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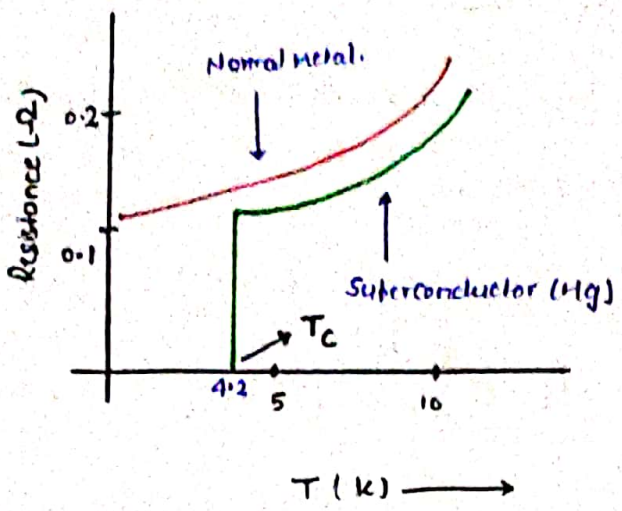
# Superconductivity

The field of superconductivity has emerged as one of the most exciting field of solid state physics & solid state Chemistry during the last decade.

The phenomenon was first discovered in 1911 by Kamerling Onnes in Leiden while observing the electrical resistance of mercury (Hg) at very low temperature close to 4.2 K, the melting point of helium. as shown in fig.




it was observed that the electrical resistance / Resistivity of Mercury decreased continuously from its melting point (233k) to 4.2k & then dropped suddenly to zero resistance. Similar results were obtained by using various other metals such as. Pb, Sn & In. Hence

"The phenomenon of complete loss of resistivity by certain metals & alloys when they are cooled below a certain temperature is called superconductivity & the material in this state was called Super conductor".

"The temperature at which a substance undergoes a transition from normal conductor to super conductor in a zero magnetic field is called Transition or critical temperature ($T_c$).

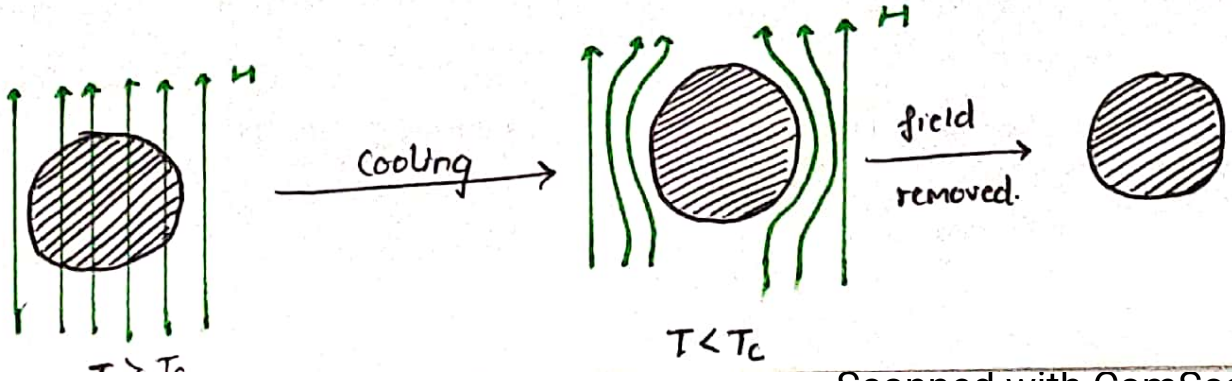
An important property of superconductor is that if current once set up in the superconducting loop can persists for years without any applied emf. Therefor it can have important practical application. but a serious difficulty in their use is a very low their critical temperature.

Scientist all over the world are busy to construct alloys which would be superconducting at room temperature. Some of the superconducting materials as given in table.

| Material | Tc (K) |
|---|---|
| Hg | 4.2 |
| $Pb_2Au$ | 7.0 |
| $YBa_2Cu_3O_7$ | 90 |
| $Tl_2Ca_2Ba_2Cu_3O_{10}$ | 120 |

**Meissener effect:-** Meissner & Ochsenfeld discovered in 1933 that a superconductor expelled the magnetic flux as the former was cooled below $T_c$ in an external magnetic field. This phenomenon is known as Meissener effect. Such a flux exclusion is also observed if superconductor is first cooled below $T_c$ & then placed in magnetic field. Hence the two mutually independent properties defining the superconducting state are the zero Resistivity & perfect diagmagnetism. ie

$$E = 0 \; ; \quad B = 0$$



## Application of Superconductor :-

- The superconducting Magnet have been employed in NMR Spectrometers & NMR Imaging used in Medical diagnostics.
- it is used in the devices that perform logic & storage function in high speed Computer.
- For producing high Magnetic fields required for research work in high energy physics.
- In long distance power transmission without any wastage of power.
- In levitation transportation.