimensional planar superconducting quantum interference device gradiometer on a $SrTiO_3$ bicrystal — •Uwe Schinkel, Christoph Becker, Veit Grosse, Alexander Steppke, Frank Schmidl, and Paul Seidel — Institut für Festkörperphysik, Friedrich Schiller Universität Jena, Germany

Superconducting sensors are state of the art for the measurement of small magnetic signals. Gradiometers with DC SQUID sensors can be used in magnetically unshielded areas, due to the high surpression of homogeneous magnetic fields. 2nd order gradiometers achieve an even higher reduction of external noise.

We show a new gradiometer layout based on YBCO thin films to detect the second order field gradient. In a planar configuration four galvanically coupled antenna structures are read out by a symmetric DC SQUID with four Josephson junctions on $SrTiO_3$ bicrystals. Simulations, the preparation process and first electric measurements are presented.

TT 15.40 Tue 14:00 Poster B

Planar flip-chip HTSC DC-SQUID gradiometers for non-destructive evaluations — •Christoph Becker[1], Alexander Steppke[1], Uwe Schinkel[1], Markus Buettner[1], Veit Grosse[1], Hendrik Schneidewind[2], Frank Schmidl[1], and Paul Seidel[1] — [1]Friedrich-Schiller-Universität Jena, Germany — [2]Institut für Photonische Technologien e.V., Jena, Germany

For the detection of small magnetic signals, for example in applications like non-destructive evaluation DC-SQUID gradiometers are successfully used today. The low noise level of our sensors and the possibility of working in unshielded environments cannot be achieved with convential methods. The sensors made out of high-temperature superconducting thin film gradiometers are inductively coupled to a flux-transformer in a flip-chip configuration.

The field gradient resolution of the complete system is below $1\,\mathrm{pT}/(\sqrt{\mathrm{Hz}}\,\mathrm{cm})$. In our investigations we focused on the spatial resolution of the sensors. Different approaches to characterize the resolution and methods to improve the signal to noise ratio for small magnetic sources are shown.

TT 15.41 Tue 14:00 Poster B

Different transport mechanisms across semiconductor junctions — •Barbara Sandow[1], Dirk Brossell[1], and Walter Schirmacher[2] — [1]Institut für Experimentalphysik, Freie Universität Berlin, Germany — [2]Physik-Department E13, Technische Universität München, Germany

We used break-junction tunnelling spectroscopy to investigate the Coulomb correlation in n-type Germanium. The Charge transport across break-junctions of n-type Germanium has been investigated. The low-T spectra of our Ge break junctions vary systematically with contact size. However, it is not always clear what kind of processes dominate the spectra of those contacts. We show how to identify and separate the different transport mechanisms across the junctions, necessary to derive the Density of states.

TT 15.42 Tue 14:00 Poster B

Fine structure in the tunneling characteristic of MgB_2 thin films — •Rudolf Schneider[1], Jochen Geerk[1], Alexander Zaitsev[1], and Hilbert von Löhneysen[1,2] — [1]Forschungszentrum Karlsruhe, Institut für Festkörperphysik, 76021 Karlsruhe — [2]Physikalisches Institut, Universität Karlsruhe, 76128 Karlsruhe

We report on a progress in the *in situ* preparation of superconducting MgB_2 thin films by thermal evaporation of Mg combined with B sputtering. By sputtering the boron from a red-hot sintered target we were able to increase the substrate temperature up to 550°C. The film properties, like T_c and the residual resistivity, significantly improved compared to films deposited at lower substrate temperatures. In the negative second derivative of the current-voltage characteristic measured on sandwich-type crossed-strip tunnel junctions on MgB_2 films with a T_c of 35 K, theoretically predicted fine structures could be resolved which were missing in our former tunnelling experiments using films with a lower T_c of 32 K. Better crystalline order within the MgB_2 grains is evidently the key to the details of the electron-phonon

coupling.

