Antiferromagnetic fluctuations in $Fe(Se_{1-x}Te_x)_{0.92}$ ($x = 0.75, 1$)

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Since the discovery of superconductivity in the FeAs systems, intensive studies on related superconductors including iron group have been reported. Although the related system shows the AF ordering in the parent materials, recent neutron diffraction measurements reported that the ordered magnetic structure of $Fe(Se_{1-x}Te_x)_y$ is quite different from that of other FeAs materials[1]. Therefore, the dynamical magnetic properties of the parent material $FeTe_{0.92}$ and superconductor $Fe(Se_{0.25}Te_{0.75})_{0.92}$ have been investigated by inelastic neutron scattering.

Figure 1 (a) shows constant energy scans with ω = 2 (89 K), 6 (89 K and 65 K) and 8 meV (65 K) for $FeTe_{0.92}$, which shows the AF ordering and a structural transition from a high-temperature tetragonal phase to a low-temperature monoclinic phase at ~ 70 K . We were able to observe the magnetic fluctuations as a broad peak around 0.9 Å^{-1}. The scattering intensities become weak as energy increases, especially below T_N. The peak centers are almost constant as the function of ω, which is consistent with what has been reported for other FeAs based materials.

Next, we will focus on the peak center for $Fe(Se_{0.25}Te_{0.75})_{0.92}$, which shows an appearance of bulk superconductivity below $T_c \approx$ 8 K. The energy evolution of the magnetic excitation spectra at 3.5 K is shown in Fig. 1 (b). For low energies ($\omega \leq 4$ meV), the magnetic excitations are located at $|Q| \approx$ 0.9 Å^{-1}, which is close to the one for pure $FeTe_{0.92}$. However, as ω increases, the peak centers increase substantially up to $|Q| \approx$ 1.2 Å^{-1} at $\omega \approx$10 meV. The measurements reported here show conclusively that a significant evolution occurs in the magnetic excitation spectra when Se is substituted for Te. We would like to note that the reciprocal lattice point $|Q| \approx 1.2$ Å^{-1} is close to the wave vectors Q = (0.5,0.5,0) ($|Q|$ = 1.17 Å^{-1}) and Q = (0.5,0.5,0.5) ($|Q|$ = 1.28 Å^{-1}), which match with the 2D nesting vector between the cylinder-like electron and hole Fermi surfaces like FeAs system. We speculate that the peak shift is related with the appearance of itinerant character of Fe magnetic moment which could be introduced by Se doping in the parent material $FeTe_{0.92}$. Our results show that substituting Se for Te may cause the system to possess possible magnetic fluctuations with the 2D nesting vector Q = (0.5,0.5).

[1]W. Bao *et al.* Phys. Rev. Lett. **102** (2009) 247001.

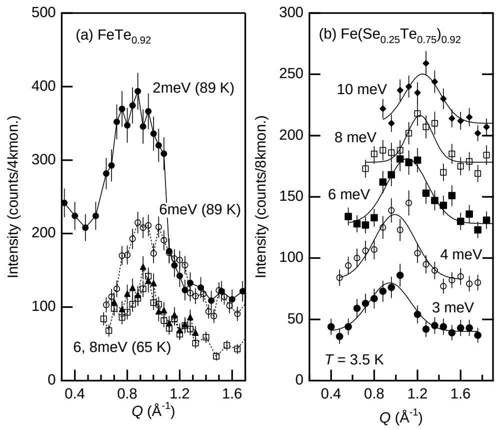

Fig. 1. (a) Inelastic scattering intensity for $FeTe_{0.92}$. (b) Inelastic scattering intensity for $Fe(Se_{0.25}Te_{0.75})_{0.92}$ at 3.5 K.