Neutron Scattering Study of $CeSn_2In$

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In this paper we report our measurements on the magnetic spectral response of $CeSn_2In$. $CeSn_2In$ belongs to the series $CeSn_{3-x}In_x$. This series shows a homogeneous evolution from mixed valent state to Kondo lattice behaviour as the In concentration is increased to 1.9. The neutron inelastic spectra of $CeSn_2In$ has been studied in polycrystalline as well as single crystal form /1,2/ and these measurements show an inelastic peak at about 9meV energy transfer with a width of about 7meV. We have repeated measurements on this compound in order to standardize our measurement procedure as such studies were being done for the first time at Trombay.

The inelastic neutron scattering masurements were performed on the Triple Axis Spectrometer (TAS) installed on T 1007 tangential beam hole at Dhruva reactor. The data were recorded on $CeSn_2In$ as well its nonmagnetic counterpart $LaSn_2In$ at various temperatures upto 10K using a closed cycle refrigerator. The experiments were performed at two different scattering angles, $\phi = 20$ and $\phi' = 90$ with the final energy E_f fixed at 25meV and the incident energy, E_i varying from 70meV to 15meV. The phonon scattering contribution to $CeSn_2In$ data at $\phi = 20$ was estimated by taking a ratio, $R(\phi, \phi', E)$ of the $LaSn_2In$ spectra at $\phi = 20$ to $LaSn_2In$ spectra at $\phi' = 90$. This $R(\phi, \phi', E)$ was multiplied to $CeSn_2In$ spectrum at $\phi' = 90$ to get the phonon scattering contribution of $CeSn_2In$ at $\phi = 20$. This was then subtracted from the experimental data of $CeSn_2In$ at $\phi = 20$ to get the pure magentic response.

At 10K the magnetic spectra of $CeSn_2In$ shows an inelastic peak centered at about 8 meV with a width of about 7 meV. We have fitted this data to an analytical expression given by Kuramato and Müller-Hartmann [KMH] /3/ using the degenerate Anderson model.

$$\chi''(\omega) = C\frac{N\omega}{\pi \tilde{E}_F^2}\frac{\sin\alpha}{u^2(u^2+4sin^2\alpha)}\left\{\sin\alpha\, ln\left[(1-u^2)^2+4u^2sin^2\alpha\right]+|u|\left[\frac{\pi}{2}-\tan^{-1}\left(\frac{1-u^2}{2|u|\sin\alpha}\right)\right]\right\} \qquad (1)$$

where $\tilde{E}_F$ is the characteristic energy closely related to Kondo temperature and $u = \omega/\tilde{E}_F$, $\alpha = \pi n_f/N$ with n_f is the occupancy of the 4f level and N is its degeneracy. In the fitting process we have fixed $n_f = 1$ and $N = 6$. This leaves only one free parameter $\tilde{E}_F$ which was obtained to be equal to 8.2±1.3 meV which is in good agreement with the value reported in the literature. Fig. 1 shows the experimental data fitted to the KMH curve. The presence of the inelastic peak indicates that the 4f electrons with energy greater than $\tilde{E}_F$ get an additional decay channel into the conduction band.

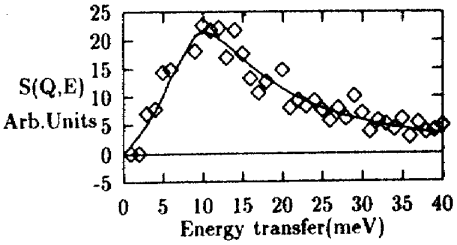

FIG. 1.

References

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