

EQUILIBRIUM IN ELECTRODELESS DISCHARGE.

PART III. ELECTRODELESS DISCHARGE THROUGH OXYGEN.

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G. Mierdel (*Ann. physik.*, 1928, 85, 612) found that oxygen showed the strongest clean-up effect of all the gases examined by him when an electrodeless ring discharge is passed through the gas. In his experiments, the rise in pressure obtained on removing the cooling bath amounted to exactly two-thirds of the total diminution in the pressure of oxygen due to the discharge. This he attributes to the formation of ozone which at low pressures of the order of 10^{-2} mms. remained stable.

It seemed interesting to study the effect of the high-frequency discharge in oxygen with the apparatus described in Part I (This *Journal*, 1937, 20A, page 27). It was also thought that the behaviour of oxygen under these conditions might throw some light on the disappearance of hydrogen.

The gas was prepared by heating pure potassium permanganate in a vacuum and passing the evolved gas over soda lime. After drying, the oxygen was fractionated at liquid air temperature. It was completely absorbed by phosphorus. The gas was stored in tubes and transferred to the apparatus through the siphon. The whole apparatus had been thoroughly evacuated, baked out and rinsed with oxygen. The Pirani gauge was then calibrated and the curve is shown in Fig. 2 of Part I (*loc. cit.*).

At about 0.6 mm. pressure the glow of the discharge was not at all visible. However, the discharge tube became quite hot showing that the discharge was passing. If a finger was put at any place outside the tube, the interior of the tube at that place was filled with a greenish glow. At 0.05 mm. pressure a bright yellowish green glow was observed showing the first negative bands of ionised molecule, O_2^+ at 6419 Å, 6026 Å, 5632 Å, 5295 Å, etc., quite intensely. The second negative spectrum in the ultraviolet was also obtained (*cf.* This *Journal*, 1937, 20A, page 39. Fig. 2, Nos. 7 and 8).

At pressures lower than 0.03 mm., luminous bodies of ellipsoidal shape with dark outline were formed when the discharge was passed. When a finger was brought near them they were deflected and sometimes broken in two. These have also been observed by R. W. Wood (*Phys. Rev.*, 1930, 35, 675) in high-frequency discharges (1.7 metres up to 30 metres). He has shown that these luminous masses were formed of singly ionised molecules of oxygen.

The red-fluorescence of silica was also observed at these low pressures. The narrow tube at one end of the discharge tube showed brilliant red colour, while the main tube was filled with a green glow and the luminous masses. This red-fluorescence was not observed in case of hydrogen at low pressures. It seems to be characteristic of oxygen as Wood (*loc. cit.*) has pointed out. It was found necessary to continue the discharge for sometime before the red-fluorescence could be excited.

The pressure measurements done when the discharge was started at various pressures are given in Table I. Liquid air was always kept under the trap T₂ during the course of the experiments.

TABLE I.

	Starting pressure mm.	End pressure mm.	Time for the run minutes
1	0.6375	0.6275	45
2	0.445	0.440	60
3	0.305	0.305	20
4	0.140	0.1400	40
5	0.1150	0.1050	75
6	0.0275	0.0250	10
7	0.015	0.0025	10
8	0.0125	0.0055	15

It will be seen from the figures given above that very little gas disappears by the action of the discharge. At higher pressures the gas does not disappear at all. During the course of the discharge the tube gets very hot. If the starting pressure is kept below 0.05 mm. the gas disappears at a comparatively quicker rate. This is quite contrary to the experiments of Mierdel who found that oxygen disappears at a much quicker rate than hydrogen. No ozone formation could be detected. It should not have been formed in Mierdel's experiments since he worked with pressures as low as 0.08 mm. of mercury and as the vapour pressure of ozone at liquid air temperature being about 0.2 mm. it could not be condensed at that temperature (K. Brewer and Westhaver, *J. Phys. Chem.*, 1930, 34, 1280). Taylor (*Nature*, 1928, 122, 347) found that the condensible product formed by a discharge through oxygen gave carbon monoxide bands on sparking. In the present work also when, at low pressures, oxygen disappeared there was a very little rise in the pressure observed on removing liquid air and a discharge through the residual gas showed the presence of CO bands quite prominently.

Whenever a discharge was passed in hydrogen or carbon dioxide in the quartz tube, intense smell of ozone was detected outside due to photochemical formation of ozone by the ultraviolet radiations from the discharge. But the discharge in oxygen in quartz tube produced no detectable ozone in the surroundings of the tube, which is probably due to the ultraviolet radiation being too feeble.

At the end of the experiments the tube was evacuated by means of the diffusion pump and was heated to 500°C. with the tap closed to see if any adsorbed gas could be obtained by treating it in the same way as was done in the case of hydrogen. The amount of gas obtained was 0.05 mm. of mercury which corresponds with the amount lost in Table I. This quantity indicates the formation of a monoatomic layer of the gas on the surface if exactly similar calculations are done in this case as in the case of hydrogen (*cf.* This *Journal*, 1937, 20A, page 35) the same quartz tube having been used in these experiments.

SUMMARY.

The effect of high-frequency electrodeless discharge through oxygen contained in a quartz tube was studied. Contrary to the observations of Mierdel, no ozone could be detected. The quantity of oxygen adsorbed by the tube corresponds to the formation of monoatomic layer of the gas on the quartz surface.

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