

Magnetic Field Dependence of Two Kinds of Magnetic Correlations in Random Magnet Fe₆₅(Ni_{0.78}Mn_{0.22})₃₅

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In a previous neutron scattering study, we found that the short-range ferromagnetic and antiferromagnetic correlations coexist in wide concentration and temperature ranges of a random magnet system Fe₆₅(Ni_{1-x}Mn_x)₃₅ [1]. This result showed that the magnetic phase diagram determined by macroscopic measurements does not properly represent the magnetic state of a competing magnetic interaction system. In order to clarify the microscopic magnetic state of the competing magnetic interaction system, we observed the magnetic field dependence of the neutron scattering patterns arising from ferromagnetic and antiferromagnetic correlations in Fe₆₅(Ni_{0.78}Mn_{0.22})₃₅.

According to the reported magnetic phase diagram, the alloy of this composition transforms from a paramagnetic phase to a spin-glass phase around 80K[2]. Spin-wave excitations with ferromagnetic character have been observed in the temperature range 10-300K[3].

As reported in ref.1, the magnetic diffuse scattering pattern arising from ferromagnetic correlation is composed by a Lorentzian (LOR) and a squared Lorentzian (SQL) components. On the other hand, signals from antiferromagnetic correlation is well traced only by a LOR function. As increasing magnetic field, the diffuse scattering pattern from ferromagnetic correlations decreases, whereas the change of the signal from antiferromagnetic correlations is small.

Figure 1 shows the field variations of the amplitude and the width of the SQL component of the ferromagnetic diffuse signal which is the major part of scattering signal.

The field variations of these parameters indicate that the magnetic clusters disappear sequentially from larger size with increasing magnetic field. The present result shows that the ferromagnetic and the antiferromagnetic clusters coexist separately in this alloy.

[1] K. Motoya and K. Hioki, J. Phys. Soc. Jpn. 72 (2003) 930.

[2] M. Shiga et al. J. Mag. Mag. Mater. 51 (1985) 345.

[3] K. Motoya and Y. Muraoka, J. Phys. Soc. Jpn. 62 (1993) 2819.

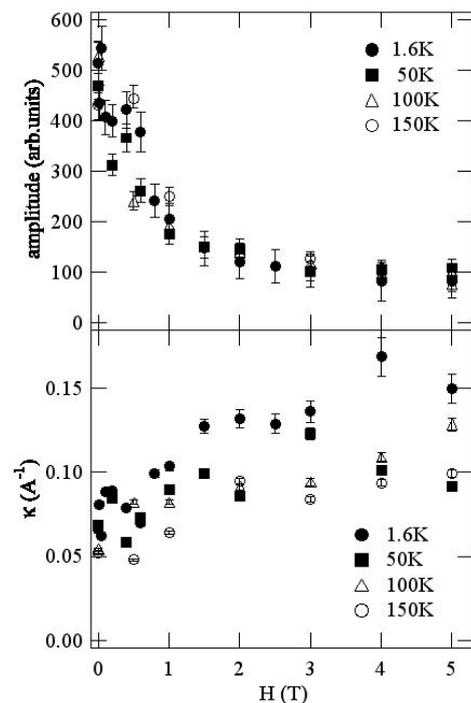


Fig. 1. Magnetic field variations of the amplitude and the width of a squared Lorentzian scattering function arising from ferromagnetic correlation measured at various temperatures.