TT 15.43 Tue 14:00 Poster B

Effect of a dc magnetic field on the microwave losses in MgB_2 thin films — •Roland Hott[1], Alexander G. Zaitsev[1], Rudolf Schneider[1], Thorsten Schwarz[2], and Jochen Geerk[1] — [1]Forschungszentrum Karlsruhe, Institut für Festkörperphysik, P.O. Box 3640, D-76021 Karlsruhe, Germany — [2]Forschungszentrum Karlsruhe, Institut für Synchrotronstrahlung, P.O. Box 3640, D-76021 Karlsruhe, Germany

The microwave surface impedance ($Z_s = R_s + iX_s$) of in situ MgB_2 thin films was measured as a function of temperature and parallel dc magnetic field at several frequencies between 5.7 and 18.5 GHz using a dielectric resonator technique. The results are consistent with the expectations for a classical type-II superconductor and, consequently, quite different from those of the high-T_c cuprates. The films cooled in zero field revealed a clear indication of the lower critical field B_{c1}, with a small hysteresis around $B \leq B_{c1}$. In higher fields ($B > B_{c1}$), the losses followed the Coffey-Clem and Brandt model, including the frequency dependences, whereas high-T_c Y-Ba-Cu-O films did not show a reasonable agreement with this model. Both the relatively high values of $\Delta X_s/\Delta R_s$ ratio and their frequency dependence indicate a weak effect of flux creep on the measured microwave loss in MgB_2 films. The temperature dependence of $\Delta X_s/\Delta R_s$ ratio can be described by a microscopic pinning model for BCS superconductors.

TT 15.44 Tue 14:00 Poster B

Static and time-resolved vortex dynamics in a-$Nb_{0.7}Ge_{0.3}$ — •Florian Otto[1], Martin Frisch[1], Ante Bilušić[1], Dinko Babić[2], Christoph Sürgers[3], and Christian Strunk[1] — [1]Inst. for Exp. and Appl. Physics, Univ. Regensburg, Germany — [2]Dept. Physics, Univ. Zagreb, Croatia — [3]Phys. Inst. and DFG Center for Funct. Nanostr. (CFN), Univ. Karlsruhe, Germany

We investigate the motion of vortices in amorphous $Nb_{0.7}Ge_{0.3}$. Because of the very low pinning in this high-κ type-II superconductor, we are able to measure local and non-local transport in the flux-flow regime over large parts of the B-T-phase diagram [1]. Interestingly, there is a finite non-local response close to T_c, even when the applied magnetic field is zero. This points towards the presence of spontaneously formed vortex-antivortex pairs above the Berezinskii-Kosterlitz-Thouless transition. In addition, we report first non-local transport measurements in the time domain, using a boxcar averaging technique.

[1] A.Helzel et al., Phys. Rev. B **74**, 220510 (R) (2006)

TT 15.45 Tue 14:00 Poster B

Unexpected temperature-dependence of the critical current in NbN-microbridges — •Andreas Engel[1], Holger Bartolf[1], Luis Gomez[1], Andreas Schilling[1], Konstantin Il'in[2], Michael Siegel[2], Alexei Semenov[3], and Heinz-Wilhelm Hübers[3] — [1]Physics Institute, University of Zürich, Winterthurerstr. 190, CH-8057 Zürich — [2]Institute of Micro- and Nano-Electronic Systems, University of Karlsruhe, Hertzstr. 16, 76187 Karlsruhe — [3]DLR e.V. Institute of Planetary Research, Rutherfordstr. 2, 12489 Berlin

Superconducting micro- and nanostructures made from NbN ultra-thin films are key elements of THz hot-electron bolometer mixers and single-photon detectors for the visible and near-infrared. Their detection mechanisms require operation with a biasing current close to but below the device's critical current I_c at temperatures well below their critical temperature. We studied the temperature-dependence $I_c(T)$ of up to 10 nm thick NbN bridges with widths between 100 nm and 10 μm. The temperature-dependence of the critical-current density j_c of sub-micrometer wide bridges is well described by the de-pairing j_c. They remain free of magnetic vortices due to a geometrically enhanced Bean-Livingston barrier. Micrometer-wide bridges show a cross-over from de-pairing to de-pinning j_c with decreasing temperature. Moreover, at low temperatures, when I_c is determined by the de-pinning of magnetic vortices due to the self-field of the applied current or small external magnetic fields, $I_c(T)$ may exhibit non-monotonic behavior, *i.e.* reduced I_c at lower temperature. We present experimental data of these unexpected features and discuss their possible reasons.

