TT 43: Superconductivity: Fe-based Superconductors – 122

Time: Tuesday 14:00–15:45 Location: H 2053

Topical Talk TT 43.1 Tue 14:00 H 2053

Magnetism and Superconductivity in Eu-Based Iron Pnictides — •Sina Zapf — 1. Physikalisches Institut, Universität Stuttgart, Germany

$EuFe_2As_2$ is an extraordinary parent compound of the iron pnictides, as it exhibits at low temperatures – additional to the Fe spin density wave – long-range magnetic order of the Eu^{2+} local moments. Nevertheless, bulk superconductivity around 30 K can be induced by mechanical pressure or chemical substitution.

In this talk we review the remarkable interplay of unconventional superconductivity, itinerant and local magnetism in Eu based iron pnictides. We focus on the appearance of a re-entrant spin glass phase that coexists with superconductivity [1] and an indirect magneto-elastic coupling, enabling the persistent magnetic detwinning by small magnetic fields [2].

This work was done in collaboration with the groups of D. N. Basov, R. Kremer, and P. Gegenwart.

[1] S. Zapf et al., Phys. Rev. Lett. 110, 237002 (2013)
[2] S. Zapf et al., Phys. Rev. Lett. 113, 227001 (2014)

TT 43.2 Tue 14:30 H 2053

Probing the density of states in $EuFe_{2-x}Ru_xAs_2$ — •Mamoun Hemmida[1], Hans-Albrecht Krug von Nidda[1], Axel Günther[1], Alois Loidl[1], Andreas Leithe-Jasper[2], Walter Schnelle[2], Helge Rosner[2], and Jörg Sichelschmidt[2] — [1]Experimental Physics V, Center for Electronic Correlations and Magnetism, Institute for Physics, University of Augsburg, 86135 Augsburg, Germany — [2]Max Planck Institute for Chemical Physics of Solids, 01187 Dresden, Germany

Electron spin resonance of Eu^{2+} ($4f^7$, $S = 7/2$) in europium-based iron pnictides successfully probes the local density of states of the conduction electrons [1]. Starting from the mother compound $EuFe_2As_2$, the usual metallic phase is characterized by the linear increase of the linewidth on increasing temperature (Korringa slope $b = 8$ Oe K^{-1}) due to the Korringa relaxation via the conduction electrons, while this Relaxation contribution is switched off in the spin-density wave phase ($T < T_{SDW}$), where the linewidth is mainly determined by the crystal-electric field of the ligands [2]. Thus, we observe the same phenomenology like in insulators, despite of the high conductivity. Substitution of ruthenium for iron gradually suppresses the SDW phase up to $x = 0.5$ and reduces the Korringa slope down to about $b = 0.3$ Oe K^{-1} for $x = 2$. This indicates a continuously decreasing conduction-electron density of states at the Fermi energy on increasing Ru Substitution in a good agreement with band-structure calculations.

[1] M. Hemmida *et al.*, Phys. Rev. B **90**, 205105 (2014).
[2] E. Dengler *et al.*, Phys. Rev. B **81**, 024406 (2010).

TT 43.3 Tue 14:45 H 2053

Crystal growth and characterization of $SrFe_2(As_{1-x}P_x)_2$ — •Agnes Adamski, Fadoua Fouta, and Cornelius Krellner — Physikalisches Institut, Goethe Universität Frankfurt, D-60438 Frankfurt am Main, Germany

Among the various iron-arsenide-based superconductors, members of the AFe_2As_2 (A = Ba, Sr, Ca), the so called 122 family, have become model systems for exploring superconductivity in this new class of high-T_C superconductors. Recently it turned out, that the different substitution series result in very different temperature-concentration phase diagrams, especially in the region where antiferromagnetism disappears and superconductivity emerge. Furthermore, the symmetry of the superconducting order parameter tends to vary from one substitution series to another.

Here, we report on the optimization of the single crystal growth of $SrFe_2(As_{1-x}P_x)_2$ using the well-established self-flux technique. However, so far the exact melting temperatures of various flux to 122 compositions are not reported in the literature. We performed differential thermal analysis (DTA) to determine these melting points as function of flux to 122 ratio and for various phosphorous concentrations. Subsequently, the obtained samples were analyzed with electron microscope, energy dispersive x-ray analysis and powder diffractometry to determine the phase relations and distribution coefficients in this series.

