2016 中技社科技研究獎學金

CTCI Science and Technology Research Scholarship

Sb-Se-Pb-Sn 熱電材料系統之相圖建構

Phase equilibria of thermoelectric Sb-Se-Pb-Sn system

國立清華大學 化學工程學系 博士班五年級 張睿紳

指導教授：陳信文 教授

研究重點

Thermoelectric materials and devices regarded as the important energy materials have been the subject of intensive study, primarily because of their abilities of direct transformation between heat and electricity. Recently, due to the development of advanced semiconductor process and nanotechnology, the researches of thermoelectric materials are moving into new territory. The Sb-Se-Pb-Sn alloys have been recently examined among various promising thermoelectric materials. In the Sb-Se-Pb-Sn system, the PbSe, Sb_2Se_3 and SnSe compounds are of interests to thermoelectric applications because of their outstanding performances reported by numerous groups. Phase equilibria information is fundamentally important to materials' development, properties' assessment and processing routes selection; however, there are only limited phase equilibrium data of Sn-Se-Pb-Se system available. The phase diagrams of the Sn-Se-Pb-Se system are thus determined in this study.

研究成果

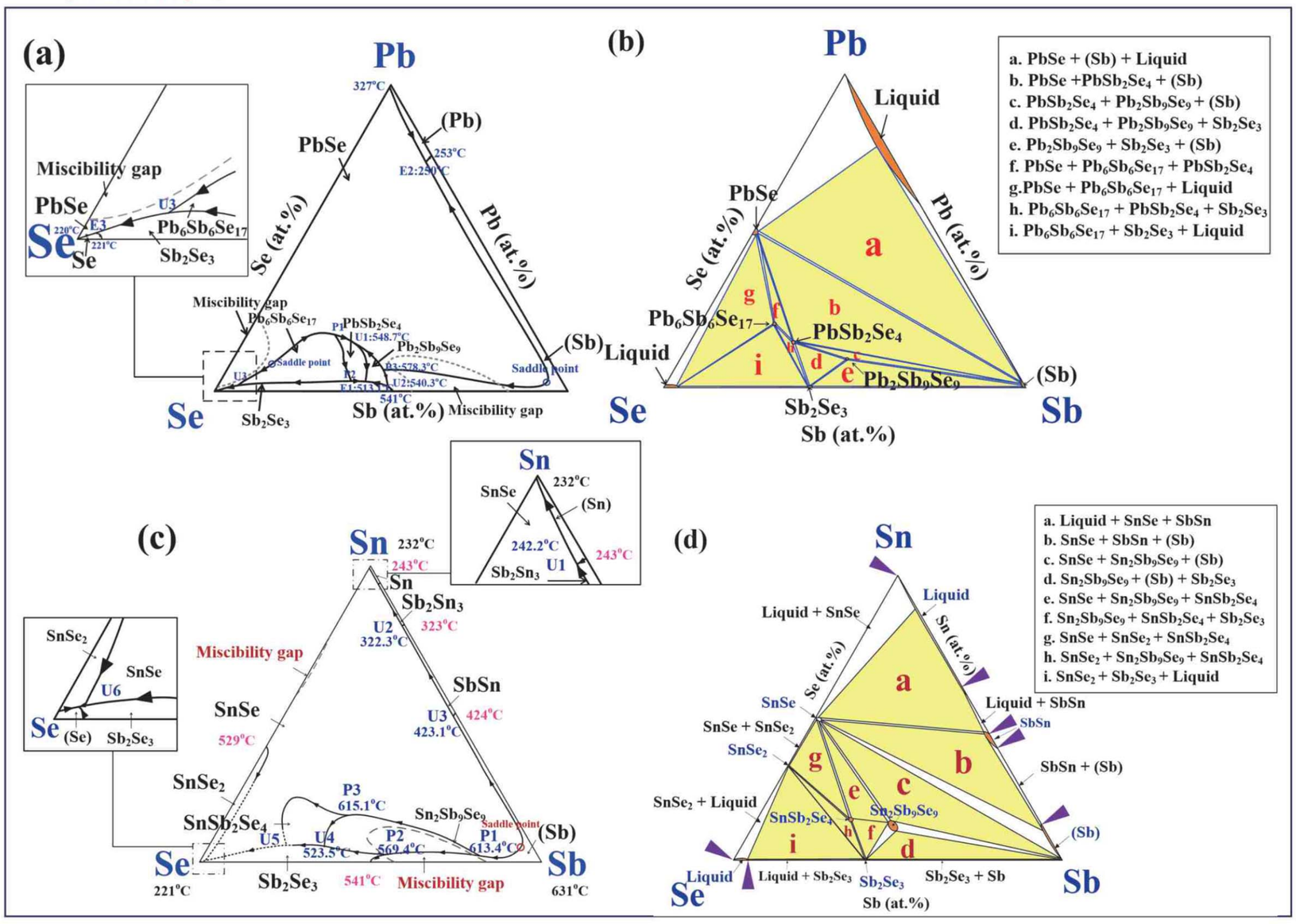

Fig. 1: (a) Liquidus projection and (b) 400°C isothermal section of Pb-Sb-Se ternary system. (c) Liquidus projection and (d) 400°C isothermal section of Sn-Sb-Se ternary system.

(A) Pb-Sb-Se ternary system

There are eight primary solidification phases. In addition to the three terminal phases, (Pb), (Sb) and (Se), there are PbSe, Sb_2Se_3, $PbSb_2Se_4$, $Pb_6Sb_6Se_{17}$, and $Pb_2Sb_9Se_9$ phases in the liquidus projection (Fig1(a)). The $Pb_2Sb_9Se_9$ compound was found for the first time in this research There are nine invariant reactions involving liquid. There are nine tie-triangles in the 400°C isothermal section (Fig1(b)).

(B) Sn-Sb-Se ternary system

In addition to the three terminal phases, (Sn), (Sb) and (Se), there are Sb_2Sn_3, SbSn, SnSe, $SnSe_2$, Sb_2Se_3, $Sn_2Sb_9Se_9$, and $SnSb_2Se_4$ phases in the liquidus projection (Fig1(c)). There are ten invariant reactions in the Sn-Sn-Se ternary system, and seven of them are experimentally determined. There are nine tie-triangles in the 400°C isothermal section of the Sn-Sb-Se ternary system (Fig1(d)).

研究生活及心得

博士班階段，感謝指導教授 陳信文老師的栽培，讓學生在研讀研究所的這段時間，有機會能參與各項學術競賽及赴美移地研究，所謂「人生沒有用不到的經歷」，各式活動經歷是學生成長的重要養分，然而，在累積豐碩成果的過程中，難免伴隨著孤獨及挫折感，於此，深深感謝一路上家人及無數的朋友扶持，讓我度過每一次的難關；最後，感謝中技社給予學生如此珍貴的獲獎機會，藉由這次的得獎，自許在未來能將研究能量奉獻社會、貢獻所長。

財團法人 中技社
CTCI FOUNDATION