

## A technique for obtaining the Raman spectra of liquids and solutions under high pressure

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**Abstract**—This note describes the design and use of a cell to obtain the Raman spectra of solutions and liquids under high pressure.

THERE IS NOW a considerable body of literature devoted to the thermodynamic and electrochemical properties of pure liquids and solutions under conditions of high pressure [1-3]. Nevertheless, few attempts have been made to use vibrational spectroscopy to obtain a more detailed understanding of the molecular processes involved. Infrared spectroscopy has been used to study the effects of pressure on solids [4] and liquids [5-7] and, although some attempts have been made to utilise Raman spectroscopy [8-12], the results have usually been qualitative in nature [13-15]. Perhaps the most serious technical difficulty in the use of i.r. spectroscopy at high pressures is the choice of window material.

Sapphire and quartz, which have high mechanical strength, are limited in their transparency in the i.r. region of the spectrum. Diamond is probably the only material that has a suitable combination of mechanical strength and good i.r. transmitting properties. In recording the i.r. spectra of liquids under pressure, it is also necessary to ensure that the pathlength of the cell does not change with pressure [16].

The use of Raman spectroscopy to obtain vibrational spectra under pressure has distinct advantages over i.r. spectroscopy. First, since exciting and Raman scattered radiation both occur in the visible region of the spectrum, sapphire or quartz windows

- [1] W. A. ADAMS and K. J. LAIDLER, *Can. J. Chem.* **45**, 123 (1967).
- [2] G. J. HILLS, *Chemical Physics of Ionic Solutions* (Edited by B. E. CONWAY and R. G. BARRADAS), Chap. 23. John Wiley, New York (1966).
- [3] E. WHALLEY, *Ann. Rev. Phys. Chem.* **18**, 205 (1967).
- [4] R. BAYER and J. R. FERRARO, *Inorg. Chem.* **8**, 1654 (1969) and references therein.
- [5] R. R. WIEDERKEHR, Ph. D. Thesis. University of Illinois (1957).
- [6] E. U. FRANCK, *Ber. Bunsenges. Physik. Chem.* **73**, 135 (1969).
- [7] R. J. JAKOBSEN, Y. MIKAWA and J. W. BRASCH, *Appl. Spectry* **24**, 333 (1970).
- [8] G. E. WALRAFEN, *Hydrogen Bonded Solvent Systems* (Edited by A. K. COVINGTON and P. JONES), p. 20. Taylor & Francis, London (1968).
- [9] S. S. MITRA, O. BRAFMAN, W. B. DANIELS and R. K. CRAWFORD, *Phys. Rev.* **186**, 942 (1969).
- [10] O. BRAFMAN, S. S. MITRA, R. K. CRAWFORD, W. B. DANIELS, C. POSTMUS and J. R. FERRARO, *Solid State Commun.* **7**, 449 (1969).
- [11] M. NICOL, *J. Opt. Soc. Am.* **55**, 1176 (1965).
- [12] J. F. ASELL and M. NICOL, *J. Chem. Phys.* **49**, 5395 (1968).
- [13] R. AUMONT, E. DAYAN, B. VODAR, H. VU, G. WIDENLOCHER, *Compt. Rend.* **268**, 1565 (1969).
- [14] A. J. MELVEGER, J. W. BRASCH and E. R. LIPPINCOTT, *Appl. Opt.* **9**, 11 (1970).
- [15] R. CAVAGNAT, J. J. MARTIN and G. TURRELL, *Appl. Spectry* **23**, 172 (1969).
- [16] W. RIGBY, R. WHYMAN and K. WILDING, *J. Phys. E. Sci. Instrum.* **3**, 572 (1970).

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