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Effect of Pr filling on the unfilled skutterudite $CoSb_3$

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Effect of rare earth elelements (*RE*) filling on unfilled skutterudite $CoSb_3$ is a interesting subject from two view points; i.e., application as thermoelctric materials and basic scientific interest. There have been reported quite a few trials to attack this subject. To increase the filling factor, some trials on partial replacement of Co site by Fe, $Ce_x(Fe_{1-y}Co_y)_4Sb_{12}$, have been reported, however 100 % filling was unsuccessful [1]. Since $CoSb_3$ is stable, it is difficult to increase the filling factor of *RE* in the antimony cage at ambient pressures. In contrast with the $RE Fe_4P_{12}$ and $RE Ru_4Sb_{12}$, no successful reports on 100% filling has been made even in $RE Fe_4Sb_{12}$ at ambient pressure [2]. Recently, we have succeeded in synthesizing high quality sample of $PrFe_4Sb_{12}$ by using high pressure synthesis, and found the physical properties are quite sensitive to the Pr site filling [3]. The magnetic ground state changes from a ferrimagnet to a highly enhanced paramagnet, which is consistent with the large density of states near the Fermi energy associated with Fe-3*d* electrons in the band calculation on $LaFe_4Sb_{12}$ [4]. This fact suggests an important role of 3*d* electrons in controlling the physical properties of these systems. To study the effect of 3*d* electrons on physical properties, we are trying to synthesize $PrCo_4Sb_{12}$ under high pressures, in which Fe is substituted for Co having one more *d* electron.

After some trials under defferent conditions, we have obtained the filled skutterudite compound $Pr_xCo_4Sb_{12}$. Figure 1 shows powder x-ray diffraction pattern of this sample. We cofirmed that the filled skutterudite was synthesized and a little unknown impurities included in the samples. The lattice constant was estimated to be 9.089 Å larger than that of unfilled skutterudite $CoSb_3$. In preliminary chemical composition analysis on field emission electron microscope, Pr site filling factor is estimated to be about 50 %. We will report the detail of synthesis techniques and the physical properties of $Pr_xCo_4Sb_{12}$ in this study.

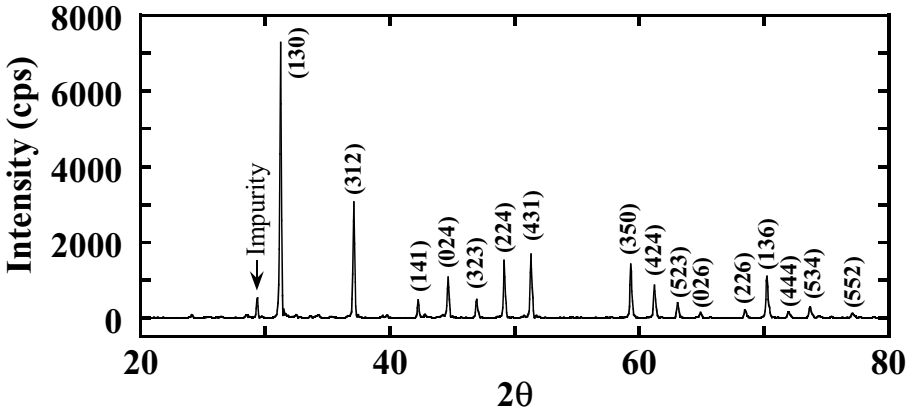

Figure 1: Powder x-ray diffraction pattern of $Pr_xCo_4Sb_{12}$

[1] D. T. Morelli *et al.*, Phys. Rev. B **56** (1997) 7376.
[2] E. Bauer *et al.*, Phys. Rev. B **66** (2002) 214421.
[3] K. Tanaka *et al.*, to be published in Physica B (2006).
[4] K. Takegahara *et al.*, J. Phys. Soc. Jpn. **71** (2002) Suppl. pp. 240.