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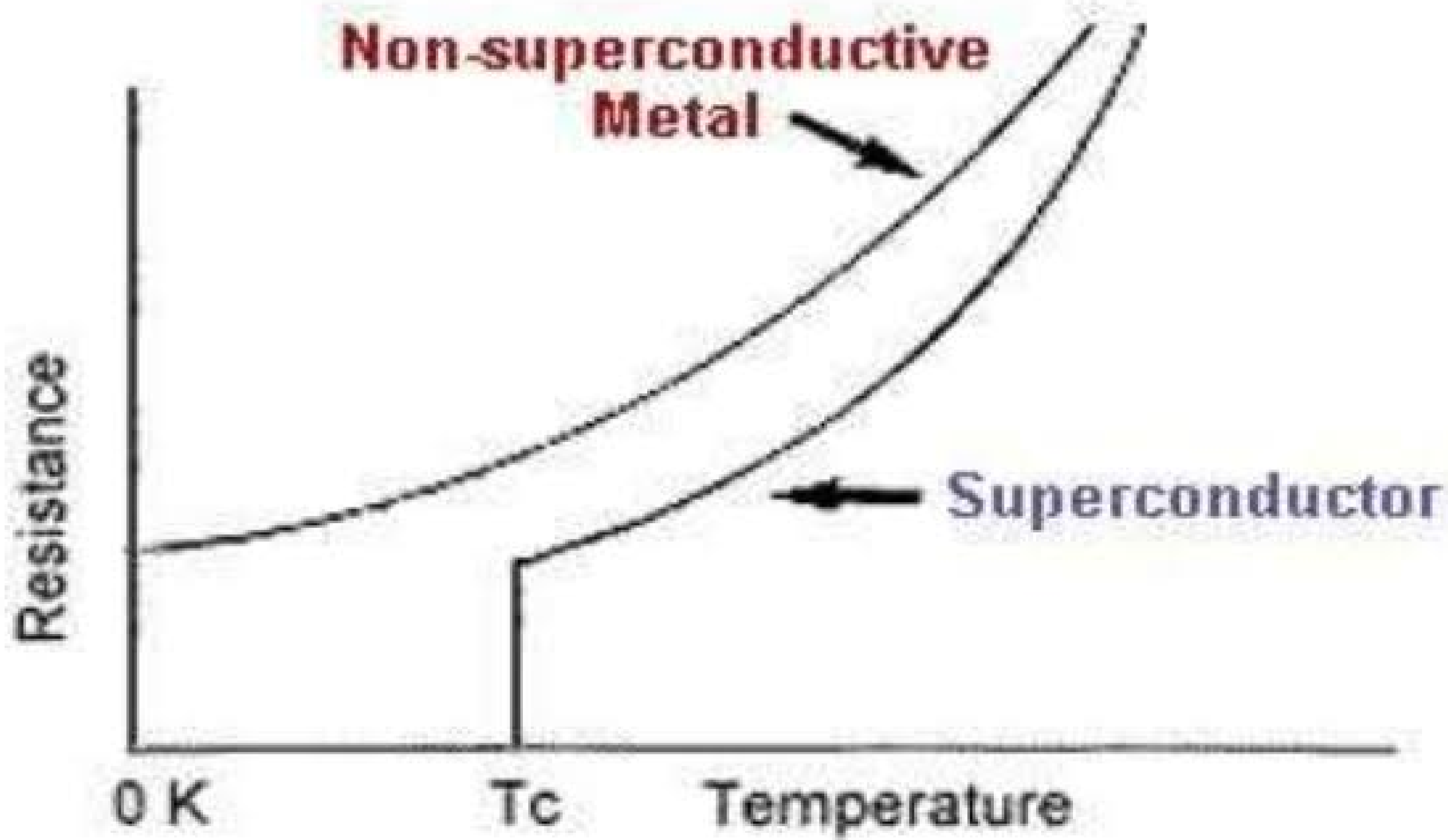
SUPER CONDUCTIVITY

