TT 5: Postersession Superconductivity: Materials - Fabrication and Properties

Time: Monday 13:00–16:45 Location: P1A

TT 5.1 Mon 13:00 P1A

Superconductivity in Ga-doped Germanium — •R. Skrotzki[1], T. Herrmannsdörfer[1], V. Heera[2], O. Ignatchik[1], M. Uhlarz[1], A. Mücklich[2], M. Posselt[2], H. Reuther[2], B. Schmidt[2], K.-H. Heinig[2], W. Skorupa[2], M. Voelskow[2], C. Wündisch[2], and J. Wosnitza[1] — [1]Hochfeld-Magnetlabor Dresden, Forschungszentrum Dresden-Rossendorf (FZD) — [2]Institut für Ionenstrahlphyik und Materialforschung, FZD

We report the first observation of superconductivity in heavily p-type doped germanium at ambient pressure conditions. Using Ga as dopant, we have produced a series of Ge:Ga samples by ion-beam implantation and subsequent short-term (msec) flash-lamp annealing. The combination of these techniques allows for Ga concentrations up to 6%, i.e., a doping level which is clearly larger than the solubility limit and not accessible to any other method so far. Transport measurements reveal superconducting transitions with T_c up to 0.5 K. In more detail, we observe a strong dependence of the superconducting critical parameters on the annealing conditions. Further, we find a strong anisotropy of the superconducting critical field reflecting the two-dimensional character of the superconducting state in the thin Ge:Ga layer having an effective depth of only 60 nm. We find critical magnetic in-plane fields even larger than the Pauli-Clogston limit. After its finding in Si [1] and diamond [2], our work reports another unexpected obervation of superconductivity in doped elemental semiconductors.

[1] E. Bustarret et al., Nature 444, 465 (2006).
[2] E. A. Ekimov et al., Nature 428, 542 (2004).

TT 5.2 Mon 13:00 P1A

Superconducting properties of boron-doped diamond — •M. Uhlarz[1], R. Skrotzki[1], T. Papageorgiou[1], J. Wosnitza[1,2], N. Dubrovinskaia[3,4], L. Dubrovinsky[5], N. Miyajima[5], A. Bosak[6], M. Krisch[6], H.F. Braun[7], and R. Wirth[8] — [1]Hochfeld-Magnetlabor Dresden, Forschungszentrum Dresden-Rossendorf — [2]Institut für Festkörperphysik, TU Dresden — [3]Institut für Geowissenschaften, Universität Heidelberg — [4]Lehrstuhl für Kristallographie, Physikalisches Institut, Universität Bayreuth — [5]Bayerisches Geoinstitut, Universität Bayreuth — [6]European Synchrotron Radiation Facility, Grenoble — [7]Physikalisches Institut, Universität Bayreuth — [8]GeoForschungsZentrum Potsdam

The question of the nature of superconductivity in boron-doped diamond (synthesized at high pressures and high temperatures) is still open. Here we present consistent measurements of resistivity and specific-heat on two samples containing pure ^{13}C and ^{12}C, revealing a 0.2 K shift of the superconducting transition temperature T_c. Hall-coefficient measurements confirm equal charge-carrier concentrations in both samples. The results are interpreted as a carbon-isotope effect more than two times larger than expected from the most simple BCS model for phonon-mediated superconductivity. Additional analyses of microstructure and exact boron content of the superconducting material show the presence of highly boron-enriched amorphous boundaries between the grains. For these investigations high-resolution transmission-electron microscopy and electron-energy-loss spectroscopy were used.

TT 5.3 Mon 13:00 P1A

Substitution and pressure effect on superconducting properties of $Na_{1-x}Ca_xAlSi$ — •Andreea Beleanu[1], Vadim Ksenofontov[1], Claudia Felser[1], and Petre Badica[2] — [1]Institute of Inorganic and Analytical Chemistry, Johannes Gutenberg - University, 55099 Mainz — [2]Institute of Physics Johannes Gutenberg - University, 55099 Mainz

This work reports on the substitution of Na^+ with Ca^{2+} in the ternary alkali-metal silicide superconductor NaAlSi. The superconducting transition of NaAlSi takes place at a critical temperature T_c of 7 K. The superconducting properties of CaAlSi were reported to the distortion of the AlSi-layers. The Si bonding network thus plays an important role for the superconducting characteristics[1]. CaAlSi shows a superconducting transition at a T_c of 8.0 K [2]. Na^+ and Ca^{2+} cations have equal ionic radii but Ca provides an additional electron. The observation of the superconducting properties in dependence of electron-doping of $Na_{1-x}Ca_xAlSi$ is shown. The superconducting properties of $Na_{1-x}Ca_xAlSi$ were measured using SQUID magnetometry.

[1] S. Kuroiwa, H. Kawashima, H. Kinoshita, H. Okabe, J. Akimitsu, Physica C, 466, 11 (2007).
[2] M. Imai, K. Nishida, T. Kimura, H. Kitazawa, H. Abe, H. Kito, K. Yoshii, arXiv:cond-mat/0210692v1,(2002)

TT 5.4 Mon 13:00 P1A

Superconducting Properties of Niobium Thin Films grown by Pulsed Laser Deposition — Christian Pansow[1], •Veit Grosse[1], Alexander Steppke[2], Frank Schmidl[1], and Paul Seidel[1] — [1]Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena, Helmholtzweg 5, 07743 Jena — [2]MPI für chemische Physik fester Stoffe, Nöthnitzer Straße 40, 01187 Dresden

Niobium (Nb) as the element showing the highest critical temperature is the most commonly used material for superconducting applications. High quality thin films can be fabricated utilising electron beam evaporation or sputtering. However, special demands on the device fabrication process may favour other deposition techniques. Note, for example, the possibility for an *in situ* growth of multilayer systems, the realisation of new Josephson Junction concepts utilising carbon nanotubes or improving film quality by increasing ionisation of the evaporated material. In this framework pulsed laser deposition is a versatile technique to meet these demands.

Here we report on the superconducting properties of niobium thin films grown by pulsed laser deposition at room temperature. Depending on film thickness we achieved a critical temperature of 8.4 K and a critical current density of $3.0 \cdot 10^6$ A/cm^2 at 4.2 K. We compare the temperature dependence of the critical current and critical magnetic field with that of electron evaporated niobium films. Our samples showed a distinct ageing behaviour during several cooling cycles which can be attributed to oxygen diffusion into the fine grained structure of the films.

TT 5.5 Mon 13:00 P1A

Tunneling into Al doped MgB_2 thin films — •Rudolf Schneider, Alexander G. Zaitsev, and Jochen Geerk — Forschungszentrum Karlsruhe, Institut für Festkörperphysik, 76021 Karlsruhe

Superconducting thin films with composition $Mg_{1-x}Al_xB_2$ ($0 \leq x < 0.6$) were prepared *insitu* by thermal sublimation of Mg combined with B rf and Al dc magnetron sputtering. The critical temperature, T_c, decreased linearly with a slope of -0.4 K per at% Al up to $x \approx 0.4$. For $0.4 < x < 0.5$ the formation of a plateau with a $T_c \approx 12$ K was observed. The plateau-like effect might be due to the formation of the superstructure $MgAlB_4$ with ordered alternating Mg and Al planes separated by B planes. Quasiparticle tunneling measurements were performed on sandwich-type crossed-strip tunnel junctions with artificial aluminum oxide barriers. Differential conductance measurements at low voltage allowed the determination of the small energy gap on the Fermi surface π sheet. The π gap decreased linearly with decreasing T_c of the films in agreement with a band filling model. Conductance measurements in the phonon region enabled the determination of the Eliashberg function α^2F for a low doping level $x \approx 0.1$ so far. Compared to the undoped MgB_2 a shift of the spectrum to higher energy was observed comparable to the renormalization of the phonon density of states measured on bulk samples with inelastic neutron scattering.

