Rajat

Experimental Survey of superconductivity:

Superconductivity:- In 1911 Kammerlingh Onnes found that the electrical resistance of some metals, alloys and compounds suddenly drops to zero when the specimen is cooled below a critical temperature. This phenomenon is called "superconductivity" and the cooled specimen is said to be a superconductor.

The critical temperature Tc below which a material undergoes a transition from a state of normal conductivity to a superconducting state is different for different materials. It varies from 23.3K for the alloy to .01K for some semi conductor.

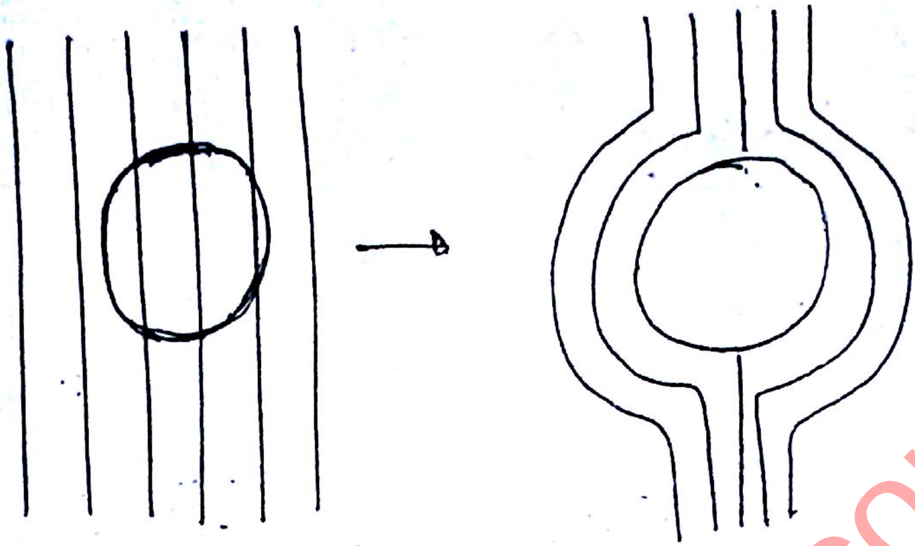
Properties of superconductor:-

(1) Electrical Properties:- The superconducting state of material is characterised by zero electrical resistance. Hence a superconductor can conduct electric current even in the absence of an applied voltage and the current can flow for year to year without any decay.

Meissner Effect:- Important

(2). Magnetic Properties:- In 1933 Meissner observed that if a superconducting material is placed in a magnetic field and is then cooled to below its critical temperature it expels all the originally present magnetic flux from its interior. This is called Meissner effect.

This means that the magnetic induction $\vec{B}$ inside the superconductor is always zero



If M is the intensity of magnetisation in magnetising field (H) then.

$$B = \mu_0 (H + M) = 0$$

Thus $\mu_0 \neq 0$ or $H + M = 0$ or $H = -M$.

or $= \frac{M}{H} = -1$ $\quad [\chi_m = \frac{M}{H}]$

$$\boxed{\chi_m = \frac{M}{H} = -1}$$

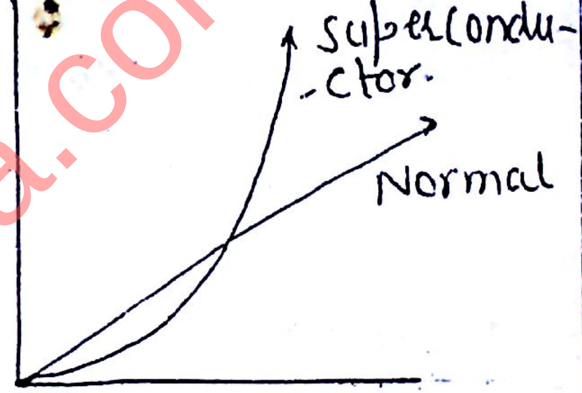
Thus superconductor behave like a Diamagnetic substance.

Thermal Properties:-

(i) Entropy:- The entropy increase as one passes from superconducting state to normal state and entropy decrease as one passes from normal conducting state to superconducting state.

(ii) Heat capacity:- In normal metal.

- Heat capacity is directly Proportional to temperature. Thus $C_v \propto T$
But in case of super conductor specific heat varies exponetial with temperature.



Isotopic Effect

In 1950 It was observed that the transition temperature (Tc) for super conductor is different for specimen having different isotopic mass. This effect is called isotope effect. It was observed by Reynold that the transition temperature (Tc) for super conductor is proportional to $M^{-1/2}$ Where (M) is isotopic mass of the ions of superconducting materials. Thus

$$T_c = M^{-1/2} \quad \text{or} \quad \sqrt{M}\,T_c = \text{constant}.$$