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Study Some Parameters of Electrical Discharge in $N_2$and CO_2Without and With Magnetic Field

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ABSTRACT:*We study the breakdown voltage under low pressure for N_2, CO_2 gases of with a magnetic field to the electrode of iron and aluminum with diameter (8.8cm) cm and distance separation between them is (3cm). by using Passion curve, we measur less effort collapsed, and we notice that less effort is linked to the collapse of a function held cities and when the magnetic field will be reduced to shed breakdown voltage. Since the breakdown voltage for CO_2 is greater than breakdown voltage N_2. Through curved Passion was calculated (γ) and when to shed the magnetic field will increase in value*

Keywords: *breakdown voltage, secondary emission coefficient*

I. INTRODUCTION

Plasma is an ionized gas containing positive and negative ions and electrons and neutral particles and degrees of ionization changed from 100% (full ionization invader) to low values (10^{-10}) and this partial ionization. And referred to the state of the plasma status of Article IV [1]Electrical breakdown in gases is to transport gas from the insulating state to the conductive state and get the situation by shedding voltage between the poles parallel submerged in the center of gases will gradually less isolated and at the continuing increase of the voltage of teams even exceed the critical value called voltage collapse [2] As a result, you will electric current flows through the center of gaseous discharge to describe the gases and to an electric current flows through the gas must get ionized molecules to the center [3] And electrons emitted from the cathode are not able to maintain the electrical discharge without shedding a voltage difference. In the presence of electric potential difference the electrons near the surface of the cathode will accelerate by the electric field and collide with gas atoms where the collision between the electrons and the atoms of gas inelastic collision will be established and this is called a discharge fiery, and operations ionization electrons and ions new and as a result, and as a result of emitted electrons and secondary generated collisions differ new ionizing and therefore discharge Altohja in plasma self-sufficient a result of the emission of electrons at the cathode and ionization in the plasma [4].Over several decades discharge was the subject of great research and a wide area of applications in science and technology industry, and experiments were conducted with the devices, which have increased considerable importance for understanding the formation of the system [5]. To study electric discharge characteristics at a given pressure either by curved voltages and current of the probe or by the spectroscope [6]. the main effect of the magnetic field on the glow discharge is the cause the electrons and ions to move no longer in straight lines but its orbit around the magnetic field lines in circular orbits of radius equal to:

$$r_e = mv = eB$$

Where v is the electron velocity, B is the magnetic field and e and m are charge and mass of electron. This radius is called the larmor or gyro radius. The particle motion across the magnetic field is thus greatly restricted through the motion along the field is essentially as before. clearly the electron larmor radius is smaller than the ion radius (for comparable T_e and T_i) by the factor :

$$(m_e / m_i)^{1/2}$$

As a result , the electrons are more strongly affected by the magnetic field than the ion[7].

II. ELECTRICAL BREAKDOWN THEORY

by applying an electric field across the gap between the poles, the electrons will deviate with heading field lines heading towards the anode due to the acquisition of sufficient electron energy, perhaps ionizes the gas molecules or atoms by collisions with them. In this case we generate a new ions and free electrons originate new side with the primary. On the electrons after X of the cathode and an ionized electrons will increase (nx), the equation linking the percentage change in the ionized electrons with the distance from the cathode is

$$dn\,(x) = \alpha nxdx \qquad (1)$$

Where α represents the first ionization of Townsend (Townsend's coefficient first ionization coefficient) and he knows the number of ionizing collisions arising from transmission electron rate (1 cm) toward the electric field. And the nature of the collision of the electron is a statistical process and α term is simply the average value of a number Altoanat per unit length of the emerging electrons drift for regular the electric field constant. There is no number of primary electrons emitted from the cathode. It turns out that the number of electrons at a distance (x) gives by the following relationship:

$$n(x) = n_\circ \exp(\alpha x) \qquad (2)$$

This equation describe exponentially equation and it seems to be reasonable due to the collapse produces ionization formidable because of the rate of electron collision process (7). Ions in the gas may be moving, although the speed is much less than the free electrons because its mass is much greater than the mass of the electron, it still interacts with the electric field lines.

