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Variation with Time of Counts in A Concentric Glass Cylindrical Configuration in Argon

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ABSTRACT

On exposing argon at a constant pressure to an applied potentials viz 0.35 kV (r.m.s.) , the number of counts in dark and under light show a remarkable periodicity with time. On application of the potential, there is always an initial large value of counts, but thereafter the number of counts rises and falls, alternately, throughout the period over which the discharge is continued. The number of counts shows a continuous behavior in that it also varies synchronously with time. However, the count in dark and in light varies in opposite sense. The results point to the occurrence of a periodic effect in the plots of discharge counts versus time of exposure to discharge obtained with and without irradiation has been compared.
Keywords: Silent discharge, Irradiation,

I. INTRODUCTION

An expression for the current in terms of counts produced experimentally by exposing a constant initial pressure of gas to an applied potential for a constant period at a definite pulse height has been derived as

$$I = B.\ V^{2.}\ Vr \text{ and} \quad (1)$$

$$B = 2k\ (R_i/R_o)\ .\ P \quad (2)$$

where k, R_i and R_o; V and V_r refers to a constant of an ionic mobility; radii of inner and outer glass cylinders of a Siemen's type tube; a potential applied to the system and lastly the reduced potential respectively. Making use of a few assumptions the above equation modified by Pimpale [1] for count rate associated with the over-voltage $(\Delta V) / V_g$ (3) where V_g represents the minimum voltage at which large current occurs at p = 10 torr. The first and the last equations, acting in conjunction with the theory of boundary layer, have been used to establish the conditions for the periodic reversal of the reaction under discharge.

Further, it is interest to study the interaction of visible radiation with the discharge counts and to observe the effect of external irradiation on the reacting vessel in order to understand the basic mechanism of time-variation of pulse rate at a constant potential from activated gas.

II. EXPERIMENTAL

The discharged tube was a Siemen's type all-glass vessel containing pure dry argon at a constant pressure which was excited with a constant potential of 2.45kV (r.m.s.) for a period of 5 minutes to condition the surface. Such tube was used to measure counts (before and after external visible radiation) - time characteristics of the discharge. The experimental arrangement was exactly the same as that described earlier [2].

III. RESULTS AND DISCUSSION

The data presented graphically in Figure 1 are for discharge counts per minute in dark and under light in argon at a constant pressure under discharge due to an applied potential of 0.35 kV (r.m.s.) for a bias of 5 volts. It is seen from the solid curve that the dark count rate falls with time from initially large value to a minimum; after that the number of counts rises rapidly to a maximum. This fall and rise is periodically repeated. This periodic fall and rise in counts is accompanied by a general decrease in the counts in darkness.

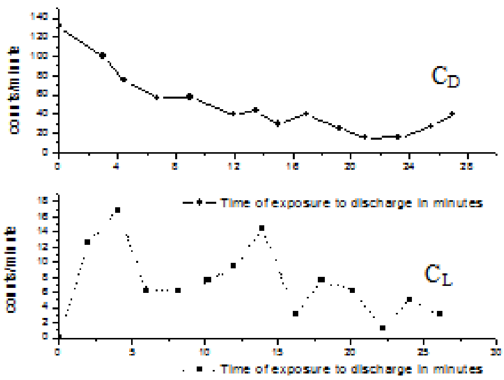

Figure 1. Variation of discharge counts with time of exposure before and after irradiation in Ar at p=10mm, a bias of 5 V and a potential of 0.35 kV (r.m.s)

The amplitude of the pulses also decreases over a period of 24 minutes. This variation with time of counts before visible radiation agrees well with the changes in the functional relationship between current and time studied by several investigators [3-5]. The discharge counts under light show a cupreous behavior in that it also varies synchronously with time but in the opposite sense. Such changes in the spectrum of discharge point out to the occurrence of a periodic reversal of the reaction, as shown in dotted curve of Figure 1. On exposure to external visible light, under otherwise same conditions, the periodicity is however, suppressed. Quantitatively, similar results have been reported by Dr. Pimpale in air [6] and in hydrogen [7]. It may be mentioned here that such a periodic effect was not observed when air was subjected to dc discharge under similar conditions of ageing, applied potential, etc [7, 8].

The influence of other physico-chemical parameters, such as applied field and electrical circuit impedance, temperature of the system, on the effect has been investigated by Pimpale [6,8]. The conditions for the optimum developments of the periodic effect are such that the corresponding changes are slow; about one reversal in about 5 minutes. The behavior of glass walls of the vessel, which form the electrodes in this work, would appear to be important. These, under the effect of applied potential, develop a strained condition as suggested by earlier by Pimpale [9,1]. Presumably, the periodic variation in the resulting current pulses is closely associated with the duration of this strained condition and the time needed for recovery thereform. In the neighborhoods of the surface of glass walls, the magnitude of the characteristics dielectric strength would also be varying periodically which would produce a like change in the time rate of discharge counts in the system as actually observed. As judges from the changes in the spectrum of the discharge during the ascending and descending portion of the period, an alternate condensation and evaporation of one or more of the products of the interaction would appear to be one of the determining factors in the production of the periodic phenomenon.

The finding of a current decrease during excitation of argon in the silent electric discharges, and the further observation that this current decrease was more pronounced under irradiation. The effect is not detected below, V_g, the threshold potential of argon despite the use of intense irradiation of all wave lengths including ultraviolet and x-rays. We are of the view that fields large enough to produce ionization by collision are necessary for the occurrence of the phenomenon.

IV. CONCLUSION

It is found that the rate of heat dissipation in the system is much greater in dark then under light associated with reduced conductivity in light. This indicates that the chief seat of the light effect may be considered to be in the ohmic part of the conductivity as distinct from the displacement components thereof.

V. REFERENCES

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