Ground State Vibrational Frequencies

A STUDY of the ground state vibrational frequencies of diatomic molecules in relation to the Periodic Table has shown that the arithmetic mean ω_m of the vibrational frequencies of the two elementary molecules A_2 and B_2 which belong to the same Periodic Group is approximately equal to the frequency of the compound molecule AB. All the relevant data are collected in the accompanying table.

Group 1			Group 5			Group 6			Group 7		
Mol.	ω	ω_m	Mol.	ω	ω_m	Mol.	ω	ω_m	Mol.	ω	ω_m
Li_2	352		N_2	2360		O_2	1568		Cl_2	565	
Na_2	159		P_2	778		S_2	727		Br_2	324	
K_2	93		As_2	432		Se_2	388		I_2	214	
Rb_2	58		Sb_2	268		SO	1124	1148	ICl	385	389
Cs_2	41		Bi_2	173		SeO[5]	(910)	978	IBr	267	269
LiK	(207)	223	PN[2]	1337	1569				BrCl	(440)	445
LiRb	(185)	205	AsN[3]	1063	1396						
LiCs	(170)	196	BiSb[4]	220	221						
NaK	123	126									
NaRb[1]	107	109									
NaCs	96	90									

Bracketed values are uncertain.

In Group 5 the BiSb molecule conforms to this rule, whereas the PN and AsN molecules do not. The ω value of the former molecule definitely refers to the ground state, as it is derived from absorption measurements, but there is no such certainty in the case of the latter molecules as their ω values are derived from emission spectra. It is suggested, therefore, that these discrepancies are due to the fact that the ω values presented here for PN and AsN do not refer to their ground states but to excited states. If this is so, it is probable that the actual ground state frequencies will be of the order of 1570 cm.$^{-1}$ and 1400 cm.$^{-1}$ respectively.

This subject will be discussed in greater detail in a future publication.

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[1] Kusch, *Phys. Rev.*, **49**, 218 (1936).
[2] Curry, L. Herzberg and G. Herzberg, *Z. Phys.*, **86**, 348 (1933).
[3] Spinks, *Z. Phys.*, **88**, 511 (1934).
[4] Nakamura and Shidei, *Jap. J. Phys.*, **10**, 11 (1935).
[5] Asundi, Jan-Khan and Samuel, NATURE, **136**, 642 (1935).
Remaining data have been obtained from Jevon's "Report on Band Spectra" (Physical Society, 1932).

A Second Sheath near the Cathode of an Arc Discharge

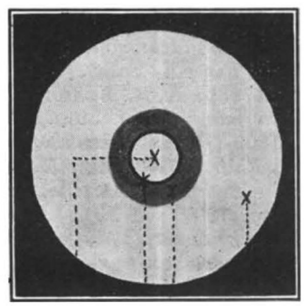
IN the course of some investigations on arc discharges with oxide-coated cathodes in rare gases, a new dark sheath with a sharp boundary was seen between the well-known Langmuir double space-charge sheath on the cathode and the light of the arc plasma. Fig. 1 shows diagrammatically (*a*) the cylindrical (indirectly heated) barium-strontium oxide coated cathode (viewed end-on), with (*b*) the well-known absolutely dark space-charge sheath, a few tenths of a millimetre in width and concentric with it, and (*c*) the almost dark sheath a few millimetres wide, followed by (*d*) the light of the plasma.

The thickness of this new sheath (*c*) varies approximately inversely with the square root of the current density and only slightly with the gas pressure. At low current density, for example, 0·1 amp. per cm.^{2}, the sheath becomes very indistinct. This dark sheath is only visible in a definite pressure range:

In helium	between	3	and	0·7	mm.	rather indistinct
,, neon + (0·1–1 per cent argon)	,,	0·6	,,	0·2	,,	sharp
,, argon	,,	0·2	,,	0·02	,,	,,
,, krypton	,,	0·14	,,	0·01	,,	,,
,, xenon	,,	0·08	,,	0·008	,,	,,
,, mercury vapour	,,	0·03 (60° C.)	and	0·007 (40° C.)		sharp.

In pure neon the sheath was barely visible. In argon, krypton and xenon the colour changes at the lower pressure limit mentioned above and at lower pressures a sheath is observed, which is brighter than the arc plasma, with almost the same dimensions as the dark sheath. At still lower pressures it disappears. In hydrogen, at 0·5 mm., a bright sheath is observed round the cathode with about the same thickness as in the case of the noble gases. Below 0·1 mm. we can see in hydrogen concentric with the dark space-charge sheath a bright and an almost dark sheath followed by the light of the discharge plasma (very distinct at 0·005 mm).

These last phenomena were also observed in argon (though very indistinct) at such a low pressure that the bright sheath had disappeared.



a *b* *c* *d*

FIG. 1. Diagram of glow from an oxide-coated cathode, in argon at 0·05 mm. pressure, current 2·0 amp., diameter of cathode 4 mm., emitting surface 2·9 sq. cm.

A more extensive report will be published in the Dutch journal *Physica*.

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Parallel-Plane Diode Magnetron

IN the discussion on a paper[1] by W. E. Benham on "Electronic Theory and the Magnetron Oscillator", it is remarked that although oscillations should be expected from plane diodes with magnetic field[2], no experimental evidence had been brought forward to support this.

We have constructed a plane diode of the Müller[3] type consisting of a plane indirectly heated oxide-coated cathode, 17 mm. in diameter, and an anode the two plane plates of which were approximately 15 mm. in diameter, situated on either side and at 1 mm. distance from the cathode. The anode plates provide the capacitance of the oscillating circuit, and the conductor joining these two plates (assumed