Magnetic excitation in CuFeP6$_6$

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Ternary alloy $CuFePt_6$ shows anomalous magnetic behavior[1]. It has fcc fundamental structure and forms Cu_3Au-type ordered structure below 1313 K. The alloys with both ordered and disordered states undergo ferromagnetic and antiferromagnetic transitions, though the transitions take place at different temperatures in the different ordered states. Temperature dependence of magnetic susceptibility first shows ferromagnetic transition at $T_C = 200$ K for the ordered state and at $T_C = 185$ K for the disordered state. Below T_C, susceptibility under FC and ZFC processes shows different behavior. The former shows normal ferromagnetic behavior but the latter shows successive antiferromagnetic-like transitions at $T_N = 100$ K for the ordered state and at $T_{N1} = 90$ K and $T_{N1} = 30$ K for the disordered state. Magnetic diffraction under zero-magnetic field shows magnetic scattering at 110 (X-point in fcc disordered state and Γ-point in sc ordered state) below T_C, and 1/2 1/2 0 (M-point in sc ordered state) below T_N and T_{N1}. The results indicate competitive existence of the two types of magnetic structures in the alloy and the magnetic phase is sensitively dependent on the magnetic field and the atomic arrangement. To investigate dynamical fluctuation in the ferromagnetic and antiferromagnetic structures, inelastic neutron scattering was performed at the triple-axis-spectrometer PONTA.

Figure 1(a) shows observed inelastic peaks with ΔE below 4 meV (black closed circles) and above 4 meV (open circles) at 7 K on (hkk) plane in the alloy with ordered state. In the figure, green, blue and red closed circles represent 000 (Γ-point), 011 (Γ-point in ordered and X-point in disordered state), and 0 1/2 1/2 (M-point in ordered state), respectively. Inelastic peaks below $\Delta E < 4$ meV show no dispersion and do not appear at the equivalent points. Inelastic intensities along $0kk$ and $1kk$ at $\Delta E = 2$ and 3 meV are shown in Fig.1(b). At $k = 0.45$ and 0.65 of $0kk$ line, inelastic peaks with both $\Delta E = 2$ and 3 meV appear, though no clear peaks are observed along the symmetrical line of $1kk$. The inelastic peaks are found to persist far above T_N. Further experiments should be necessary to clarify the origin of the magnetic excitation.

[1] M. Takahashi, *et al* : J. Alloys. Compd. in print.

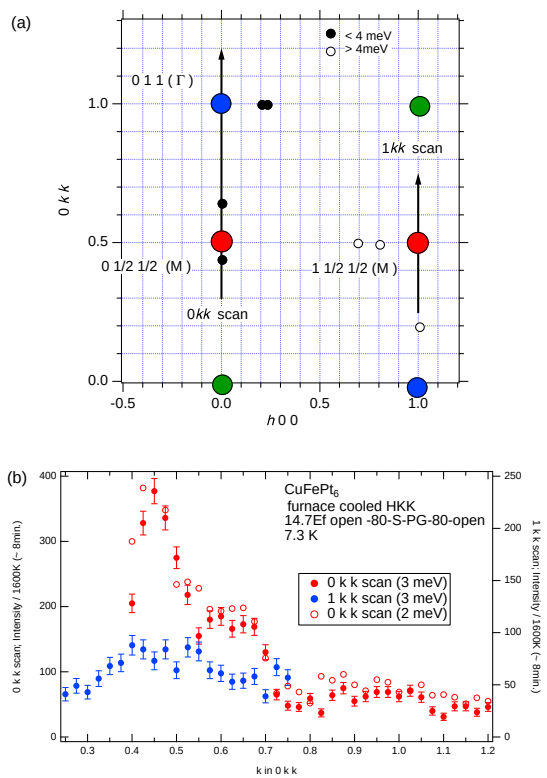

Fig. 1. (a)Inelastic peaks with ΔE below and above 4 meV (closed and open black circles) at 7 K. (b) Inelastic intensities along $0kk$(red circles) and $1kk$(blue circles) at $\Delta E = 2$ (open circles) and 3 meV (closed circles).