PC4-1-INV

Quasilinear quantum magnetoresistance in pressure-induced nonsymmorphic superconductor CrAs

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Linear magnetoresistance is a subject of high interest. The helimagnet CrAs undergoes a quantum phase transition to a nonmagnetic superconductor under pressure [1, 2]. We have measured the transverse magnetoresistance of CrAs under pressure [3]. In the pressure range close to where the superconducting transition temperature is maximised, our low-temperature magnetoresistance exhibits striking non-saturating, quasilinear magnetic field dependence up to 14 T (Figure 1a). Our bandstructure calculations reveal a subtle band crossing near the Y-point of the Brillouin zone (Figure 1b), which is protected by the nonsymmorphic crystal symmetry. In this presentation, I will show that the quasilinear magnetoresistance arises from an intricate interplay between the nontrivial band crossing and strong magnetic fluctuations.

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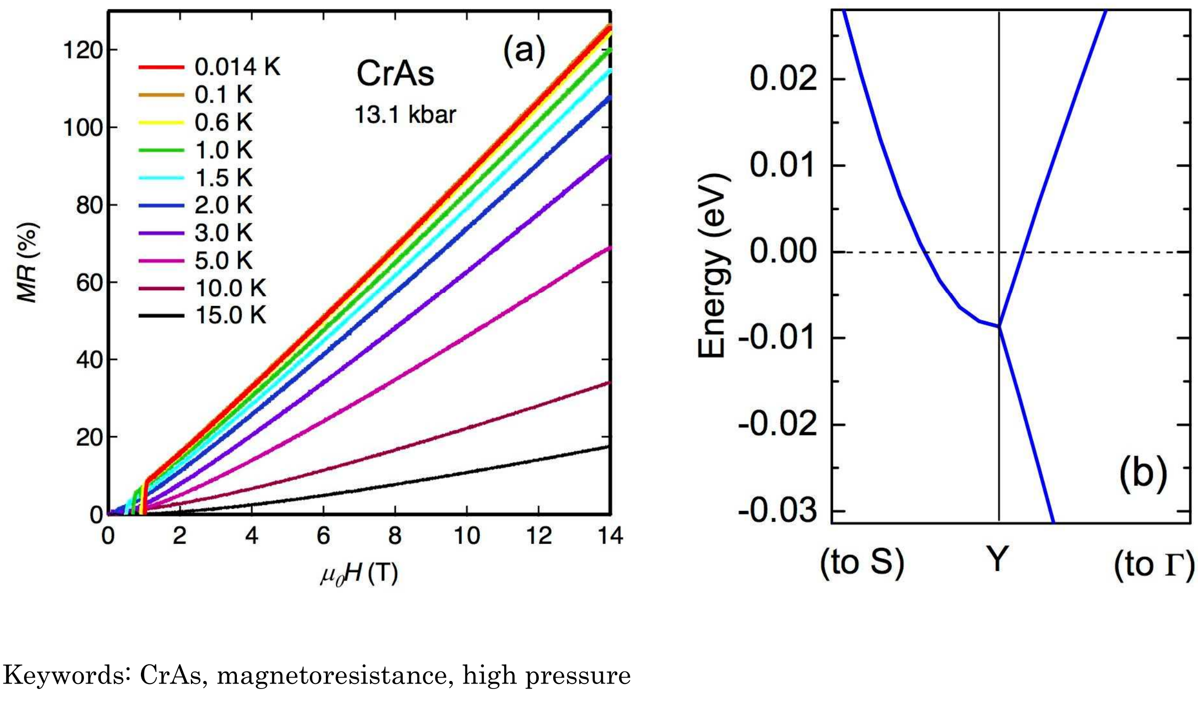

Keywords: CrAs, magnetoresistance, high pressure

PC4-2-INV

High Temperature Superconductivity and Quantum Phase Transitions in crytalline 2D Superconductors

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By direct transport and magnetic measurements, we provide fist direct evidence for high temperature superconductivity in the 1-UC FeSe films grown on insulating STO substrates with the onset Tc and critical current density much higher than those for bulk FeSe.[1] Furthermore, thickness dependent of superconductivity is carefully studied and interesting phenomena, such as superconductor-insulator transition and linear magnetoresistance, are observed.[2-5] These investigations may pave the way to enhancing and tailoring superconductivity by interface engineering.[4] Furthermore, quantum phase transition is one of most important topics in condensed matter physics. When we study the superconductor-metal transion in ultrathin cyrtalline Ga films grown on GaN substrate [6], we firstly discover quantum Griffiths singularity in two dimensional (2D) system and superconductors [7], which is a new quantum phase transition in 2D superconductors. This discovery is further revealed in LAO/STO(110) interface superconductors [8] and monolayer Ising superconductor $NbSe_2$ films[9].

