EFFECT OF CONDUCTIVITY ON VARIOUS MATERIALS WITH RESPECT TO RELAXATION TIME

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ABSTRACT

Relaxation time or rearrangement time is that the time it takes a charge placed within the interior of the fabric to drop to 1/e times of its initial worth. This paper shows the result of conduction on conductors, dielectrics and semiconductors w.r.t to time constant. Conduction has inverse relationship with time constant, because the conduction of the materials will increase time constant goes on decreases. It's short for sensible conductors, long for dielectrics .For conductors relative permittivity forever one except for insulators and semiconductor it's completely different i.e. completely different for various material. In conductors, the valence band and the conduction band is attached here on overlap each other. There is no forbidden energy gap. In insulator, the valence band of those material remains full of electrons. The conduction band of those material remains empty. The forbidden energy gap between the conduction band and the valence band is widest. In semiconductor,the forbidden energy gap of a semiconductor is nearly same as insulator. The energy gap is narrower.

Keywords: Rearrangement Time, Coulomb Forces, CE.

I. INTRODUCTION

A conductor is associate object or kind of material that allows the flow of electrical current in one or additional directions. for instance, a wire is associate electrical conductor which will carry electricity on its length .In metals like copper or Al, the movable charged particles area unit electrons. . . A insulator material may be a substance that's a poor conductor of electricity, however an economical supporter of electric fields. If the flow of current between opposite charge poles is unbroken to a minimum whereas the static lines of flux don't seem to be obstructed or interrupted, an electric field will store energy. This property is beneficial in electrical condensers, particularly at radio frequencies, insulator materials are utilized in the development of radio-frequency transmission lines. A material that is neither a good conductor of electricity (like copper) nor a good insulator (like rubber). The most common semiconductor materials are silicon and germanium. These materials are then doped to create an excess or lack of electrons.

II. DESCRIPTION FOR RELAXATION TIME

If some amount of charge is placed inside a volume of conducting material, the Coulomb forces on the individual charges cause them to migrate away from each other (assuming the charge is all positive or all negative). The end result is a surface charge on the outer surface of the conductor while the inside of the conductor remains charge-neutral. The time required for the conductor to reach this charge-neutral state is related to a time constant designated as the relaxation time. According to the continuity equation(CE) solution:

$$\rho\left(\underline{r}, t\right) = \rho_0\left(\underline{r}\right) e^{-\left(t/\tau_r\right)}$$

where $\mathbf{t_r = \varepsilon/\sigma}$

is the time constant of the process called the Rearrangement time .

1. A material is considered to be a good conductor if

$$\tau_r << T = \frac{1}{f} \Rightarrow \tau_r f << 1$$

S.No	Material	σ (conductivity)	ε(relative permittivity	T(relaxation time)
1.	Zinc	1.7x10^7	1	1.5x10^-4
2.	Carbon	3x10^4	1	2.655x10^-7
3.	Aluminium	3.5x10^7	1	3.09x10^-3
4.	Lead	5x10^6	1	4.425x10^-5
5.	Silver	6.1x10^7	1	5.398x10^-4

2. A material is considered to be a good insulator if

$$\tau_r >> T = \frac{1}{f} \Rightarrow \tau_r f >> 1$$

S.No	Material	σ (conductivity)	ε(relative permittivity)	T(relaxation time)
1.	**Bakellite**	**10^-10**	**5**	**0.4425**
2.	**Paper**	**10^-11**	**7**	**6.195**
3.	**Glass**	**10^-12**	**5-10**	**5.31**
4.	**Mica**	**10^-15**	**6**	**153100**
5.	**Paraffin**	**10^-15**	**2.2**	**19470**