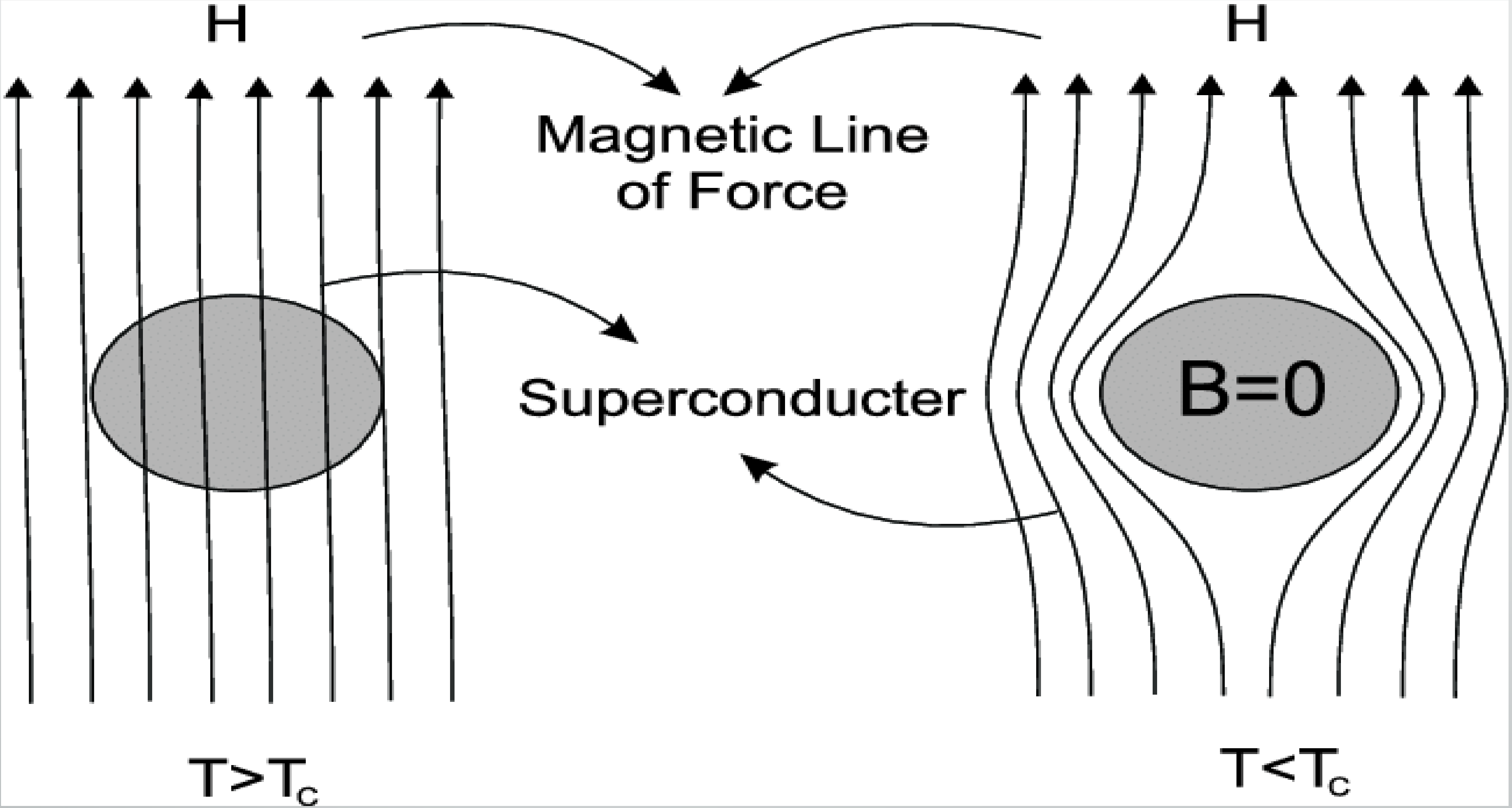
- Super conductivity is a phenomenon of exactly zero electrical resistance and expulsion of magnetic flux fields occurring in certain materials, called super conductors when cooled below a characteristic critical temperature.
- The electrical resistance of a metallic conductor decreases gradually as temperature is lowered. In ordinary conductors, such as copper or silver this decrease is limited by impurities and other defects.
- Even near absolute zero a real sample of a normal conductor shows some resistance.
- It was discovered by Dutch Physicist Heike Kamerlingh Onnes.
- Super conductivity is characterized by the Meissner Effect.



Non-superconductive
Metal
Superconductor
Resistance
0 K
Tc
Temperature

MEISSNER EFFECT

- When a material makes the transition from the normal to superconducting state, it actively excludes magnetic fields from its interior; this is called Meissner effect.
- German physicists Walther Meissner and Robert ochsenfeld discovered this phenomenon by measuring the magnetic field distribution outside superconducting Tin and Lead samples.
- A superconductor with little or no magnetic field is said to be in the Meissner state. This state breaks down when the applied magnetic field is too strong.


H
H
Magnetic Line of Force
Superconducter
B=0
T>T_c
T<T_c

- Super conductor can be divided in to two classes according to how this breakdown occurs, behavior and properties.