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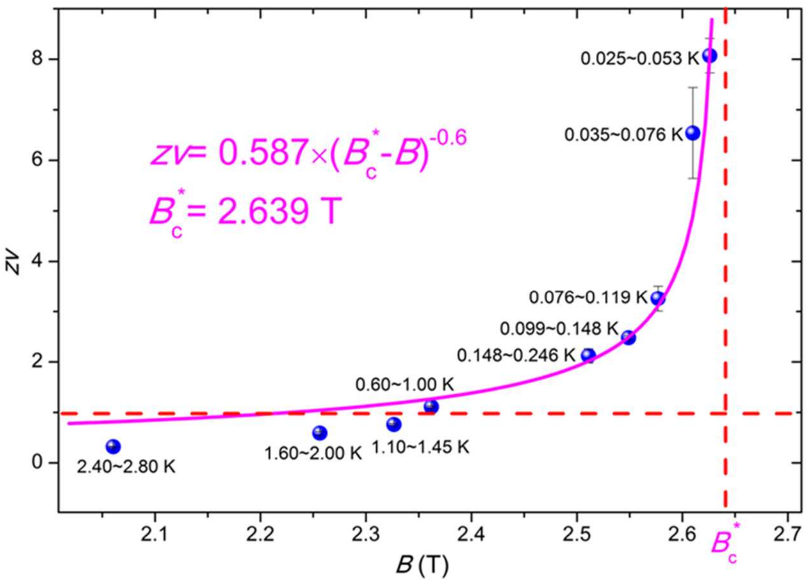

Keywords: High Temperature Superconductivity, Quantum Phase Transition, Crytalline 2D Superconductor, Quantum Griffiths Singularity

PC4-3-INV

Structural Phase Diagram and Anomalous Magnetic Properties in a Superconductor of $LnO_{1-x}F_xBiS_2$ (Ln: rare earth elements)

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Since the discovery of BiS_2-based superconductor, $Bi_4O_4S_3$ and $LnO_{1-x}F_xBiS_2$ (*Ln*: rare-earth elements) by Mizuguchi *et al.* in 2012[1, 2], we have studied physical properties of $LnO_{1-x}F_xBiS_2$ more precisely by using single crystals. Especially, we have focused on the relation between the emergence of superconductivity and crystal structure, and on the relation between the transport properties and the magnetism of the block layers, which contain *Ln* ions.

From our systematic structural investigations of $LaO_{1-x}F_xBiS_2$ by using a high-flux synchrotron X-ray diffraction, it has been revealed that $LaO_{1-x}F_xBiS_2$ has complex structural phase diagram in the *x* vs. temperature plane. Even for non F-doped compound (x=0), which was initially reported to have a tetragonal structure, a monoclinic structure with space group $P2_1/m$[3] is realized at room temperature. Recently we found that a structural phase transition to a tetragonal structure at ~ 550 K with increasing temperature, and the structure of this system is also very sensitive to *x*.

Recently we also succeeded to observing the anomalous behaviors related with magnetic freedom of *Ln* ion in $LnO_{1-x}F_xBiS_2$. For example, anomalous $-\log T$ divergence of specific heat in $CeOBiS_2$ at low temperatures[4] and a extremely heavy fermion like behaviour in C/T in Nd system as show in Fig. (b). Although these behaviors seems to be very similar to the typical heavy fermion systems such as $CeRu_2Si_2$, $CeCu_6$ and $CeNi_2Ge_2$, the mechanism should be different from ordinary one considering the electronic structure. In this presentation, we would like to present these data and discuss on the electronic structures of $LnO_{1-x}F_xBiS_2$.

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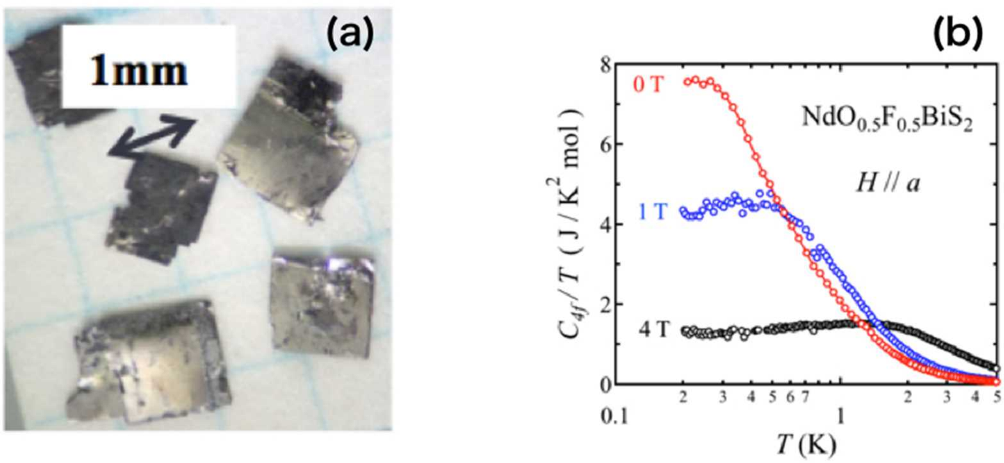

