(PD3)

μSR Study of Sm-based Phosphide 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 variety of the physical properties, such as the heavy fermion (HF) behavior, the metal-insulator (M-I) transition, the antiferro-quadrupolar (AFQ) order and the magnetic order (FM/AFM). The electronic states of these compounds have been studied by the μSR and the ^{31}P-NMR.

The FM (T_C = 1.6 K) in $SmFe_4P_{12}$ and AFM (T_N = 4.6 K) in $SmOs_4P_{12}$ have been confirmed from microscopic viewpoints by our ZF-μSR measurements (at RIKEN-RAL in UK and at PSI in Switzerland) and the ^{31}P-NMR measurements in the applied magnetic fields. However, $SmRu_4P_{12}$ system seems to be not so simple [1]. $SmRu_4P_{12}$ was reported to exhibit the M-I transition at T_{MI} = 16.5 K below which two successive transitions occur: AFQ order below 16.5 K and the AFM below 15K, respectively in ZF [2].

We have observed the muon spin precessions in both $SmFe_4P_{12}$ (not shown) and $SmOs_4P_{12}$ (Fig. 1) due to the magnetic orders with the static internal magnetic fields below each transition temperature. The internal magnetic fields of 650 Oe in $SmFe_4P_{12}$ and of 250 Oe in $SmOs_4P_{12}$ were evaluated from each resonance frequency. The difference of the magnitudes would be reflected by the magnetic structures (FM in $SmFe_4P_{12}$ and AFM in $SmOs_4P_{12}$) [3,4]. In contrast, the muon spin precession was not observed in $SmRu_4P_{12}$ below T_N (Fig. 2). The internal magnetic field is not homogeneous, which is consistent with the results of our ^{31}P-NMR measurements.

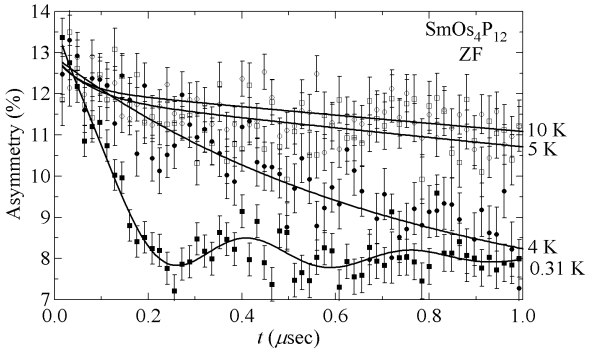

Fig. 1 Temperature dependence (around T_N) of the μSR time spectrum of $SmOs_4P_{12}$ (at RAL).

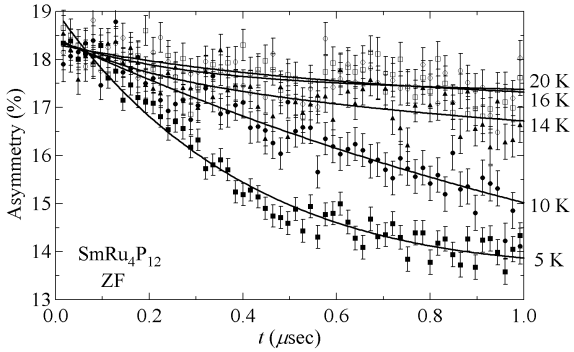

Fig. 2 Temperature dependence (around T_{MI}) of the μSR time spectrum of $SmRu_4P_{12}$ (at RAL).

[1] K. Hachitani *et. al*: Journal of the Institute of Pure and Applied Physics (In Press).
[2] C. Sekine *et. al*: Acta Physica Polonica B **34** (2003) 983.
[3] R. Giri *et. al*: Physica B **329-333** (2003) 458.
[4] N. Takeda and M. Ishikawa: Physica B **329-333** (2003) 460.