TT 15.46 Tue 14:00 Poster B

Flux dynamics in HT-superconductor thin films influenced by a surface acoustic wave — •Munise Rakel[1], Arno Wirsig[1], Carsten Hucho[1], and Joachim Albrecht[2] — [1]Paul-Drude-Institut, 10117 Berlin, Germany — [2]Max-Planck-Institut für Metallforschung, 70569 Stuttgart, Germany

We report on magneto-optic investigations of the influence of a traveling strain wave on the magnetic flux density distribution in a type-II superconductor. The investigations are performed on a thin film of YBCO on a piezoelectric substrate using a custom-made magneto-optical microscope. The strain wave is generated by interdigital transducers on the piezoelectric substrate. An external magnetic field applied perpendicular to the surface enters the polycrystalline superconductor depending on the pinning properties. Strain-wave induced pinning-changes or SAW-induced depinning is reported to result in changes in the flux dynamics. We analyze magneto-optic greyscale images of films with dynamically altered pin-state to yield information on the influence of the combined dynamic strain- and electric field on the pinning behavior of the superconducting film.

TT 15.47 Tue 14:00 Poster B

Reconstruction of the electric field distributions for flux dynamics studies in superconducting thin films — •Carolina Romero-Salazar[1], Omar Augusto-Flores[2], and Christian Jooss[1] — [1]Institut fuer Materialphysik, Friedrich Hund Platz 1, 37077 Goettingen, Germany — [2]Instituto de Fisica, Universidad Autonoma de Puebla, Apdo. Post. J-48, Puebla, Mexico

It is well known that in type-II superconductors there are electric fields due to vortex motion. The space-resolved study allows for insights into the mechanism of vortex dynamics and the occurrence of local losses. This is an important and challenging problem for the development of high-current carrying applications with low electromagnetic losses. The electric field in high- T_c superconducting films is reconstructed employing magneto-optical imaging of the magnetic induction $B_z(r)$ distributions. We developed a consistent method to calculate both dynamic and static contributions of the electric field, for a thin film in the so called perpendicular geometry. We investigate the contrasts between our technique, which employs magnetic relaxation measurements, and the theoretical scheme which requires an effective material law, $E = \rho J$, obtained from current transport experiments. Understanding the vortex dynamics in homogeneous superconducting films, provides a necessary background to study materials with complicate structures as patterned holes or inhomogeneous pinning.

TT 15.48 Tue 14:00 Poster B

Nernst effect of Ni-doped $NdBa_2Cu_3O_{7-\delta}$ — •Niko Johannsen[1], Thomas Wolf[2], Alexander V. Sologubenko[1], Thomas Lorenz[1], Axel Freimuth[1], and John A. Mydosh[1] — [1]II. Physikalisches Institut, University of Cologne, Germany — [2]Forschungszentrum Karlsruhe, Germany

The mechanism of high-temperature superconductivity is still unsolved. Possible relations to other phenomena such as the pseudogap may play a key role towards an understanding of this mechanism. Using the Nernst effect, we are able to detect vortex-like excitations very sensitively. In $NdBa_2\{Cu_{1-y}Ni_y\}_3O_{7-\delta}$, magnetic Ni-impurities suppress T_c and at the same time enhance the pseudogap. So, this is an ideal system to study possible relations between the pseudogap and superconductivity via the Nernst effect. We present measurements on a series of optimally doped (O_7) and two underdoped ($O_{6.8}$, $O_{6.9}$) samples with Ni contents ranging from y=0 to 0.12. For the optimally doped samples, the onset temperature of the anomalous Nernst signal (T^ν) decreases with increasing Ni content as does T_c. The underdoped ($O_{6.8}$) samples show a slightly different behavior. T^ν is not affected by an increase of the Ni content. The slope of T^ν of the intermediate doping level ($O_{6.9}$) lies between the aforementioned two. None of the detected anomalous vortex Nernst signals shows a relation to the enhanced pseudogap in this system.

