Studies of iron pnictide superconductors from 112 and 122 families using synchrotron radiation

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Superconductivity in high-temperature superconductors is very often achieved by chemical doping, which results in transfer of electrons or holes between elements. This charge transfer can be tracked only by few experimental techniques. One of them is nuclear magnetic resonance, which was successfully used to study charge transfer in the cuprates by measuring resonances of ^{63}Cu and ^{17}O [a]. In iron pnictide superconductors, due to properties of ^{57}Fe nucleus, such studies are not possible. Here, one can use x-ray absorption spectroscopy (XAS). During the presentation XANES and EXAFS results carried out on Fe and As *K* edges of several compounds from 112 and 122 families, namely $EuFeAs_2$ and $EuFe_2As_2$ doped with Co or Ni, will be presented. It was found that changes in the crystal and electronic structures are rather small, but for almost all compounds we observed an increase of the electron population at the Fe site with its simultaneous decrease at the As site, which indicates a redistribution of electronic charge caused by the doping [b]. These measurements were conducted thanks to the CERIC-ERIC Consortium. In the last part of the talk, it will be shown that nematicity observed in iron pnictides might be related to uneven occupation of Fe *d* orbitals, which we studied using x-ray linear dichroism of Fe $L_{2,3}$ absorption edge [c].

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b) J. Stępień, D. Rybicki, M. Sikora, Z. Bukowski, M. Babij, Ł. Gondek, Cz. Kapusta, T. Strączek, K. Goc, D. Oliveira De Souza, *Effects of Ni/Co doping on structural and electronic properties of 122 and 112 families of Eu based iron pnictides*, Sci. Reports, 13 (2023), 10.1038/s41598-023-40419-8
c) D. Rybicki, M. Sikora, J. Stępień, Ł. Gondek, K. Goc, T. Strączek, M. Jurczyszyn, Cz. Kapusta, Z. Bukowski, M. Babij, M. Matusiak, M. Zając, *Direct evidence of uneven d_{xz} and d_{yz} orbital occupation in the superconducting state of iron pnictide*, Phys. Rev. B, 102 (2020), 10.1103/PhysRevB.102.195126

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Short bio:

Rybicki Damian, born in Poland. Graduated from AGH University of Krakow, Poland. PhD obtained at this university and Charles University in Prague, Czechia under supervision of Prof. C. Kapusta and Prof. H. Stepankova. After obtaining PhD degree worked for 7 years at the Leipzig University, Germany in a group of Prof. J. Haase. Currently holds a position of associate professor at the AGH University. Since the beginning of the research career used nuclear magnetic resonance and synchrotron radiation techniques, mostly x-ray absorption spectroscopy, to study electronic properties of magnetic systems (Eu compounds) and high-temperature superconductors (cuprates and iron pnictides).