MAR14-2013-020219

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Strong electronic correlations in iron pnictides: Comparison of the optical spectra for $BaFe_2As_2$-related compounds

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The role of electronic correlations in iron pnictides is one of the hottest issues in research of iron-based superconductors. Utilizing optical spectroscopy, we quantified the strength of electronic correlations in $BaFe_2As_2$-related compounds. For the parent compound $BaFe_2As_2$, the fraction of the coherent spectral weight in the low-energy optical conductivity spectrum is distinctly small. Such a spectral feature is also observed in KFe_2As_2, indicating that the charge dynamics is highly incoherent in iron arsenides. It is found that the strength of electronic correlations significantly changes by chemical substitution, either through changing the electron filling and/or the As-Fe-As bond angle. The present result indicates that superconductivity of the iron pnictides emerges when the materials possess adequate amount of electronic correlations, and that either too weak or too strong correlations are not favorable for high-T_c superconductivity. The degree of electronic correlations in iron arsenides turns out to be comparable to that in the hole-underdoped cuprate superconductors. In this sense, the iron arsenides are classified into strongly correlated systems, probably arising from the Hund's rule coupling. This work was done in collaboration with S. Ishida, K. Kihou, Y. Tomioka, C. H. Lee, A. Iyo, T. Ito, H. Eisaki (AIST), T. Tanaka, T. Kakeshita, S. Uchida (University of Tokyo), T. Saito, H. Fukazawa, and Y. Kohori (Chiba University).