DETERMINATION OF INTERATOMIC DISTANCES OF SOLIDS UNDER PRESSURE

I. Compressibility of Barium and Strontium

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We have developed a simple method of determining compressibility by x-ray diffraction patterns obtained at pressures up to 15,000 kg/cm^2. The error in the determined values of the compressibility of strontium and barium did not exceed 3%.

The determined values were compared with those obtained by Bridgman [1], who used linear compressibility.

It is well known that some properties of metals depend greatly on the interatomic distances. This dependence is found, for example, in the case of electrical, galvanomagnetic, and magnetic properties (displacement of the Curie and Neil points under the effect of pressure [2,3]). Consequently, knowledge of the correct values of interatomic distances and their variation with pressure are of utmost importance for the understanding of processes occurring in metals. In the majority of cases, the variation of interatomic distances under the effect of pressure is determined by measurements of compressibility under pressure.

Measurements of volume compressibility under high hydrostatic pressure are usually made either by the "movable piston" method or by determining the linear compressibility, from which volume compressibility is calculated.

In both cases, it is necessary to make numerous corrections of the results by accounting for the deformation of the compression chamber, pistons, and compression gaskets, and the compressibility of the pressure-transferring medium and other parts of the apparatus.

If the relative change of the length of the sample is measured with an instrument with a sliding contact, it is necessary to make corrections for the variation of the electrical resistance of the standard wire with pressure, for the unevenness of its cross section along its length, etc.

The conversion factor by which the measured linear compressibility is transformed into volume compressibility must be corrected; this factor cannot be equal exactly to 3, even in the case of substances with cubical symmetry, because the compressibility may be different in different directions due to the presence of a binding substance between the crystals of the sample.

The compressibility of the intercrystalline substances and of the microspaces between the crystals of the sample cannot be determined by this method; they become part of the total compressibility of the substance. Therefore, it seems of interest to compare the data obtained by this method with those obtained by the x-ray diffraction method.

The x-ray diffraction method of determining the relative change of the volume by the change of the lattice parameters of the substance is free of these defects.