TT 5.6 Mon 13:00 P1A

Carbon Doping as an Effective Way to Enhance the Superconducting Properties of Mechanically alloyed in-situ MgB_2 — •Marko Herrmann[1], Wolfgang Hässler[1], Juliane Scheiter[1], Christian Rodig[1], Margitta Schubert[1], Ania Kario[1], Christine Mickel[1], Nadezda Kozlova[1], Konstantin Nenkov[1], Manfred Ritschel[1], Wolfgang Gruner[1], Ludwig Schultz[1,2], and Bernhard Holzapfel[1,2] — [1]Leibniz Institute for Solid State and Materials Research (IFW) Dresden, P.O.Box 270116, 01171 Dresden, Germany — [2]Dresden University of Technology, Department of Physics, 01062 Dresden, Germany

Up to now, carbon doping is the only reliable way to enhance the superconducting properties of Mg_2 significantly. Due to the substitution of carbon on boron sites of the lattice, increased impurity scattering results in an enhanced upper critical field. Subsequently, an improved high field j_c-performance of carbon-doped MgB_2 is observed. Among the plethora of carbon-containing compounds studied so far, nanos-

tructured carbon and carbon nanotubes (CNT) are potentially the most promising materials. Especially the elongated microstructural features of CNTs may additionally function as artificial pinning centers. In this work, the impact different carbon sources has on the structural and superconducting properties of nanocrystalline MgB_2 bulk samples and tapes is discussed. Precursor powders of carbon-doped MgB_2 were produced by mechanical alloying. In order to preserve the microstructural features of the CNTs, the standard processing procedure was modified.

TT 5.7 Mon 13:00 P1A

A mechanism of superconductivity in non-centrosymmetric system — •TETSUYA TAKIMOTO and PETER THALMEIER — max planck institute for chemical physics of solids, dresden

Unconventional superconductivity in non-centrosymmetric compounds like $CePt_3Si$, $CeRhSi_3$, and $CeIrSi_3$ attracts much attention. The most exotic feature of these compounds is a quite large upper critical field of superconductivity, which exceeds the Pauli limiting field. Therefore, it is considered that the possibility of spin-triplet superconductivity is not excluded in the non-centrosymmetric system. In addition, the Sigrist group has suggested that the d-vector of possible triplet superconductivity in non-centrosymmetric systems is parallel to the Rashba field, by which the inversion symmetry is broken. Based on a Hubbard model including the Rashba field, we study the superconductivity with an assumption suggested by the Sigrist group. The superconductivity is induced by spin fluctuations including anomalous spin fluctuations, which vanish in centrosymmetric systems. We will also discuss property of the superconducting state.

TT 5.8 Mon 13:00 P1A

Response and transport in non–centrosymmetric superconductors — •LUDWIG KLAM[1], DIETRICH EINZEL[2], and DIRK MANSKE[1] — [1]Max-Planck-Institut für Festkörperforschung, Heisenbergstrasse 1, 70569 Stuttgart, Germany — [2]Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany

We formulate a kinetic theory for non–centrosymmetric superconductors (NCS) at low temperatures in the clean limit. The transport equations are solved quite generally in spin– and particle–hole (Nambu) space by performing first a transformation into the so–called helicity–band basis and second a Bogoliubov transformation to the quasiparticle–quasihole phase space. Our result is a particle–hole–symmetric, gauge–invariant and charge conserving description, which is valid in the whole quasiclassical regime ($|q| \ll k_F$ and $\omega \ll E_F$). Including the long–range Coulomb interaction, we calculate the Lindhard, the dielectric, and the Raman response function.

For the Raman case, we present within this framework our recent results for the polarization–dependence of the electronic (pair–breaking) Raman response for NCS at zero temperature. Furthermore, we use a Green's function approach in order to calculate the dynamic spin susceptibility for the β-band of $CePt_3Si$ where the 3D band–structure can be obtained from recent ARPES measurements. Finally, we identify the relevant wave vectors for Cooper–pairing mediated by the spin susceptibility.

TT 5.9 Mon 13:00 P1A

Angular dependence of the upper critical field H_{c2} for $CeCu_2Si_2$ — •HUGO A. VIEYRA[1], NIELS OESCHLER[1], JEEVAN S. HIRALE[1,2], CHRISTOPH GEIBEL[1], and FRANK STEGLICH[1] — [1]Max Planck Institute for Chemical Physics of Solids, D-01187 Dresden, Germany — [2]I. Physik. Institut, Georg-August-Universität Göttingen, D-37077 Göttingen, Germany

Unconventional superconductivity is one of the most important and fascinating topics within solid state physics. It plays a major role in the study of high-T_c and heavy-fermion superconductors. Nevertheless, the underlying physical mechanism of unconventional superconductivity is still not completely understood. A clear example of this paradigm is $CeCu_2Si_2$, the first unconventional superconductor discovered almost three decades ago. Angular dependent measurements have already proven to be powerful techniques to study the properties of the unconventional superconducting state. In this work, we present angular-dependent resistivity measurements on single-crystalline $CeCu_2Si_2$ samples with antiferromagnetic order below 800 mK and a superconducting transition around 600 mK. From the angular dependence of the upper critical field H_{c2}, no anisotropy is observed within the basal plane, whereas a large anisotropy is observed when the magnetic field rotates out of plane ($\mathbf{H}//\mathbf{a}$) towards the crystallographic c-axis ($\mathbf{H}//\mathbf{c}$). As the angular dependence deviates from the prediction based on the anisotropic mass model, strong Pauli paramagnetic limiting seems to dominate the upper critical field at low temperatures.

TT 5.10 Mon 13:00 P1A

Deviations from the conventional BCS behavior in the penetration depth of lutetium-nickel-borocarbide films at terahertz frequencies — •T. FISCHER[1], A. V. PRONIN[1], J. WOSNITZA[1], T. NIEMEIER[2], and B. HOLZAPFEL[2] — [1]Hochfeld-Magnetlabor Dresden (HLD), FZ Dresden-Rossendorf, 01314 Dresden, Germany — [2]IFW Dresden, 01171 Dresden, Germany

We have measured the temperature and frequency-dependant transmission and phase shift through $LuNi_2B_2C$ thin films on MgO substrates at terahertz frequencies. From the measured data, we could accurately determine the complex dielectric constant, $\hat{\epsilon}$, the complex optical conductivity, $\hat{\sigma}$, and the penetration depth, λ. Comparing our measured results with theory, we find strong deviations from the standard one-band BCS predictions. These deviations can be attributed to the multiband nature of the superconducting state in $LuNi_2B_2C$.

