

EQUATION OF STATE SYNCHROTRON EXPERIMENTS WITH HYDROGEN AT HIGH PRESSURES
H.K. Mao, L. Finger, R. Hazen, J. Xu, R. Hemley, A. Jeffcoat, Geophysical
Laboratory, Washington, D.C. and P.M. Bell, Norton Co., Worcester, MA

High pressure experiments with hydrogen (and deuterium) have led to the first measured accurate equation of state. Densified hydrogen (and deuterium) were pumped into the sample chamber of a diamond-window high-pressure apparatus at room temperature. The initial density of a deuterium single crystal was determined by in situ X-ray diffraction measurements utilizing static, rotating anode, and synchrotron X-ray generation sources. On the conventional X-ray sources, the apparatus was held in a 4-circle crystal goniometer. On the synchrotron source, the apparatus was held on a special 2-circle goniometer, utilizing an energy-dispersive detector. The beam diameter at the pressurized single crystal was 10 micrometers. The beam was located, and the pressure measured, by means of a laser-fluorescence micro-spectrograph and diode array imaging system. At 54 Kbar the molar volume at 25 degrees Celsius was

(A) 7.994 cubic centimeters per mole.

(B) Rapid increases in the density of the pressurized hydrogen sample were determined by measuring the elastic velocity. The measurements were obtained by observing Brillouin scattering of the sample at pressures to 200 Kbar.

The results differ from the equation of state of H. Shimizu et al. (Phys. Rev. Lett. 47, 128, 1981) by less than 2 percent, and thus they are in good agreement. There is less agreement with the theoretical calculations of M. Ross et al. (J. Chem. Phys. 79, 1487, 1983), the initial difference being approximately 8 per cent. The new results provide model data for the interiors of the major planets.