TT 15.49 Tue 14:00 Poster B

Proximity Effect in Nb/Au and NbN/Au bi-layers for THz Antenna Structures of HEB Mixers — •Axel Stockhausen[1], Konstantin Il'in[1], Michael Siegel[1], Alexei Semenov[2], Heinz-Wilhelm Hübers[2], Reinhard Schneider[3], and Dagmar Gerthsen[3] — [1]IMS, University of Karlsruhe, Karlsruhe, Germany — [2]DLR e.V. Institute of Planetary Research, Berlin, Germany — [3]LEM, University of Karlsruhe, Karlsruhe, Germany

Hot-electron Bolometer (HEB) mixers are high sensitive heterodyne detectors made from ultra-thin (< 5 nm) NbN film deposited on Si substrate. For proper operation of these devices in THz frequency range a superconducting detecting element is embedded into antenna

structure made from thick Au layer. In systems where a superconducting film with thickness about the coherence length is in contact with a thick normal metal layer superconductivity will be suppressed due to proximity effect. Increasing transparency of superconducting-to-normal metal interface leads to stronger suppression of superconductivity in ultra-thin NbN film. However it allows to decrease RF losses on contact resistance between antenna and detecting element and improve performance of HEB mixer. We have developed processes for deposition of Au antenna structure with superconducting buffer of Nb or NbN. This allows us to avoid deterioration of HEB mixer performance causing by proximity effect even in case of perfectly transparent interface. The superconducting and normal state properties of different Nb and NbN thin films and Nb/Au and NbN/Au bi- and multi-layers will be presented and properties of the interfaces will be discussed.

TT 15.50 Tue 14:00 Poster B

Kinetic Inductance Detectors Based On Quarter Wavelength Resonators — •Gerd Hammer, Stefan Wünsch, Konstantin Ilin, and Michael Siegel — Institut für Mikro- und Nanoelektronische Systeme, Universität Karlsruhe (TH), Karlsruhe, Deutschland

Quarter wavelength resonators with high-Q values as core part of a complete readout system for kinetic inductance detectors opens the possibility of a extremely sensitive measurement method for radiation in a wide spectral range. Absorbted radiation causes a change of quasiparticle density and subsequently to a change of kinetic inductance of the resonator. This results in a detuning of the cavity circuit which can be detected by measurement of amplitude or phase. Superconducting thin-film niobium resonators with different geometries in coplanar waveguide topology for 6 GHz were developed, fabricated and measured. Simulation and measurement results of the quality factors Q_R show strong influences of the coupling capacitances and has to be optimized. Measurements at cryogenic temperatures with quality factors Q_R in the range of $10^5 - 10^6$ were achieved in a temperature range of 4 K to 8 K.

TT 15.51 Tue 14:00 Poster B

Response of NbN ultra-thin superconducting films to optical irradiation — •Dagmar Rall[1,3], Konstantin Ilin[2], Stefan Wünsch[2], Felix Glöckler[1], Uli Lemmer[1], and Michael Siegel[2] — [1]Light Technology Institute, University of Karlsruhe, Germany — [2]Institute for Micro- and Nanoelectronic Systems, University of Karlsruhe, Germany — [3]Karlsruhe School of Optics and Photonics, Germany

We study energy relaxation processes in ultra-thin NbN films suitable for development of hot-electron bolometers and superconducting single photon detectors. Improvements of device performance require optimization of material properties of NbN films focussing on increasing of sensitivity and speed of the detector. The NbN thin films with different thickness and stoichiometry are fabricated by dc reactive magnetron sputtering and patterned into narrow strip lines and terminated by the detecting element. Energy relaxation processes in the films are studied using a time domain technique. NbN strips are cooled below critical temperature in a continuous-flow helium cryostat fitted with high-frequency readout electronics and optical window. Femtosecond laser pulse irradiation absorbed in ultra-thin NbN film excites hot-electrons resulting in a voltage pulse. Time propagation of the response pulse is determined by electron energy relaxation processes via inelastic electron-electron and electron-phonon interaction and escape of non-equilibrium phonons from film to substrate. Results on fs-laser pulse response of NbN thin films with different material properties and geometry of the sample will be presented and discussed.

TT 15.52 Tue 14:00 Poster B

Microfabrication of magnetic calorimeters — •Stefan Lausberg, Andreas Pabinger, Andreas Burck, Christian Domesle, Christan Höhn, Sebastian Kempf, Lena Maerten, Christian Pies, Jan-Patrick Porst, Sönke Schäfer, Richard Weldle, Thomas Wolf, Loredana Fleischmann, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, INF 227, D-69120 Heidelberg, Germany

Metallic magnetic calorimeters (MMCs) detect the energy of particles by measuring the heat input into a metallic absorber that is thermally well connected to a paramagnetic Au:Er sensor. The sensor is situated in a weak magnetic field. An incident particle deposits energy inside the absorber and heats up the sensor which results in a change of magnetization. This change is proportional to the particle energy and is read out by a SQUID magnetometer. For large area MMCs, the magnetic field is generated by a microstructured meander shaped niobium coil. A persistent current can be frozen in this structure producing an inhomogeneous field in the region of the sensor, which is directly sputtered on top. Both the sputtering of Au:Er sensors with thermodynamical properties that agree with the ones of bulk material as well as the deposition of niobium films with high critical currents are crucial process steps for the microfabrication of MMC detectors with high resolution power. We give a detailed description of the two processes that we presently use for microfabrication of MMC detectors and discuss the achieved results.