TT 5.11 Mon 13:00 P1A

Quantum Oscillations in the superconducting state of $LuNi_2B_2C$ — •B. BERGK[1], O. IGNATCHIK[1], M. BARTKOWIAK[1], T. MANIV[2], V. ZHURAVLEV[2], P.C. CANFIELD[3], and J. WOSNITZA[1] — [1]Hochfeld-Magnetlabor Dresden, Forschungszentrum Dresden-Rossendorf, Dresden, Germany — [2]The Schulich Faculty of Chemistry, Technion Israel Institute of Technology, Haifa, Israel — [3]Ames Laboratory and Department of Physics and Astronomy, Iowa State University, Ames, Iowa, USA

We have studied the de Haas-van Alphen (dHvA) effect of the borocarbide superconductor $LuNi_2B_2C$ both in the normal and in the superconducting state by use of the field-modulation method in high magnetic fields up to 15 T and at low temperatures down to 0.5 K. In the superconducting state we observed an additional damping of the dHvA oscillation amplitudes compared to the normal state for different dHvA frequencies. This is due to the opening of the superconducting gap and, therefore, enables us to determine the magnetic-field-dependent gap for different bands from this experiment. The possibility to perform the measurements at various crystal orientations in the magnetic field allows to examine the angular dependence of the superconducting gap parameter.

TT 5.12 Mon 13:00 P1A

Multiband superconductivity in YNi_2B_2C single crystals studied by use of specific-heat measurements — •A. BEKKALI[1,2], J. WOSNITZA[1,2], M. UHLARZ[1], R. BEYER[1], M. SCHNEIDER[3], G. BEHR[3], S.-L. DRECHSLER[3], and G. FUCHS[3] — [1]Institut Hochfeld-Magnetlabor Dresden, Forschungszentrum Dresden-Rossendorf, D-01314 Dresden, Germany — [2]TU Dresden, Institut für Festkörperphysik, D-01062 Dresden, Germany — [3]Leibniz-Institut für Festkörper- und Werkstoffforschung, D-01171 Dresden, Germany

We present new specific-heat data for two different YNi_2B_2C single crystals grown by a zone-melting method. The two samples ($T_{c,A} = 15.26(4)$ K, $T_{c,B} = 15.6(1)$ K) were studied in magnetic fields up to $B = 9$ T in the temperature range from $T = 0.35 \ldots 20$ K, using both a relaxation and a heat-pulse method. In the superconducting state ($B = 0$) we find an uncommon dependence of the electronic contribution to the specific heat, $C_{el}(T)$, strengthening the assumption of a multiband nature of the superconducting state of YNi_2B_2C. A quantitative analysis of $C_{el}(T)$ evidences multiple electronic contributions from electrons with very different electron-phonon coupling strengths, thus exhibiting several different superconducting energy gaps $\Delta(T, B = 0)$. This feature is in agreement with recent de Haas – van Alphen results [1] and point-contact spectroscopy data [2].

[1] B. Bergk et al., PRL **100** (2008) 257004.
[2] P. Raychaudhuri et al., Physica C **460-462** (2007) 95.

TT 5.13 Mon 13:00 P1A

Organic Superconductors Revisited: STM imaging and DFT calculations of the bc plane of κ-(BEDT-TTF)$_2$Cu(NCS)$_2$ — JOHANNES M. BÜTTNER[1], •CARSTEN L. ROHR[1], FLORIAN A. PALITSCHKA[1], NATASCHA D. KUSHCH[2], MARK V. KARTSOVNIK[3], WERNER BIBERACHER[3], and BIANCA A. HERMANN[1] — [1]Dept. of Physics / CeNS, LMU Munich and Walther-Meissner-Institute (WMI), Munich, Germany — [2]Institute of Problems of Chemical Physics, Russian Academy of Science, Chemogolovka, Moscow-region, 142432 Rus-

sia — [3]Walther-Meissner-Institute (WMI) and TU Munich, Munich, Germany

Organic superconductors of the BEDT-TTF family are of a layered nature and show a pseudogap. Because of that, these materials are of high interest for the understanding of the physics of high-temperature superconductors. Due to the fragility of organic superconductor crystals caused by the weak charge-transfer bonding, we conducted a study on single crystals of drastically different age[1]:The surfaces of a ten years aged crystal and a freshly prepared κ-(BEDT-TTF)$_2$Cu(NCS)$_2$ crystal were imaged by scanning tunneling microscopy. The molecularly-resolved STM images of the bc plane of the crystals agree well with each other. The variation in brightness at the various positions of the molecules matches a new Density-Functional-Theory (DFT) simulation (Perdew-Wang91 gradient-corrected exchange-correlation functional) of the cationic layer, based on a crystal structure of [2]. Hence, we attribute this symmetry breaking of the BEDT-TTF dimers to intrinsic surface electronic states.

TT 5.14 Mon 13:00 P1A

Inducing Superconductivity with Picosecond Pressure Pulses in a Quasi-2D Organic Salt — •Julia Stähler, Arzhang Ardavan, and Andrea Cavalleri — University of Oxford, Department of Physics, Clarendon Laboratory, Parks Rd, Oxford OX1 3PU, UK

The quasi-2D organic compounds of the BEDT-TTF family are prototype materials for unconventional superconductivity. In particular, the κ-(BEDT-TTF)$_2$Cu[N(CN)$_2$]Cl exhibits a very rich phase diagram including a pressure-driven antiferromagnetic insulating to superconducting (AF-SC) phase transition below 13 K. So far, all studies of organic superconductors focused on the equilibrium properties of these materials, i.e. the system's response to slow adiabatic changes of the environment. The present work, however, aims at investigating the dynamic formation of the SC phase after excitation of a picosecond pressure transient using femtosecond laser pulses: The laser intensity is absorbed and leads to a significant local temperature increase at constant volume. As a direct consequence, a pressure pulse is launched in the material. This coherent acoustic pulse traverses through the sample at the speed of sound and is expected to induce the AF-SC phase transition. This phase transition will lead to noticeable changes of the sample's conductivity and therefore affect the dielectric function $\epsilon(\omega)$ of the material. In particular, at low energies in the region of the superconducting gap, a significant variation of reflectivity is anticipated. Thus, we employ THz radiation(1 THz = 4 meV) as a probe of the superconducting state. Picosecond time resolution is realized by tuning the time delay between pump laser pulse and THz pulse.

TT 5.15 Mon 13:00 P1A

$Na_{1-x}CoO_2$ bulk preparation by sol-gel and solid state routes — •Sandra Heinz[1], Ingo Fritsch[2], Claudia Fasel[1], Philipp Komissinskiy[1], Jose Kurian[1], Hanns-Ulrich Habermeier[2], and Lambert Alff[1] — [1]Department of Materials Science, TU Darmstadt, Germany — [2]Max-Planck-Institute for Solid State Research, Stuttgart, Germany

For the investigation of unconventional superconductivity thin films are advantageous for Josephson junctions and tunneling devices. In case of the possible p-wave superconductor water intercalated sodium cobaltate, high quality thin films showing superconductivity have been obtained [1,2]. The first step of thin film preparation by pulsed laser deposition is a reproducible, phase pure bulk target. Here we report on sodium cobaltate target fabrication by a sol-gel and by a solid state route. Two preparation routes are described to receive high quality, stable targets without parasitic phases. The targets were characterized by X-ray diffraction, high resolution scanning electron microscopy, energy dispersive X-ray analysis, thermal gravimetric analysis and magnetometry. $Na_{1-x}CoO_2$ targets can be obtained for x between 0.3 and 0. Textured targets can be realized with grain sizes down to the nanometer range by the sol-gel method.

[1] Y. Krockenberger, I. Fritsch, G. Cristiani, A. Matveev, L. Alff, H.-U. Habermeier, and B. Keimer, Appl. Phys. Lett. 86, 191913 (2005).

