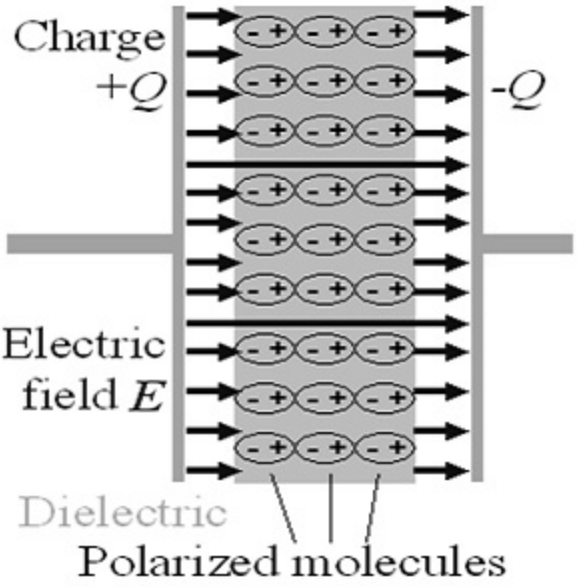
What is Dielectric Material – Properties & Applications

Materials are categorized as conductors, insulators and semiconductors based on conducting properties. Every material is made up of molecules which in turn made up c subjected to electric field these atoms in the material undergoes certain displacements a properties. In October 1745, an experiment done by Ewald Georg von Kleist of Germany b high-voltage electrostatic generator to a volume of water collected in a hand-held jar using that charge can be stored. Using this phenomenon, Pieter van Musschenbroek invented th called “Leyden Jar”. The new material property that backed this invention was “Dielectric”.

What is the Dielectric?

Every material is made up of atoms. Atoms contain both negatively and positively charge central nucleus of the atom is positively charged. In any material, the atoms are arran represented with a positive and negative charge on its end. When these materials are subj field dipole moment takes place.

A conductor material starts conducting when electricity is applied. An insulator oppos electricity as it does not have any free moving electrons in its structure. But Dielectric is a insulator that does not conduct electricity but gets polarized when subjected to electricity.



Polarization-in-Dielectric

In Dielectric materials, when subjected to the electric field the positive charges present in th displaced in the direction of the applied electric field. The negative charges are shifted opposite to the applied electric field. This leads to Dielectric polarization. In dielectric m charges do not flow through the material. Polarization reduces the overall field of the dielect

Properties of Dielectric

The term Dielectric was first introduced by William Whewell. It is the combination of two w 'electric'. The electrical conductivity of a perfect dielectric is zero. A dielectric stores an electrical energy similar to an ideal capacitor. Some of the main properties of a Dielect Electric Susceptibility, Dielectric polarization, Dielectric dispersion, Dielectric relaxation, Tun

Electric Susceptibility

How easily a dielectric material can be polarized when subjected to an electric field is m electric susceptibility. This quantity also determines the electric permeability of the material.

Dielectric Polarization

An electric dipole moment is a measure of separation of negative and positive charge in t relationship between the dipole moment (M) and the electric field (E) gives rise to th dielectric. When the applied electric field is removed the atom return to its original state. T an exponential decay manner. The time taken by the atom to reach its original stat Relaxation time.

Total Polarization

There are two factors that decide the polarization of dielectric. They are the formation of and their orientation relative to the electric field. Based on the elementary dipole type ther electronic polarization or ionic polarization. Electronic polarization P_e occurs when the diele forming the dipole moment are composed of neutral particles.

Ionic polarization P_i and electronic polarization both are independent of temperature. Pe moments are produced in the molecules when there is an asymmetrical distribution of c different atoms. In such cases, orientational polarization P_o is observed. If a free charge is dielectric material it would lead to the Space charge polarization P_s. The total polarizati involves all these mechanisms. Thus the total polarization of the dielectric material is

$$P_{Total} = P_i + P_e + P_o + P_s$$

Dielectric Dispersion

When P is the maximum polarization attained by the dielectric, t_r is the relaxation time polarization process, the dielectric polarization process can be expressed as

$$P(t) = P[1-\exp(-t/t_r)]$$

The relaxation time varies for different polarization processes. Electronic polarization is ver by ionic polarization. Orientation polarization is slower than ionic polarization. Space charg very slow.

