



## CHANGES IN THE VOLT-AMPERE CHARACTERISTICS OF A DIODE UNDER THE INFLUENCE OF A MAGNETIC FIELD AND LIGHT

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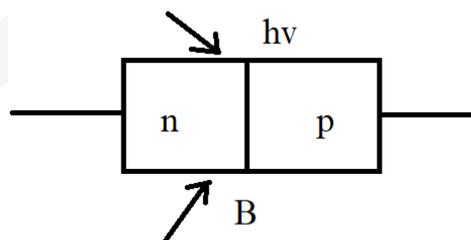
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### Abstract

In this work, the influence of a magnetic field and light on the current-voltage characteristic of a diode is studied. When current flows through the diode, the Hall voltage across the cross section increases with increasing magnetic field, and as a result, the current passing through the diode decreases in proportion to the magnitude of the magnetic field. It is noted that the magnetic field causes a monotonic decrease in the photocurrent in the diode with increasing field.

**Key words:** Hall voltage, I–V characteristics, photomagnetic EMF

Remember my simultaneous application to the p-n transition of the magnetic field in the light, until I get the following formula [1-4].





$$j = j_s \left( e^{\frac{e\varphi_0 - U - U_1 + J((R_b - AU^n) + aR_x J\beta)}{kT_e}} - 1 \right) + \frac{U}{R_u} - J_f \quad (1)$$

Here  $R_b$  is the base resistance,  $R$  is the Hall constant,  $R_u$  is the leakage resistance,  $J_f$  is the photocurrent.

To this expression  $k := 1.38 \cdot 10^{-23}$ ;  $q := 1.62 \cdot 10^{-19}$ ;  $U_1 := 0$ ;  $J_s := 10^{-9}$ ;  $R_b := 200$ ;  $R_u := 50000$ ;  $J_f := 10^{-4}$ ;  $T := 300$ ;  $t_e := 300$ ;  $R := 1000$ ;  $l := 1$ ;  $l := 1$  when we get the CVC graph by putting the given numeric values

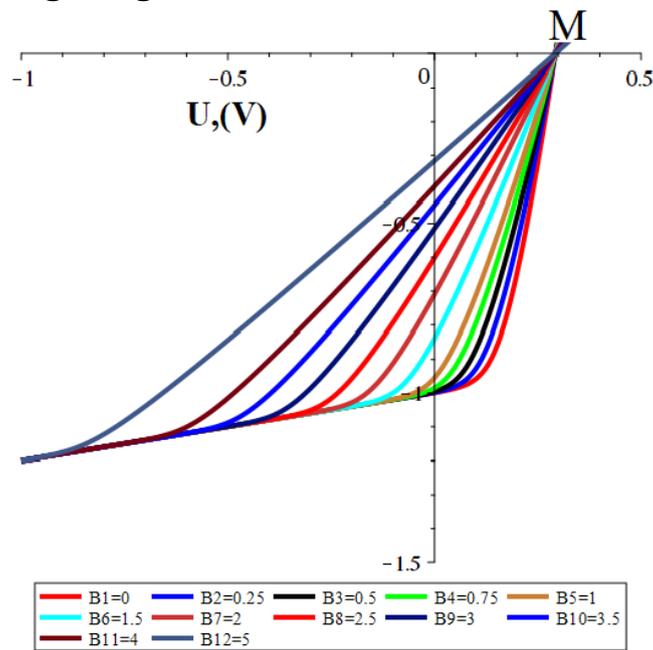


Fig- 1. VAX under magnetic field and light

It can be seen from this graph that under the action of a magnetic field and light, a photomagnetoECC is formed in the CVC[5-7], and as the magnetic field increases, the photocurrent decreases. The short circuit photocurrent decreases from 1 to 0.3 in the magnetic field range  $0 < B < 5$ . We explain this phenomenon as follows:

The photocurrent is perpendicular to the p-n junction and the Lorentz force, and the trajectories of photoelectrons and photoholes are curved due to the Lorentz force[2, 7,12]. The Hall voltage on the p-n plane changes the height of the potential barrier of the p-n junction. As a result, the height of the potential barrier and the width of the space charge in the cross section of the p-n junction are not constant. The current



passing through the diode, basically begins to pass through the area where the potential barrier is the smallest. In areas where the potential barrier is large, the value of the current density begins to decrease sharply. As a result, the total current passing through the resulting diode begins to decrease sharply with increasing magnetic field. Initially, in the absence of a magnetic field, the current density was the same over the entire cross section of the p-n junction, but the magnetic field causes an uneven distribution of the current density over the diode cross section. The current flowing through the diode is, as it were, clamped on the edge of the p-n junction.

