

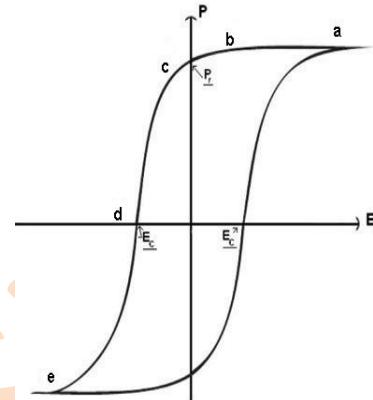
**CL56\_Q1. Elaborate on the behaviour of a Ferro-electric material in the presence of an external field.**

**Ans:**

The hysteresis in ferroelectrics is explained on the basis of ferroelectric domains. In the absence of an external electric field, the domains are oriented randomly and the net polarization is zero. When electric field is applied, domains orient in favourable directions and starts growing in size at the expense of unfavourably oriented domains.

The growth occurs initially slowly, and then more rapidly.

Finally, the unfavourable domains are rotated into the favourable direction till all the domains are lined up in the direction of the applied field. If the electric field is switched off, the domains cannot rotate back to their original orientation and the sample retains remanent polarization,  $P_r$ . An electric field ( $-E_c$ ) in the opposite direction is to be applied to disorient the domains.


**CL56\_Q2. The hysteresis is a memory phenomenon. How can this property of ferroelectrics be used to make memory devices?**

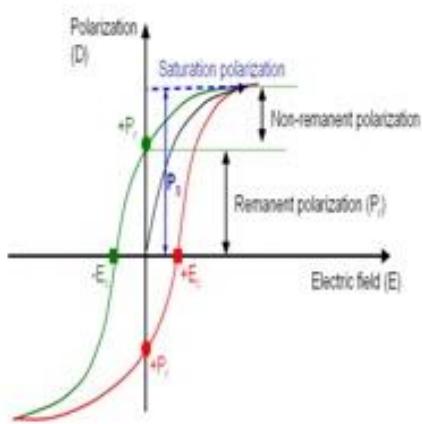
**Ans:**

The ability of ferroelectric materials to switch robustly from one polarization state to other forms the basis of a new thin film technology for storing data.

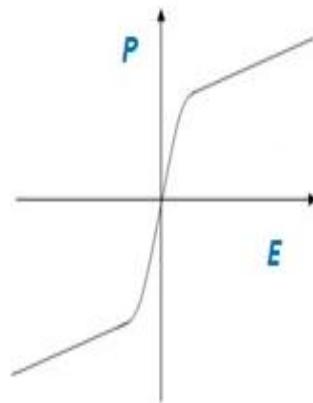
Ferroelectric materials spontaneously polarize on cooling below the  $T_c$ . The magnitude and direction of polarization can be reversed by the application of an external electric field. The ferroelectric RAMs (FRAMs) made from ferroelectric thin films make use of this phenomenon to store data. Data is stored by localized polarization switching in the microscopic regions of ferroelectric thin films. The ferroelectrics, which exhibit a square loop in polarization versus electric field characteristics, are more useful in memory technology. Barium-strontium, strontium bismuth titanates are used in this application.

**CL56\_Q1. Sketch the variation of spontaneous polarization with temperature in ferroelectrics.**

*Below  $T_c$  - exhibits spontaneous polarization*



*Above  $T_c$  - does not exhibits spontaneous polarization*



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