TT 43.4 Tue 15:00 H 2053

Scanning Tunneling Spectroscopy of $SrFe_2(As_{1-x}P_x)_2$ — •Jasmin Jandke, Petra Wild, Michael Schackert, and Wulf Wulfhekel — Physikalisches Institut, Karlsruhe Institute of Technology, Wolfgang-Gaede-Str. 1, 76131 Karlsruhe, Germany

The antiferromagnetic parent compound $SrFe_2As_2$ shows a supression of the spin density wave and a subsequent superconducting state upon partial substitution of As by P [1]. We investigated single crystals for four different P-concentrations x in the superconducting (x=0.35,0.46) as well as in the spin density wave phase (x=0,0.2). The superconducting samples display a v-shaped superconducting gap, which suggests nodal superconductivity in this system. Furthermore, we were able to determine the superconducting coherence length by measuring the spatial resolved superconducting density of states. From inelastic tunneling spectra it is possible to determine the Éliashberg function from the normal state [2]. We thus investigated bosonic excitations for the four different P-concentrations. Indeed, evidence suggests peaks which can be related to bosonic modes. The phonon an non-phonon mechanism for the origin of these peaks will be discussed.

[1] T. Kobayashi et al. *J.Phys.Soc.Jpn.* **81**, SB045 (2012)
[2] M. Schackert et al. arXiv:1402.0071 [con-3mat.supr-con]

TT 43.5 Tue 15:15 H 2053

Unusually high critical current of P-doped $BaFe_2As_2$ single crystalline thin film — •Fritz Kurth[1,2], Chiara Tarantini[3], Vadim Grinenko[1], Jens Hänisch[1,4], Jan Jaroszynski[3], Elke Reich[1], Yasohiro Mori[5], Akihiro Sakagami[5], Takahiko Kawaguchi[5], Jan Engelmann[1,2], Ludwig Schultz[1,2], Bernhard Holzapfel[4], Hiroshi Ikuta[5], Ruben Hühne[1], and Kazumasa Iida[1,5] — [1]IMW, IFW Dresden, Dresden, Germany — [2]TU Dresden, Dresden, Germany — [3]ASC, NHMFL, Florida, USA — [4]ITEP, KIT, Karlsruhe, Germany — [5]Department of Crystalline Materials Science, Nagoya University, Nagoya, Japan

Microstructurally clean, isovalently P-doped $BaFe_2As_2$ single crystalline thin films have been prepared by molecular beam epitaxy. These films show a superconducting transition temperature (T_c) of over 30 K and high transport self-field critical current densities (J_c) of over 6 MA/cm^2 at 4.2 K, which are among the highest for Fe based superconductors. In-field J_c exceeds 0.1 MA/cm^2 at $\mu_0 H = 35$ T for $H \| ab$ and $\mu_0 H = 18$ T for $H \| c$, respectively, in spite of moderate upper critical fields compared to other FeSCs with similar T_c. This unusually high J_c makes P-doped Ba-122 very favorable for high-field magnet applications.

TT 43.6 Tue 15:30 H 2053

Ultrafast structural dynamics of the Fe-pnictide parent compound $BaFe_2As_2$ — •L. Rettig[1], S.O. Mariager[1], A. Ferrer[1,2], S. Grübel[1], J.A. Johnson[1], J. Rittmann[1,3], T. Wolf[4], S.L. Johnson[2], G. Ingold[1], P. Beaud[1], and U. Staub[1] — [1]Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland — [2]ETH Zürich, CH-8093 Zürich, Switzerland — [3]EPFL, CH-1015 Lausanne, Switzerland — [4]KIT, D-76021 Karlsruhe, Germany

Understanding the interplay of the various degrees of freedom such as the electrons, spins and lattice is essential for many complex materials, including the high-temperature superconductors. In the Fe pnictides, especially the strong sensitivity of the electronic and magnetic properties to the Fe-As tetrahedra angle plays a crucial role for superconductivity and demonstrates a strong magneto-structural coupling.

Here, we use femtosecond time-resolved x-ray diffraction to investigate the structural dynamics in the Fe-pnictide parent compound $BaFe_2As_2$. We observe fluence dependent intensity oscillations of two specific Bragg reflections. Their distinctly different sensitivity to the pnictogen height demonstrates the coherent excitation of the A_{1g} phonon mode and allows us to quantify the coherent modifications of the Fe-As tetrahedra. By a comparison with time-resolved photoemission data we derive the electron-phonon deformation potential for this particular mode, which is comparable to theoretical predictions. Our results demonstrate the importance of this structural degree of freedom for the electron-phonon coupling in the Fe pnictides and indicate an ultrafast increase of the Fe magnetic moments.