PC3-1-INV

On the interfacial superconductivity of FeSe/STO

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Recently, interfacial superconductivity up to 75K has been discovered in FeSe/STO and FeSe/BTO interfaces [1,2]. We combine angle resolved photoemission spectroscopy (ARPES), scanning tunneling microscopy (STM) and molecular beam epitaxy (MBE) to study the superconductivity at interfaces and surfaces. Based on the impurity effects and quasiparticle interference behaviors revealed in our STM data, we found that the pairing symmetry of FeSe/STO is the plain *s*-wave type [3]. Moreover, with surface electron doping, the FeSe thick film exhibits an anomalous phase diagram with a correlated insulating phase and a superconducting phase with Tc up to 46K [4]. By placing such a heavily electron doped FeSe superconducting layer closer to the FeSe/STO interface, its superconducting gap increases exponentially to the single layer FeSe/STO value [5], which resembles the behavior of the STO phonon strength measured by EELS [6]. Our results demonstrate the critical role of interfacial electron-phonon interactions in the high Tc of FeSe/STO interface.

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Keywords: interfacial superconductivity, FeSe/STO, ARPES, STM

PC3-2

Effect of orbital ordering on charge dynamics in $FeSe_{1-x}Te_x$ studied by optical spectroscopy

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For most iron-based superconductors, the superconducting phase emerges in the vicinity of the antiferromagnetic-orthorhombic (AFO) phase. However, FeSe exhibits the tetragonal-to-orthorhombic structural phase transition at $T_s \sim$ 90 K, below which the orbital ordering was observed, without accompanying the magnetic phase transition. Although the change in the band structure across T_s has been intensively studied, the effect of the orbital ordering on the charge dynamics remains unclear.

In this work, we performed optical spectroscopy for $FeSe_{1-x}Te_x$ thin films (x = 0, 0.1, 0.2, and 0.4) on CaF_2 substrates grown by the pulsed laser deposition method [1]. One of the advantages of using thin films is that the measurement can be carried out on Te-substituted compositions which are unstable for bulk samples. No abrupt change in the optical spectrum of FeSe was observed across T_s, in contrast with the case of iron pnictides showing the AFO phase, in which a clear gap feature is observed. Below T_s, the weight of a coherent Drude component decreases with decreasing temperature, indicative of a gradual suppression of the coherent carrier density [2]. This highlights a peculiar metallic state in FeSe that the Fermi surface gradually modified with temperature. For x = 0.2 and 0.4, the coherent Drude weight does not change for the whole temperature range investigated in the present study. This indicates that the orbital order is suppressed by Te substitution, consistent with a recent transport study [3].

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Keywords: Iron chalcogenide, Thin film, Optical spectroscopy

PC3-3

High-Resolution ARPES Study of Quasiparticle Band Dispersion in Electron-Doped FeSe Thin Films

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The recent discovery of high-temperature (T_c) superconductivity in one- monolayer FeSe thin films has attracted considerable attention [1-3] because the T_c value of ~65 K is the highest among iron-based superconductors despite the low T_c (<10 K) character of bulk FeSe crystal. One of the key ingredients to trigger high-T_c superconductivity in one-monolayer FeSe is electron doping [2-4] which results in unique Fermi-surface topology distinct from that in bulk iron-based superconductors. To understand the origin of T_c enhancement by electron doping, we have fabricated high-quality electron-doped FeSe thin films and investigated their electronic structure by high-resolution angle-resolved photoemission spectroscopy (ARPES). In this presentation, we report the evolution of the quasiparticle band dispersions as a function of temperature and discuss the relationship with the emergence of high-T_c superconductivity.

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Keywords: FeSe, Electronic structure, Angle-resolved photoemission spectroscop

PC3-4-INV

Superconductivity in the Noncentrosymmetric Iridium Phosphide ScIrP

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5*d* band metals of heavy elements such as Ir and Pt are promising candidate to show unconventional superconductivity caused by the strong spin-orbit interaction of heavy 5*d* atoms. Typical examples are platinum boride and arsenide superconductors Li_2Pt_3B and SrPtAs; the spin triplet pairing is reported to be dominant in the former, while the chiral *d*-wave or other unconventional pairings are theoretically predicted in the latter. Moreover, many Ir- or Pt-based superconductors have been discovered in recent years, indicating they are one of the hot spots for the search for novel superconductors.
Here we report the discovery of a bulk superconducting transition at 3.4 K in the ternary iridium phosphide ScIrP [1]. ScIrP crystallizes in the hexagonal ordered Fe_2P-type structure with a noncentrosymmetric space group of *P*-62*m* (left figure) [2]. We prepared polycrystalline samples of ScIrP by a solid state reaction method. As shown in the right figure, electrical resistivity and magnetization show a sharp drop to zero and a strong diamagnetic signal at 3.4 K, respectively, indicating a bulk superconducting transition occurs at this temperature. On the basis of heat capacity data in a zero magnetic field, ScIrP is suggested to be a weakly-coupled BCS superconductor. Alternatively, experimental results under magnetic fields indicate that this material is a type-II superconductor with an upper critical field H_{c2} above 5 T at zero temperature. This moderately high H_{c2} does not violate the Pauli limit, but it does imply that there is a significant effect from the strong spin-orbit interaction of 5*d* electrons in the noncentrosymmetric crystal structure. *The work has been done in collaboration with T. Inohara, H. Nagaso, Y. Yamakawa, A. Yamakage, and K. Takenaka (Nagoya University).