TYPE- I super conductors

and

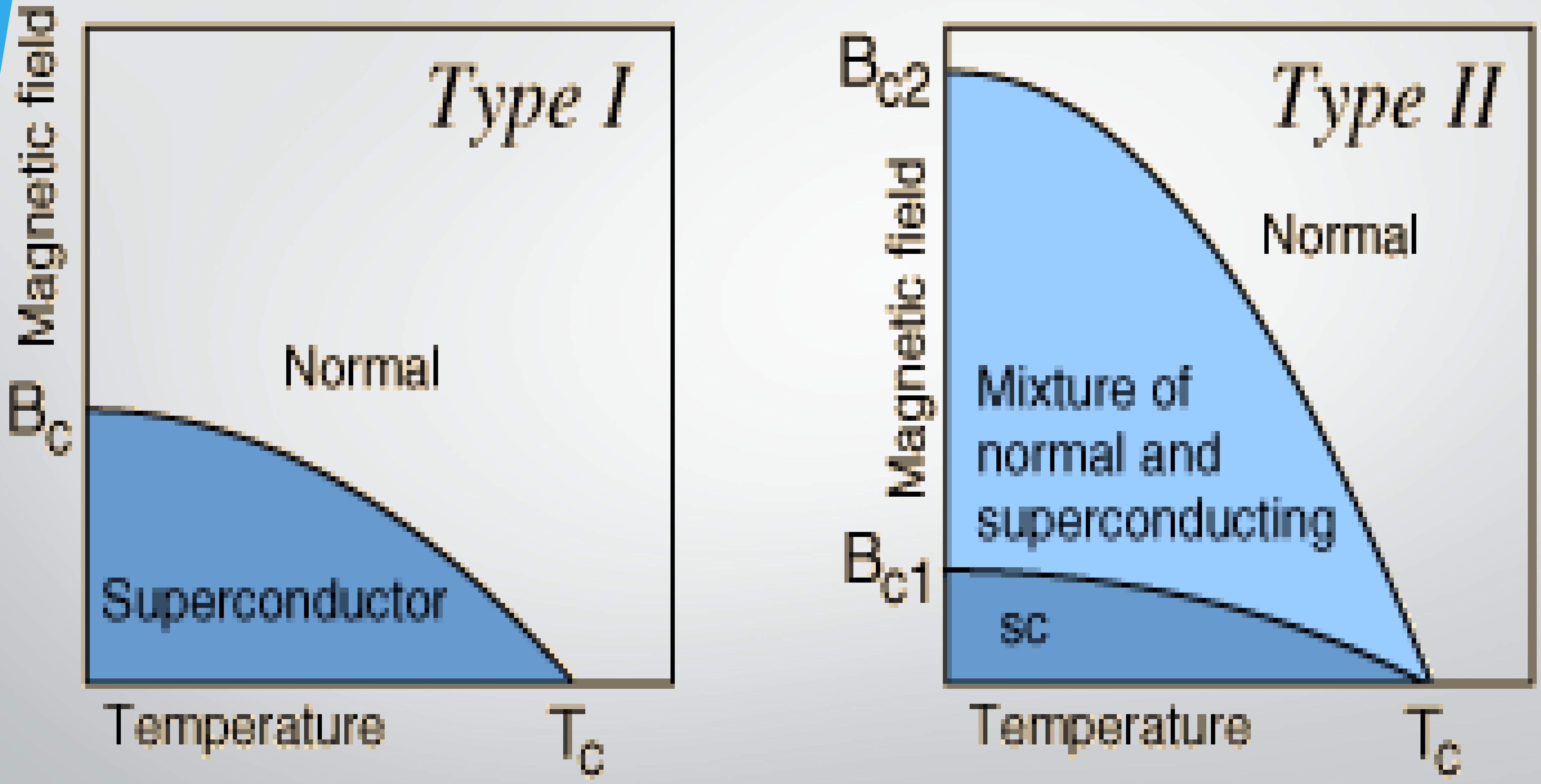
TYPE-II super conductors

TYPE-I Super conductors

- Low temperature super conductors.
- Perfectly obey the Meissner effect: magnetic field cannot be penetrate inside the material.
- It exhibits single critical magnetic field.
- Easily lose the superconducting state by low intensity magnetic field. Therefore TYPE-I super conductors are also known as soft super conductors.

- Type-I super conductors are generally pure metals. Slight impurity does not affect the super conductivity of Type-I superconductors.
- Due to the low critical field soft super conductors have limited applications.
- Examples:

  Hg, Pb, Zn, etc..