TT 15.53 Tue 14:00 Poster B

Development of a Fully Microfabricated Two Pixel Magnetic Calorimeter — •S. Schäfer, A. Burck, C. Domesle, C. Höhn, S. Kempf, S. Lausberg, A. Pabinger, C. Pies, J.-P. Porst, R. Weldle, A. Fleischmann, L. Fleischmann, and C. Enss — Kirchhoff-Institut für Physik, Im Neuenheimer Feld 227, 69120 Heidelberg

The feasibility to microfabricate single metallic magnetic calorimeter detectors and detector arrays has been studied. These detectors consist of an absorber for x-rays and a paramagnetic temperature sensor placed in a weak magnetic field. At working temperatures below 100 mK any energy deposition in the detector produces a temperature rise which changes the magnetization of the sensor material. By a read out scheme with sensitive low noise SQUID magnetometers, the absorption of single x-ray quanta can be detected and their energy can be measured precisely. The steps of a microfabrication process were developed and optimized which allows for a fabrication of calorimeter arrays with mushroom shaped detectors increasing the sensible area by overhanging absorbers. On a single chip, two detectors were fabricated and read out by two separate circuits. Due to this special setup, it was possible to analyze the crosstalk between both pixels. In addition to measurements in the flux-locked-loop mode, magnetization measurements and spectra were obtained in open-loop mode. In this mode of operation electro-thermal-feedback effects were observed which result in changing the decay times of the pulses. In particular, in this mode faster pulses can be achieved which allows higher count rates.

TT 15.54 Tue 14:00 Poster B

Metallic magnetic calorimeters with superconducting absorbers — •Christian Höhn, Richard Weldle, Jan-Patrick Porst, Andreas Burck, Chriatian Domesle, Sebastian Kempf, Stefan Lausberg, Lena Maerten, Andreas Pabinger, Christian Pies, Sönke Schäfer, Loredana Fleischmann, Andreas Fleischmann, and Christian Enss — KIP, Universität Heidelberg, INF 227, D-69120 Heidelberg, Germany

In metallic magnetic calorimeters (MMCs) the absorbed energy of incoming particles, e.g. X-rays, causes an increase of temperature in the detector which leads to a change of magnetisation in the Au:Er paramagnetic sensor. The resulting change in magnetic flux can be measured with a SQUID-magnetometer. As the flux change depends on the change of temperature which is inversely proportional to the heat capacity, it is attractive to use a superconducting absorber material. The first experiment presented here consists of a rhenium crystal as absorber with a gold foil glued on top that partly covers the surface of the absorber. The different pulse shapes that occur due to X-rays, either hitting directly the rhenium, therefore causing Cooper pairs to break, or the gold, producing a heat signal only phononically coupled to the rhenium, are presented. One idea to reduce the long rise time that occurs when superconductors are used as absorbers is to include magnetic impurities. These impurities reduce the energy gap of the superconductor which may lead to a faster quasiparticle recombination. The results obtained with MMCs having pure Al and Al:Mn absorbers are presented and the differences in pulse shape will be discussed.

TT 15.55 Tue 14:00 Poster B

Electrodeposition of gold absorbers for metallic magnetic calorimeters — •Christian Pies, Stefan Lausberg, Andreas Burck, Christian Domesle, Christian Höhn, Sebastian Kempf, Lena Maerten, Andreas Pabinger, Jan-Patrick Porst, Sönke Schäfer, Richard Weldle, Thomas Wolf, Andreas Fleischmann, Loredana Fleischmann, and Christian Enss — Kirchhoff-Institut für Physik, Im Neuenheimer Feld 227, D-69120 Heidelberg, Germany

Metallic magnetic calorimeters are increasingly used for particle detection. A metallic paramagnetic sensor is situated in a weak magnetic field. Incident particles, like x-rays, dissipate their energy inside a gold absorber which is thermally well connected to the sensor. The temperature rise in the absorber causes a rearrangement of magnetic

moments in the sensor. This change in magnetization is read out by a two-stage SQUID setup.

