The System Indium Antimonide–Lead

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PRELIMINARY investigation of the ternary system indium-antimony-lead by x-ray analysis and microscopic examination revealed that the InSb phase and lead probably formed a true quasi-binary section. This isopleth was thoroughly investigated by thermal analysis, x-ray, and microscopic examination.

MATERIALS

The lead (American Smelting and Refining Co.) and the antimony (Bunker Hill Co.) each had a purity of 99.99+% by spectrographic analysis. The indium (on loan from the Indium Corp. of America) had a guaranteed purity of 99.97+% by chemical analysis.

EXPERIMENTAL

All alloys were prepared by weighing the desired amount of each element on an analytical balance in a borosilicate glass tube, then evacuated, sealed off, and placed in a muffle furnace controlled at about 575° C., which is at least 50° above the melting point of the highest-melting composition in the series. During the 20 to 30 minutes that the alloy was held at temperature, it was vigorously shaken to ensure homogenization. The alloy weights varied between 60 and 90 grams each, depending on the specific gravity of the alloy. After air cooling and reweighing, the alloys were transferred to borosilicate glass test tubes to take the thermal data.

The cooling curves were recorded with the alloys under a protective atmosphere of either nitrogen or argon at 2° to 4° per minute with mechanical stirring. The temperature of the alloys was measured by means of a calibrated chromel-alumel thermocouple which was protected from the molten liquid and centered in the alloy by a thin-walled quartz tube. Since the electromotive force (EMF) produced by the chromel-alumel thermocouple was often greater than the range of the Honeywell Extended Range Recorder used for charting the EMF, an external potentiometer was used as an auxiliary.

The samples for metallographic examination were polished by conventional techniques. Etching of samples high in InSb was carried out with mixtures of solutions of 30% acetic acid and 10% ammonium persulfate. For samples high in lead many different etchants were tried; a solution of acetic acid and hydrogen peroxide gave best results.

RESULTS

Twenty specimens along this section were examined by thermal analysis. Table I contains the thermal data, and Figure 1 shows the results plotted graphically. InSb and lead form a simple eutectic system with the eutectic reaction occurring at 93.5 weight % lead at 298.5° C. The composition of the eutectic was substantiated by microscopic examinations. X-ray and microscopic analysis show that there is no appreciable solid solubility on the InSb end of the diagram, and the solubility of InSb in lead is 1% at the eutectic temperature.

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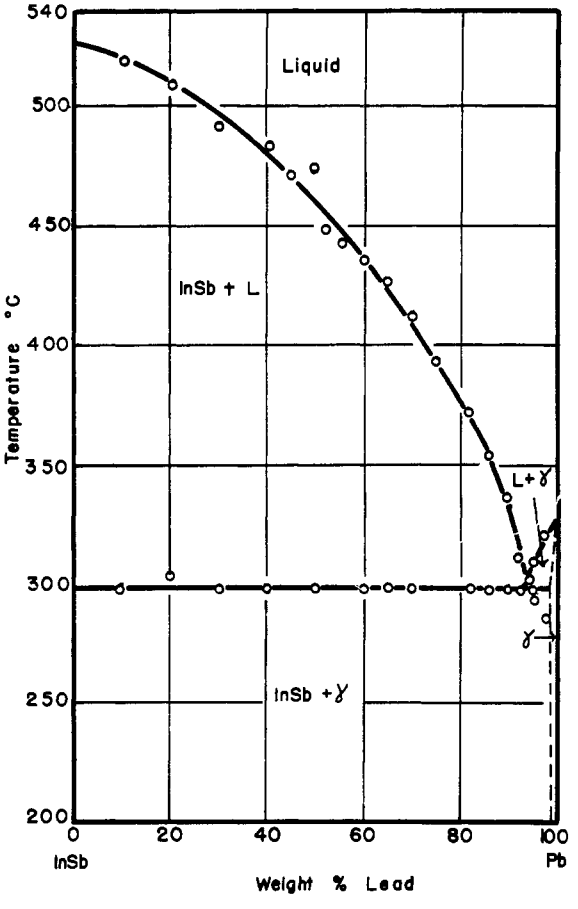

Figure 1. The system InSb-Pb

Table I. Thermal Data for InSb-Pb System

Alloy, Wt. % Pb	Temperature, ° C. 1st arrest	2nd arrest
10.0	521.8	298.0
20.0	508.8	303.3
30.0	491.5	299.0
40.0	484.2	299.4
45.0	471.0	...
50.0	472.1	298.3
52.5	450.0	...
55.0	447.3	...
60.0	435.5	299.0
65.0	426.1	298.8
70.0	411.8	298.3
75.0	393.1	...
82.0	371.5	299.0
86.0	354.6	298.0
90.0	336.9	298.6
92.5	310.5	298.6
93.5	298.6	298.1
94.0	300.8	297.3
95.0	309.6	294.3
97.5	321.6	285.5

ACKNOWLEDGMENT

We thank the Indium Corp. of America and Bunker Hill Corp. for indium and antimony and the National Science Foundation for a grant that made this work possible.

RECEIVED for review January 31, 1962. Accepted April 27, 1962.