PCP2-12

Co-Intercalation of Li and Ethylenediamine into the Bi-based Chalcogenides with the Layered Structure by Solvothermal Technique

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We have reported that the co-intercalation of alkali metals or alkaline-earth metals and organic molecules into the transition-metal chalcogenides is effective to induce superconductivity or enhance the superconducting transition temperature T_c [1,2]. Through the co-intercalation, carriers can be doped and the electronic density of states at Fermi level is expected to increase due to the change of the electronic structure from three-dimensional to two-dimensional by the expansion of spacing between the conductive layers. It is reported that the topological insulator Bi_2Se_3 with the layered structure exhibits superconductivity with T_c ~ 2-4 K through the intercalation of several kinds of metals [3-5]. Therefore, the enhancement of T_c is expected by the expansion of spacing between the conductive Bi-Se layers through the co-intercalation. In this study, we have carried out the co-intercalation of Li and ethylenediamine (EDA) into the Bi-based chalcogenides with the layered structure of Bi_2Se_3 and $SnBi_2Se_4$.

Host materials were prepared by the solid-state reaction method. The co-intercalation was carried out at 180-190ºC for 7 days by the solvothermal technique using the Teflon-lined steel autoclave.

As for Bi_2Se_3, new Bragg peaks are observed through the co-intercalation, as shown in Figs. 1(a) and (b). It has been found that the new co-intercalation compound of $Li_x(EDA)_yBi_2Se_3$ is successfully synthesized. As for $SnBi_2Se_4$, it is not clear if the co-intercalated sample is obtained because only one new Bragg peak is observed as shown in Figs. 1(c) and (d). We will report whether superconductivity appears or not.

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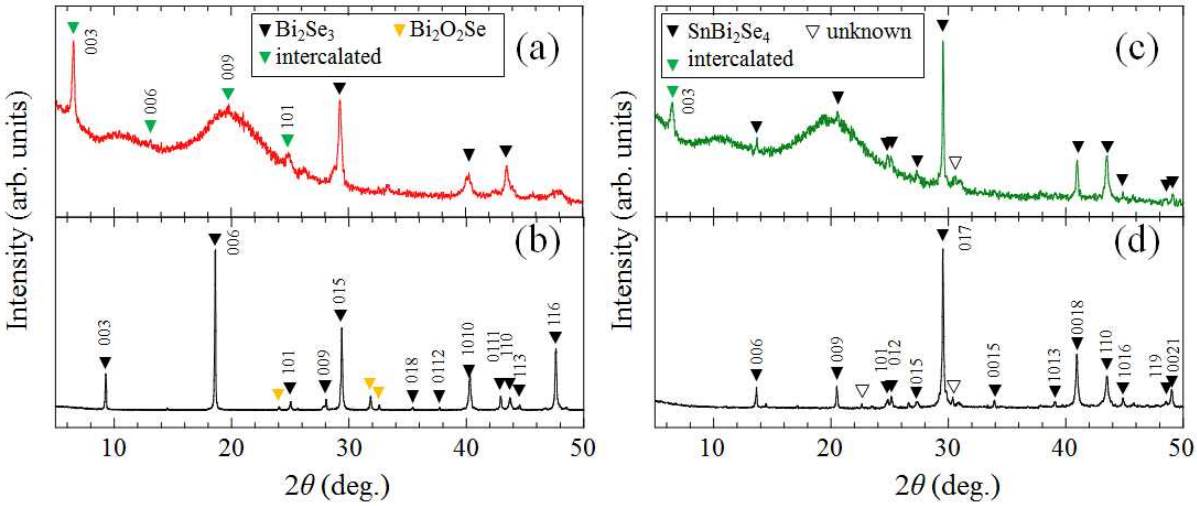

Fig.1. Powder X-ray diffraction patterns of samples obtained through the co-intercalation of Li and EDA for (a) Bi_2Se_3 and (c) $SnBi_2Se_4$. Those of host samples of (b) Bi_2Se_3 and (d) $SnBi_2Se_4$ are also shown for reference.

Keywords: Superconductor, Intercalation, Solvothermal Technique