

## Electrical and magnetic properties of new skutterudite compounds prepared at high pressure

I. Shirotni, N. Araseki, K. Kihou, S. Sato, R. Nakata and C. Sekine

Muroran Institute of Technology, Mizumoto, Muroran-shi 050-8585, Japan

We have systematically prepared new filled skutterudites with heavy lanthanide using a cubic anvil-type apparatus at high pressure [1,2]. Electrical and magnetic properties of these compounds have been studied at low temperatures. Figure 1 shows dc magnetic susceptibility and inverse susceptibility of  $\text{HoFe}_4\text{P}_{12}$  measured in a magnetic field of 1 tesla (T). The susceptibility follows a Curie-Weiss behavior. The linear slope of the  $\chi^{-1}$  vs. T curve from 10 to 300 K yields an effective magnetic moment of  $10.43 \mu_B$ . This value is close to the magnetic moment of  $\text{Ho}^{3+}$  ion calculated from Hunds rule,  $10.60 \mu_B$ . The positive Weiss constant and the sudden increase of susceptibility in  $\text{HoFe}_4\text{P}_{12}$  suggest the ferromagnetic transition at around 5 K. Figure 2 shows dc magnetic susceptibility and inverse susceptibility of  $\text{YbFe}_4\text{P}_{12}$  measured in a magnetic field of 1 T. The susceptibility of  $\text{YbFe}_4\text{P}_{12}$  follows the Curie-Weiss behavior at higher temperatures. The linear slope of the  $\chi^{-1}$  vs. T curve from 50 to 300 K yields an effective magnetic moment of  $4.93 \mu_B$ . The value obtained from the linear slope between 2 and 30 K is  $3.37 \mu_B$ . The magnetic moment of  $\text{Yb}^{3+}$  ion calculated from Hunds rule is  $4.54 \mu_B$ . Thus, there may be the mixed valence states between  $\text{Yb}^{2+}$  and  $\text{Yb}^{3+}$  at low temperatures.

[1] I. Shirotni, Y. Shimaya, K. Kihou, C. Sekine, T. Yagi, *J.SolidStateChem.*, **174**, 32 (2003).  
 [2] K. Kihou, I. Shirotni, Y. Shimaya, C. Sekine, T. Yagi, *Mater.Res.Bull.*, **39**, 317 (2004).

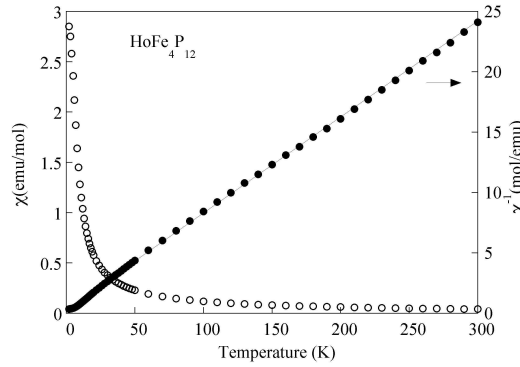


Figure 1: Magnetic susceptibility and inverse susceptibility of  $\text{HoFe}_4\text{P}_{12}$

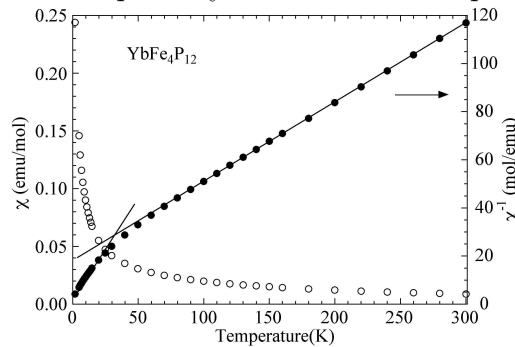


Figure 2: Magnetic susceptibility and inverse susceptibility of  $\text{YbFe}_4\text{P}_{12}$