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^{31}P-NMR and μSR Studies of SmT_4P$_{12}$ (T = Fe, Ru and Os)

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SmT_4P$_{12}$ (T = Fe, Ru and Os) have recently attracted much attention for the wide variety of the physical properties, such as the heavy fermion system and the metal-insulator transition, the antiferro-quadrupolar order and the magnetic order (ferro-/antiferro-magnetism). The electronic states of these compounds have been studied by the ^{31}P-NMR and μSR.

The spin-lattice relaxation rate $1/T_1$ of SmFe$_4$P$_{12}$ reported as the first Sm-based heavy fermion ferromagnet shows the heavy fermion behavior ($T_1T \sim$ constant) below the Kondo temperature $T_K = 30$ K and the ferromagnetic fluctuations of the Sm moments above the Curie temperature $T_C = 1.6$ K (Fig. 1) [1,2]. In addtion, the phase transition at zero field was comfirmed by means of the ZF-μSR measurements at RIKEN-RAL muon Facility in UK. The internal field $\sim$ 650 Oe was estimated from the muon spin precession observed in the ZF-μSR spectra below the T_C (Fig. 2). In the ZF-μSR measurements on SmOs$_4$P$_{12}$ reported as the antiferromagnet with the Néel temperature $T_N = 4.6$ K [3], the precession below the T_N was also observed, and the internal field $\sim$ 250 Oe was estimated. On the contrary, the precession was not observed in the μSR measuremets on SmRu$_4$P$_{12}$ reported to exhibit the metal-insulator transition at $T_{MI} = 16$ K which consists of two successive transitions, *i.e.* antiferro-quadrupolar order below 16 K and the antiferromagnetic order below 14K, respectively [4].

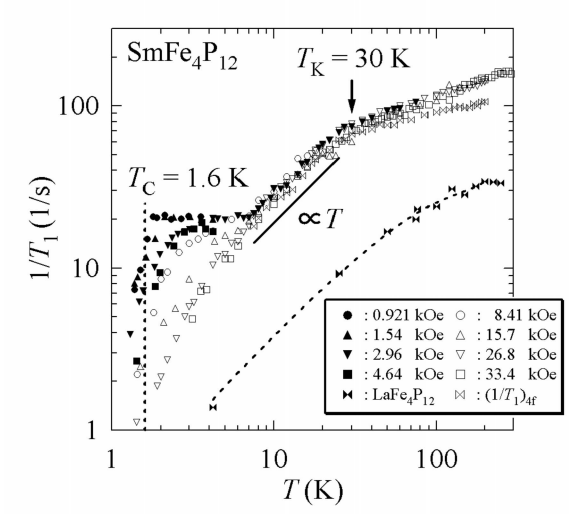

Fig. 1 Temperature T and applied magnetic field dependences of the spin-lattice relaxation rate $1/T_1$ of SmFe$_4$P$_{12}$.

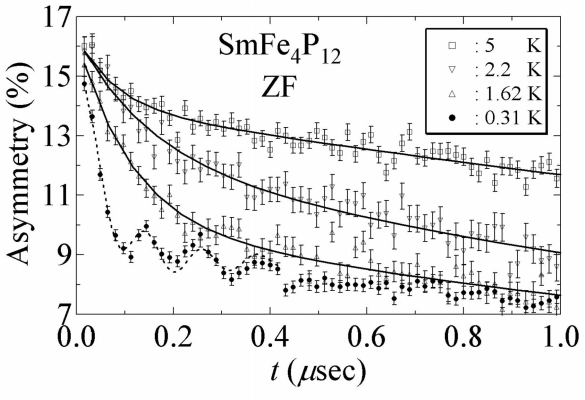

Fig. 2 Temperature dependence of the ZF-μSR spectrum of SmFe$_4$P$_{12}$.

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[2] K. Hachitani *et. al*: Journal of Magnetism and Magnetic Mterials (In Press).
[3] R. Giri *et. al*: Physica B **329-333** (2003) 458.
[4] C. Sekine *et. al*: *Science and Technology of High Pressure, University Press, Hyderabad, India (2000) 826.*