[2] Y. Krockenberger, I. Fritsch, G. Cristiani, H.-U. Habermeier, Li Yu, C. Bernhard, B. Keimer, and L. Alff, Appl. Phys. Lett. 88, 162501 (2006).

TT 5.16 Mon 13:00 P1A

Electron-Phonon Interaction and Phonon Renormalization in the Lamellar Cobaltate Na_xCoO_2 — •Johannes Knolle[1], Alexander Donkov[1], Ilya Eremin[1,2], and Maxim Korshunov[1,3] — [1]Max-Planck-Institut für Physik komplexer Systeme, 01187 Dresden, Germany — [2]Institute für Mathematische und Theoretische Physik, TU Braunschweig, 38106 Braunschweig, Germany — [3]Siberian Branch of Russian Academy of Sciences, L.V. Kirensky Institute of Physics, 660036 Krasnoyarsk, Russia

We study theoretically the electron-phonon interaction in Na_xCoO_2. For the A_{1g} and E_{1g} phonon modes found in Raman experiments, we calculate the matrix elements of the electron-phonon interaction. Analyzing the feedback effect of the conduction electrons on the phonon frequency ω, we investigate the doping dependence of these two phonon modes. Due to the momentum dependence of the electron-phonon interaction, we find the strongest renormalization of the E_{1g} mode around the Brillouin zone boundary which should be observed in the neutron scattering. At the same time, the A_{1g} mode shows the strongest coupling to the conducting electrons around the Γ point and reveals its doping dependence in the Raman experiments. Our results shed light on the possible importance of the electron-phonon interaction in the lamellar sodium cobaltates.

TT 5.17 Mon 13:00 P1A

Superconductivity and magnetism in electrochemically doped oxides — •Andreia Ioana Popa[1], Hemke Maeter[2], Christine Täschner[1], Ingo Hellmann[1], Rüdiger Klingeler[1], Bernd Büchner[1], and Hans-Henning Klauss[2] — [1]Leibniz-Institute for Solid State and Materials Research IFW Dresden, Germany — [2]IFP, TU Dresden, Germany

We study the magnetic and electronic properties of transition metal oxides in which the valency of the metal ions is modified electrochemically by Li intercalation/deintercalation. The electrochemical doping strongly affects the electronic and magnetic properties. One example is the evolution of superconductivity in the CuO_2 planes of $Li_xSr_2CuO_2Br_2$. Electron doping is realized by Li-intercalation and superconductivity is found below 9K. Electrochemical treatment hence allows studying the electronic phase diagram of this new electron doped cuprate superconductor. Another relevant class of materials under study are mixed valent vanadium-oxide multiwall nanotubes which represent a technologically relevant material for lithium-ion batteries. Upon electron doping of VO_x-NTs, our data confirm a higher number of magnetic V^{4+} sites. Interestingly, room temperature ferromagnetism evolves after electrochemical intercalation of Li making VO_x-NTs a novel type of self-assembled nanoscaled magnets.

TT 5.18 Mon 13:00 P1A

Masked ion beam patterning of nano-size regions of high-T_c superconducting thin films — •Marius Bodea[1], Khurram Siraj[1], Johannes Pedarnig[1], Dieter Bäuerle[1], Wolfgang Lang[2], Herbert Richter[2], Markus Marksteiner[2], Christine Hasenfuss[1], Leopold Palmetshofer[1], Renata Kolarova[1], Peter Bauer[1], and Costas Grigoropoulos[3] — [1]Technical and Natural Science Faculty, Johannes Kepler University, A-4040 Linz, Austria — [2]Faculty of Physics, University of Vienna, A-1090 Vienna, Austria — [3]Department of Mechanical Engineering, University of California, Berkeley, CA 94720-1740, USA

Ion-beam irradiation of the high-temperature superconductor (HTS) $YBa_2Cu_3O_7$ (Y-123) creates different types of defects depending on ion mass, energy and dose. Irradiation with Helium ions of moderate energy (75 keV) primarily creates point defects by displacement of oxygen atoms in Y-123. The He ions penetrate thin films of Y-123 (thickness 100 nm) producing defects that are distributed homogeneously in the HTS layer. The collision cascades show small lateral straggle. This allows for patterning of nanostructures by directing a low divergence ion beam onto a HTS thin film sample through a mask. The modification of electrical transport properties of Y-123 thin films by He ion irradiation, the variation of thin film resistivity and critical temperature with ion dose and the patterning of features about 200 nm in size by masked ion beam irradiation are presented. Computer simulations indicate that nano-patterning of Y-123 thin films with 10 nm lateral resolution is achievable.

TT 5.19 Mon 13:00 P1A

A new experimental setup for the preparation of oxide thin film - nanoparticle heterostructures — •Maria Sparing, Elke Backen, Ruben Hühne, Sebastian Fähler, Bernd Rellinghaus, Ludwig Schultz, and Bernhard Holzapfel — IFW Dresden, IMW, P.O. Box 270116, D-01171 Dresden, Germany

The application of superconducting $YBa_2Cu_3O_{7-x}$ (YBCO) thin

films in external magnetic fields is limited by their critical current density J_c. Since J_c strongly depends on the density and structure of pinning defects in the material, it can be improved by the introduction of artificial pinning centers, as e.g. created by nanoparticles. Although the influence of nanoparticles has been widely studied, a direct correlation between particle properties, defect structure and superconducting properties is still lacking, mainly because the control of the particle properties is not straight forward. Well controlled size distributions and areal densities of nanaoparticles with mean diameters between 3 nm and 20 nm can be obtained by DC magnetron sputtering in an inert gas atmosphere. We have already shown that, when implemented in YBCO thin film structures, such particles clearly influence J_c [1]. Here, we present a new experimental setup, which combines the inert gas condensation of nanoparticles with the preparation of oxide thin films by pulsed laser deposition in one chamber. This setup allows for the preparation of novel particle - thin film heterostructures, which yield the potential for a better understanding of the correlation between particle properties, defect structure and J_c.

[1] M. Sparing et *al.*, Supercond. Sci. Technol. **20**, 239 (2007)

TT 5.20 Mon 13:00 P1A

An influence of gamma irradiation on oxygen mobility in $YBa_2Cu_3O_{7-\delta}$ — •Anis Saad[1], Mikalai Kalanda[2], and Sergey Demyanov[2] — [1]Al-Balqua Applied University, Salt, Jordan — [2]Scientific-Practical Materials Research Centre NAS of Belarus, Minsk, Belarus

It is known, that in the process of irradiation, physical-chemical properties of $YBa_2Cu_3O_{7-\delta}$ considerably change due to the formation of radiation defects of various kind.

The most effective way of investigation of the Co^{60} isotope gamma ray irradiation effect on oxygen exchange dynamics and anions redistribution in CuO_x crystal structure planes of HTS $YBa_2Cu_3O_{7-\delta}$ compound is a plotting of superconducting critical temperature T_c, the superconducting transition temperature width ΔT_c and crystal lattice parameters difference $\Delta(b-a)$ dependences on irradiation dose.

In this way, as a result of comparison of T_c and ΔT_c values for irradiated high-density sample and non-irradiated high-density sample, respectively, it was determined that the gamma irradiation with energy 1.25 MeV, subsequent annealing at temperature 770 K and oxygen partial pressure pO_2 = 5 x 10^5 Pa during 12 h, leads to the T_c and $\Delta(b-a)$ values rise and decrease of ΔT_c value.

One can suppose that during the Co^{60} isotope gamma ray irradiation, radiation defects are formed which promote ionization of oxygen atoms. This process promotes redistribution of anions in CuO_x chained layers and stimulates oxygen sorption-desorption processes in the studied structures.

