Raman Effect in Liquid Ethylene

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Because of inconsistencies in the reports of previous investigators (Table I) we have studied the Raman spectrum of liquid ethylene (−120°C). Ten Raman shifts have been measured. Nine of these have been recorded at one time or another in the literature. Our results include two lines found in the gas by Dickinson, Dillon, and Rasetti[1] which had not been checked by subsequent experimenters.[2, 3] Only six of the frequencies can be assigned to fundamental vibrations of the molecule.[3]

The new frequency 1601 cm^{-1} found by us is a faint companion to the strong Raman line 1621 cm^{-1} which has been attributed to parallel vibrations of the carbon atoms with relatively large displacements.[3, 4] The new line is apparently produced by this same type of vibration in those molecules which contain the C^{13} isotope.[5] Calculation checks roughly the separation observed, and the intensity ratio is appropriate.

TABLE I.

Liquid Ethylene			Ethylene Gas		
Glockler Renfrew[8] (1938)	Hemptinne Jungers Delfosse[6] (1937)	Bonner[3], (1936)	Daure[7] (1929)	Bhagavantam[2] (1936)	Dickinson Dillon Rasetti[1] (1929)
942		950			
1339	1341	1341	1340	1343	1342.4
1601					
1621	1621	1619	1620	1626	1623.3
1655		1654		1656	
2871		2880		2880	2880.0
3009	3007	3009	3000	3020	3019.3
3076	3082	3069	3080		
3231					3240.0
3264					3272.0

The weak 942 cm^{-1} line is very diffuse; also diffuse is the somewhat stronger line 3076 cm^{-1}. A faint "shadow" accompanies the strong 3009 cm^{-1} frequency; however, microphotometer tracings failed to show a separate line. All other lines are well defined, though in some cases they are very weak.

The 3-prism Steinheil spectrograph used in this laboratory gives a dispersion of 8A/mm at 4916A. Exposures of 12 hours brought out all lines. No filters were used. The strongest Raman frequencies were excited by Hg lines 4047, 4078, and 4358; the weak lines by 4047 and 4358, except for the Raman shift 1655 cm^{-1} which falls behind the Hg "triplet" when excited by 4047.

Ethylene (99.95 percent) manufactured for anaesthesia was used.

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