Spring, 2012 Date of Issue: April 16, 2012
Superconductivity Web21
Published by International Superconductivity Technology Center
1-10-13, Shinonome, Koto-ku, Tokyo 135-0062, Japan Tel: +81-3-3536-7283, Fax: +81-3-3536-5717

Feature Articles: ISS2011
- Physics, Chemistry, and Magnetic Flux Physics

Hiroshi Kontani, Associate Professor
Department of Physics
Nagoya University

There were a total of 32 oral presentations (including one keynote lecture) and 75 poster presentations at this year's ISS2011. This year again saw many presentations pertained to iron-based superconductors (18 oral presentations). Even though three and a half years have passed since the discovery of these materials, it was clearly evident that research into this material system is still popular as ever. Research efforts have focused on the possible existence of a sign-reversing gap function at superconducting states (s±wave states, s++wave states), as well as new many-electron states (e.g. two-fold (nematic) symmetric electronic structure not accompanied by a lattice deformation). This article focuses on iron and copper oxide based high temperature superconductors.

Dr. Analytis (Stanford University) reported the remarkable in-plain anisotropy of electrical resistance in the orthorhombic phase and in the electron nematic symmetry states of $Ba(Fe,Co)_2As_2$ and $BaFe_2(As,P)_2$. Dr. Yoshizawa (Iwate University) reported the significant softening of the elastic constant C_{66} in the tetragonal phase of $Ba(Fe,Co)_2As_2$, emphasizing the existence of orbital fluctuations in an iron-based superconductor. On the other hand, Dr. Fernandes (Colombia University) presented a theoretical report regarding the spin nematic symmetry derived from spin fluctuations. Dr. Machida (Japan Atomic Energy Agency) reported their research findings for orbital order based on a first-principle calculation approach. From experiments of transport phenomena and magnetic penetration depth, Dr. Kasahara (Kyoto University) clarified the existence of a quantum critical point in $BaFe_2(As,P)_2$. Furthermore, Dr. Li (National Institute for Materials Science) argued the possibility of s++wave states since the effect of impurities on T_C is small for $(Ba,K)Fe_2As_2$, while Dr. Nabeshima (The University of Tokyo) argued the possibility of s±wave states by measuring the effects of impurities in Fe(Se,Te). Dr. van der Beek (Ecole Polytechnique) indicated that considered the pinning strength of quantum flux, $Ba(Fe,Co)_2As_2$ was a dirty superconductor that would contradict the s±wave states. Dr. Tamegai (The University of Tokyo) reported the effects of radiation on the measured critical currents in (Ca, RE)Fe_2As_2, a 122 system with the highest reported T_C. Dr. Okada (The University of Tokyo) argued the superconducting symmetry in LiFeAs by measuring microwaves.

The development of new iron-based superconductor materials is currently very vigorous, with a number of interesting reports highlighting the research undertaken. Dr. Guo (National Institute for Materials Science) and Dr. Zhang (Chinese Academy of Science) reported on the electron states and the lattice structure of $K_xFe_2Se_2$, a new iron-based superconductor that has sparked interest due to it having a no hole-like Fermi surface. Dr. Shirage (National Institute of Advanced Industrial Science and Technology) and Dr. Katagiri (Tokyo Institute of Technology) reported on composite materials comprised of a so-called perovskite structure iron-based superconductor, detailing its superconducting states. Dr. Nakajima (The University of Tokyo) also reported on the superconducting states of a new superconductor, $Lu_2Fe_3Si_5$.

This symposium also addressed the latest research findings on copper oxide high temperature superconductor. Dr. Fujita (Cornell University) showed the existence of nematic order in the pseudo-gap regime from accurate STM/S measurements. Dr. Yamamoto (NTT) highlighted that using pure thin films of

Superconductivity Web21

Published by International Superconductivity Technology Center
1-10-13, Shinonome, Koto-ku, Tokyo 135-0062, Japan Tel: +81-3-3536-7283, Fax: +81-3-3536-5717

Pr_2CuO_4 and Nd_2CuO_4 fabricated by Molecular Beam Epitaxy, superconducting states were present without the need of carrier doping. Dr. Nojima (Tohoku University) successfully fabricated n-type metal from a p-type composite YBCO by an electrostatic carrier doping technique.

(Published in a Japanese version in the December 2011 issue of *Superconductivity Web 21*)

Top of Superconductivity Web21