TT 5.21 Mon 13:00 P1A

A check on the checkerboard-like STM patterns of the Bi-cuprates — •Lars Schumachenko, Olaf Lübben, Hendrik Glowatzki, Lenart Dudy, Alica Krapf, Christoph Janowitz, and Recardo Manzke — Humboldt Universität zu Berlin

Topological scanning tunneling microscopy (STM) patterns of the high-temperature superconducting Bi-cuprates are long known to have beside the atomic grid an incoherent background (see, e.g., [1,2]). Measuring the Bi-cuprate Bi2212 at low bias and temperatures below the pseudogap-temperature [3], this background is ordered with a typical periodicity of $4a_0$ x $4a_0$ (here a_0 is the inplane Cu-O-Cu-length). We will present STM-measurements of the Bi-cuprates La-Bi2201 and Bi2212 and show thereby that at room temperature and relative high bias the background is already ordered. In our interpretation, this ordered background is preferentially caused by the extra Oxygen present in these materials. How these findings would challenge the interpretation of the 4x4 order as the revelation of the hidden checkerboard order [4] will be discussed.

[1] S. H. Pan et al., Nature 413, 282 (2001).
[2] Ø. Fischer et al., Rev. Mod. Phys. 79, 353 (2007).
[3] M. Vershinin et al., Science 303, 1995 (2004).
[4] T. Hanaguri et al., Nature 430, 1001 (2004).

TT 5.22 Mon 13:00 P1A

Evidence for static, site centered stripe order by photoemission on $Bi_2Sr_{1,2}La_{0,8}CuO_6$ — •Valentina Scherer[1], Christoph Janowitz[1], Beate Müller[1], Lenart Dudy[1], Alica Krapf[1], Helmut Dwelk[1], Recardo Manzke[1], Taichi Okuda[2], and Akito Kakizaki[2] — [1]Institut für Physik, Humboldt-Universität zu Berlin — [2]Institute for Solid State Physics (ISSP),University of Tokyo, Japan

$Bi_2Sr_{1,2}La_{0,8}CuO_6$ single crystals with a single CuO_2-layer per unit cell, a nominal hole doping around $n_H = 0,1$ and, vanishing T_C were grown and characterized. High resolution photoemission revealed an electronic structure decisively different from any hitherto reported one on Bi-cuprates. While no spectral weight, dispersion, or Fermi surface crossings along the nodal line could be detected, a strong buildup of spectral weight around the antinodal M-point occured. By comparison to spectral functions, dispersions, and Fermi surfaces from different calculations it will be shown that for this doping level indeed the site centered stripe model is realized.

TT 5.23 Mon 13:00 P1A

Checking the band structure of $Bi_2Sr_2CaCu_2O_{8+\delta}$ on polarization dependencies via angle resolved photoemission spectroscopy — •Hendrik Vita, Beate Müller, Lenart Dudy, Stephan Thürmer, Christoph Janowitz, and Recardo Manzke — Humboldt-Universität zu Berlin, Institut für Physik, Newtonstr. 15, 12489 Berlin

High resolution angle resolved photoemission spectroscopy (ARPES) has been performed on $Bi_2Sr_2CaCu_2O_{8+\delta}$, a classical representative of cuprate superconducters. With this approach the complex electronic structure of valence electrons in solids gets accessible. The excitation is generated by a high flux He-I_α ultaviolett source. Measuring the emitted electrons near zone boundary point M in reciprocal space, we focus on structures near the Fermi suface and around 1 eV binding energy. In particular linear polarized light is used, which is realized by a new monochromator equipped with a stage to rotate the orientation of the polarization. We assume that different excitations in the energy distribution curves show similar dependence on polarization. Especially for related systems like the single layer $Bi_2Sr_{2-x}La_xCuO_{6+\delta}$, phenomena measured in different polarization planes were already observed [1]. There the splitting of the superconducting peak up in two seperate excitations is reported. These measured structures are strongly correlated in respect to polarization.

[1] R. Manzke et. al., Phys. Rev. B **63**, R100504 (2001)

TT 5.24 Mon 13:00 P1A

Valence-bond stripes in cuprates: ARPES and inter-layer tunneling — •Alexander Wollny and Matthias Vojta — Institut für Theoretische Physik, Universität zu Köln, Zülpicher Straße 77, 50937 Köln, Germany

The effect of stripe formation in the underdoped cuprates has been a much discussed topic for more than ten years. Motivated by recent neutron scattering and STM experiments we develop a phenomenological mean-field model for valence-bond stripes dominated by local singlet formation.

We explore the electronic spectrum for valence-bond stripes and its interplay with d-wave superconductivity. The results are compatible with ARPES data for $La_{1.675}Eu_{0.2}Sr_{0.125}CuO_4$. Further we derive the effect of long ranged stripe order (with and without magnetic ordering) on the interlayer tunneling between two CuO_2-layers, giving an alternative mechanism, besides the anti-phase SC scenario, for effective layer decoupling in $La_{1.875}Ba_{0.125}CuO_4$.

TT 5.25 Mon 13:00 P1A

Optical sum rule anomalies in high-temperature superconductors — •Alessandro Toschi[1], Giorgio Sangiovanni[1], Karsten Held[1], Massimo Capone[2,3], and Claudio Castellani[2] — [1]Institut für Festkörperphysik, Technische Universität Wien, Austria — [2]Dipartimento di Fisica, Università "La Sapienza", Roma, Italy — [3]SMC, CNR-INFM, Roma, Italy

Many unusual features recently observed in the optical spectroscopy experiments in the cuprates can be simply understood[1] as arising from the vicinity to the Mott transition, without invoking more involved and exotic mechanisms. Specifically, we compare calculations based on the Dynamical Mean Field Theory (DMFT) of the Hubbard model with the optical spectral weight W_{opt} of different cuprates, explaining most of the anomalies found in the optical sum rules with respect to normal metals, including the existence of two different energy scales for the doping- and the T-dependence of W_{opt}. A further support to this result is provided by the analysis of the optical conductivity in a typical case of the Mott-Hubbard metal-insulator transition, namely the V_2O_3[2].

[1] A.Toschi, M. Capone, M. Ortolani, P. Calvani, S. Lupi, and C. Castellani, Phys. Rev. Lett. 95, 097002 (2005); A.Toschi, and M. Capone, Phys. Rev. B 77, 014518 (2008).
[2] L. Baldassarre , A. Perucchi, D. Nicoletti, A.Toschi, G. San-

giovanni, K.Held M. Capone, M. Ortolani, L. Malavasi, M. Marsi, P. Metcalf, P. Postorino, and S. Lupi, Phys. Rev. B 77, 113107 (2008).

TT 5.26 Mon 13:00 P1A

Superconductivity at the interfaces of oriented graphite crystalline regions? — Jose Barzola-Quiquia and •Pablo Esquinazi — Division of Superconductivity and Magnetism, University of Leipzig, D-04103 Leipzig

Magnetotransport measurements in bulk graphite as well as in mesoscopic multigraphene samples show a behaviour compatible with granular superconductivity with critical temperatures above 20 K [1]. Transmission electron microscope characterization and the thickness dependence of the transport behaviour suggest that the superconducting regions are located at the interfaces between crystalline graphite regions.

[1] P. Esquinazi et al., Phys. Rev. B **78**, 134516 (2008).

