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HIGH PRESSURE VESSEL FOR OPTICAL STUDIES IN THE 1-8000 ATM RANGE

S. Claesson

High Pressure Vessel for Optical Studies in the 1-8000 atm range

By Stig Claesson, Sture Malmrud and Björn Lundgren

Institute of Physical Chemistry, Uppsala University, Uppsala, Sweden

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A portable high-pressure vessel is described. It weighs less than 20 kg and can maintain a pressure as high as 8000 atm after being detached from a press or intensifier. Its optical windows (2, 3 or more) make it possible to study the effect of pressure upon light scattering, u.-v., visible and infra-red spectra of substances, their fluorescence etc. Many important technical improvements are outlined.

Spectroscopic and other optical studies of solutions under high pressure are of considerable interest. Pressure perturbs molecular energy levels, and, since such perturbations depend on the character of intra- and inter-molecular forces operating in the liquid, much information about their nature may be gained from studies of such systems. In most cases, it is sufficient to attain pressures of 5000-10 000 atm to induce appreciable changes in the properties of the solutions.

Optical studies under high pressure are greatly facilitated if the pressure vessel, provided with suitable windows, is portable and maintains the pressure developed in it after its detachment from the hydraulic press or intensifier. Such a vessel can be placed in conventional optical instruments for measuring u.-v., visible and i.-r. spectra, fluorescence and phosphorescence, light-scattering, etc. An apparatus fulfilling these conditions has been described in a preliminary note.[1] A detailed description of a slightly modified design and of its operation is given below.

GENERAL DESIGN CONSIDERATIONS

The geometrical configuration of the pressure vessel depends on its particular use and can be varied within wide limits. However, the weight should be minimized so that it is easily portable ; the vessels made in this Institute weigh less than 20 kg.

The four most important parts of such vessels are the pistons, the locking system which maintains the pressure, the windows with their support and the optical cells. For the moderate pressure-range (<8000 atm) the design can be simple, reliable and convenient to work with. The parts have been standardized and therefore may be used in vessels of different geometry. In all our studies, glycerol was used as the pressure transmitting medium. Its good optical transmission, low compressibility and small tendency to leak out makes it superior to other fluids.

THE MAIN BODY is usually cylindrical. The central axial hole, with pistons and supporting screws placed at *both* ends, forms the main pressurized volume. Such an arrangement facilitates the dismounting of the vessel, which is awkward when it is closed at one end and equipped with only one piston. The increased number of pistons causes no trouble because the reliability of the O-rings is high. For double-beam work, cells with two axial holes have been built, and for light-scattering work with three and five radial holes.

THE PISTONS are O-ring sealed [2] and made either of steel or Nylon. The number