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Electronic structure studies of Ba/EuFe₂As₂ based superconductors by angle and time-resolved photoemission spectroscopy

JOERG FINK, Helmholtz-Zentrum Berlin/ IFW Dresden

We report high-resolution ARPES studies on the evolution of the electronic structure of Ba/EuFe₂As₂ compounds upon n-type doping by replacing Fe by Co and applying chemical pressure by substituting As by P. In particular, we have investigated the nesting conditions between the hole pockets in the centre and the electron pocket at the corner of the Brillouin zone (BZ) for various wave vectors perpendicular to the FeAs layers. In the case of chemically doped systems we observe a shift of the Fermi level in an almost rigid band system. These changes of the electronic structure upon doping cause a reduction of the nesting conditions, possibly yielding a microscopic explanation of the phase diagrams in which antiferromagnetic (AF) order is destroyed, followed by the appearance and disappearance of superconductivity at higher doping concentration. On the basis of the almost equivalent phase diagram obtained upon chemically pressurizing the compound, one expects a similar change of the electronic structure. However, in this case, with increasing P concentration, we observe a non-rigid-band-like change of the electronic structure in the centre of the BZ. In spite of this difference, also here the nesting conditions decrease with increasing P substitution, possibly providing a microscopic explanation for the phase diagram. Finally, we have performed femtosecond time-resolved ARPES studies on undoped and doped Ba/EuFe₂As₂ after optical pumping. Regarding the relaxation processes we obtain information on the complex dynamics of the excited electronic state in these semi metallic systems. Furthermore, we derive a small electron-phonon coupling constant making electron-phonon coupling an unlikely candidate for the mechanism of high- T_c superconductivity in these compounds. This work is performed in collaboration with S. Thirupathiah, E. Rienks, H. A. Dürr, S. de Jong, E. van Heumen, E. Slooten, Y. Huang, R. Huisman, M. S. Golden, L. Rettig, R. Cortes, U. Bovensiepen, M. Wolf, A. Erb, T. Wolf, H.S. Jeevan, P. Gegenwart.