TT 5.27 Mon 13:00 P1A

The Superconducting Phase Diagram of $Ba_{1-x}K_xFeAs$ Single Crystals — •M. Bartkowiak[1], G.L. Sun[2], C.T. Lin[2], B. Keimer[2], and J. Wosnitza[1] — [1]Hochfeld-Magnetlabor Dresden (HLD), Forschungszentrum Dresden-Rossendorf, Postfach 510119, 01314 Dresden — [2]Max-Planck-Institut für Festkörperforschung, Heisenbergstr. 1, 70569 Stuttgart

The discovery of superconductivity in iron pnictides has opened up a new class of high-T_c superconductors. It is quite remarkable that superconductivity is induced in layers of FeAs. These layers are separated by either rare-earth oxides or barium, which when doped act as charge-carrier reservoir. Single crystals of the (122) phase are currently available. We have determined the temperature dependence of the critical field H_{c2}, for various single crystals of K-doped $BaFe_2As_2$ using ac-transport measurements.

The experiments were done at the pulsed-field facility in Dresden in fields up to 60 T applied parallel and perpendicular to the superconducting planes. The obtained phase diagram serves as an excellent benchmark for theoretical models of the order parameter.

TT 5.28 Mon 13:00 P1A

Crystal growth and selected properties of alkali/alkaline earth metal iron arsenides by flux growth and floating zone melting — •Andreea Claudia Budea[1], Igor Morozov[2], Norman Leps[1], Agnieszka Joanna Kondrat[1], Jorge Enrique Hamann-Borrero[1], Christian Hess[1], Rüdiger Klingeler[1], Günter Behr[1], and Bernd Büchner[1] — [1]IFW Dresden, Dresden, Germany — [2]Inorganic Chemistry Department, Moscow State University, Moscow, Russia

Large high quality crystals of various classes of novel alkali/alkaline earth metal-iron arsenides were grown by flux or by high pressure floating zone (FZ) methods. Careful selection and handling of high-purity starting materials and the control of oxygen impurities during the whole preparation process is required. The process parameters crucially depend on solution temperature and the solidification mode of the compound from tin flux. The relatively small partial pressures of arsenic in this class of compounds and the nearly congruent melting behavior enable the melting and crystallization in a high pressure floating zone facility under argon pressures above 40 bar. The characterization and selected physical properties of $Li_{1-x}FeAs$, $Ba_{1-x}K_xFe_2As_2$, $Ba(Fe_{1-x}Co_x)_2As_2$ are reported.

TT 5.29 Mon 13:00 P1A

Crystal growth and sample-dependent physical properties of new superconducting $SrFe_{2-x}M_xAs_2$ (M = transition metal) compounds — •Andreas Leithe-Jasper, Walter Schnelle, Helge Rosner, and Ulrich Burkhardt — MPI für Chemische Physik fester Stoffe, Nöthnitzer Str. 40, 01187 Dresden, Germany

We have recently reported about superconductivity with T_c up to 20 K in Co-substituted $SrFe_2As_2$ polycrystalline samples [1]. Here, electron-doping of the FeAs layers was accomplished by direct substitution of the transition metal. It was found that sample preparation and distribution of impurity phases influences the observed physical properties in a subtle way. The temperature dependence of the electrical conductivity as well magnetic susceptibility (superconducting parameters, magnetic secondary phases, homogeneity) and specific heat capacity will be presented and discussed. Crystals have been grown by a modified self-flux technique and the distribution of transition-metal dopants has been investigated by electron microprobe analysis. A comparison of the observed features with polycrystalline samples will be given. In addition, the possibility of complementary direct hole-doping has been explored.

[1] A. Leithe-Jasper, W. Schnelle, C. Geibel, H. Rosner, Phys. Rev. Lett. 101, 207004 (2008).

TT 5.30 Mon 13:00 P1A

Thermal expansion studies on $RFeAsO_{1-x}F_x$ (R=La, Ce, Pr, Sm, Gd) — •L. Wang, N. Leps, U. Köhler, G. Behr, R. Klingeler, C. Hess, and B. Büchner — Leibniz Institute for Solid State and Materials Research (IFW) Dresden, Germany

We present thermal expansion α and magnetostriction data of $RFeAsO_{1-x}F_x$ with R=La, Ce, Pr, Sm, Gd. The undoped compounds, with $x = 0$, exhibit thermal expansion anomalies at both the spin ordering transition T_N and the structural phase transition T_S. A negative anomaly of α at T_N clearly implies the negative pressure dependence of magnetic ordering. In addition, we find a large regime of structural fluctuations above T_S which exhibit a positive pressure dependence. While no qualitative changes occur for different R-ions at higher temperature, the presence of magnetic R-sites yields antiferromagnetic order of 4f-moments. A finite magnetostriction far above the 4f-ordering temperatures indicates magnetic fluctuations. Upon doping, superconductivity evolves while both features indicating T_N and T_S disappear. The thermodynamic properties at the superconducting transitions are discussed.

TT 5.31 Mon 13:00 P1A

Superconductivity and magnetism in the oxypnictides: high field ESR and μSR studies of (La,Gd)$FeAsO_{1-x}F_x$ compounds — •Ferenc Murányi[1,2], Alexey Alfonsov[2], Vladislav Kataev[2], Anke Köhler[2], Jochen Werner[2], Günter Behr[2], Norman Leps[2], Rüdiger Klingeler[2], Agnieszka Kondrat[2], Christian Hess[2], Bernd Büchner[2], Rustem Khasanov[3], Hubertus Luetkens[3], and Hans-Henning Klaus[4] — [1]Physics Institute, University of Zürich, Winterthurerstr. 190, 8057 Zürich, Switzerland — [2]IFW Dresden, Helmholtzstraße 20, 01069 Dresden, Germany — [3]Paul Scherrer Institut, 5232 Villigen PSI, Switzerland — [4]IFP, TU Dresden, D-01069 Dresden, Germany

The discovery of a new class of superconducting materials, $ReFeAsO_{1-x}F_x$, stirred up the scientific community. Here we report the Gd^{3+} high field ESR study of differently doped (La,Gd)$FeAsO_{1-x}F_x$ compounds. In lightly Gd-doped LaFeAsO samples the SDW transition yields line-broadening at the transition temperature, the SDW transition is then suppressed upon F-doping. In the dense compound, GdFeAsO, with SDW transition around 140 K, the Gd-ESR was also studied. With 15% F-doping superconductivity appears at $\sim$ 21 K. The SDW and SC transitions are clearly seen in ESR and in μSR as well. Surprisingly the reminiscence of the SDW transition of the undoped material (GdFeAsO) was identified in the doped (15% F) compound at lower temperature ($\sim$ 80 K). This indicates the importance of the the interplay between superconductivity and magnetism in oxypnictides.

