Prof. Cho, Beongki

광주과학기술원 신소재공학부
School of Materials Science & Engineering

School Seminar (2015-13)

School of Materials Science & Engineering

"Evolution of superconducting gap structure in $(Ba_{1-x}K_x)Fe_2As_2$ studied by London penetration depth with electron irradiation"

Dr. Cho, Kyuil

(Ames Laboratory & Iowa State Univ., USA)

2015. 05. 18. (Mon.) 16:00

APRI 1F, Auditorium Hall

Title: Evolution of superconducting gap structure in $(Ba_{1-x}K_x)Fe_2As_2$ studied by London penetration depth with electron irradiation.

Speaker: Kyuil Cho, Assistant scientist in the Ames Laboratory, USA

Abstract: The discovery of iron-based superconductor (IBS) in 2008 was among the most significant breakthroughs in condensed matter physics in the past decade. It has attracted a significant experimental and theoretical effort due to its rather high critical temperature of 56 K, close proximity to antiferromagnetism and unconventional superconducting mechanism. Among diverse families of IBS, $(Ba_{1-x}K_x)Fe_2As_2$ is one of most interesting compounds which shows a dramatic change of the superconducting gap structure with increasing K- content: from the full s-wave gap at optimally doped compounds (x = 0.47) to the line nodal gap in over-doped compound (x > 0.8). We extensively studied high quality single crystals of $(Ba_{1-x}K_x)Fe_2As_2$ with various K-content (x = 0.22 (T_c = 16 K), 0.25, 0.34, 0.47 (T_c = 38 K), 0.56, 0.65, 0.80, 0.83, 0.9, 0.92, 1.0 (T_c = 3.6 K)) by measuring the London penetration depth and found an anomalous behavior near x = 0.8 which might be related to the transition of gap structure from the s-wave full gap to the nodal gap. In addition, we also studied the disorder dependence of the superconducting gap structure since the different gap structure is expected to respond in different ways upon introduction of disorder. The artificial disorder was generated by conducting electron irradiation (up to 3.4 C) in LSI, Ecole polytech in France (2.4 MeV source). In this talk, I will discuss experimental findings and corresponding theoretical models.

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Kyuil Cho

Assistant Scientist
Ames Laboratory and Iowa State University

Email : kcho@ameslab.gov
Phone(Office): 1-515-294-4908
Phone(Lab) : 1-515-294-7249
Mail : A117 Zaffarano Hall
Ames Laboratory and Iowa State University
Ames, IA 50011-3020

Research Interests

1) Strongly correlated electron systems.

2) Unconventional superconductivity in high-T_c (Fe-based and cuprate), heavy Fermion, and organic superconductors.

3) Coexistence of superconductivity with magnetism.

4) Quantum phase transition.

5) Implementation of Tunnel diode resonator (TDR) technique under high pressure.

Selected Publications

6) K. Cho, M. A. Tanatar, N. Spyrison, H. Kim, Y. Song, P. Dai, C. L. Zhang, and R. Prozorov, "Doping-dependent anisotropic superconducting gap in $Na_{1-d}(Fe_{1-x}Co_x)As$ from London penetration depth", Physical Review B 86, 020508 (R) (2012).

5) K. Hashimoto, K. Cho, T. Shibauchi, S. Kasahara, Y. Mizukami, R. Katsumata, Y. Tsuruhara, T. Terashima, H. Ikeda, M. A. Tanatar, H. Kitano, N. Salovich, R. W. Giannetta, P. Walmsley, A. Carrington, R. Prozorov, and Y. Matsuda, "A Sharp Peak of the Zero-Temperature Penetration Depth at Optimal Composition in $BaFe_2(As_{1-x}P_x)_2$", **Science 336, 1554 (2012)**.

4) K. Cho, M. A. Tanatar, H. Kim, W. E. Straszheim, N. Ni, R. J. Cava, and R. Prozorov, "Doping-dependent superconducting gap anisotropy in the two-dimensional pnictide $Ca_{10}(Pt_3As_8)[(Fe_{1-x}Pt_x)_2As_2]_5$", Physical Review B 85, 020504(R) (2012).

3) K. Cho, H. Kim, M. A. Tanatar, J. Hu, B. Qian, Z. Q. Mao, and R. Prozorov, "Precision global measurements of London penetration depth in $FeTe_{0.58}Se_{0.42}$", Physical Review B 84, 174502 (2011).

2) K. Cho, H. Kim, M. A. Tanatar, Y. J. Song, Y. S. Kwon, W. A. Coniglio, C. C. Agosta, A. Gurevich, and R. Prozorov, "Anisotropic upper critical field and possible Fulde-Ferrel-Larkin-Ovchinnikov state in the stoichiometric pnictide superconductor LiFeAs", Physical Review B 83, 060502(R) (2011).

1) K. Cho, B. E. Smith, W. A. Coniglio, L.Winter, C. C. Agosta, and J. A. Schlueter, "Upper critical field in the organic superconductor b"-$(ET)_2SF_5CH_2CF_2SO_3$: Possibility of Fulde-Ferrell-Larkin-Ovchinnikov state", Physical Review B 79, 220507(R) (2009).