(28c1)

NMR Study of Uranium Filled Skutterudite UFe_4P_{12}

Y. Tokunaga[1], T.D.Matsuda[1], H.Sakai[1], H.Kato[1], S.Kambe[1], R.E.Walstedt[1], Y. Haga[1] and Y. Ōnuki[1,2]

1 - Advanced Science Research Center, Japan Atomic Energy Research Institute
2-4 Shirane, Tokai, Naka, Ibaraki 319-1195, Japan
2 - Department of Physics, Graduate School of Science, Osaka University,
Toyonaka, Osaka, 560-0043, Japan

UFe_4P_{12} is the first reported uranium based filled skutterudite compound containing 5f electrons.[1-4] Ferromagnetic ordering with a Curie temperature $T_C = 3K$ was reported on the basis of AC susceptibility, specific heat and magnetization measurements. On the other hand, the electrical resistance shows a semiconductive T-dependence, i.e., increases nearly 7 orders of magnitude as T is lowered from room temperature to liquid helium temperatures. A large negative megnetoresistence was also found near T_C.[2] In order to clarify the role of 5f electrons in the Uranium filled skutterudite compound, we have performed the first NMR measurements on UFe_4P_{12} using a single crystal.

Figure 1 shows a ^{31}P-NMR spectrum obtained at 50K and $H \sim 5$ T. From the hyperfine field analysis by point-dipole model, we can assign all the peaks to 12 P sites surrounding a U atom, as shown in the inset to the figure. In this analysis, we assumed that U has a local moment along the field direction, which generates a hyperfine field at the P sites through dipolar interactions. The T-dependence of the spin-lattice relaxation rate (T_1) has been measured using the same single crystal at several different fields. In low field (H $\sim$ 1T), $1/T_1$ shows a small divergence near T_C, indicative of the critical slowing down of U moment fluctuations, and then becomes T-independent in the temperature range from 10 K to 60 K. These T_1 behaviors support a localized picture of 5f electron-derived moments for UFe_4P_{12}. The origin of the large negative megnetoresistence will be discussed on the basis of the field dependence of $1/T_1$ near T_C.

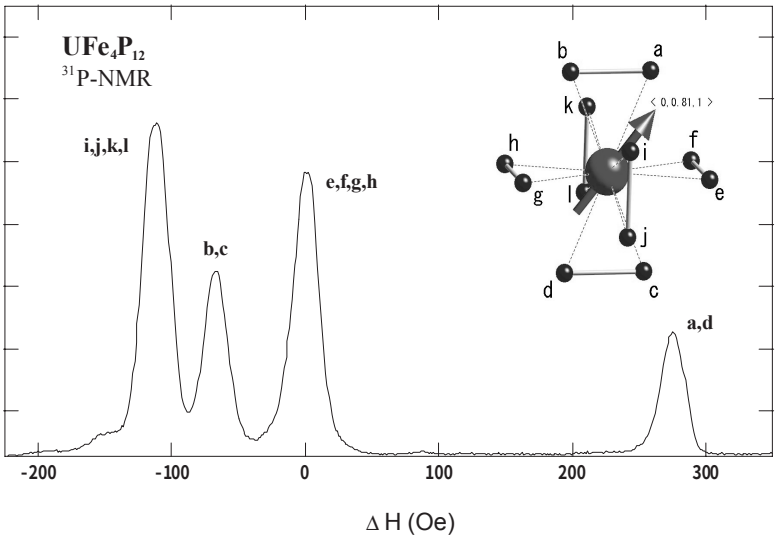

Figure 1: ^{31}P-NMR spectrum in UFe_4P_{12} single crystal at 50K and 5 T. The inset shows the positions of the 12 P sites surrounding a U atom.

[1] G.P Meisner *et al.*, J. Appl. Phys. **57** (1985) 3073. [2] M.S. Torikachvili, *et al.* J. Magn. Magn. Mater, **54-57** (1986) 365-366. [3] G.P. Guertin *et al.* Phys. Rev. B**36** (1987) 8665. [4] H.Nakotte *et al.* Physica B**259-261** (1999) 280-282.