Magnetic structure in $FeTe_{0.92}$

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The discovery of Fe-based superconductor has led to intensive studies on related superconductors including iron group. They possess a FeX (X=As, Se,Te) layer in their structure and their non-doped counterparts commonly exhibit an antiferromagnetic (AF) ordering with an adjacent structural phase transition from tetragonal to orthorhombic structure. A precise understanding of the magnetic properties among the related compounds would provide a useful guideline for understanding the superconductivity.

$FeTe_{0.92}$ shows the AF ordering at ~ 70 K with a structural transition from a high-temperature tetragonal phase to a low-temperature monoclinic phase. Figure 1 (a) displays observed, calculated, and difference neutron diffraction patterns at 160 K. All the reflections of $FeTe_{0.92}$ at 160 K could be indexed in the $P4/nmm$ symmetry and structure parameters were successfully refined from the powder diffraction. Inset of Fig, 1 (a) shows Fermi surface of FeTe from non-spin-polarized calculation with crystal parameters determined by our Rietveld analysis. This result is consistent to previous study[1] proposed that the Fermi surface structure of FeSe and FeTe, which causes AF magnetic ordering characterized by the 2D nesting vector Q = (0.5,0.5) between the cylinder-like electron and hole Fermi surfaces.

At T = 8 K, we observed several superlattice reflection shown in Fig. 1(b). This observation corresponds to the AF ordering with the ordering vector Q = (0.5,0,0.5), indicating that the magnetic unit cell is $\sim 2a \times a \times 2c$, where a and c are the lattice parameters of the chemical unit cell.

Although the end compounds in $Fe(Se_{1-x}Te_x)_y$ and other FeAs based system show quite different magnetic orderings from each other, the superconducting materials have the surprising common character of the proximity to an AF fluctuation with a 2D Q = (0.5,0.5)[2]. This suggests that the mechanism of superconductivity in two systems may share some common features and especially that the AF correlation with 2D Q = (0.5,0.5) may play an important role in the mechanism of superconductivity in Fe-based superconductors.

[1] A. Subedi, L. Zhang, D. J. Singh, and M. H. Du, Phys. Rev. B **78** (2008) 134514.
[2] S. Iikubo, M. Fujita, S. Niitaka, and H. Takagi, J. Phys. Soc. Jpn. **78** (2009) 103704.

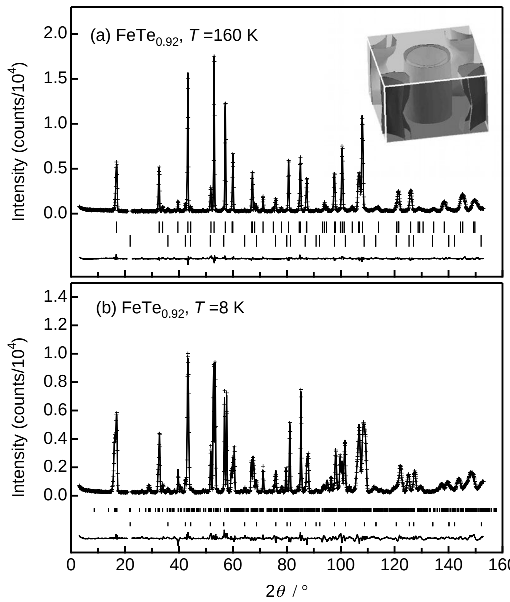

Fig. 1. The result of the Rietvelt analysis at (a) 160 K and (b) 8 K. inset: Fermi surface of FeTe from non-spin-polarized calculation.