Nano structured materials-synthesis, properties, self assembly and applications

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MODULE 4 (LECTURE 4 & 5): DIELECTRIC PROPERTIES

Problem :

1. What do you understand by dielectric
2. What are the properties associated with a normal dielectric material.
3. What properties (dielectric behaviour) you observe when the dimension of the material is reduced.
4. Define a)Polarization b) polarizability c) capacitance d) dielectric constant
5. What is the dielectric constant of water.
6. Contribution of different types of polarizability of a molecule towards dielectric behaviour of a material.
7. What is a ferroelectric material.
8. What do you understand by hysteresis loop.
9. Applications of ferroelectric materials.
10. Define a)Dielectric relaxation b) dielectric loss
11. What are the three main parameter which decides how good a dielectric material
12. Give examples of dielectric materials
13. What are the applications of dielectric material.
14. What is SAND

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Solution :

1. Is an electrical insulator that can be polarized by an applied electric field
2. Dielctric material under the influence of applied field undergo motion of charges inside. This leads to storage of electrical energy and capacitance.
3. Capacitance increseas with decrease in size
4. *Polarization is* charge separation in insulating materials
   Polarizability is the ability for a molecule to be polarized.
   *Capacitance*is the ability of a body to store an electrical charge.
   Dielectric constant is the ratio of the permittivity of a substance to the permittivity of free space
5. 80
6. Electronic polarizability, Inonicpolarizability, dipolar polarizability, space charge polarizability
7. is a property of certain materials that have a spontaneous electric polarization that can be reversed by the application of an external electric field.
8. Hysteresis is the dependence of a system not only on its current environment but also on its past environment.If a given input alternately increases and decreases, the output tends to form a loop
9. Multilayer capacitors, non volatile random access memory.
10. Dielectric relaxation – relaxation defined in terms of permittivity as a function of frequency, which can for ideal system can de described by debye relaxation.

When the relaxation time and frequency of the applied field are similar, a phase lag occurs and energy is absorbed. This is called dielctric loss.

11. Dielectric loss, Dielectric constant, temperature coefficient
12. $Ba_3ZnTa_2O_9$, $Ba_3MgTa_{2-x}Nb_xO_9$
13. Capacitors, dielectric resonators
14. Self- assembled nanodielectrics