

The use of this cell requires a high degree of expertise and further requires high precision machine shop facilities to construct it. The cell has been used for pressure applications of 180 kbar at 773 K [34] and 55 kbar at 77 K [35]. The cell has been modified to be used for liquids or solutions [41,43]. The Drickamer cell or modifications thereof have also been used for Raman measurements at high pressures [45,46]. This application will be discussed in a later section. A Drickamer-type apparatus for pressures to 400 kbar has been reported [47].

(3) Anvil-type cell

Perhaps the most versatile pressure cell that has been used for optical studies has been the diamond anvil cell (DAC), as developed by Weir and associates [48]. Figure 2 shows the details of this cell. The diamonds serve as the pressure transmitting material as well as the windows. Pressures close to 100 kbar, depending on the size of the diamonds, are routinely reached. However, the DAC has been used with pressure as high as 300 kbar [49], and conceivably smaller diamonds could generate even higher pressures. The cell can be used for solutions or liquids, although a gasket is necessary for this application. Figure 3 illustrates a gasketing technique used with liquids [50]. The

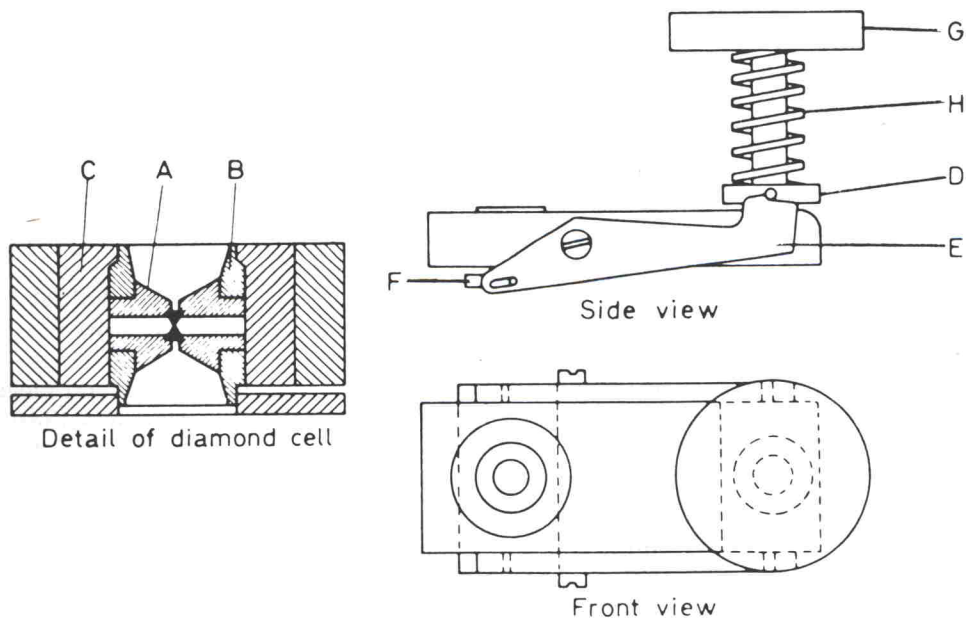


Fig. 2. Diamond anvil high pressure optical cell. A and B, parts of pistons; C, hardened steel insert; D, pressure plate; E, lever; G, screw; H, calibrated spring. (Figure reproduced through the courtesy of the authors and Applied Spectroscopy.)

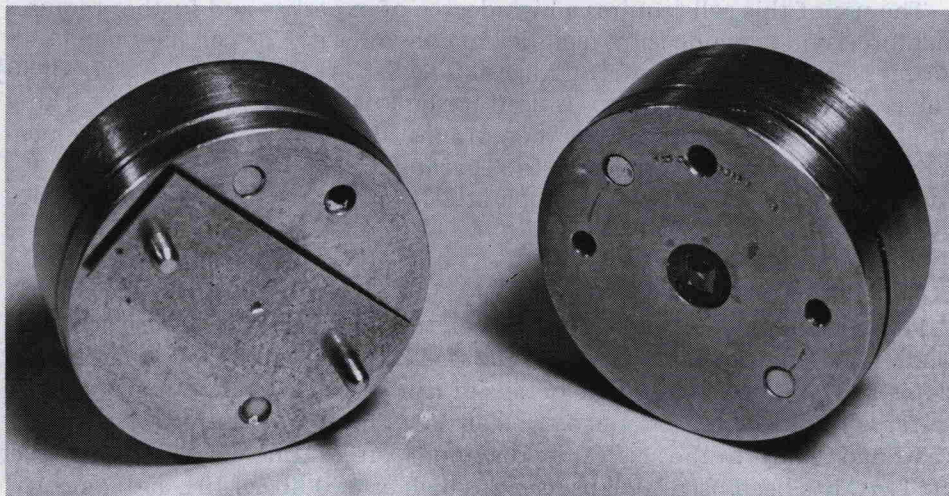


Fig. 3. A gasket technique with DAC [50]. (Figure reproduced through the courtesy of the authors and Applied Spectroscopy.)

DAC has also been used at temperatures of ca. 3000 K [51] and cooled down to liquid nitrogen temperatures [52].

Recently improved versions of the DAC were developed [53,54], and Fig. 4 illustrates the details of the modifications used by Adams and Payne. Pressure in this cell is applied through a small hydraulic ram instead of the calibrated screw of the original version. The other improved version of the DAC is the Waspaloy cell [54]. Figure 5 shows the essential parts of the design. The diamond alignment is improved from the original design. One diamond is mounted in a hemisphere, while the other diamond is mounted on a plate which is translationally positioned for axial alignment by screw adjustments. A loose fitting heating coil is placed in the cell. The cell can be used with gaskets for hydrostatic pressure to 100 kbar, and has been used to 973 K and 200 kbar pressure.

An ultrahigh pressure diamond cell has now been developed [55], and megabar pressures can be generated. The cell is made of hardened (RWC-55) 4340 alloy steel. For high temperature studies the cell can be made from Inconel. Mao and Bell [56] have described an ultrahigh-pressure diamond cell, which they claim to have used to 1.7 Mbar [57]. These new ultrahigh pressure cells now make experiments simulating geochemical reactions in the mantle of the earth possible.

One shortcoming of the DAC is the lack of hydrostatic pressure across the diamond faces. This pressure gradient, which may demonstrate pressures 1.5 times greater at the center than the edges [58], may not be entirely disadvantageous. However, with the use of a gasket and a pressure transmitting fluid the