TT 5.32 Mon 13:00 P1A

Magnetism, structure, thermodynamics and transport of $RO_{1-x}F_xFeAs$ (R=La, Ce, Sm, Gd) superconductors — J. E. Hamann-Borrero[1], A. Kondrat[1], N. Leps[1], L. Wang[1], A. Alfonsov[1], F. Hammerath[1], A. Narduzzo[1], H. Grafe[1], G. Lang[1], D. Paar[1], J. Werner[1], G. Behr[1], V. Kataev[1], •C. Hess[1], R. Klingeler[1], B. Büchner[1], H. Luetkens[2], H.-H. Klauss[3], S. Kimber[4], R. Feyerherm[4], D. Argyriou[4], M. Kosmala[5], O. Schumann[5], and M. Braden[5] — [1]Leibniz-Institute for Solid State and Materials Research, IFW Dresden, 01171 Dresden, Germany — [2]Laboratory for Muon-Spin Spectroscopy, PSI, CH-5232 Villigen, Switzerland — [3]Institut für Festkörperphysik, TU Dresden, D-01069 Dresden, Germany — [4]Helmholtz-Zentrum Berlin für Materialien und Energie (HZB), 14109 Berlin, Germany — [5]II. Physikalisches Institut, Universität zu Köln, 50937 Köln, Germany

We discuss magnetism, structure, thermodynamics and transport properties of the new oxypnictide superconductors $RO_{1-x}F_xFeAs$ (R=La, Ce, Sm, Gd). At zero fluorine doping we observe a close link between electronic, structural and magnetic degrees of freedom at the structural and the magnetic phase transitions $T_S \approx 160$ K and $T_N \approx 138$ K. F-doping leads to the suppression of these transitions and the emergence of superconductivity. The superconducting doping levels exhibits an interesting interplay between magnetism and

superconductivity. We discuss the influence of different R-ions on the physical properties.

TT 5.33 Mon 13:00 P1A

Electronic phase separation and magnetic order in the cobalt doped $RFe_{2-x}Co_xAs_2$ (R=Sr, Eu) iron pnictide superconductors — A. Kwadrin[1], H. Maeter[1], H.-H. Klauss[1], H. Luetkens[2], R. Khasanov[2], A. Amato[2], •M. Kraken[3], J. Litterst[3], A. Jesche[4], A. Leite-Jasper[4], H. Rosner[4], W. Schnelle[4], and C. Geibel[4] — [1]Institut für Festkörperphysik, TU Dresden — [2]Laboratory for Muon-Spin Spectroscopy, Paul Scherrer Institut, CH-5232 Villigen, Switzerland — [3]Institut für Physik der Kondensierten Materie, TU Braunschweig — [4]Max-Planck-Institut für Chemische Physik fester Stoffe Dresden

We have investigated the magnetic and superconducting properties of $RFe_{2-x}Co_xAs_2$ with R=Sr, Eu and $0 \leq x \leq 0.4$ by means of muon spin relaxation (μ^+SR) and Mössbauer spectroscopy. Under ambient pressure the antiferromagntic ordering temperature, T_N of $SrFe_{2-x}Co_xAs_2$ decreases with increasing Co-doping. However, T_N remains finite even as superconductivity appears as a function of doping. This shows that electronic phase separation plays a role in this system. High pressure experiments show a reduction the magnetic ordering temperature by pressure. On the contrary, $EuFe_{2-x}Co_xAs_2$ does not show superconductivity under ambient pressure but a peculiar interplay of the rare earth and iron magnetic order as a function of the Co-doping level.

TT 5.34 Mon 13:00 P1A

Electronic phase diagram of the $LaO_{1-x}F_xFeAs$ superconductor: A muon spin relaxation study — •H. Luetkens[1], H.-H. Klauss[2], F.J. Litterst[3], T. Dellmann[3], R. Klingeler[4], C. Hess[4], R. Khasanov[1], A. Amato[1], C. Baines[1], M. Kosmala[5], O.J. Schumann[5], M. Braden[5], J. Hamann-Borrero[4], N. Leps[4], A. Kondrat[4], G. Behr[4], J. Werner[4], and B. Büchner[4] — [1]Laboratory for Muon-Spin Spectroscopy, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland — [2]Institut für Festkörperphysik, TU Dresden — [3]Institut für Physik der Kondensierten Materie, TU Braunschweig — [4]Leibniz-Institut für Festkörper- und Werkstoffforschung (IFW) Dresden — [5]II. Physikalisches Institut, Universität zu Köln

The structural and electronic phase diagram of $LaO_{1-x}F_xFeAs$ and, in particular, the exact nature of the change from the magnetically ordered to the superconducting state that was determined by means of x-ray scattering, muSR and Mössbauer spectroscopy will be presented [1-3]. A discontinuous first-order-like change of the Néel temperature, the superconducting transition temperature, the sublattice magnetisation and the superfluid density is found between x=0.04 and x=0.05. While these results strongly question the relevance of quantum critical behaviour in iron pnictides they prove an important role of the structural orthorhombic distortion disappearing exactly at the SDW magnetism and superconductivity phase boundary.

[1] H. Luetkens et al., Phys. Rev. Lett. 101, 097009 (2008).
[2] H.-H. Klauss et al., Phys. Rev. Lett. 101, 077005 (2008).
[3] H. Luetkens et al., arXiv:0806.3533 (2008).

TT 5.35 Mon 13:00 P1A

Electronic structure studies of $BaFe_2As_2$ by angle-resolved photoemission spectroscopy — •Thirupathaiah Setti[1], Jörg Fink[1,2], Ruslan Ovsyannikov[1], Hermann Andreas Dürr[1], Cludia Felser[3], Shafagh Dastjani Farahani[3], Dirt Johrendt[4], Marianne Rotter[4], Yingkai Huang[5], Sanne de Jong[5], and Mark Golden[5] — [1]Helmholtz Zentrum, Berlin — [2]IFW, Dresden — [3]Inst.für Anorg. Chemie und Anal. Chemie, Johannes Gutenberg-Universität, Mainz — [4]Department Chemie und Biochemie, LMU München, München — [5]Vander Waals-Zeeman Institute, University of Amsterdam, Amsterdam, The Netherlands

We report high resolution angle-resolved photoemission spectroscopy (ARPES) studies of the electronic structure of $BaFe_2As_2$, which is one of the parent compounds of the Fe-pnictide superconductors. ARPES measurements have been performed at 20 K and 300 K, corresponding to the orthorhombic antiferromagnetic phase and the tetragonal paramagnetic phase, respectively. Photon energies between 30 and 175 eV and polarizations parallel and perpendicular to the scattering plane have been used.Changes in spectral weights at the Fermi level upon variation of the polarization of the incident photons yield important information on the orbital character of the states near the Fermi level. Only small differences in the electronic structure are observed between 20 and 300 K. The results are compared with LAPW calculations for the tetragonal paramagnetic phase and the orthorhombic antiferromagnetic state. Finally, the photon energy dependence of the spectra provides information on the kz dispersion of the bands.

TT 5.36 Mon 13:00 P1A

NMR studies on the new iron arsenide superconductors including the superconducting state — •Hans-Joachim Grafe[1], Guillaume Lang[1], Franziska Hammerath[1], Dalibor Paar[1,2], Katarina Manthey[1], Nicholas Curro[3], Günther Behr[1], Jochen Werner[1], and Bernd Büchner[1] — [1]IFW Dresden, Helmholtzstr. 20, D-01069 Dresden, Germany — [2]Dept. of Physics, Faculty of Science, Univ. of Zagreb, P. O. Box 331, — [3]Dept. of Physics, Univ. of California, Davis, CA 95616, USA

We summarize our Nuclear Magnetic Resonance (NMR) and Nuclear Quadrupole Resonance (NQR) results on the new iron arsenide superconductor $LaO_{1-x}F_xFeAs$ in the normal state [1,2], and show new NMR data in the superconducting state. Beyond early evidence of nodes and spin-singlet pairing [2], we find evidence of a deviation of the T^3 behaviour of the spin lattice relaxation rate, $1/T_1$, at temperatures significantly below T_c, which would agree with the suggested extended s-wave symmetry [3]. The deviation of the T^3 behaviour is induced by the pair breaking effect of impurities. Different amounts of impurities would lead to different temperature dependences of $1/T_1$, which would allow to differentiate between d-wave and extended s-wave symmetries.