When you hit the surface of the cathode ions liberated electrons. This ionization process is called process of secondary ionization cause (secondary ionization). [53] the ionization coefficient actually depends on the distribution energy the electrons in the gas, which depends only on the (E / P) where (E) hanging electric field, (P) gas pressure and thus the equation can be written as

$$\frac{\alpha}{P} = f(\frac{E}{P}) \qquad (3)$$

This reliability is confirmed in practice. There are a number of secondary processes that contribute to the electrical breakdown process, some of which include secondary electrons resulting from collisions cation surface of the cathode, the secondary electrons emitted from the cathode by photons. To calculate these processes feet Tosind secondary ionization coefficient (γ) can calculate the current through the relationship [8

$$I = I_\circ \frac{e^{\alpha d}}{1-\gamma\left(e^{\alpha d}-1\right)} \qquad (4)$$

Experimental values for (γ) are determined from the equation (4) and through knowledge of the values of each of the (p, E, d, α) where (γ) depends on the surface of the cathode properties, and the work function metal and sessile get high emissions where the value (γ) when they are low values (E / P) and sessile has high when the values (E / P) high, When the values of (E / P) high, there will be a large number of positive ions and photons with high energy, including enough to take out electrons from the cathode surface

$$i = i_\circ \frac{e^{(pd)f(\frac{V}{pd})}}{1-\gamma\left(e^{(pd)f\left(\frac{V}{pd}\right)} - 1\right)} \qquad (5)$$

By increasing the voltage, polarizationcurrent at the anode increases according to the equation (4). When increasing stream Calcined the shrine of the equation (4) becomes zero

$$\gamma(e^{\alpha d} - 1\,) = 1 \qquad (6)$$

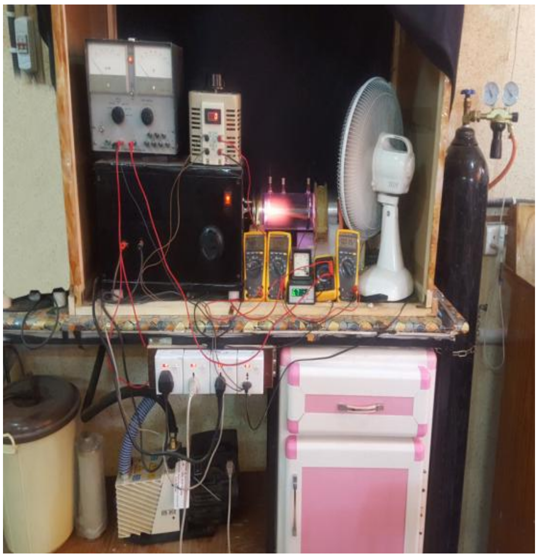
At this point predicted by equation (4-2) to the pole stream becomes indefinitely. This is known as the transition from self-discharge to electrical breakdown [9]

In 1889 the deployment of the world's Passion (Friedrich paschen) law known as the Passion law. Since the breakdown voltage (V_B) between the electrodes is a function of (pd) and the resulting pressure inside the pipe and the distance between the electrode where he found the following relationship

$$V_B = \frac{BPd}{\ln\left(\frac{Apd}{\ln\frac{1}{\gamma}}\right)} \qquad (6)$$

III. PREPARATION EXPERIENCE

To study the electrical discharge in the gaseous bi-dioxide and nitrogen We used a tube of glass Albaerks length (30cm) and outer diameter (10cm). The innerdiameter (9.4cm)are containing three holes in order insert the probe to study the properties



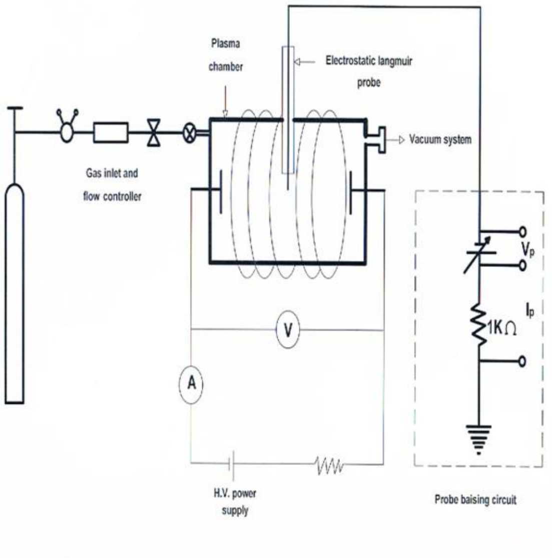


Figure 1 represents discharge unloading system dc**Figure (1)** illustrates the scheme for electric circuit used to measure the voltage collapse of gases