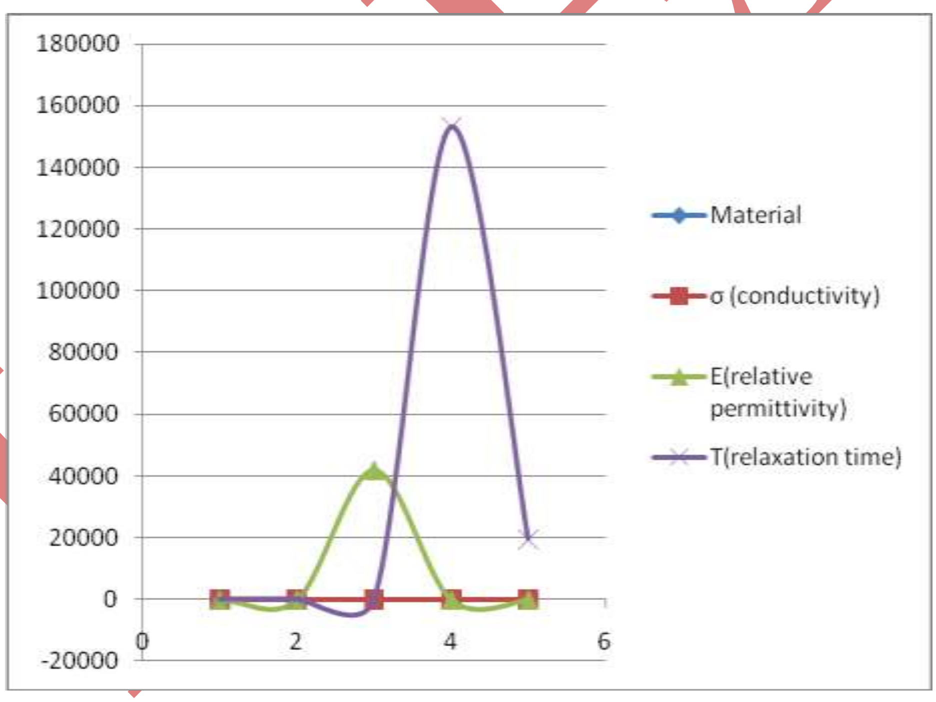

Fig 1 A Conductivity effect on Relaxation time (insulator)

3. A material is considered to be a good semiconductor if

$$\tau_r = T = \frac{1}{f} \Rightarrow \tau_r f = 1$$

S.No	Material	σ (conductivity)	ε (relative permittivity	T(relaxation time)
1.	Germanium	2.2	16	6.436x10^-11
2.	Silicon	4.4x10^-4	11.9	2.39x10^-7

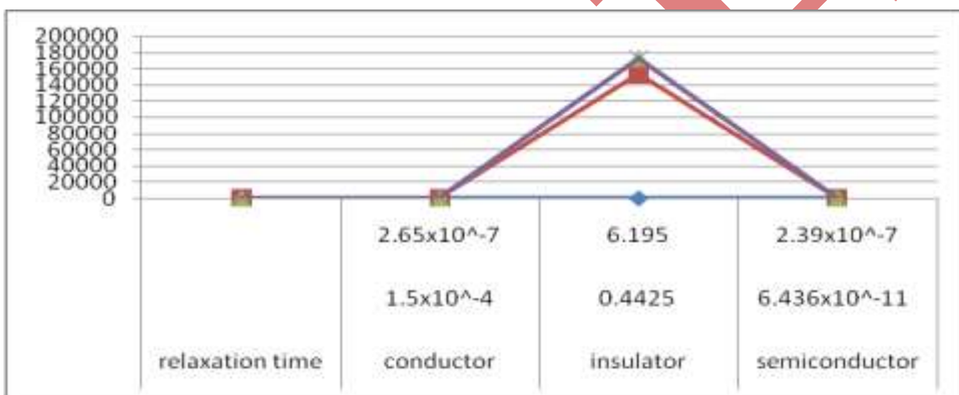

Fig 2 A Conductivity effect on Relaxation time for different materials

III .CONCLUSION

For a good conductor, the time required for the charge to decay to zero at any point in the bulk of the conductor (and to build up on the surface of the conductor) is very small. For insulator the time required for the charge to decay to zero at any point in the bulk of the conductor (and to build up on the surface of the conductor) is very long.

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