



Contribution ID: 150

Type: ORAL CONTRIBUTION

Density of Phonon States at the Fe Sites in Superconducting FeSe as Function of Temperature and Pressure

Wednesday 15 September 2010 12:10 (20 minutes)

The temperature and pressure dependence of the partial density-of-phonon states (phonon-DOS) at the iron sites in superconducting (sc) Fe_{1.01}Se was studied by ⁵⁷Fe nuclear inelastic scattering (NIS) of synchrotron radiation, a method well adapted for these studies as function of temperature and pressure [1,2]. As proved by a recent study of the isotope effect at the Fe sites on the sc temperature T_c in FeSe, superconductivity is intrinsically connected with the Fe phonon modes [3]. The sc properties of the present Fe_{1.01}Se sample and their pressure dependencies were well characterized in previous studies using various methods, including ⁵⁷Fe-Mössbauer spectroscopy [4-7]. The high energy resolution in the present ⁵⁷Fe-NIS study allows for a detailed observation of spectral properties in the phonon-DOS not observed before, e.g. shifts of all spectral features to higher energies by $\sim 4\%$ with decreasing temperature from 296 K to 10 K. No detectable changes in the partial Fe phonon-DOS were observed at the tetragonal-orthorhombic transition around 100 K [7,8]. An applied pressure of 6.7 GPa, combined with an increase of the sc temperature T_c from 8 K to 34 K [8], resulted in an increase of the optical phonon-mode energies by $\sim 12\%$, and an even more pronounced increase in energies of the lowest-lying transversal acoustic modes. Despite of these strong pressure-induced changes in the partial Fe phonon-DOS we conclude that the pronounced increase of T_c in Fe_{1.01}Se with pressure cannot be described in the framework of classical electron-phonon coupling [8]. This suggests the importance of spin fluctuations for the observed superconductivity [9]. The present results are discussed in conjunction with the phonon-DOS of FeSe_{0.5}Te_{0.5} X-tals, studied including its polarization dependence by ⁵⁷Fe-NIS [10], where $T_c = 15$ K was observed at ambient pressure. Finally we present a synopsis of the complementary information on the sc Fe_{1.01}Se and FeSe_{0.5}Te_{0.5} systems, obtained from the elastic channel, ⁵⁷Fe-ME [4-7], as well as from the inelastic channel, ⁵⁷Fe-NIS [8, 10], of the ⁵⁷Fe(14.4 keV)-Mössbauer resonance. References: * wortmann@physik.upb.de [1] A.I. Chumakov et al., Phys. Rev. B 54, R9596 (1996). [2] R. Lübbbers, H.F. Grünsteudel, A.I. Chumakov, G. Wortmann, Science 287, 1250 (2000). [3] R. Khasanov et al., arXiv:1002.2510.v1. [4] T.M. McQueen et al., Phys. Rev. B 79, 014522 (2009). [5] S. Medvedev et al., Nature Mater. 8, 630 (2009). [6] V. Ksenofontov et al., contribution to this conference. [7] T.M. McQueen et al., Phys. Rev. Lett. 103, 057002 (2009). [8] V. Ksenofontov et al., Phys. Rev. B (in print); see arXiv:1004.2007. [9] T. Imai et al., Phys. Rev. Lett. 102, 177005 (2009). [10] V. Ksenofontov, G. Wortmann, T. Gasi, J. Deisenhofer, V. Tsurkan, C. Felser (unpublished)

Are you a student, a delegate from developing countries or a participant with physical needs and would like to apply for a sponsored accomodation. Please answer with yes or no.

no

Please specify whether you would prefer an oral or poster contribution.

oral

Author: Prof. WORTMANN, Gerhard (2Department Physik, Universität Paderborn)

Co-authors: CHUMAKOV³, A.I. (European Synchrotron Radiation Facility); FELSER, C (Institut Anorg. Analyt. Chemie, Universität Mainz); CAVA, R. J. (Department of Chemistry, Princeton University); MEDVEDEV, S (Institut Anorg. Analyt. Chemie, Universität Mainz); GASL, T (Institut Anorg. Analyt. Chemie, Universität Mainz); MCQUEEN, T. M. (Department of Chemistry, Princeton University); KSENOFONTOV, V (Institut Anorg. Analyt. Chemie, Universität Mainz)

Presenter: Prof. WORTMANN, Gerhard (2Department Physik, Universität Paderborn)

Session Classification: LATTICE DYNAMICS, ION-SOLID INTERACTIONS

Track Classification: Lattice Dynamics, Ion-Solid Interaction