

Fig. 8. The Raman spectrum of pyridine adsorbed on to  $\gamma$ -alumina. (a) 0.217 g, (b) 0.147 g, (c) 0.111 g pyridine on 1.19 g alumina, (d) after evacuation at 90 °C. (Reproduced from P. J. Hendra, J. R. Horder and E. J. Loader, *Chem. Commun.*, (1970) 563.)

and chemical adsorption, and to indicate the nature of the bonding of pyridine to these surfaces (Fig. 8).

The Raman spectrum of acetone adsorbed onto  $\gamma$  alumina<sup>43,4</sup> exhibits bands at 1575, 1625 and 1685–1703  $\text{cm}^{-1}$  which are not present in the spectrum of liquid acetone. The first two bands are due to an electron donor–electron acceptor complex. The band at 1685–1703  $\text{cm}^{-1}$  is attributed to a hydrogen-bridge bond between the C–O group and a surface hydroxyl group.

#### (v) The Raman spectra of black compounds

A restrictive requirement of Raman spectroscopy is that the sample should not absorb the exciting wavelength. This restriction resulted in all studies using the mercury arc 4358 Å exciting line being confined to colourless samples. The advent of tuneable laser sources has almost totally overcome the "colour problem", nevertheless black compounds still present an exciting challenge to the Raman spectroscopist.

The usual technique for obtaining the Raman spectra of black compounds is the back scattering method, in which the same surface is used for excitation and for collection of the Raman scattered radiation. Due to the absorption characteristics of the material the observed spectra are induced in a thin surface layer, and it is thus surprisingly possible to excite the spectra of black samples with any exciting wavelength provided it is of sufficient power.

The first report of the Raman spectrum of an opaque material appeared in 1965 when Russell reported the Raman spectrum of silicon using He/Ne excitation

(ref. 435). Beattie and Gilson have recently reported the Raman spectra of the nearly opaque materials  $\text{Fe}_2\text{O}_3$  and  $\text{Cr}_2\text{O}_3$  using both He/Ne and  $\text{Ar}^+$  (green 5145 Å) excitation<sup>43,6</sup>.

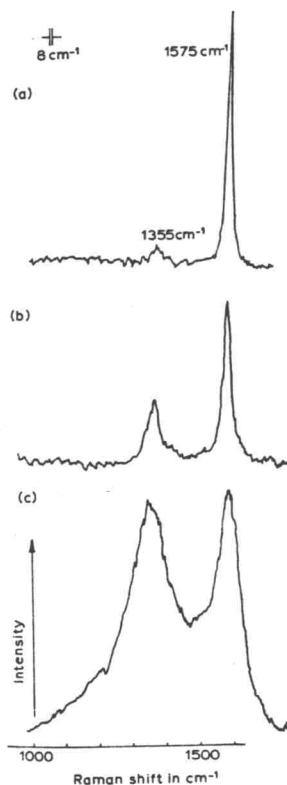


Fig. 9. Comparison of the Raman spectra of (a) stress-annealed pyrolytic graphite, (b) a commercial graphite and (c) activated charcoal. (Reproduced from F. Tuinstra and J. L. Koenig, *J. Chem. Phys.*, 53 (1970) 1126.)