^{75}As NMR Investigations on $BaFe_{1.993}Mn_{0.007}As_2$ Single Crystal

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Introduction

The recent discovery of high-Tc superconductivity in Fe-based materials[1] has accelerated further investigations on related compounds of this new family of superconductors.[2] The 3d electrons originating from the FeAs layers form multiple bands at the Fermi level and play an important role in superconductivity (SC). In particular, undoped compounds commonly exhibit a structural phase transition with an adjacent antiferromagnetic (AFM) order and a "so called" nematic order is claimed to play an important role on these transitions. Hence, the relation between the magnetic order and structural distortion is one of the vital issues in the investigations of such compounds.

Mn-doped $BaFe_2As_2$ (122) is an oxygen-free iron-arsenide. At room-T, $Ba(Fe_{1-x}Mn_x)_2As_2$ crystallizes in a tetragonal (T) structure with the space group symmetry of I4/mmm, but for low doping, the system undergoes a structural and magnetic phase transition to an orthorhombic (O) structure with the space group Fmmm and a striped AFM with the space group Fcmm'm, similarly to what is observed for other transition metal dopants.

Experimental

$BaFe_{1.993}Mn_{0.007}As_2$ single crystals were grown by In-flux technique [3]. The NMR spectra were taken as field swept at fixed temperatures in the 4 K – 150 K range and magnetic fields around 13.5 T. The sample was aligned so that the magnetic field was applied either parallel or perpendicular to the crystallographic c-axis.

Results and Discussion

We have observed a central transition with very narrow line width, indicating high crystallographic quality. Our NMR data suggest coexistence of tetragonal/paramagnetic (T/PM) and orthorhombic/SDW (O/SDW) phases in a ~ 7 K range, as shown in Fig. 1. These complementary results are in consonance with our previous investigation on K [4], Cu and Co-substituted Ba122 [5].

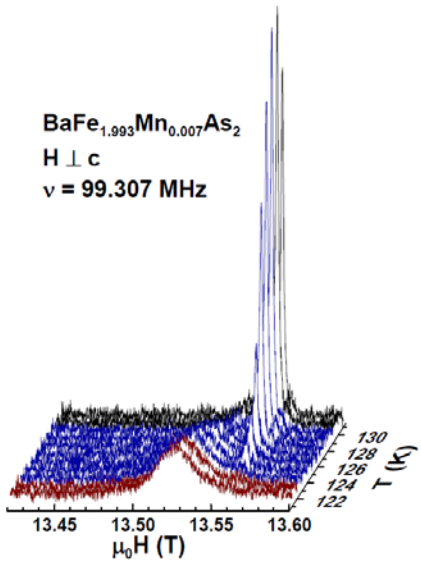

Fig. 1 ^{75}As NMR signal across the transition with magnetic field perpendicular to the *c*-axis for Mn substituted BaFe2As2.

Conclusions

Our NMR results support the high quality of our In-flux grown samples and, due to such a high quality, we have observed coexistence of T/PM and O/SDW phases in the same temperature range for different substituting atoms, which indicate that this is inherent to the as grown single crystals of the Ba122 family. These NMR results have provided strong support to previous papers [4,5] and are forming the basis to another that will come out soon.

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References

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