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Research on the Electrical Breakdown Process in Noble Gases

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The electrical breakdown mechanism in gas has been previously investigated by many investigators, theoretically or experimentally. But in those investigations, only the gap conditions have been taken into consideration, and the conditions of electrode surface have not been considered.

In this study, it is explained that in case the rectangular impulse voltage is imposed on parallel plate electrodes in N_2 gas, the condition of the electrode surface or gas purity makes remarkable effect upon the sparking potential, the formative time lag, the time process of current buildup, etc, at comparatively low pl. That is

(1) According as the electrode surface becomes clearer, the sparking potential becomes lower. But on the other hand, the formative time lag increases according to the advance of the clearance of the cathode. Especially when the electrode has been treated with high frequency heating device, one becomes to the order of some milli-seconds, and at a certain pl over the critical pl, the breakdown mechanism shows such procedure as glow discharge to glow discharge.

(2) Assuming the time process of the current buildup as $I=I_0e^{(1/\theta)t}$, the time constant for the buildup of the discharge, θ, is directly proportional to formative time lag, T_f, without the condition of the electrode.

(3) It is known that time lag of the spark, T_g, contains the formative time lag and the statistical time lag. By examining time constant, θ, it becomes clear that the formative time lag also has some fluctuations.

On the other way, for the purpose of examining whether these phenomena are the peculiarity of N_2 gas or not, the same experiments were performed in not only N_2 gas but Ar gas considered as chemically comparatively stable, on same condition of the electrode surface. And it became clear that the same phenomenon happens in Ar gas as well as N_2 gas.

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