Indium Telluride Metal

Abstract. *Metallic indium telluride, InTe(II), is metastable up to 125°C at one atmosphere pressure. It has a cubic crystal structure and has a light blue color.*

The indium-tellurium temperature-pressure phase diagram (*1*) which shows a metallic phase above 32,000 bars has led us to attempt to isolate the metallic phase in a metastable state under ordinary laboratory conditions just as we isolated indium antimonide (*2*). This attempt has proven successful. The new metal is metastable to about 125°C, and has properties of considerable general interest. Its x-ray diagram shows it to be a simple cubic structure as reported earlier (*1*). Our parameters are given in Table 1. The lattice spacing is 3.07 Å corresponding to a theoretical density of 6.69 g/cm³. Our density, directly measured, is slightly lower presumably because of imperfections in the crystalline compact arising from the high pressure preparation.

Indium telluride (I) was prepared by heating In and Te, each 99.999 percent pure, in an atom ratio of 1.000 to 1.000 ± 0.001, in an evacuated quartz tube, while being thoroughly mixed at approximately 100°C above the melting point of the compound (*3*).

Debye-Scherer x-ray diffraction patterns, Fig. 1, of the InTe(I) showed no lines attributable to In or Te above the background, thus indicating that the reaction was at least 98-percent complete.

Our technique for the preparation of metallic indium telluride, InTe(II), was similar to that used for the preparation of the indium antimony metal (*2*)—heating at high pressure to remove nucleation centers, followed by chilling with liquid nitrogen while under pressure, and subsequent pressure release and removal from the pressure apparatus. This metal is more easily isolated than indium antimonide. The latter requires temperatures below −63°C while the indium telluride is metastable at temperatures below about 125°C. X-ray diffraction of metallic indium telluride taken at 25°C, Fig. 1, exhibits no diffraction lines corresponding to In, Te, or InTe(I) thus indicating that the conversion was essentially complete.

The cubic structure with six nearest neighbors causes an insufficiency in the valence electrons for covalent bonding, which we believe leads to a condition of resonance equivalent to the metallic state (*4*).

The physical properties are interesting. Whereas the InSb metal is very hard, nearly as hard as steel, the InTe metal is very soft and friable. It is readily scratched by glass. Our preparations have consisted of crystals of mean dimensions of 2000 Å as judged from the width of the x-ray lines.

The most remarkable of the obvious physical properties is the beautiful light blue color which the new metal shows on all its crystalline faces. This light blue metallic luster changes to a darker blue when the metal is cooled to −197°C.

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Table 1. Lattice spacings of metallic indium telluride, InTe(II). The lattice spacing is 3.07 Å, theoretical density 6.69 g/cm³, CuKα radiation.

h k l	*d* (Å)
100	3.056
110	2.174
111	1.773
200	1.536
210	1.374
211	1.255

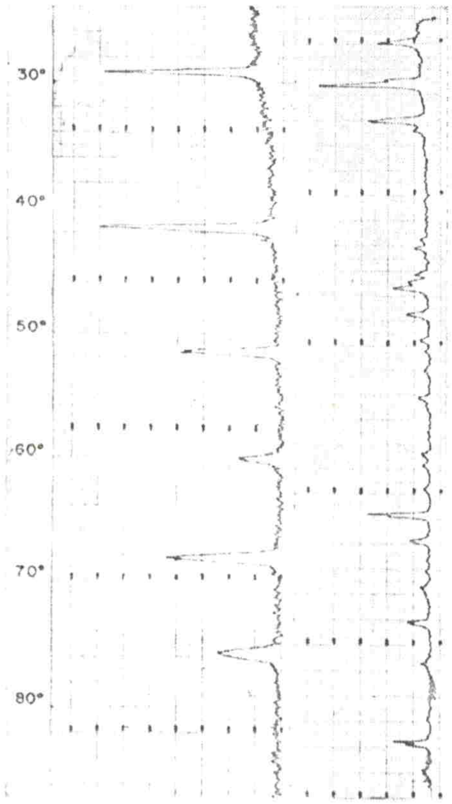

Fig. 1. X-ray diffraction patterns for allotropes of InTe; ordinate, degrees (2θ); abscissa, relative intensity. Left trace: InTe(II), cubic form; right trace: InTe(I), tetragonal form.

References and Notes

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