# Indium Antimonide: the Metallic Form at Atmospheric Pressure

Abstract. *The crystal structure of metallic indium antimonide at atmospheric pressure and −197°C is essentially identical with that of white tin at 26°C.*

Compression of group IV elements and of group III–V and group II–IV binary compounds transforms them into metals (*1–3*). The phase change is marked by a large increase in density and a rise in the number of equivalent near neighbors from four, which is characteristic of these materials at low pressure, to six, which is characteristic of the new phase (*4*). The work of Drickamer and his co-workers (*3*) and of Kennedy and his co-workers (*1*) has clearly demonstrated the generality of the phenomenon.

Jamieson has examined the crystal structure of the metallic form of indium antimonide under high pressure and found it to be analogous to that of white tin. We now report a low-pressure study that shows the structure to be essentially identical with that of ordinary metallic tin.

The metallic form of InSb may be obtained at low pressures by cooling the material while it is under pressure and then reducing the pressure. The metallic form was first made as described previously (*1–3*) by application of pressures a few kilobars in excess of the transition pressure of 23 kb at a temperature of about 95°C. Periods of several hours were used to insure complete conversion.

Liquid nitrogen was then used to cool the entire assembly of press and sample. When the temperature of the sample had dropped to well below 210°K (−63°C) the pressure was released, and the sample was removed from the cylinder, which contained tungsten carbide. We found that the material was a very good metal with a very low resistance, comparable to that of aluminum at temperatures between 77° and 210°K. It was very shiny and metallic and extremely hard, somewhat like tool steel. It was found, empirically, to be stable for weeks, so long as it was kept at temperatures below −63°C, and it was even possible to machine it.

An x-ray diagram was taken by the Debye-Scherrer technique at 77°K. The spectrum with CuK $\alpha$ radiation is given in Table 1, together with the lattice spacings of ordinary white tin (*5*).

Table 1. Lattice spacings of white (or $\beta$ tin) and metallic indium antimonide, InSb(II). The unit-cell dimensions for Sn($\beta$) at 26°C and InSb (II) at −197°C are, respectively, *a*, 5.831 and 5.72 ± 0.16Å; *c*, 3.182 and 3.18 ± 0.03Å. The corresponding densities are, respectively, 7.286 and 7.54 ± 0.16 g/cm³.

| *hkl* | Sn($\beta$), d(Å), Cu. 1.5405 Å | InSb(II), d(Å), Cu. 1.5405 Å |
|---|---|---|
| 200 | 2.915 | 2.90 |
| 101 | 2.793 | 2.78 |
| 220 | 2.062 | 2.05 |
| 211 | 2.017 | 2.02 |
| 301 | 1.659 | 1.65 |
| 112 | 1.484 | 1.48 |
| 400 | 1.458 | |
| | | 1.44* |
| 321 | 1.442 | |

* Unresolved.

It is clear from these data that the two structures are identical to within 0.02 Å in the spacings for the body-centered tetragonal lattice (*6*).

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### References and Notes

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