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NMR studies on a (Sm,La)Fe_4P_{12} single crystal

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Filled skutterudite compound $SmFe_4P_{12}$ is known to take a heavy-Fermion state below $\sim$ 30 K followed by a ferromagnetic transition at 1.6 K [1]. In order to elucidate the electronic state microscopically, we have carried out NMR measurements of ^{31}P in single crystals of $Sm_{1-x}La_xFe_4P_{12}$ with $x = 0$ and 0.2. Fig. 1 (a) shows the T-dependence of the nuclear spin-lattice relaxation rate T_1^{-1} for the compounds with $x = 0$, 0.2 (present work) and 1.0 (by Ishida *et. al.* [2]). For $x = 0$ at low external field of $H = 0.23$ T, T_1^{-1} exhibits four distinct T-dependences with decreasing T: near T-independent behavior above $\sim$ 40 K (localized electron state), T_1T = const. behavior for 8-30 K (Fermi liquid state), and an additional T-independent behavior below $\sim$ 8 K followed by the rapid decrease below $\sim$ 2 K associated with the ferromagnetic transition. It is worth noting that the additional T-independent behavior at low T is very sensitive to the strength of H.

The dilution of Sm ions in $SmFe_4P_{12}$ with La suppresses the ferromagnetic transition. Shown in Fig. 1 (b) is the change in the $(T_1T)^{-1}$ = const. values with the replacement of La for Sm observed in the Fermi-liquid state. The decrease in $(T_1T)^{-1}$ with increasing x indicates the decrease of the density of states at E_F.

[1]
[2]

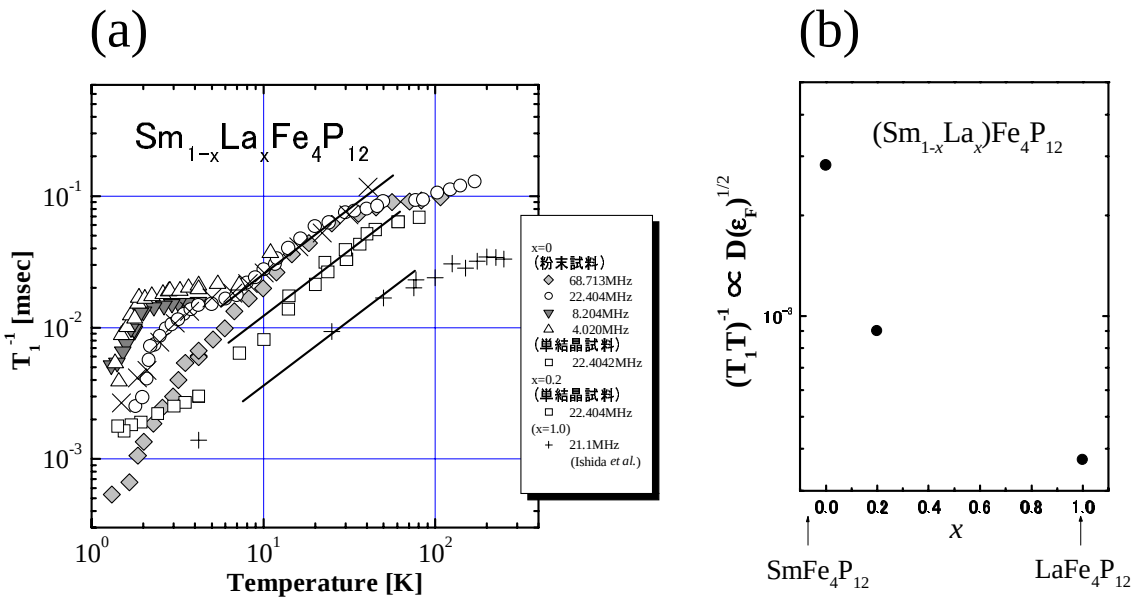

Figure 1: (a) The temperature and field dependence of $1/T_1$ in $Sm_{1-x}La_xFe_4P_{12}$ together with the data for $LaFe_4P_{12}$ [2]. (b) The $(T_1T)^{-1}$ = const. values are plotted against x.