(PS 22)

^{31}P-NMR study of heavy fermion ferromagnet $SmFe_4P_{12}$

K. Hachitani[1], H. Fukazawa[1,2], Y. Kohori[1,2], Y. Yoshimitsu[3], K. Kumagai[3], R. Giri[4], C. Sekine[4], I. Shirotani[4]

1 - Graduate School of Science and Technology, Chiba University, Yayoi-cho 1-33, Inage-ku, Chiba, 263-8522, Japan
2 - Department of Physics, Faculty of Science, Chiba University, Yayoi-cho 1-33, Inage-ku, Chiba, 263-8522, Japan
3 - Graduate School of Science, Hokkaido University, Kita 10-jo Nishi 8-tyome, Kita-ku, Sapporo, 060-0810, Japan
4 - Department of Electrical and Electronic Engineering, Muroran Institute of Technology, Mizumoto-cho 27-1, Muroran, 050-8585, Japan

$SmFe_4P_{12}$ was reported as the first Sm-based heavy fermion ferromagnet. The electrical resistivity, the magnetic susceptibility and the specific measurements reveal that $SmFe_4P_{12}$ is a ferromagnet with the Curie temperature $T_C = 1.6$ K and that it has a Kondo lattice (Kondo temperature $T_K = 30$ K) with the large electronic specific heat coefficient 370 mJ/mol K^2 [1-3].

We have carried out ^{31}P nuclear magnetic resonance (^{31}P-NMR) measurements on $SmFe_4P_{12}$ in order to investigate the system from more microscopic viewpoints [4]. The ^{31}P-NMR spectra do not show distinct signs of the magnetic order above the T_C. Figure shows the temperature T and the applied magnetic field dependences of the spin-lattice relaxation rate $1/T_1$. We observed a Fermi liquid behavior ($T_1 T \sim$ constant) in the temperature range of 7.5-25 K (just below the T_K). Below the T_K, a portion of the 4f electrons of the Sm ions would behave itinerantly by the hybridization effect with the conduction electrons. $1/T_1$ measured at low magnetic fields are nearly T independent above the T_C, and rapidly decrease at lower temperatures. This rapid decrease indicates the existence of the phase transition with no magnetic field. On the other hand, the rapid decrease generally becomes broader with increasing magnetic field. Moreover, the critical slowing-down phenomenon was not observed even in the presence of the small magnetic fields. These behaviors suggest that a ferromagnetic transition really occurs at the T_C in $SmFe_4P_{12}$ and that the ferromagnetic fluctuations of the residual Sm moments are strongly suppressed by the magnetic fields.

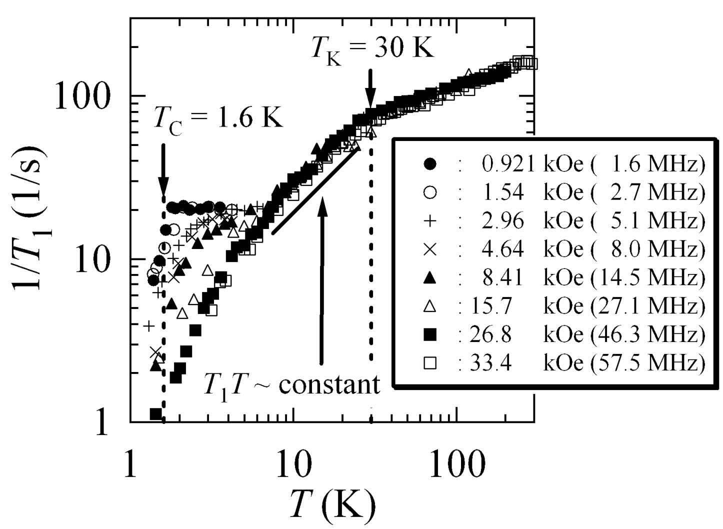

Figure The temperature T and the applied magnetic field dependences of the spin-lattice relaxation rate $1/T_1$.

[1] R. Giri *et al.*: Physica B **329-333** (2003) 458.
[2] N. Takeda and M. Ishikawa: Physica B **329-333** (2003) 460.
[3] N. Takeda and M. Ishikawa: J. Phys.: Condens. Matter **15** (2003) L229.
[4] K. Hachitani *et al.*: *Proc. of Int. Conf. on Magnetism (ICM) 2003, Rome, 2003.*