BPT-401 Date-12/04/2021

Dielectrics → non-polar
→ polar

↓

Ferroelectric and Paraelectric

Polarization

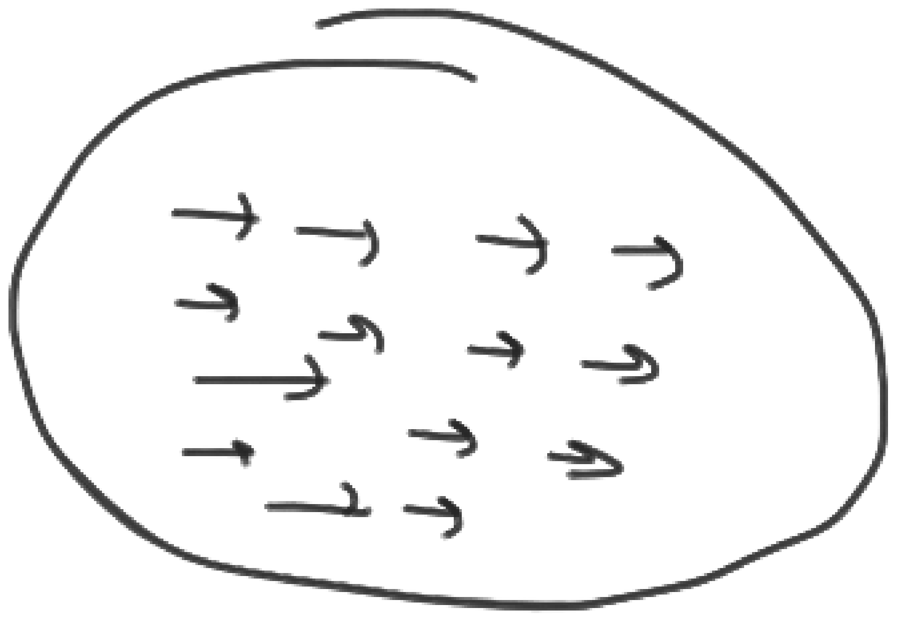
$$\vec{P} = \varepsilon_0(\varepsilon_r - 1)\vec{E}$$

where $\vec{E} = \bar{E}_0 + \bar{E}'$ → Field due to polarisation charge

$\Downarrow$ External

Now, $\bar{E} = \dfrac{\bar{E}_0}{\varepsilon_r} \Rightarrow$

$$\vec{P} \propto \vec{E}$$



$\bar{E}_0$

Polarising field $\vec{E}_0$

$\Downarrow$

If we remove $\bar{E}_0$, $\vec{P}$ should vanishes

In certain cases,

$$\bar{E}_{int} = \bar{E} + \frac{\vec{P}}{3\varepsilon_0}$$

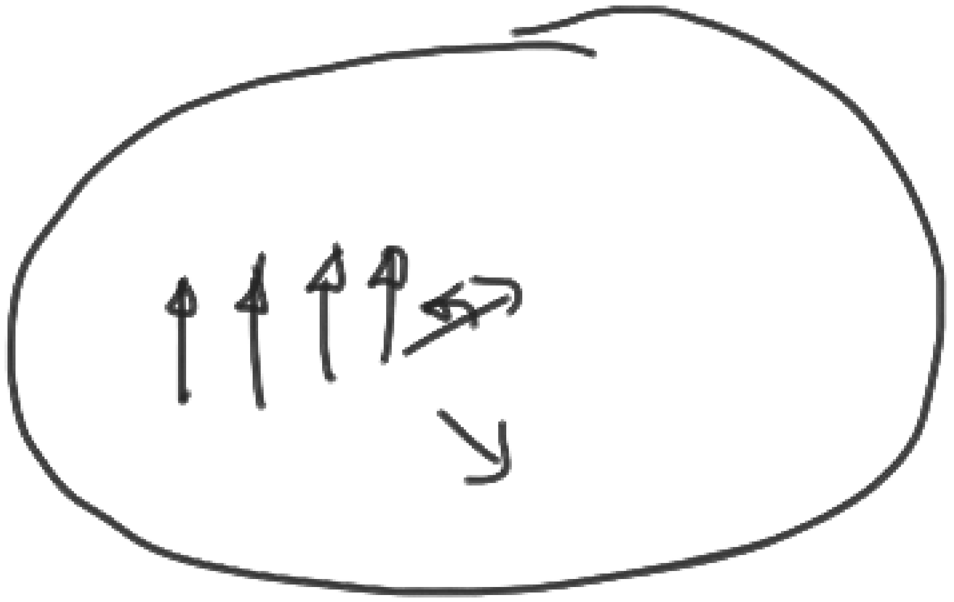
Now, if $\vec{E}_0 = 0$, then $\vec{E} = 0$

But $\boxed{\vec{E}_{int} = \dfrac{\vec{P}}{3\varepsilon_0}}$.