We used poles flat surface discs for different materials Authority (aluminum, iron) with a diameter (8cm.8) and thickness (1cm) respectively and (3cm) the distance between the electrode and using the pump unloading to unload tube Albaerks to pressure (0.01mbar) which is the minimum can be up to this pump the suitable for work pressure and to measure the pressure within the system we use a Pirani type (EDWARDS) and serial number to him (D395-90-000) and the gas pressure within the system changes from (0.053 - 2.28 torr). To generate a magnetic field we consider a file on the glass tube consists of (950) rolls to generate a magnetic field up to 120 G

IV. RESULTS AND DISCUSSION

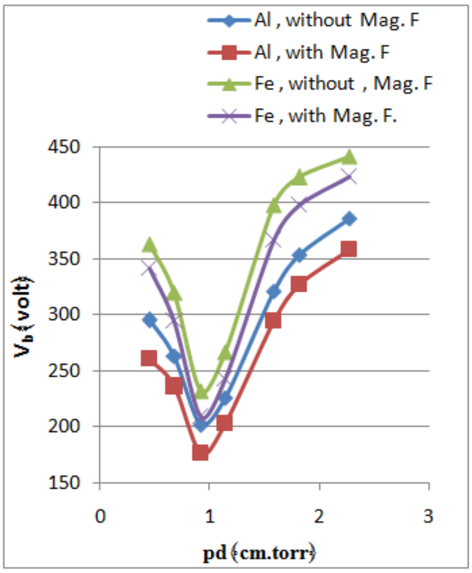
For measuring the collapse of the gases effort, and breakdown voltages in the gas depends on the gas pressure and the distance between the polarization which consider to measure the collapse of Ghazi dual dioxide efforts (co_2) and nitrogen (N_2), where pd range of gas bi-dioxide is a bout (0.18 - 1.5 Torr.cm) for nitrogen (0.4 - 2.28 Torr.cm)

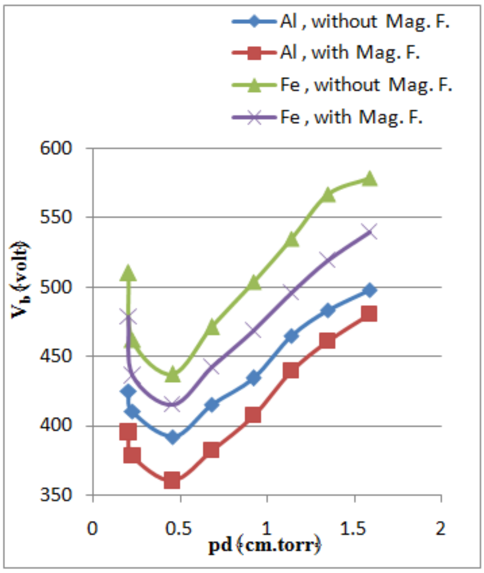
Measuring the breakdown Voltage of the Gaseous bi-dioxide and Nitrogen

In Figure (2) shows a curved Passion for dual-dioxide gas by using four electrodes. Where we noticed less effort the collapse is of the two poles occurs when the value of pd is equal to (0.456 Torr.cm). the less effort collapse of the gas depends on type cathode electrode material and that means different work function metal cathode electrode material affect on the lower voltage collapse. Left end of the curve Passion decreases when increasing the value of (pd) due to the increased the number of collisions between electrons and neutral atoms. the right of curved Passion denote voltage collapse Teda which increase with increase in the value of (pd) due to fact of the low ionization section so the electrons need more energy to occur collapse so increasing voltages[10]. Figure (3) illustrates the Passion curve of nitrogen gas using four poles. Less electrical breakdown of the four poles occurs at value of(pd = 0.9 Torr.cm). we noticed that the effort collapse of nitrogen gas is less than the collapse of a bilateral effort carbon dioxide gas. When we shine a magnetic field on the edge of the cathode This makes the path of electrons moving spiral standing, the plasma frequency increases depending on the number of collisions as a result of inventory decreases plasma collapse of gases effort

Cathode material	$\emptyset$ (eV)	$(V_b)_{min}$ (volt) B=0G , CO_2	$(V_b)_{min}$ (volt) B=120G , CO_2	$(V_b)_{min}$ (volt) B=0G , N_2	$(V_b)_{min}$ (volt) B=120G , N_2
Aluminium (Al)	3.6	392	360	202	176
Iron (Fe)	4.63	437	415	232	209

Table (1) The work function $\emptyset$ and the minimum breakdown potential for different type and different gases .