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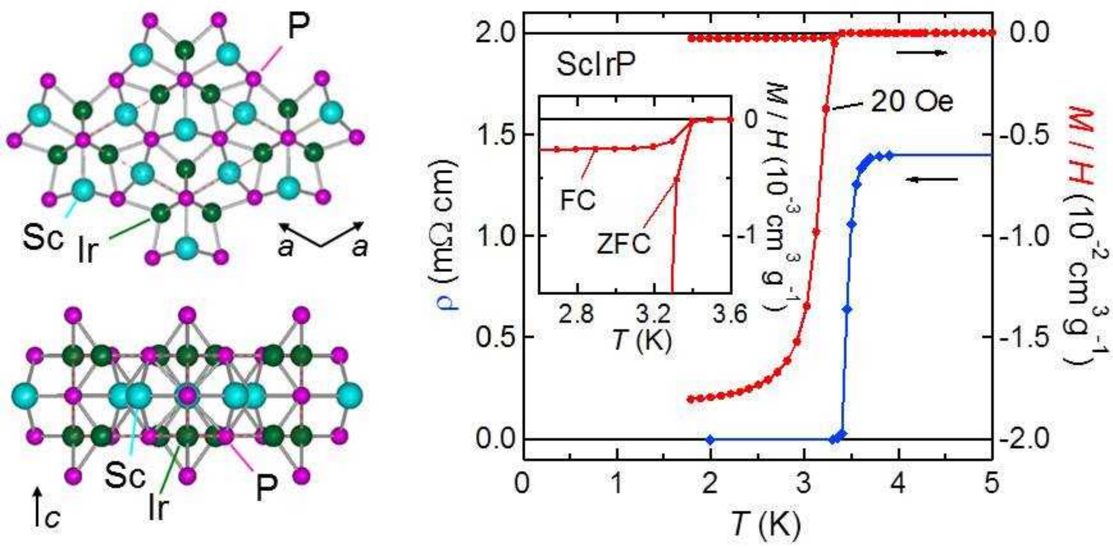

Fig. (left) Crystal structure of ScIrP. (right) Temperature dependence of electrical resistivity and magnetization of a polycrystalline sample of ScIrP.

Keywords: 5d electron system, iridium phosphide

PC3-5-INV

Nonlinear superconducting transport in noncentrosymmetric superconductors

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Symmetry breaking of crystal is known to affect the electric transport, offering a variety of novel properties and functionalities in solids. Among them, noncentrosymmetric superconductors have been studied as the basic platform and attracting much interest from both fundamental and technological view point. Nonlinear magnetotransport, in which magnetoresistance for forward and backward current are not equivalent, is one of the manifestations of the lattice symmetry breaking in electric transport. Although there have been several studies of such an asymmetric electric transport in chiral and polar materials [1,2], reports on the nonlinear transport in superconducting phase is elusive.
In this presentation, I will report the observation of the nonlinear superconducting transport in noncentrosymmetric superconductors. Such superconductivity without space inversion symmetry is realized in nanostructures of transition metal dichalcogenides via ionic liquid gating. In two-dimensional MoS_2, nonlinear second harmonic voltage signals are largely enhanced in electric-field-induced superconducting state, showing the characteristic selection rule (presence of absence of signals as a function of electric current directions) [3].
We also studied the electric-field-induced superconductivity in a chiral WS_2 nanotube[4]. **Second harmonic signals originating from the tube chirality also show the large enhancement in superconducting region and characteristic quantum oscillations due to the quantum interference of supercurrent along the circumference of the nanotube have been observed.**
These results imply the universality of unidirectional superconducting transport and also provide a powerful approach for probing the exotic superconducting state in noncentrosymmetric superconductors.

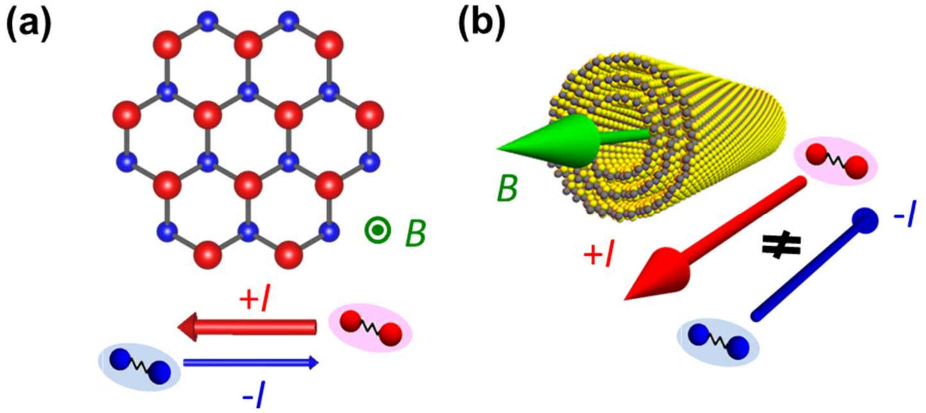

Fig.Nonlinear superconducting transport in (a) MoS_2 and (b) WS_2 nanotube

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Keywords: Noncentrosymmetric syperconductor, Nonlinear transport, Transition metal dichalcogenides, Ionic liquid gating