

Low-Energy Phonon Anomaly of CeRu₄Sb₁₂

K. Iwasa¹, R. Igarashi¹, L. Hao², Y. Murakami¹
*Tohoku Univ.*¹, *China Institute of Atomic Energy*²

Anomalous anharmonic lattice properties of the rare-earth filled skutterudites RT₄X₁₂ (R = rare earth, T = transition metal, X = pnictogen) have been studied, in addition to the various strongly correlated electron phenomena originating from 4*f* electrons. The filled ions locating within the icosahedral X cage vibrate with large amplitude, as evidenced by the large Debye-Waller factors. One of the attractive lattice properties is the dispersion of elastic constants of PrOs₄Sb₁₂, interpreted as low-energy Pr-ion motion within the Sb cage (T. Goto *et al.*: Phys. Rev. B **69** (2004) 180511). We have reported the anomalous softening of phonon due to Pr vibration with decrease of temperature and the possible electron-phonon interaction in PrOs₄Sb₁₂ and PrRu₄Sb₁₂ (K. Iwasa *et al.*: Physica B **378-380** (2006) 194, J. Phys. Conference Series **92** (2007) 012122). In the present study, we have investigated the low-energy phonon spectra of CeRu₄Sb₁₂ using the triple-axis spectrometer TOPAN (6G).

The figure shows temperature dependence of the peak energy position corresponding to the phonon excitation measured at the reciprocal lattice point $\mathbf{Q} = (6 \ -0.4 \ -0.4)$ of CeRu₄Sb₁₂. It shows decreasing behavior of excitation energy with decreasing temperature from 300 down to 13 K. This softening mode was confirmed to be less dispersive like an optical mode assigned to the Ce motion in the Sb cage of CeRu₄Sb₁₂ (C. H. Lee *et al.*: J. Phys. Soc. Jpn. **75** (2006) 123602). The presence of such anharmonic low-energy phonon is seen also in the previously investigated three compounds of PrOs₄Sb₁₂, PrRu₄Sb₁₂, CeOs₄Sb₁₂ which was reported in the Meeting of Physical Society of Japan (Sep. 2007). Therefore, the anharmonicity appearing in the low-lying optical mode of rare earth ions inside the Sb cages is a characteristic

property among the rare-earth filled skutterudite with the Sb cage.

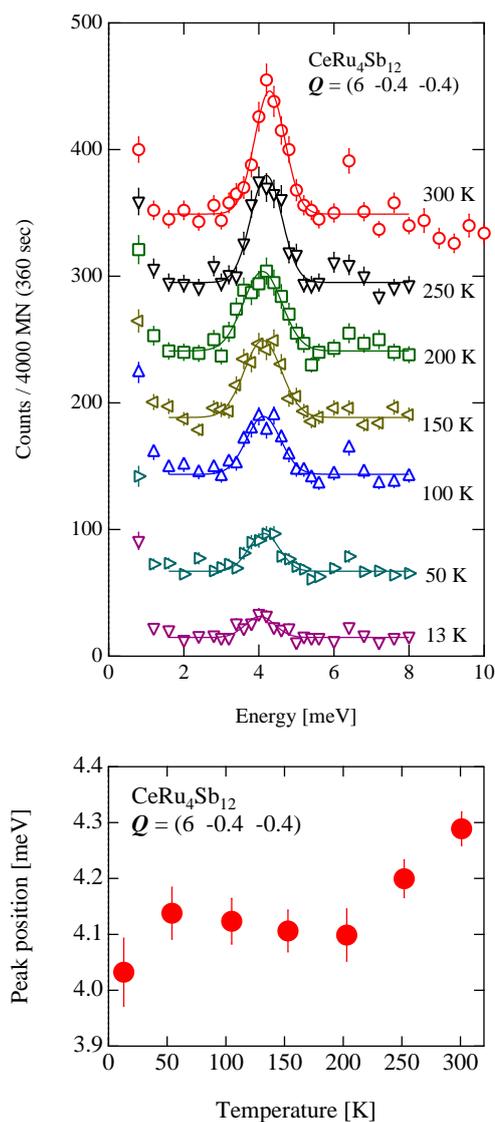


Fig. 1. Temperature dependence of the phonon spectra and the peak energy at $\mathbf{Q} = (6 \ -0.4 \ -0.4)$ of CeRu₄Sb₁₂.