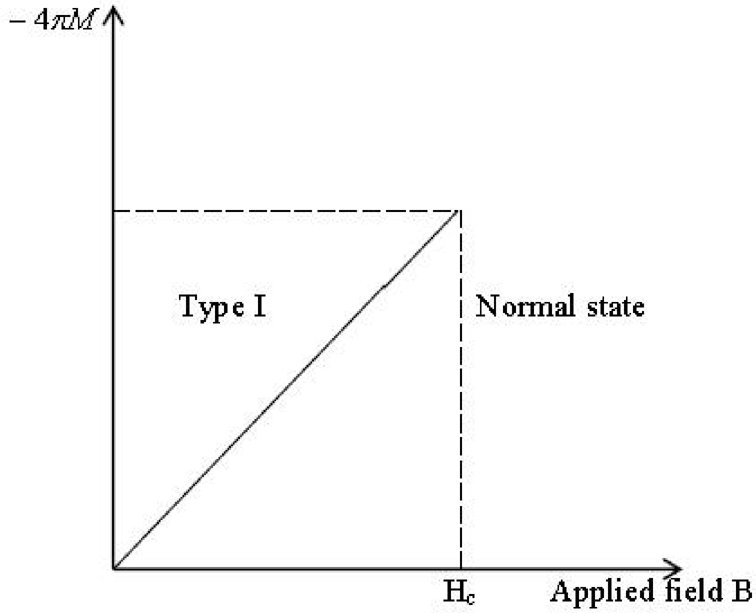
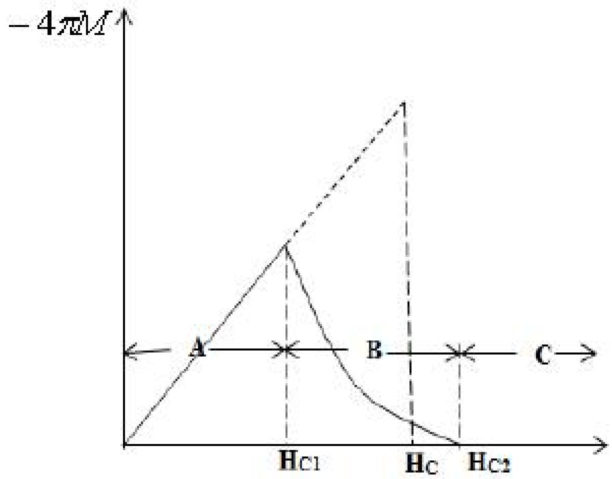


and the magnetisation is too small to be seen on scale. In general for type 1 superconductors, the superconducting state is destroyed and the normal state is restored by application of an external magnetic field in excess of a critical value H_c. Aternatively, we can say that superconductivity is destroyed by a modest applied magnetic field.

TYPE II SUPERCONDUCTORS

These are alloyed or transition with high values of electrical resistivity in the normal state i.e the electronic mean free path in the normal state is short.



Type 2 superconductors have superconducting electrical properties up to the field denoted by H_{C_2}. Between H_{C_1} and H_{C_2}, $B \neq 0$ and thus the Meissner effect is said to be incomplete. Hence the specimen is said to be in vortex state. In the vortex state there is no chemical or crystallographic difference between the metals in the normal and superconducting states. It describes the saturation of superconducting currents in vortices throughout the specimen. The flux starts to penetrate the specimen at a field which is lower than the critical point H_c. Above H_{C_2}, the specimen is a normal conductor in every respect except for possible surface effect.

In summary,

1. There is no difference in the mechanism of superconducting in type 1 and type 2 superconductors since both have similar thermal properties at the superconductor-normal transition in zero magnetic field.

2. A good type 1 superconductor excludes a magnetic field until superconductivity is destroyed suddenly and then the electric field is completed. A good type 2 superconductor excludes the field completely up to H_{C_1}; above H_{C_1} the field is partially excluded but the specimen remains electrically superconductivity. At much higher field, H_{C_2} the flux penetrates completely and superconductivity vanishes.

3. If the coherent length is longer than penetration depth then the superconductor is type 1 where as if the coherence length is short and penetration depth is longer, such that the mean free path is short then the superconductor is type 2.

4. Type 1 metals can be changed to type 2 by a modest addition of alloyed elements.

Read about: Tunneling in superconductors.

MAGNETIC PROPERTIES OF MATERIALS

Diamagnetic and Paramagnetic

The magnetic moment of a free atom has 3 basic processes namely:

(i) the spin with which electrons are moving.

(ii) the orbital angular momentum of electrons around the nucleus.

(iii) the change in orbital momentum induced by an applied field.

Magnetisation

This is defined as the magnetic moment per unit volume.

Magnetic Susceptibility, χ_m

A magnetic field can be described either by magnetic induction B or magnetic field strength $\vec{H}$; i.e $\vec{B} = \mu_0\vec{H}$. When a material is placed in a magnetic field the medium is magnetised and the magnetic induction inside the medium is given by $\vec{B} = \mu_0\vec{H} + \mu_0\vec{M}$, where $\mu_0\vec{H}$ is the external applied magnetic field and M is the magnetisation of the medium. System magnetisation is induced by the field. M is considered to be proportional to the field strength, H. i.e $\vec{M} \propto \vec{H}$, $\vec{M} = \chi_m\vec{H}$, where χ_m is a dimensionless quantity called magnetic susceptibility.

Thus it is defined as the magnetic moment per unit field strength.

From $\vec{B} = \mu_0\vec{H} + \mu_0\vec{M}$ and $\vec{M} = \chi_m\vec{H}$.

$\Rightarrow \vec{B} = \mu_0\vec{H}(1 + \chi_m)$.

In any medium $\vec{B} = mu\vec{H}$.

$\Rightarrow \mu_r = \frac{\mu}{\mu_0} = 1 + \chi_m$, where μ_r is the relative susceptibility.

CLASSIFICATION OF MATERIALS BY MAGNETIC PROPERTIES

Magnetic materials may be grouped into 3 magnetic classes depending on the sign of magnitude of magnetic susceptibility.