

Magnetic excitation spectrum in the frustrated triangular lattice antiferromagnet $\text{CuFe}_{1-x}\text{Al}_x\text{O}_2$

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Magnetic oxide $\text{CuFe}_{1-x}\text{Al}_x\text{O}_2$ has been extensively investigated to elucidate the spin-polarization coupling in the ferroelectric incommensurate (FEIC) phase that is magnetic field- or impurity-induced (see Fig.1 b) from the 4-sublattice ground state. Beyond multiferroic study on static coupling between spin and electric polarization, we have started inelastic neutron scattering study, aiming to investigate its dynamical spin-polarization coupling. However, since higher-temperature-partially disordered (PD) state is spatially co-existing in the FEIC phase at low temperature, quantitative inelastic neutron scattering measurement in the FEIC phase under zero magnetic field has been difficult for the Al-doped CuFeO_2 , although PD-contamination-free FEIC phase can be obtained by transverse magnetic field cooling [1].

Taking accounts of that coexistence of PD state might be due to local distortion around doped Al^{3+} ions with smaller ionic radius than that of Fe^{3+} , we newly choose Ga-doped system, $\text{CuFe}_{1-x}\text{Ga}_x\text{O}_2$, where ionic radius of doped Ga^{3+} ions seems to be close to that of Fe^{3+} . As was in previous studies on $\text{CuFe}_{1-x}\text{Al}_x\text{O}_2$ [2-3], we performed elastic as well as inelastic neutron scattering measurements on the single crystal $\text{CuFe}_{1-x}\text{Ga}_x\text{O}_2$ sample with $x = 0.35$, using the triple-axis neutron spectrometer HER(C1-1) installed at JRR-3.

As shown in Fig.1 a, diffraction profile of magnetic (q , q , 1.5) reflection in the FEIC phase is resolution-limited single peak as is in the OPD phase, clearly suggesting that the FEIC phase in Ga-doped system, $\text{CuFe}_{1-x}\text{Ga}_x\text{O}_2$, is PD-contamination-free. Actually, the discontinuous phase transition between PD state

and FEIC state is quite sharp. Adapting magnetic phase transition temperatures obtained from present experiment to the magnetic phase diagram of $\text{CuFe}_{1-x}\text{Al}_x\text{O}_2$, Ga-doping with $x=0.035$ effectively corresponds to Al-doping with $x=0.019$ as is shown in Fig.1 b. Since, in preliminary inelastic measurement on the Ga-doped system, relatively clear magnetic excitation spectrum than that in previous measurement [3] has been observed, further systematic inelastic study using Ga-doped system is desired.

References

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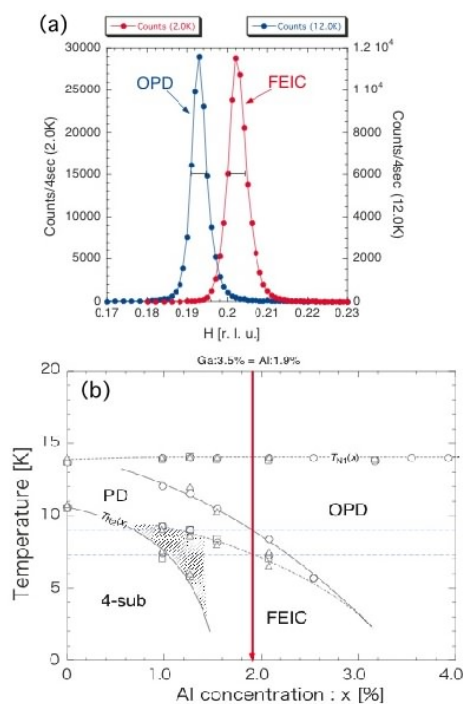


Fig. 1. (a) magnetic diffraction profiles for PD and FEIC state, (b) x - T magnetic phase diagram of $\text{CuFe}_{1-x}\text{Al}_x\text{O}_2$ [2]