If the Hall voltage increases the height of the potential barrier across the diode from one side to the other, the current density in the raised sections of the potential barrier decreases sharply [8-11]. This phenomenon can be imagined as a decrease in the cross section of the diode through which the current passes, under the influence of a magnetic field. In other words, one can imagine that the effective value of the current cross section of the diode decreases as the magnetic field increases[12].

On fig. 1 shows the intersection of CVC in different magnetic fields from point M. The physical reason for this is easy to explain. Due to the fact that the current flowing through the diode is 0 at forward voltage ( $U_{oc}$ ), the Hall voltage does not appear on the cross section of the diode [13-16]. As a result, the height of the potential barrier remains unchanged for various magnetic fields. This leads to the fact that CVC in different magnetic fields intersect at one point. As current begins to flow through the diode, the Hall voltage across the cross section increases with increasing magnetic field. As a result, the current passing through the diode decreases in proportion to the magnitude of the magnetic field. The above points explain the CVC displacement shown in the figures in a magnetic field [17,18].

If we try to influence our expression (1) from different angles, we get expression (2). [9-12]

$$j = j_s \left( e^{\frac{e\varphi_0}{kT} \frac{e(\varphi_0 - U - U_1 + J((R_b - AU^n) + aR_x J \beta \sin \alpha))}{kT_e}} - 1 \right) + \frac{U - J(R_b - AU^n)}{R_u} - J_f \quad (2)$$

The  $k := 1.38 \cdot 10^{-23}$ ;  $q := 1.62 \cdot 10^{-19}$ ;  $U_1 := 0$ ;  $J_s := 10^{-9}$ ;  $R_{b1} := 1000$ ;  $R_{u1} := 500000$ ;  $J_f := 10^{-4}$ ;  $T := 300$ ;  $T_e := 300$ ;  $R_x := 1000$ ;  $l := 1$ ;  $B := 2$ ;  $A_1 := 1$ ;  $\varphi_{hi}$



$\alpha := 0.6$ ;  $a := \text{Pi}/18$ ;  $a_1 := \text{Pi}/9$ ;  $a_2 := \text{Pi}/6$  we can see the graph below by putting numerical values.

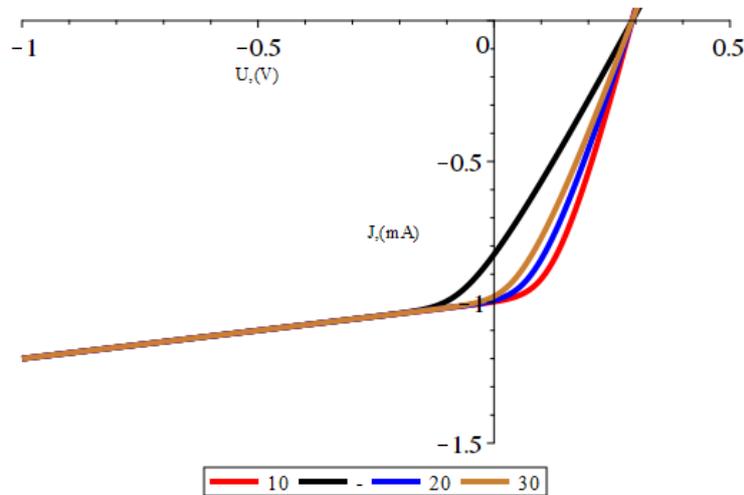


Fig-2. Change in CVC under the influence of a magnetic field at different angles  
From fig. Figure 2 shows that under the action of the Lorentz force on the p-n junction at different angles, CVC [19] shifts are observed even in the presence of the same magnetic field and light.

## CONCLUSION

We conclude that the magnetic field causes a monotonic decrease in the photocurrent in the diode with increasing field. If the Hall voltage increases the height of the potential barrier on the cross-sectional surface of the p-n junction diode from one side to the other, then the current density in the raised section of the potential barrier decreases. This is a reduction in the cross-section through which the current passes under the influence of the magnetic field of the diode. In other words, one can imagine that the effective value of the current cross section of the diode decreases as the magnetic field increases.

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