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Effect of Pressure on the Volume and Lattice Parameters of Magnesium*

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The effect of pressure to 300 kbar has been measured on the volume and on the lattice parameters (c and a) of the hcp magnesium lattice. The a axis compresses in a regular manner, but the c axis compresses relatively rapidly to 70 kbar, then becomes continuously more incompressible in the range 70–120 kbars, which results in a distinct increase in c/a. The compressibility increases in the region 120–200 kbar and c/a is essentially constant. Beyond 200 kbar the c-axis compressibility decreases again and c/a increases rapidly. These results and earlier measurements of resistance as a function of pressure are interpreted qualitatively in terms of the theories of Jones and Goodenough and the Fermi surface as calculated by Falicov.

THE effect of pressure has been measured on the volume and lattice parameters of magnesium to 300 kbar. Two sources of magnesium were used, powder from Fisher Chemical Company and turnings from a sample from Dow Chemical Company. No difference was noted. The high pressure x-ray methods have been previously described.[1] The pressure calibration is obtained by the addition of an appropriate marker of known compressibility. The markers used in this work were molybdenum and MgO. The density of molybdenum as a function of pressure is known from sock-wave velocity measurements.[2] The compressibility of MgO has been measured in this laboratory.[3] Some eighteen runs were made in all.

The calculations were largely based on the 101, 100, and 110 lines, with occasional checks made on other lines. The data were smoothed by plotting 2θ for the 101 reflection versus 2θ for each of the other reflections. Figures 1 and 2 are typical plots. Features to be especially noticed are the distinct discontinuity in slope near $2\theta_{101}=18.0°$, and the convexity of slope in the sections of the curve on either side of the discontinuity. Figure 3 shows a plot of $2\theta_{101}$ versus pressure.

In Fig. 4 the volume as a fraction of the atmospheric volume is plotted as a function of pressure. The curve shows a small but distinct irregularity in slope near 150 kbar but is otherwise quite smooth. Bridgman's[4] P-V data to 100 kbar and the data obtained from shock velocity measurements[2] are shown for comparison. Bridgman's data indicate a slightly lower compressibility; the shock wave data show a slightly higher value. A large temperature correction is necessary for the shock wave data, because of the high compressibility.

Figure 5 contains plots of c and a versus pressure. Figure 6 shows c/a. In both figures the resistance data of Stager[5] are shown. These are used in the discussion below. The results are summarized in Table I.

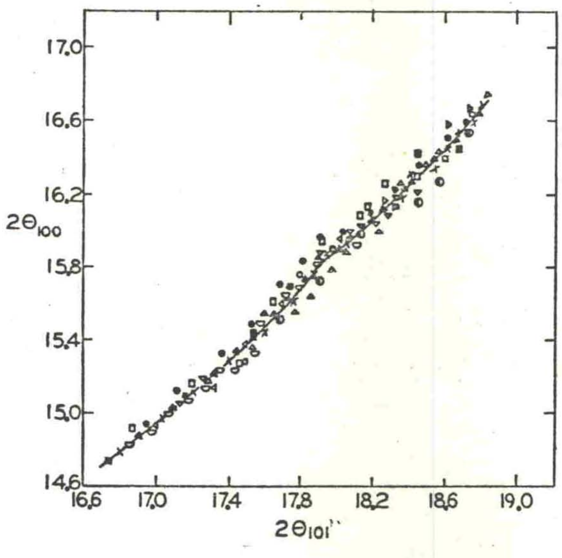

FIG. 1. Diffraction angle $2\theta_{100}$ versus $2\theta_{101}$—magnesium.

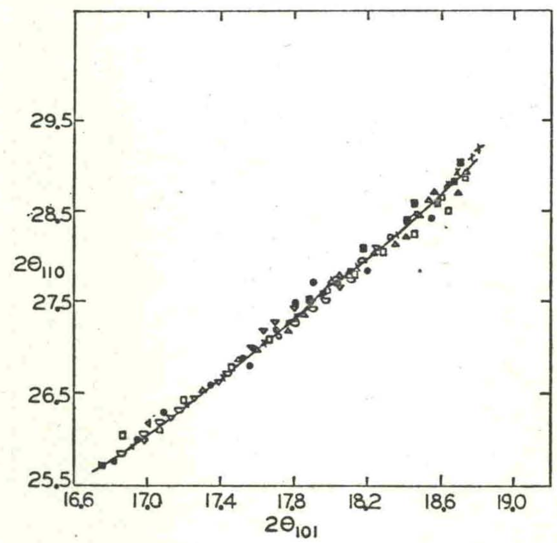

FIG. 2. Diffraction angle $2\theta_{110}$ versus $2\theta_{101}$—magnesium.

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