band theory language the scattering of conducting electrons will result.

The conduction act itself can be most clearly envisaged as the removal of an electron from the resonating molecule at one edge of the crystal at the cost of the ionization potential, the distribution of the resultant positive charge uniformly over the entire molecule because of the three-dimensional resonance, followed by the neutralization by acquisition of an electron at the opposite side of the crystal with the regaining of the energy corresponding to the ionization potential. In the presence of an electric field the positive charge obviously will not be completely uniformly distributed at any finite temperature because the relaxation time for the molecular lattice will necessarily be the time for the transport act itself, and this limitation in rate will cause a charge gradient to exist across the molecule. At the absolute zero of temperature this electrical resistance would appear to be zero.

Drickamer[4–7] and his co-workers have shown that, like true metals, the new compressed phases absorb light down to the lowest frequencies. This can be envisaged as being due to the close-lying states in the crystal (molecule) corresponding to charge displacement from one end of the crystal to the other.

IV. METALLIC InSb

Many of the properties of the normal semiconducting form of indium antimonide are similar to those of gray tin. The lattice constant of the zincblende type of[18] InSb is almost identical with that of gray tin.[19] Gebbie *et al.*[20] found that the room-temperature resistivity of InSb drops several orders of magnitude at 30 000-atm pressure. Kennedy *et al.*,[1,2] Ponyatovskii *et al.*,[21] and Banus *et al.*[22] give pressure-temperature phase diagrams which show a solid-solid transition in InSb at high pressure. Kennedy *et al.*[1,2] suggested that this solid (I)-solid (II) transition is analogous to the gray-white transition in tin. Smith *et al.*,[23] Jamieson,[17] and Banus *et al.*[22] have examined the crystal structure of the high-pressure form of indium antimonide and found it to be analogous in structure to white or metallic tin.

Darnell and Libby,[24] Geller *et al.*,[25] and Stromberg *et al.*[26] have obtained the metallic form of indium antimonide at atmospheric pressure by temperature quench of the high-pressure form. Metallic indium antimonide, like tin, readily solidifies into large crystals. Single crystals of InSb(II) from 1–2 mm were obtained when molten indium antimonide was cooled slowly at 25-kbar pressure.

A. Crystal Structure and Spacing

Metallic indium antimonide at atmospheric pressure has lattice spacings and lattice parameters which are essentially identical[24] to those of metallic tin[27] (Table I). The "average" value of the valence of In and of Sb is equivalent to that of Sn. At present it has not been proven experimentally that the In and Sb atoms occur in the regular alternating order necessary to our understanding of the metallic state.

B. Compressibility

The compression $\Delta V/V_0$ for InSb(II), InSb(I), and Sb(β) were measured in a piston-cylinder apparatus at −196°C. The averages of the compression and decompression measurements are given in Fig. 1. The compressibility $(1/V)(dV/dP)_T$ obtained from the initial slopes in Fig. 1 are 0.9, 3.6, and 3.1×10^{-6} bar^{-1} for InSb(II), InSb(I), and Sn(β), respectively. Thus, the compressibility of InSb(II) is only approximately $\frac{1}{3}$ of that of metallic tin. This, as we shall see, later appears to accompany an increase in hardness as well.

C. Density

The density of InSb(I) is 5.79 g/cm^{-3} from its lattice parameter[18] at 298°K. The density of InSb(II) calculated from its lattice parameters at 77°K (Table I) is 7.28 g/cm^{-3}. The directly measured density of InSb(II) is 7.13±0.06 g/cm^{-3}.

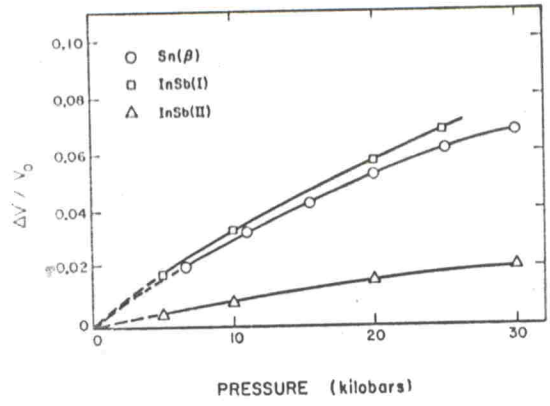

FIG. 1. Compression of InSb(I), InSb(II), and Sn(β) at −197°C.

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