

MAGNETIC TO NON-MAGNETIC CROSSOVER PHENOMENA IN  $\text{CeSi}_{2-x}\text{Ga}_x$ 

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The intermetallic compounds belonging to the series  $\text{CeSi}_{2-x}\text{Ga}_x$ ,  $0.7 \leq x \leq 1.3$  show typical anomalies associated with the competition between the single site Kondo effect and the ferromagnetic interatomic exchange interactions /1, 2/. In order to investigate the crossover phenomena in this system, we have performed inelastic neutron scattering experiments on the polycrystalline samples of  $\text{CeSi}_{2-x}\text{Ga}_x$  with  $x = 0.7, 1.0$  and  $1.3$  on the Triple Axis Spectrometer at Dhruva, Trombay. The spectra were recorded at two scattering angles,  $\phi = 20$  and  $95$  at different temperatures from 10K to 300K with final energy,  $E_f$  fixed at 25 meV. The phonon contribution estimated from the high angle,  $\phi = 95$  scattering data was subtracted from the raw data at  $\phi = 20$ . The obtained excitation energy,  $\Delta$  is listed in Table I. The presence of only one inelastic peak has led us to assume that the two excited doublets lie very close to each other and cannot be separated due to the limited energy resolution of the spectrometer. The Kondo temperature  $T_K$  was estimated from the residual quasielastic linewidth by fitting its observed values at different temperatures to the equation  $\Gamma = \Gamma_0 + AT^{1/2}$  and  $\Gamma_0 = k_B T_K$ . From the Coqblin-Schrieffer model /3/,

$$T_K = D \left[ \frac{D}{T_K + \Delta_1} \right] \left[ \frac{D}{T_K + \Delta_2} \right] \exp \left[ -\frac{1}{2|\rho J|} \right] \quad (1)$$

where  $D$  is the halfwidth of the conduction band,  $\rho$  is the density of states of conduction electrons at Fermi level and  $J$  is the strength of exchange interaction. Here  $\Delta_1 = \Delta_2$  and assuming  $D \sim 10000\text{K}$  we have estimated c-f coupling constant  $|\rho J|$  from the above equation. The characteristic temperature of RKKY interactions was calculated from  $T_{\text{RKKY}} \sim D|\rho J|^2$ . Table I summarizes  $T_K$ ,  $|\rho J|$  and  $T_{\text{RKKY}}$  of  $\text{CeSi}_{2-x}\text{Ga}_x$ . The result indicates that the crossover transition in  $\text{CeSi}_{2-x}\text{Ga}_x$  is caused by increase of the c-f coupling constant with increasing  $x$  over its critical value above which the intra-site Kondo interactions dominate the intersite RKKY interactions. The critical value was found to be around 0.8 in this system. This is in good agreement with the value obtained from the bulk properties measurements,  $x = 1.0$ .

x	$\Delta(\text{K})$	$T_K(\text{K})$	$ \rho J $	$T_{\text{RKKY}}(\text{K})$
0.7	150	10	0.0329	10.85
1.0	174	17	0.0350	12.24
1.3	128	29	0.0353	12.48

TABLE I. Excitation energy  $\Delta$ , Kondo temperature  $T_K$ , c-f coupling constant  $|\rho J|$  and  $T_{\text{RKKY}}$  for  $\text{CeSi}_{2-x}\text{Ga}_x$

## References

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