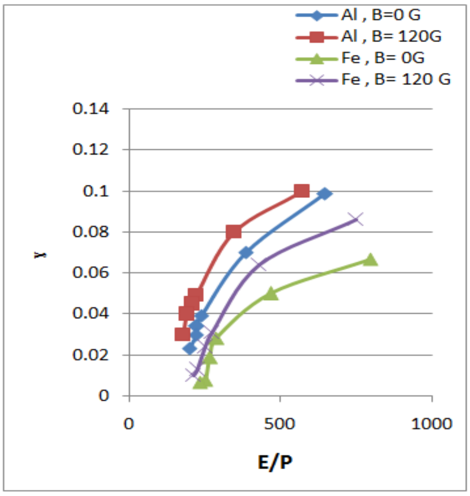




(Figure 4) as a function of voltage collapse pd and**(Figure 3)** as a function of voltage collapse pd and
the influence of the magnetic field of gas $N_2$the influence of the magnetic field of gas co_2

Secondary Emission Coefficient

The variation of the secondary electron emission coefficient (γ) the reduced field E/P as show in fig. 4 and 5 for co_2 and N_2, respectively. It usually observed that the curve of $\gamma(E/P)$ has minimum[11] . but in the experimental range of reduced field, we investigated only the ascending branches of the curves are obtained . we show that ɣ rises faster for CO_2 then for N_2 and that it increases with the magnetic field, while especially for argon , becomes less effective as the reduced field is decreesed . the secondary emission of electrons can be due to any combination of effects of impacts of positive ions , photons , excited atoms on the aluminum electrode and depends also on the state of the cathode surface . for weak reduced fields , the mean electron energy is low and excitation within the gas becomes more important than ionization . secondary electrons are then ejected from the cathode mainly by pho-ton impact (photoelectric effect) , a mechanism less sensitive to the magnetic field . on the other hand , at high values of Eon the other hand , at high values of E\P the secondary electron emission is governed by impact of ions on the cathode and , at even higher values , by the impact of neutral rapid species . these mechanisms are dependent on the dynamics of the charged particles , and the emission of secondary electrons is enhanced by the confinement effect promoted by the application of a magnetic field . the magnetic field effect associated with the increase of , at a given value of E\P, is equivalent to a decrease in the work function of the cathode material , because , in the presence of a B-field , a lower voltage would be required to maintain the discharge as would be for case of field-free discharge but with a cathode of lower work function . the efficiency of electron emission by the incidence of the ions onto the cathode increases when using a smaller ion mass



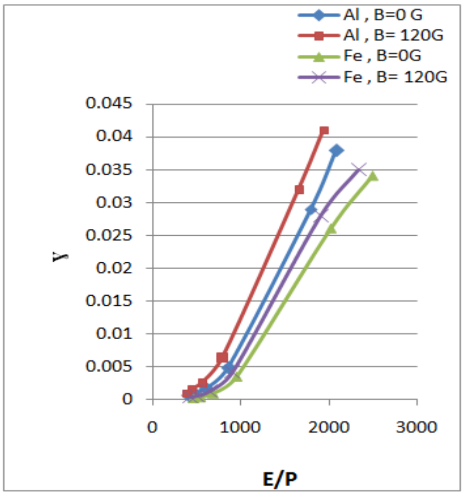


Figure 5 Variation of the secondary ionization**Figure6**Variation of the secondary ionization
with E/p N_2 for gas with E/p CO_2 for gas

V. CONCLUSIONS

The breakdown voltage in low pressure gases have been measured for argon and nitrogen discharge using plane-parellel aluminum electrodes. We have investigated the influence of a longitudinal magnetic field on the Paschen curves and on the Townsend parameters . we observed that the magnetic field applied along the discharge axis promoted a reduction of the breakdown voltage . the breakdown is facilitated by the magnetic confinement of electrons which reduces the electron losses and effectively increases the collision frequency between electrons and the gas particles at a given reduced field , thus increasing the ionization efficiency . this effect is equivalent to a change of the operating gas by another of low ionization potential . the presence of the magnetic field enhances the secondary ionization coefficient at a given E/P value .

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