[1] H.-J. Grafe et al., arXiv:0811.4508
[2] H.-J. Grafe et al., PRL 101, 047003 (2008)
[3] A. Chubukov et al., PRB 78, 134512 (2008)

TT 5.37 Mon 13:00 P1A

High pressure study of $CaFe_2As_2$ and $BaFe_2As_2$ — •William Duncan[1], Oliver Welzel[2], Xian-hui Chen[3], Malte Grosche[2], and Philipp Niklowitz[1] — [1]Royal Holloway, University of London, Egham, UK — [2]Cavendish Laboratory, Cambridge, UK — [3]Dept. of Physics, University of Science and Technology of China, Hefei, People's Republic of China

The high pressure behaviour of the stoichiometric 1-2-2 iron arsenide compounds has been controversial. We investigate high quality stoichiometric single crystals grown from FeAs self-flux. Measurements on $CaFe_2As_2$ in a piston-cylinder pressure cell indicate a very low critical pressure of about 2 kbar for the onset of superconductivity. The pressure range in which full resistive transitions can be observed is exceedingly narrow, much less than one kbar, supporting suggestions in the literature that pressure-induced superconductivity is not a bulk phenomenon in $CaFe_2As_2$.

$BaFe_2As_2$ has been investigated up to 30 kbar in a piston-cylinder cell, and at higher pressures using anvil cell techniques, with both solid and liquid pressure media. Our data show a gradual suppression of the spin density wave/structural transition with pressure, falling below 100 K above 50 kbar. Low temperature anomalies in the resistivity below about 25 K suggest the onset of filamentary superconductivity.

We continue to explore the phase diagram of both systems to higher pressure, in order to investigate, in particular, the vicinity of the expected quantum critical point in $BaFe_2As_2$.

TT 5.38 Mon 13:00 P1A

Raman spectroscopic studies on single crystals of the iron-based superconductor $SmFeAsO_{1-x}F_x$ — •Ivan Jursic[1], Joachim Schoenes[1], Zbigniew Bukowski[2], and Janusz Karpinski[2] — [1]Technische Universität Braunschweig, Institut für Physik der Kondensierten Materie, 38106 Braunschweig, Germany — [2]ETH Zürich, Laboratorium fuer Festkörperphysik, 8093 Zürich, Switzerland

The recent discovery of superconductivity in iron-based oxypnctides has led to a great interest in this new class of non-cuprate high-T_c superconductors. Though theoretical work predicts a small electron-phonon coupling, which means that this should not be the driving mechanism for the observerd T_c's in this class of material, the exact coupling mechanism is still under debate.

We present Raman studies on superconducting $SmFeAsO_{1-x}F_x$ single crystals where the T_c was determined by SQUID magnetometric measurements to be 34 K. At room temperature polarized measurements were performed to assign the phonon modes. Furthermore studies at different temperatures reaching from 5K to 300K were done to investigate the phonon behavior. The phonon frequencies shift with temperature and we investigate this shift in terms of electron-phonon coupling.

TT 5.39 Mon 13:00 P1A

Multi-orbital Dynamical Correlations in Iron Pnictides — •L. Craco — Max-Planck-Institut fuer Chemische Physik fester Stoffe

In view of the importance of dynamical correlations associated with electron interactions in Fe-pnictides, we will discuss our recent LDA+DMFT results for the correlated electronic structure of Sm- and La-based compounds [1,2]. We will show why multi-orbital electronic correlations are necessary for a concrete description of key physical responses found in their normal state. We present theory-experiment comparison of the one- and two-particle spectral functions. Such a comparison is required for deciding whether a given system is correlated, and if so, how strongly. Our study supports the view that superconductivity in Fe-pnictides arises from a bad metallic, incoherent normal state that is proximate to a Mott-Hubbard insulator.

[1] L. Craco, M. S. Laad, S. Leoni, and H. Rosner, Phys. Rev. B **78**, 134511 (2008); and, Virtual Journal of Applications of Superconductivity **15**, Issue 8 (2008).

[2] M.S. Laad, L. Craco, S. Leoni, and H. Rosner, arXiv:0810.1607.

TT 5.40 Mon 13:00 P1A

Feedback spin resonance in the Fe-pnictide superconductors — •Alireza Akbari[1], Peter Thalmeier[2], Ilya Eremin[1], and Peter Fulde[1] — [1]Max Planck Institute for the Physcis of Complex Systems, D-01187 Dresden, Germany — [2]Max Planck Institute for the Chemical Physics of Solids, D-01187 Dresden, Germany

The superconducting feedback resonance in inelastic neutron scattering has been found in numerous unconventional superconductors of the cuprate, heavy fermion type and recently in the FeAs class. This collective spin excitation in the 3d FeAs superconducting layers appears below T_c at an energy $\omega_r < 2\Delta_0$ and momentum transfer $\mathbf{Q}$ $[\Delta(\mathbf{k}+\mathbf{Q}) = -\Delta(\mathbf{k})]$. This resonance has been found in some Fe_2As_2 type superconductors and may be a more general phenomenon. An indirect evidence for enhanced Fe 3d spin dynamics in the superconducting state was recently observed in $CeFeAsO_{1-x}F_x$. The crystalline electric field (CEF) excitations of localized Ce 4f- states at 20 meV were found to couple weakly to the spin excitations in the FeAs layers leading to characteristic frequency shift and broadening effects. The temperature dependence of CEF excitations is studied within a RPA approximation. The experimental decrease of CEF excitation energy with temperature in the normal state is explained. Below T_c the feedback effect leads to an enhanced 3d spin response around 20 meV at $\mathbf{Q} = (\pi, \pi)$. The spectral shape and its temperature dependence of 3d and total 4f-3d spin dynamics are calculated. We compare the results to similar examples in the unconventional heavy fermion superconductors.

TT 5.41 Mon 13:00 P1A

Pecularities of the superconducting gaps and the fermion-boson interaction in $TmNi_2B_2C$ as seen by point-contact spectroscopy — •Oksana Kvitnitskaya[1,2], Yurii Naidyuk[1], Lidiya Tiutrina[1], Igor Yanson[1], Günter Fuchs[2], Konstantin Nenkov[2], Günter Behr[2], and Stefan-Ludwig Drechsler[2] — [1]ILT Kharkiv, Ukraine — [2]IFW Dresden

Point-contact (PC) investigations on the title compound in the normal and superconducting (SC) state ($T_c \simeq 10.6$ K) are presented. The T-dependence of two SC gaps in $TmNi_2B_2C$ determined by Andreev-reflection spectroscopy deviates from the BCS behavior in displaying a maximum at about $T_c/2$. Additional evidence for the presence of a 2nd gap half as large as the main gap is given. For the first time "reentrant" features were found in the Andreev-reflection spectra measured in magnetic fields. The PC spectroscopy of the fermion-boson interaction in $TmNi_2B_2C$ reveals a pronounced phonon maximum at 9.5 meV and a more smeared one around 15 meV, while at higher energies the PC spectra are almost featureless. Additionally, the intense peak slightly above 3 meV observed in the PC spectra of $TmNi_2B_2C$, is presumably caused by crystalline-electric-field excitations. The peak near 1 meV detected for some spectra is connected with a modification of the crystal electric field probably due to boron or carbon vacancies.