Dielectric Breakdown

When higher electric fields are applied, the insulator starts conducting and behaves as such conditions, dielectric materials lose their dielectric properties. This phenomeno

Dielectric Breakdown. It is an irreversible process. This leads to the failure of dielectric mate

Types of Dielectric Material

Dielectrics are categorized based on the type of molecule present in the material. There a dielectrics – Polar dielectrics and Non-polar dielectrics.

Polar Dielectrics

In polar dielectrics, the center of mass of positive particles does not coincide with the ce negative particles. Here the dipole moment exists. The molecules are asymmetrical in sh electric field is applied the molecules align themselves with the electric field. When the removed random dipole moment is observed and the net dipole moment in the molecules Examples are H2O, CO2, etc…

Non-Polar Dielectrics

In the non-polar dielectrics, the center of mass of positive particles and negative particles is no dipole moment in these molecules. These molecules are symmetrical in shape. Ex polar dielectrics are H2, N2, O2, etc…

Examples of Dielectric Material

Dielectric materials can be solids, liquids, gases, and vacuum. Solid dielectrics are highly u engineering. Some examples of sold dielectrics are porcelain, ceramics, glass, paper, nitrogen, sulfur hexafluoride and the oxides of various metals are examples of gaseous diel water, transformer oil are common examples of liquid dielectrics.

Applications of Dielectric Material

Some of the applications of dielectrics are as follows-

- These are used for energy storage in capacitors.
- To enhance the performance of a semiconductor device, high permittivity dielectric mater
- Dielectrics are used in Liquid Crystal Displays.

- Ceramic dielectric is used in Dielectric Resonator Oscillator.
- Barium Strontium Titanate thin films are dielectric which are used in microwave t providing high tunability and low leakage current.
- Parylene is used in industrial coatings acts as a barrier between the substrate ar environment.
- In electrical transformers, mineral oils are used as a liquid dielectric and they assist process.
- Castor oil is used in high-voltage capacitors to increase its capacitance value.
- Electrets, a specially processed dielectric material acts as electrostatic equivalent to mag

FAQs

1). What is the use of dielectric in capacitors?

Dielectrics used in the capacitor helps to decrease the electric field which in turn decreases thereby increasing the capacitance.

2). Which dielectric material is widely used in capacitors?

In capacitors, dielectric materials such as glass, ceramic, air, mica, paper, plastic film are wi

3). Which material has the highest dielectric strength?

A perfect vacuum is noted to have the highest dielectric strength.

4). Are all insulators are dielectrics?

No, although the dielectrics behave as insulators, not all insulators are dielectrics.

Thus, Dielectrics form an important part of capacitors. A good dielectric material sho dielectric constant, dielectric strength, low loss factor, high-temperature stability, high s good frequency response and should be amendable to industrial processes. Dielectrics a

role in high-frequency electronic circuits. Measurement of dielectric properties of material gi about its electrical or magnetic characteristics. What is a dielectric constant?

SHARE THIS POST:

‹ PREVIOUS

What are Network Nodes in Computer Network and Their Types

What is an Instrument Transfor and Their

RELATED CONTENT

Setting Up an NVIDIA H100 Server : Components, Scaling & PCIe Gen5 Importance

Clash of AI Titans : NVIDIA vs AMD – A Battle for Supremacy

NVIDIA RTX A6000 : Features, Specifications, Architecture, Working, Differences & Its Applications

AI-Enabled S BrainChip Pr

CATEGORIES

- Communication
- Electrical
- Electronics
- Project Ideas
- Robotics
- Technology

RECENT COMMENTS

K BALAJI on Simple Electronic Circuits for Beginners

Anny Arbert on Gyroscope Sensor Working and Its Applications

Abhuday dangi on What is a UJT Relaxation Oscillator – Circuit Diagram and Applications

Satyadeo Vyas on Construction and Working of a 4 Point Starter