TT 42: SC: Fe-based Superconductors - Fe(Se,Te)

Time: Wednesday 18:45–20:00 Location: HSZ 304

TT 42.1 Wed 18:45 HSZ 304

Physical properties of $FeSe_{0.5}Te_{0.5}$ single crystals — •Vladimir Tsurkan[1,2], Joachim Deisenhofer[1], Axel Günther[1], Christian Kant[1], Florian Schrettle[1], Hans-Albrecht Krug von Nidda[1], and Alois Loidl[1] — [1]Experimentalphysik V, Center for Electronic Correlations and Magnetism, Institute for Physics, Augsburg University, D-86135 Augsburg, Germany — [2]Institute of Applied Physics, Academy of Sciences of Moldova, MD-2028 Chişinău, Republic of Moldova

We report on structural, magnetic, conductivity, and thermodynamic studies of $FeSe_{0.5}Te_{0.5}$ single crystals grown by self-flux and Bridgman methods. The lowest values of the susceptibility in the normal state, the highest transition temperature T_c of 14.5 K, and the largest heat-capacity anomaly at T_c were obtained for pure (oxygen-free) samples. The upper critical field H_{c2} of ~ 500 kOe is estimated from the resistivity study in magnetic fields parallel to the c-axis. The anisotropy of the upper critical field $\gamma_{H_{c2}} = H^{ab}_{c2}/H^{c}_{c2}$ reaches a value ~ 6 at $T \longrightarrow T_c$. Extremely low values of the residual Sommerfeld coefficient for pure samples indicate a high volume fraction of the superconducting phase (up to 97 %). The electronic contribution to the specific heat in the superconducting state is well described within a single-band BCS model with a temperature dependent gap $\Delta_0 = 27(1)$ K. A broad cusp-like anomaly in the electronic specific heat of samples with suppressed bulk superconductivity is ascribed to a splitting of the ground state of the Fe^{2+} ions at 2c sites. This contribution is fully suppressed in the ordered state in samples with bulk superconductivity.

TT 42.2 Wed 19:00 HSZ 304

Superconducting $FeSe_{0.5}Te_{0.5}$ under high pressure: Susceptibility, XRD and Mössbauer studies. — •Vadim Ksenofontov[1], Leslie Schoop[1], Sergey Medvedev[2], Michail Eremets[2], Vladimir Tsurkan[3], Joachim Deisenhofer[3], Alois Loidl[3], Gerhard Wortmann[4], and Claudia Felser[1] — [1]Institute of Inorganic and Analytical Chemistry, Johannes Gutenberg - University, Mainz, Germany — [2]Max-Planck-Institute for Chemistry, Mainz, Germany — [3]Institute of Physics, University of Augsburg, Augsburg, Germany — [4]Department of Physics, University of Paderborn, Paderborn, Germany

High-pressure magnetic, structural and Mössbauer studies were performed on single-crystalline samples of superconducting (sc) $FeSe_{0.5}Te_{0.5}$ with $T_c = 14.5$ K [1]. Susceptibility data up to 1.5 GPa revealed a strong increase of Tc up to 25 K, followed by a plateau in T_c up to 6.0 GPa. Further increase of pressure leads to a disappearance of sc state around 7.0 GPa. Structural and Mössbauer studies explain this fact by a structural phase transition of the sc PbO to the non-sc NiAs structure. We discuss the fact of an almost pressure-independent T_c, between 1.5 and 6.0 GPa by the respective variation of the lattice constants and hyperfine parameters in FeSe [2]. We conclude that the strong increase of T_c in $FeSe_{0.5}Te_{0.5}$ with pressure up to 1.5 GPa can not be attributed to a change in the phonon-DOS [3].

[1] V. Tsurkan et al., arXiv:1006.4453.
[2] S. Medvedev et al., Nature Mater. 87, 630 (2009).
[3] V. Ksenovontov et al., Phys. Rev. B 81, 184510 (2010).

