(PS 7)

Optical response of filled skutterudite compounds

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We have studied the optical properties of a series of filled skutterudite compounds in order to obtain information on the charge carrier dynamics and the electronic structure near the Fermi level, and to study the infrared-active phonon.

For $PrRu_4P_{12}$ and $SmRu_4P_{12}$, which undergo a metal-insulator (M-I) transition at T_{MI} = 60 K and 16 K, respectively, the optical conductivity spectra show the clear opening of a charge gap below T_{MI}. In addition, anomalies of infrared-active phonons are observed around T_{MI}. For $PrRu_4P_{12}$, as shown in the left panel of Fig. 1, new phonon peaks appear in the spectra below T_{MI}, which is interpreted as a sign of charge ordering [1]. On the other hand, for $SmRu_4P_{12}$, although no additional phonon peaks appear below T_{MI}, anomalous softening is observed upon decreasing temperature around T_{MI}, which may be related to the antiferro-quadrupolar ordering. These results may indicate that the mechanism of M-I transition is slightly different between $PrRu_4P_{12}$ and $SmRu_4P_{12}$.

For Ce-filled skutterudites $CeRu_4P_{12}$, $CeRu_4Sb_{12}$ and $CeOs_4Sb_{12}$ [2], a pronounced mid-infrared peak is observed in the optical conductivity spectra as shown in the right panel of Fig. 1. Since the peak can be interpreted in terms of optical excitations across the gap originated from the hybridization between conduction (c) and Ce $4f$ state, the peak energy should mainly reflect the degree of c-f hybridization.

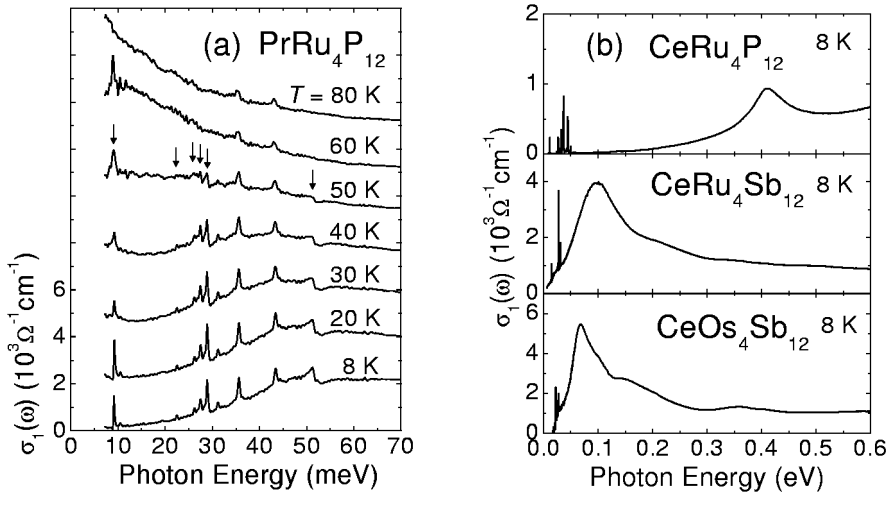

Figure 1: Optical conductivity of (a) $PrRu_4P_{12}$, (b) $CeRu_4P_{12}$, $CeRu_4Sb_{12}$ and $CeOs_4Sb_{12}$.

[1] M. Matsunami et al., J. Magn. Magn. Mater. (in press).
[2] M. Matsunami et al., J. Phys. Soc. Jpn. **72** (2003) 2722.