Ferroelectric Dielectrics :

This analogoues to Ferromagnetism

$E \doteq 0$



Spontaneous polarrisation

$\varepsilon_r \gg 1$ and $\chi_e > 1$

Examples Rochelle salt, $BaTiO_3$, $SrTiO_3$, $KNbO_3$

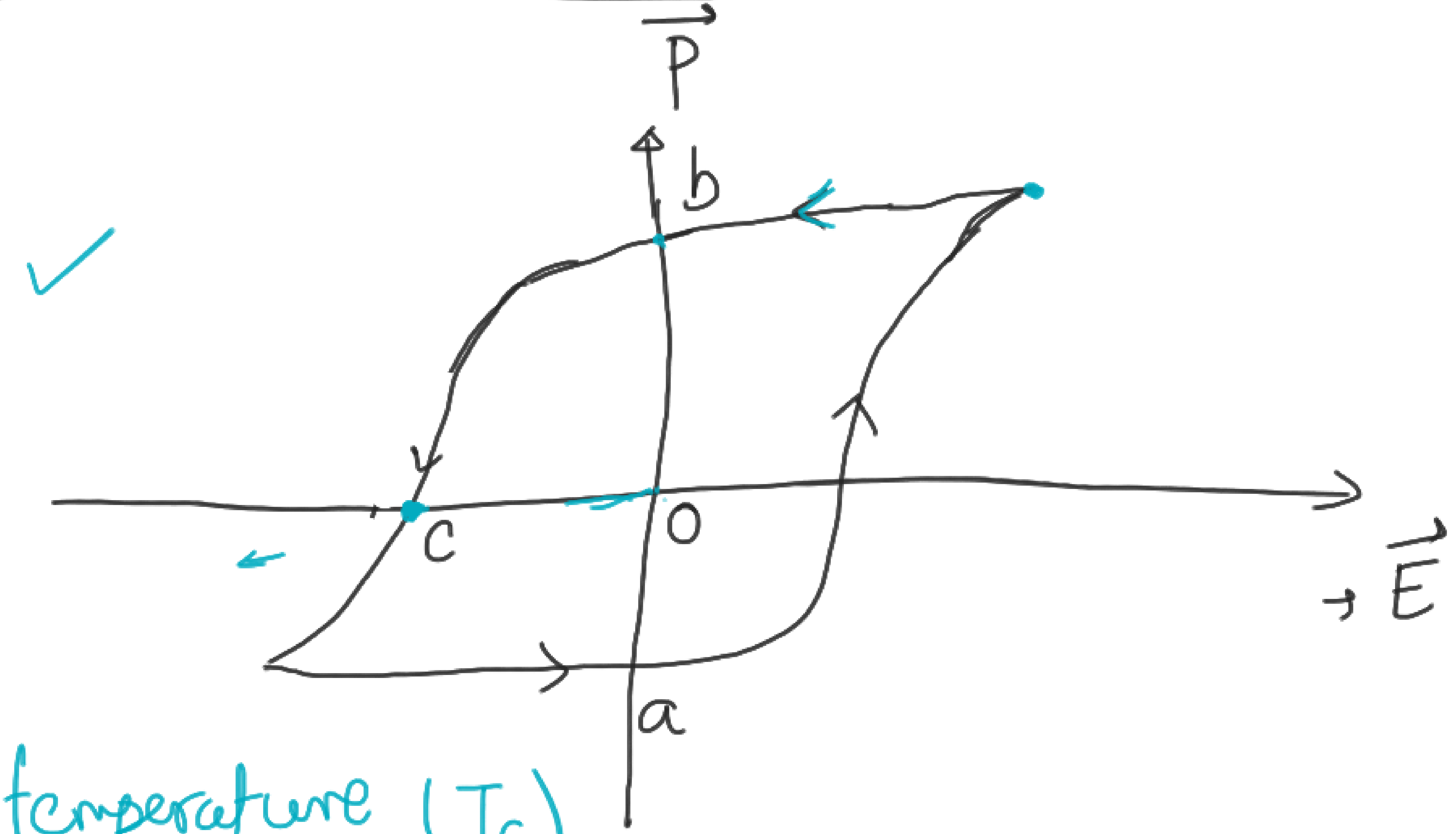
Para electric material:

ε_r and χ_e are +ve but smaller value than Ferro electric materials

Exception, vacuum $\varepsilon_r = 1$

$\boxed{\text{Dia-electric does not exist}}$ *

Hysteresis loop for Ferroelectric :

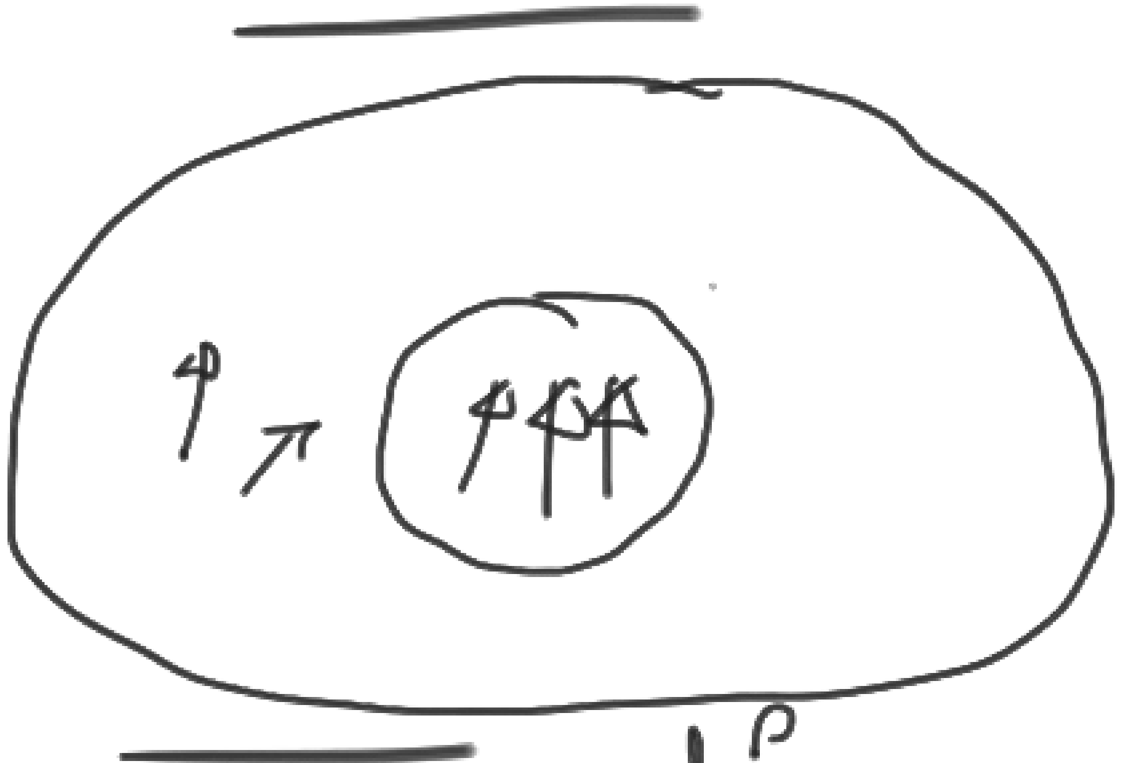


✓ **Curie temperature (T_c)**

Below a certain tempr. the spontaneous polarisation exist

- $T > T_c$, Para electric behavior

- $T < T_c$, Ferroelectric "



✓ spontaneous polarisation

⇒ Thermal agitation

non-polar
polar

✓ Ferroelectric ⇒

- Paraelectric ⇒

Modern Physics

Wave - Particle duality :

In classical physics → Particle
→ wave

separate

physical reality has its root in microscopic world

⇓

moving electron has wave as well as particle manifestation

Special relativity and wave particle duality is central to understanding of modern physics