TT 42.3 Wed 19:15 HSZ 304

57Fe NIS studies of phonon DOS in superconducting $FeSe_{0.5}Te_{0.5}$ single crystals — •Gerhard Wortmann[1], Vadim Ksenofontov[2], Teuta Gasi[2], Aleksandr Chumakov[3], Vladimir Tsurkan[4], Joachim Deisenhofer[4], Alois Loidl[4], and Claudia Felser[2] — [1]Department of Physics, University of Paderborn, Paderborn, Germany — [2]Institute of Inorganic and Analytical Chemistry, Johannes Gutenberg - University, Mainz, Germany — [3]European Synchrotron Radiation Facility, Grenoble, France — [4]Institute of Physics, University of Augsburg, Augsburg, Germany

FeSe and isostructural $FeSe_{0.5}Te_{0.5}$ could provide valuable information for the understanding of the principal mechanisms of superconductivity (SC) in the novel Fe-based superconductors. Using ^{57}Fe nuclear inelastic scattering (NIS) we have measured the phonon-DOS in single-crystalline samples of $FeSe_{0.5}Te_{0.5}$ [1] parallel and perpendicular to the c-axis. A study of the phonon-DOS as function of temperature revealed a very similar temperature dependence as observed in FeSe [2], also no changes of the phonon-DOS above and below $T_c = 14.5$ K. Together with results of conventional ^{57}Fe-Mössbauer studies, we can exclude any phonon softening connected with the observed SC [3]. Based on these results and previous studies of FeSe [2,4], we discuss the role of phonons in the mechanisms for SC in the Fe-based systems.

[1] V. Tsurkan et al., arXiv:1006.4453.
[2] V. Ksenovontov et al., Phys. Rev. B 81, 184510 (2010).
[3] J. Lindén et al., arXiv:1008.1680.
[4] S. Medvedev et al., Nature Mater. 87, 630 (2009).

TT 42.4 Wed 19:30 HSZ 304

Tunnelling spectroscopy (SI-STM) study of Fe(Se,Te) — •Seth Cullen White, Udai Raj Singh, Yong Liu, Chengtian Lin, and Peter Wahl — Max-Planck-Institute for Solid State Research, Stuttgart, Germany

We use spectroscopic imaging scanning tunnelling microscopy (SI-STM) to investigate the local electronic structure of iron-based superconductors. Fe(Se,Te) has the simplest structure of these superconductors, consisting of planar iron layers with chalcogen anions above and below. The crystal structure provides a well defined cleavage plane between chalcogenide layers. In this study we map spatially the local density of states on a $Fe_{1.08}Se_{0.28}Te_{0.72}$ sample, which is superconducting below 14 K, revealing spectral features associated with defects. We investigate further the spectral features associated with excess Fe impurities, which are predicted to have a magnetic moment leading to local suppression of superconductivity.

TT 42.5 Wed 19:45 HSZ 304

Quasiparticle interference in an iron-based superconductor — •Steffen Sykora[1,2] and Piers Coleman[2] — [1]IFW Dresden, Institute for Theoretical Solid State Physics, P.O. Box 270116, D-01171 Dresden, Germany — [2]Center for Materials Theory, Rutgers University, Piscataway, New Jersey 08854, USA

We develop a model for the effect of a magnetic field on quasiparticle interference in an iron-based superconductor. Recently, scanning tunneling experiments have been performed on Fe(Se,Te) to determine the relative sign of the superconducting gap from the magnetic-field dependence of quasi-particle scattering amplitudes. Using a simple two-band BCS model we study three different cases of scattering in a spin-split spectrum. The dominant effect of a magnetic field in iron-based superconductors is caused by the Pauli limiting of conduction electrons. Thereby time reversal odd scattering is induced which enhances the sign-preserving and depresses the sign-reversing peaks in the quasiparticle interference patterns.