18C/2011G555

X-ray diffraction study of CeT_2Al_{10} (T=Fe, Ru, Os) at high pressures

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1 Introduction

CeT_2Al_{10} (T=Fe, Ru, Os) crystallizes in the orthorhombic $YbFe_2Al_{10}$-type (space group *Cmcm* No. 63) crystal structure [1]. These compounds exhibit a long range ordering with unusually high transition temperature (T_0) and Kondo semiconducting behavior [2-4]. The long range ordering suddenly disappears under high pressures (at 2 GPa (T = Os) and 4 GPa (T = Ru)). In order to investigate a structural change around the pressures the order disappears, we performed synchrotron X-ray diffraction study at room temperature under high pressure.

2 Experiment

Single crystals of CeT_2Al_{10} (T=Fe, Ru, Os) were grown by using Al self-flux method. The single crystals of CeT_2Al_{10} were crushed into a fine powder. The X-ray diffraction measurements under high pressures were conducted using synchrotron radiation. An imaging plate was used as a detector. The pressure was applied by diamond anvil-type pressure cell. A 4:1 mixture of methanol/ethanol was used as a pressure-transmitting medium. The applied pressure was determined from a pressure shift in the fluorescence spectrum of ruby.

3 Results and Discussion

No additional peak is observed up to 10 GPa on CeT_2Al_{10} (T = Fe, Ru, Os), indicating no structural change. Figure 1 shows the lattice parameters of CeT_2Al_{10} normalized at ambient pressure. All lattice parameters decrease monotonically with increasing pressure. The monotonic decrease of lattice parameters indicates that reduction of a long range ordering at 2 GPa on $CeOs_2Al_{10}$ and that at 4 GPa on $CeRu_2Al_{10}$ are not attributed to a structural distortion.

While the decrease ratio of lattice parameters along a-axis and c-axis are almost the same, that along b-axis is the smallest in every compound. The high-energy syncrotron x-ray powder diffraction experiments of $LaRu_2Al_{10}$ clarified the charge density distribution [5]. The charge density around Ru site and Al5 site are connected along b-axis. We propose that the hardness of the lattice parameter along b-axis is attributed to this charge density connecting Ru and Al5 site.

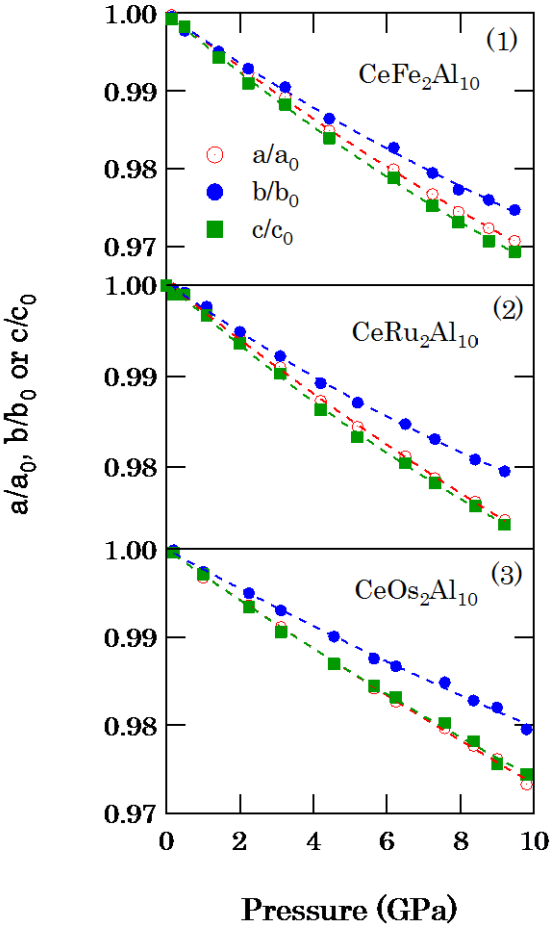

Fig. 1: The lattice parameters normalized at ambient pressure a/a_0(red, open circle), b/b_0(blue, closed circle), c/c_0(green, closed square) on $CeFe_2Al_{10}$ (1), $CeRu_2Al_{10}$ (2) and $CeOs_2Al_{10}$ (3).

Acknowledgement

The authors gratefully acknowledge the support from Muroran Institute of Technology (a grant for the Kidorui (Rare Earth) Program).

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