

On the compounds structurally related to the filled Skutterdites

Kazuya Suzuki

Faculty of Environment and Information Sciences, Yokohama National University,
Yokohama, 240-8501

Filled Skutterudite compounds RT_4X_{12} have attracted much attention since they show various interesting physical properties such as Pr-based heavy fermion behavior, heavy fermion superconductivity, and rattling motion of R atoms in the cages formed of pnictogen X. The appearance of these interesting phenomena in RT_4X_{12} is strongly related to the specific conditions of crystallographic and electronic structures. Although the properties of the filled Skutterudite, in which more than 200 compounds can be prepared, have not been fully investigated nor understood yet and novel properties can be expected, to search for the compounds structurally related to the filled Skutterudite is another route to find novel physical phenomena. We survey the various crystallographic databases to find the compounds with cage-structure. Followings are the candidates:

- Cubic system: 1. $R_2Ni_{21}B_6$ (Fm3m), 2. $R_2Rh_{15}Si_7$ (Pm3m), 3. $R_3Pt_{23}Si_{11}$ (Fm3m),
4. $R_4Pd_{29}Si_{14}$ (Fm3m), 5. RCO_2Al_{20} (Fd3m)
- Tetragonal system: RCO_9Si_4 (I4/mcm)
- Hexagonal system: RCO_2Al_9 (P6/mmm)

We have attempted to prepare single-phase specimens for some of these compounds, and succeeded for $R_2Rh_{15}Si_7$ with R=La, Ce and Pr. The magnetic susceptibility shows the Ce-compound is in the valence-fluctuating state of the 4f electron and the Pr-compound has well localized 4f electrons with the degenerated ground state but is paramagnetic down to 1.8 K. To synthesize other compounds is rather difficult, since there are several phases which chemical composition is close to the target compounds, especially in the compounds that contain B or Al elements. We also consider possible compounds with strong p-f mixing containing pnictogen or chalcogen elements, however, it is very rare that the cage structure appears in these compounds. Among the layered compounds, Fokwa et al. recently suggested that $PrSeTe_2$ is a strong p-f mixing system and the Pr $4f^2$ state lies very close to the Fermi level. We are preparing single crystal and revealing the physical properties of this compound.