polish synchrotron radiation society

International School and Symposium
on Synchrotron Radiation in Natural Science
Krakow, Poland, 22-25 August 2022

Comparison of 112 and 122 iron pnictides families from the perspective of XAS spectroscopy

Poster/Oral Presentation
Date of presentation
Time of presentation

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Iron pnictides are a family of superconductors with the second highest T_c- values after the cuprates and currently are actively studied with hope to understand what is responsible for setting their T_c value and how to increase it. There are several families of iron pnictides known. One of the most intensively studied is the 122 family (e.g. $EuFe_2As_2$). In this family superconductivity can be induced by mechanical pressure, isovalent substitution and by electron or hole doping e.g. on Fe or As sites. Chemical doping raises a question where the doped charge is localized and how it changes electronic properties of materials leading to superconductivity but also affecting magnetic order and nematic order.

In Eu based compounds from the 122 family, besides magnetic order (spin density wave) of Fe, also Eu magnetic moments order at low temperature (with ordering temperature T_{Eu}≈20 K) and this magnetic order coexists with superconductivity. Recently Eu containing 112 family has been successfully prepared with superconductivity first achieved by La doping in $Eu_{1-x}La_xFeAs_2$ [1]. The most notable difference between 122 and 112 families is their crystal structure. In 122 families there are two alternating layers: of Eu and FeAs while in the 112 family every second FeAs layer is replaced by As in zigzag chains. Interestingly, the stoichiometric $EuFeAs_2$ compound reveals Eu magnetic moments ordering at significantly higher temperature (T_{Eu}≈40 K) than $EuFe_2As_2$. Moreover, superconductivity in 112 family can be achieved by Co and Ni doping [2] with maximum T_c≈17 K. This is in contrast to the 122 family, for which $Eu(Fe_{1-x}Co_x)_2As_2$ is superconducting, while $Eu(Fe_{1-x}Ni_x)_2As_2$ is *not*.

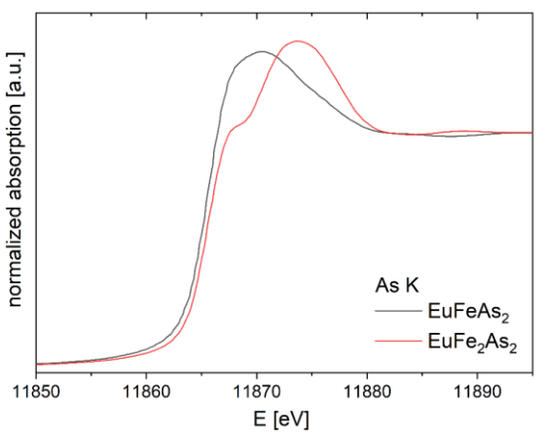

Figure.1. As K edge of undoped samples of both iron pnictides families.

To verify the influence of Co and Ni doping on electronic and structural properties of iron pnictides a comprehensive set of XAFS measurements (at absorption edges of Fe, Ni, Co and As) were performed on both, the $EuFe_2As_2$ family and the recently obtained $EuFeAs_2$ family, and modeled by means of FDMNES code. Preliminary results show a significant differences between As K-edge XAS of undoped samples from both families as shown in Figure 1. Introduction of dopants influences the measured shape of As K-edge only for the 112 family, but not for the 122 family. On the other hand, Fe K-edge spectra show much smaller changes in shape between undoped 112 and 122 and no significant shape evolution upon doping. This leads us to the conclusion that introduction of transition metal dopants does not change crystal structure for the 122 family - hence the

source of different transport properties of the Co doped samples is due to changes of the electronic rather than structural properties. On the other hand, the slight structural relaxations observed in 112 family may contribute to the emergence of superconductivity in $Eu(Fe_{1-x}Ni_x)As_2$.

Acknowledgements: This work was supported by the National Science Centre, Poland (Grant No. 2018/30/E/ST3/00377). Z.B. and M.B. acknowledge financial support from the National Science Centre, Poland (Grant No. 2017/25/B/ST3/02868). The authors acknowledge the CERIC-ERIC Consortium for the access to experimental facilities: XAS and XAFS beamlines at SOLARIS and ELETTRA synchrotrons.

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