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Use of Cesium Chloride for Transmitting High Pressures at High Temperatures*

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SILVER chloride is sometimes used to transmit pressure hydrostatically at very high pressures.¹ It is the purpose of this note to point out that cesium chloride is also useful in this respect and to describe an application where it appears to have some advantages over silver chloride.

Most of the pressure apparatus used was made after the designs of F. R. Boyd.² A schematic diagram is shown in Fig. 1. Single crystals of potassium chloride are to be subjected to high pressure and high temperature for a solid state diffusion experiment. Figure 2 is a detail drawing of the inside of the pressure vessel, showing the arrangement developed in this Laboratory to subject the crystal to high temperature and high pressure without fracturing the crystal. The cesium chloride crucible provides a "cushion" of relatively soft material to protect the crystal from the nonhydrostatic forces existing in the less plastic lava. The specimen is protected from cesium chloride contamination by a thin pure graphite envelope. Without the cesium chloride cushion the lava will always pinch off the specimen into a large number of thin platelets when the pressure is released. Unfortunately, the alkali halides have a relatively high thermal and electrical conductivity, making it difficult to achieve high temperatures if an alkali halide is used as the entire pressure medium.

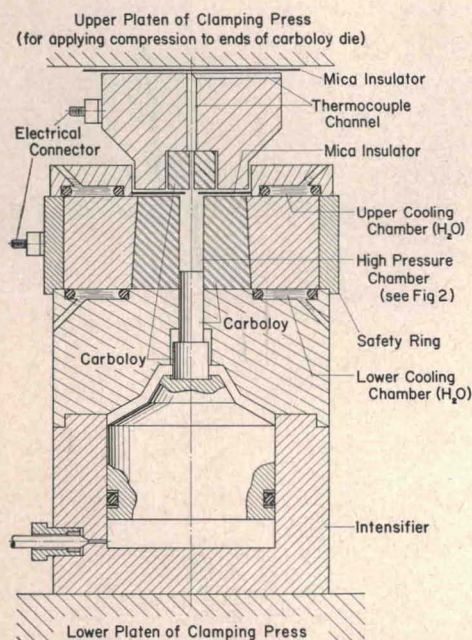


FIG. 1. Schematic drawing of high-pressure apparatus.

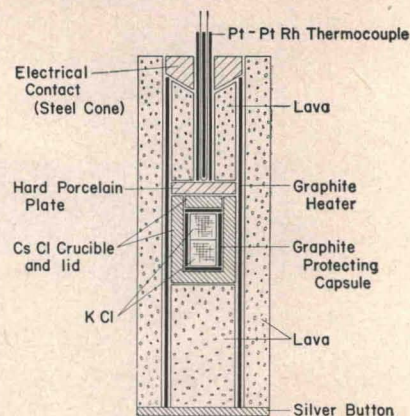


FIG. 2. Detail of interior of pressure vessel.

Cesium chloride crucibles were pressed from the powder³ under a pressure of 4000 atmos. Crucibles of silver chloride can also be formed in this manner, though with more difficulty, the silver chloride having a tendency to seize the forming die. Cesium chloride has an additional advantage over silver chloride in that its melting point at atmospheric pressure is higher, permitting measurements at temperatures relatively close to the melting point of potassium chloride at quite low pressures. The melting point of cesium chloride increases relatively rapidly with pressure, and above 9000 atmos its melting point is higher than the corresponding high pressure melting point of any of the sodium or potassium halides except sodium fluoride and probably potassium fluoride.⁴

The apparatus has been used to subject a single crystal cylinder of potassium chloride to approximately 16 000 atmos and 1100°C, melting the potassium chloride but not the cesium chloride. The specimen was recovered as a single polycrystalline cylinder with no apparent cracks perpendicular to the axis. Subjection of single crystals to pressures in the same range at lower temperatures permitted the recovery of a single crystal with slight cracks but still with strength enough to permit sectioning. The present method should be useful for diffusion measurements to pressures as high as 30 000 atmos and over 1000°C.

The same arrangement for heating will be employed for diffusion experiments at atmospheric pressure at temperatures very close to the melting point of a specimen where the time of the diffusion anneal should be only a few minutes in length. It appears that the time to reach temperature equilibrium at 700°C can be reduced to less than one minute.

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¹ H. Tracy Hall, Rev. Sci. Instr. 29, 267 (1958).

² F. R. Boyd and J. L. England, J. Geophys. Research (to be published).

³ Prepared from cesium carbonate, American Potash and Chemical Corporation, Los Angeles, California.

⁴ S. Clark, J. Chem. Phys. (to be published).