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Anomalous behavior of $SmFe_4P_{12}$ proved by NMR

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$SmFe_4P_{12}$ shows heavy Fermion-like behavior below ~30K followed by a ferromagnetic ordering at 1.6K [1]. In order to elucidate the electronic and magnetic states microscopically, we have carried out ^{31}P-NMR measurements.

Fig.1 shows the T-dependence of the nuclear spin–lattice relaxation rate $1/T_1$ at various magnetic fields. The important point to be notified is the unusual behavior observed below ~8K, that is similar to the T-dependence of $1/T_1$ for $PrFe_4P_{12}$ [2]. $PrFe_4P_{12}$ shows an antiferroquadrupolar ordering at ~6.5K. On the other hand, from the broad hump observed around 8K in the T-dependence of the specific heat of $SmFe_4P_{12}$ [1,3], we consider that the anormalous $1/T_1$ behavior is caused by a crossover associated with the thermal excitation between the ground state and the first excited state of the CEF splitting energy levels, rather than the phase transition.

Fig.2 shows the T-dependence of ^{31}P-NMR spectra below ~10K, well above $T_c(H)$, where the NMR spectra are largely broadened and have a structure in shape. This is not caused by ferromagnetic ordering but is interpreted as an overlap of two distinct spectra. .

[1] N. Takeda and M. Ishikawa., J, Phys.: Condens. Matter **15** (2003) L229.

[2] K. Ishida *et. al*., to appear in Phys. Rev. B.

[3] K. Matsuhira *et al.***,** to appear in J. Phys. Soc. Jpn.

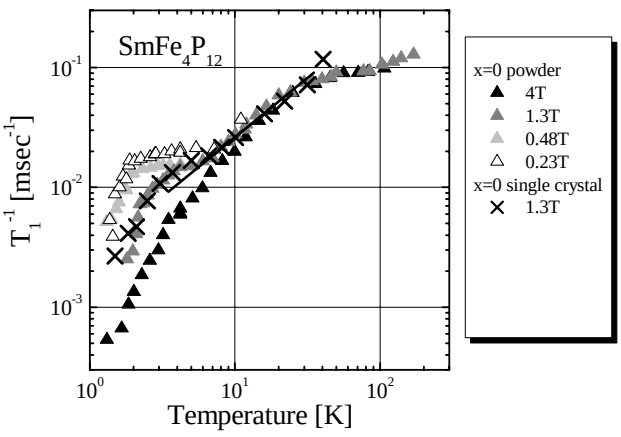

Fig.1 Temperature dependence of $1/T_1$ at various magnetic fields.

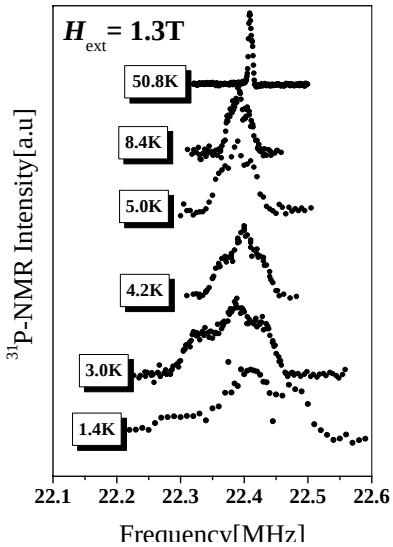

Fig.2 Temperature dependence of ^{31}P-NMR spectra.