Fig. (a) Single crystals of $NdO_{0.5}F_{0.5}BiS_2$. (b) Temperature dependence of C_{4f}/T of $NdO_{0.5}F_{0.5}BiS_2$.

Keywords: BiS2-based superconductor, Single crystal, Structural phase transition, Heavy fermion like behavior

PC4-4

The superconducting anisotropy of La-$O_{0.5}F_{0.5}$-BiS_2 single crystal

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Being one of the most heavily studied members in the layered BiS_2-based superconductor family, the optimally fluorine doped La-$O_{0.5}F_{0.5}$-BiS_2 that grown under ambient pressure was found to be superconducting at transition temperature T_c ~3 K at ambient pressure [1]. Additionally, its T_c can be further enhanced to a maximum of 10 K with the application of pressure [2]. Band structure calculations have revealed a two-dimensional-like Fermi surface, implying a highly anisotropic normal state [3, 4]. In order to probe the anisotropy of the superconductivity experimentally, we measure the upper critical field of an as-grown La-$O_{0.5}F_{0.5}$-BiS_2 single crystal at ambient pressure by electrical resistivity measurement with a magnetic field oriented along the *c*-axis and the *ab*-plane, respectively. Our results show a very high superconductivity anisotropy factor γ which is also temperature dependent. Meanwhile, a pronounced upward curvature of the in-plane upper critical field $H_{c2}^{ab}(T)$ near T_c and an anomalously high $H_{c2}^{ab}(0)$ that exceeds single band Pauli limit are also observed in the *H*-*T* phase diagram. These features can be explained by two-gap model in dirty limit [5, 6], suggesting the La-$O_{0.5}F_{0.5}$-BiS_2 system to be a multigap superconductor.

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Keywords: BiS2-based superconductors, upper critical field, anisotropy, two-gap model

PC4-5

Nearly isotropic superconductivity in layered Weyl semimetal WTe_2 at 98.5 kbar

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Tungsten ditelluride WTe_2 is a layered transition-metal dichalcogenide. At ambient pressure, it exhibits no superconductivity but extremely large magnetoresistance. Superconductivity can be induced, along with the rapid suppression of the magnetoresistance, by application of a physical pressure (P) [1,2]. The superconducting phase emerges after ~30 kbar and the superconducting critical temperature (T_c) reaches a maximum at ~100–150 kbar before decreases again [1,2], thus forming a dome-shaped T_c(P). WTe_2 was originally considered to be electronically 2-dimensional because of the layered structure. Interestingly, subsequent experiments including transport [3] and spectroscopic measurements [4] reveal that the electronic structure is in fact a three-dimensional system at ambient pressure. Here, we present the angular and temperature dependence of the upper critical field of WTe_2 under 98.5 kbar down to 30 mK. Our results reveal a remarkably small and temperature-independent anisotropy factor (=$H_{c2//ab}/H_{c2//c}$), leading to our conclusion that the superconducting state in WTe_2 is nearly isotropic.

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Keywords: WTe2, High pressure, Upper critical field anisotropy

PC4-6

Strong Pauli Paramagnetic Effects in the Quasi-Two-Dimensional Superconductor Restacked TaS_2 Nanosheets

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Recently we reported an enhanced superconductivity in restacked monolayer TaS_2 nanosheets compared with the bulk TaS_2, pointing to the exotic physical behaviors of low dimensional systems. Here we tune the superconducting properties of this system with magnetic field along different directions. It is found that the present system bears a strong Pauli paramagnetic spin-splitting effects under high fields. Importantly, an unusual angular dependence of the upper critical field deviating from the Ginzburg-Landau model (GL model) and Thinkham model is observed, showing a strong evidence for the presence of triplet component of the superconducting order parameter in the mixed state. Moreover, with the vertical field fixed, we find that the superconducting transition temperature Tc can be enhanced by increasing the transverse field and forms a dome-shaped phase diagram. The present finding is significant in the viewpoint of fundamental physics and may also facilitate the applications of low-dimensional superconductors in the environment of high field.

Keywords: Pauli Paramagnetic Effects, Low-Dimensional Superconductors, Restacked TaS2 Nanosheets