TT 25: Superconductivity: Fe-based Superconductors - 1111 & 111

Time: Tuesday 9:30–10:45 Location: H19

TT 25.1 Tue 9:30 H19

Crystal growth and characterization of *RE*FeAsO (*RE* = La, Nd) and LaFePO — •Agnes Adamski, Mahmoud Abdel-Hafiez, and Cornelius Krellner — Physikalisches Institut, Goethe Universität, D-60438 Frankfurt am Main

Since the discovery of iron-based superconductors, much effort was put on the crystal growth of the various systems and their characterization. Although, the initial flurry of activities was mainly performed on the 1111 systems, the focus has been rapidly shifted towards other materials, were large high-quality crystals are available. In contrast, the growth of sizeable high-quality single crystals of 1111 compounds is extremely challenging, slowing down the scientific progess in this type of compounds.

Here we report on the crystal growth of 1111-type materials under ambient pressure conditions and by using the flux technique. The influence of the material to flux ratio was systematically studied. Subsequently, the obtained samples were analyzed with powder diffractometry, electron microscope, energy dispersive x-ray analysis, Laue diffractometry and magnetic measurements to analyze the structural and magnetic properties.

TT 25.2 Tue 9:45 H19

Impact of concomitant Y and Mn substitution on properties of $La_{1-z}Y_zFe_{1-y}Mn_yAsO_{0.9}F_{0.1}$ — •Rhea Kappenberger[1,2], Franziska Hammerath[1,2], Mesfin Asfaw Afrassa[1,3], Pierre Rousse[1], Christian Hess[1], Giacomo Prando[1], Matteo Moroni[1], Samuele Sanna[4], Pietro Carretta[4], Gianrico Lamura[5], Anja U. B. Wolter[1], Sirko Kamusella[2], Hans-Henning Klauss[2], Sabine Wurmehl[1,2], and Bernd Büchner[1,2] — [1]Leibniz Institute for Solid State and Materials Research Dresden IFW, Dresden, Germany — [2]Institut für Festkörperphysik, TU Dresden, Dresden, Germany — [3]Addis Ababa University, College of Natural Science, Addis Ababa, Ethiopia — [4]Dipartimento di Fisica and Unitá di CNISM di Pavia, Pavia, Italy — [5]CNR-SPIN and Universita di Genova, I-16146 Genova, Italy

The substitution of constituents is frequently used as a local probe to check the microscopic properties of an unconventional superconductor in response to such an "impurity".

In this talk, we present several structural parameters and the superconducting critical temperatures in response to different substitution levels of Mn and Y in $La_{1-z}Y_zFe_{1-y}Mn_yAsO_{0.9}F_{0.1}$. We will discuss our findings in the light of chemical pressure inflicted by Y, which has a significantly smaller ionic radius than La, and strong electron localization caused by small amounts of paramagnetic Mn impurities.

TT 25.3 Tue 10:00 H19

Unusual temperature evolution of superconductivity in LiFeAs — •Pranab Kumar Nag[1], Ronny Schlegel[1], Danny Baumann[1], Hans-Joachim Grafe[1], Robert Beck[1], Sabine Wurmehl[1,2], Bernd Büchner[1,2,3], and Christian Hess[1,3] — [1]Leibniz-Institute for Solid State and Materials Research, IFW-Dresden, 01069 Dresden, Germany — [2]Institute for Solid State Physics, TU Dresden, 01069 Dresden — [3]Center for Transport and Devices, TU Dresden, 01069 Dresden, Germany

We have performed temperature dependent scanning tunneling spectroscopy on an impurity-free surface area of a LiFeAs single crystal [1]. Our data reveal a highly unusual temperature evolution of superconductivity: at $T_c^* = 18$ K a partial superconducting gap opens, as is evidenced by subtle, yet clear features in the tunneling spectra, i.e. particle-hole symmetric coherence peaks and dip-hump structures. At $T_c = 16$ K, these features substantiate dramatically and become characteristic of full superconductivity. Remarkably, this is accompanied by an almost jump-like increase of the gap energy at T_c to about 87% of its low-temperature gap value. The energy of the dip as measured by its distance to the coherence peak remains practically constant in the whole temperature regime $T \leq T_c^*$. We compare these findings with established experimental and theoretical results.

[1] P. K. Nag *et al.*, arXiv:1509.03431(2015)

TT 25.4 Tue 10:15 H19

Physical Properties of Off-Stoichiometric LiFeAs — •Uwe Gräfe[1], Shiv Jee Singh[1], Robert Beck[1], Hans-Joachim Grafe[1], Sabine Wurmehl[1,3], Christian Hess[1,2], and Bernd Büchner[1,3] — [1]IFW Dresden, Institut für Festkörperforschung, Postfach 270116 01171 Dresden — [2]Center for Transport and Devices, TU Dresden, 01169 Dresden — [3]Institut für Festkörperphysik, TU Dresden, 01062 Dresden

It is known that small modifications on the stoichiometry of LiFeAs have high impact on the physical properties in the normal and superconducting state. Here we present a systematic study on the Li-Fe-As system by XRD, NQR and resistivity. We synthesized samples with different nominal compositions of Li, Fe and As by solid state reaction and show that, besides stoichiometric LiFeAs, only enriching the system with Fe forms phase pure samples. The modifications due to this enrichment can be tracked by a shift of the NQR-frequency and the lattice constants. Thus NQR can be taken as a measure for the changes induced by additional Fe in Li-Fe-As. We further show that these changes are not only decreasing T_c but also cause a sudden reduction of normal state resistivity and electron-electron scattering. Altogether we therefore conclude that Fe has a charge doping effect on Li-Fe-As.

TT 25.5 Tue 10:30 H19

Superconductivity in LiFeAs probed with quasiparticle interference — •Zhixiang Sun[1], Pranab Kumar Nag[1], Danny Baumann[1], Rhea Kappenberger[1], Sabine Wurmehl[1,2], Bernd Büchner[1,2,3], and Christian Hess[1,3] — [1]Leibniz-Institute for Solid State and Materials Research, IFW-Dresden, 01069 Dresden, Germany — [2]Institute for Solid State Physics, TU Dresden, 01069 Dresden — [3]Center for Transport and Devices, TU Dresden, 01069 Dresden, Germany

In spite of many theoretical and experimental efforts on studying the superconductivity of iron-based high temperature superconductors, the puzzle about LiFeAs's superconducting mechanism and pairing symmetry are still not clear. Here we want to present our low temperature scanning tunneling microscopy results on probing the superconductivity of LiFeAs. By taking conductance spectroscopic maps for both the superconducting state and normal state, we identify the scatterings due to the electron and hole bands close to the Fermi level. We observe a strong indication that the superconducting behavior in the hole bands are important for the formation of superconductivity in LiFeAs. Our results may also shine light on understanding the superconductivity in other iron pnictide superconductors.