In order to stop x-rays in the energy range of more than 100 keV, gold absorbers of several hundred microns in thickness are needed. Techniques like sputtering or vapor deposition can effectively produce films of no more than a few microns. Therefore an electrodeposition process was developed to fabricate thick gold layers with high purity and better residual resistivity ratio than sputtered or evaporated films. We use sulfite based gold electrolytes which can produce films of more than 200 microns. In order to control the geometry of the electrodeposited absorbers, we use the SU-8 negative photoresist, which can be structured up to 1 mm in thickness with a high aspect ratio.

TT 15.56 Tue 14:00 Poster B

Microstructured metallic magnetic calorimeter with meander shaped pickup coil — •Sebastian Kempf, Andreas Burck, Christian Domesle, Christian Höhn, Stefan Lausberg, Lena Maerten, Andreas Pabinger, Christian Pies, Jan-Patrick Porst, Sönke Schäfer, Richard Weldle, Thomas Wolf, Andreas Fleischmann, Loredana Fleischmann, and Christian Enss — Kirchoff-Institute for Physics, Heidelberg, Germany

It was recently shown that metallic magnetic calorimeters (MMC) are a promising and powerful tool for many applications. A MMC consists of an absorber for the particles to be detected and a paramagnetic temperature sensor positioned in a weak magnetic field. According to the calorimetric detection principle, the deposition of energy in the detector due to the impact of a massive particle or the absorption of an x-ray photon causes a rise of temperature and results in a change of magnetization of the sensor. This is detected as a change of magnetic flux in a low-noise high-bandwidth dc-SQUID magnetometer and serves as a precise measure of the deposited energy.
We present a fully microstructured MMC which consists of a gold absorber, a 3 μm thick sputter-deposited paramagnetic Au:Er-sensor and a meander shaped niobium thin film pickup coil. By means of temperature dependent measurements of magnetization and detector signal size we will compare the thermodynamic properties of the sputtered sensor material to the properties of bulk material. We discuss the achieved energy resolution, the noise of the detector signal and the shape of the detector response as a function of temperature and magnetic field.

TT 15.57 Tue 14:00 Poster B

Silber-Erbium-Legierungen: Neues Sensormaterial für magnetische Kalorimeter — •A. Burck, S. Kempf, C. Domesle, C. Höhn, S. Lausberg, L. Maerten, A. Pabinger, C. Pies, J. Porst, S. Schäfer, R. Weldle, T. Wolf, A. Fleischmann, L. Fleischmann und C. Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, INF 227, Heidelberg, Germany

In den meisten der bisher entwickelten magnetischen Kalorimeter wurden paramagnetische Legierungen von Gold und dem Seltenerdmetall Erbium als Temperatursensor eingesetzt. Diese Legierungen stellten einen ausgewogenen Kompromiss zwischen einer schnellen Thermalisierungszeit und einer grossen Signalgrösse dar. Das relativ grosse Kernquadrupolmoment von Gold führt jedoch zusammen mit den elektrischen Feldgradienten in der Umgebung der Erbium-Ionen zu einem nicht vernachlässigbaren Beitrag zur Wärmekapazität, der eine Reduzierung der Signalgrösse zur Folge hat. Dieser ungewollte Beitrag lässt sich eliminieren, indem ein Wirtsmaterial verwendet wird, dessen Kernspin $I \leq 1/2$ ist. Demnach sollte sich Silber ($I = 1/2$) besser als Wirtsmaterial der verdünnten paramagnetischen Legierungen eignen. Wir stellen ein mikrostrukturiertes magnetisches Kalorimeter vor, welches auf einer mäanderförmigen Detektionsspule basiert auf der ein 5um dicker Sensor aus AgEr aufgebracht ist, der eine Erbiumkonzentration von 1300 ppm besitzt. Die Temperatur- und Feldabhängigkeit der Magnetisierung des Sensormaterials, das Rauschen des Detektorsignals, die auftretenden Signalformen, wie auch die Energieauflösung des Detektors werden diskutiert.