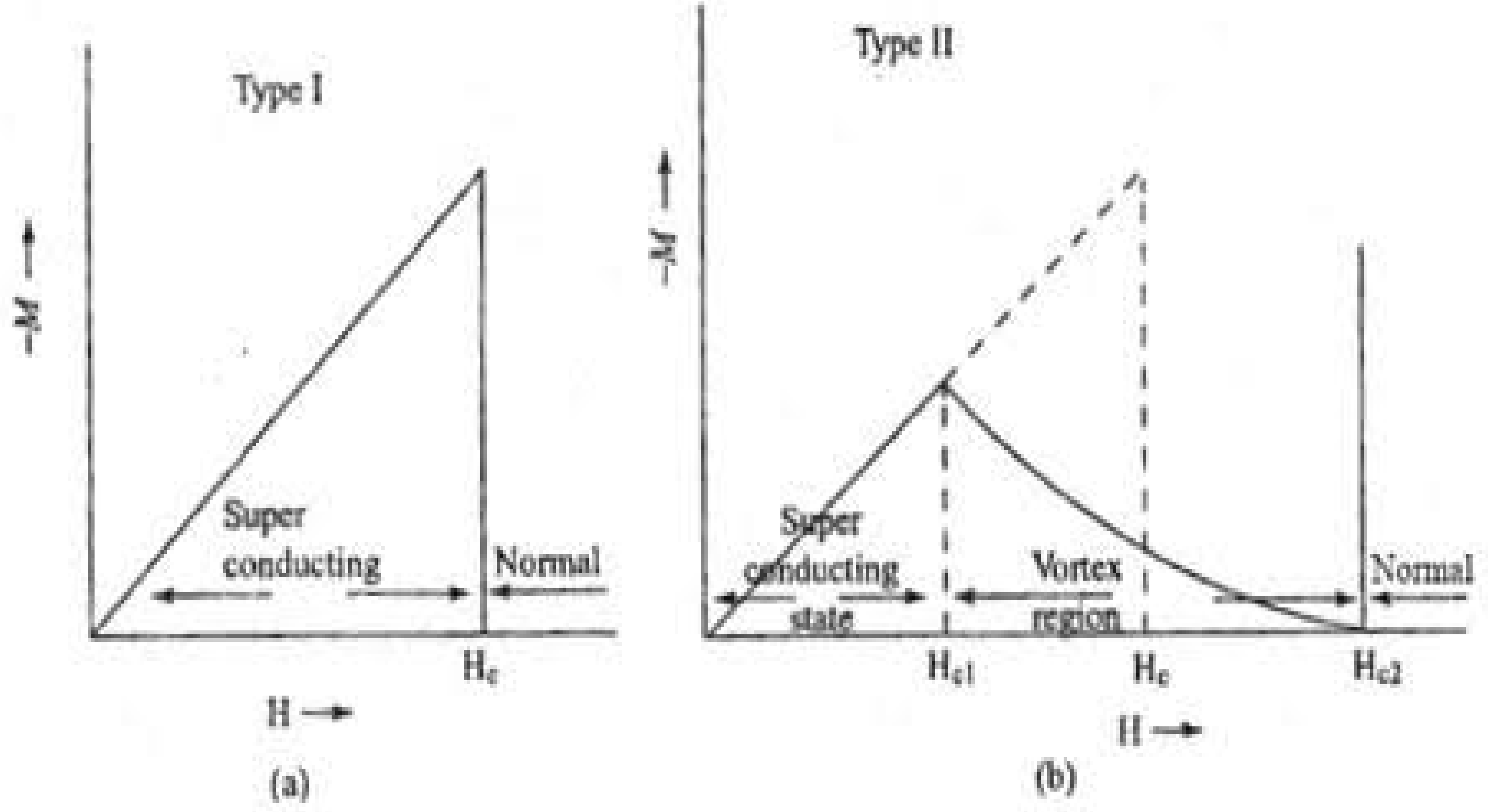

Type I
Magnetic field
Normal
Bc
Superconductor
Temperature
Tc
Type II
Bc2
Magnetic field
Normal
Mixture of normal and superconducting
Bc1
sc
Temperature
Tc

TYPE-II Super conductors

- High critical temperature.
- High critical magnetic field.
- Partially obey the Meissner effect but not completely; Magnetic field can penetrate inside the material.
- It exhibits two critical magnetic field.
- Does not easily lose the superconducting state by external magnetic field. Therefore, TYPE-II superconductors are also known as hard super conductors.

- Type-II super conductors are generally alloys and complex oxides of ceramics.
- Slight impurity greatly affects the superconductivity of type-II superconductors.
- Due to the high critical magnetic field, Type-II superconductors have wider technical applications.
- Examples:

  Nb_3Sn,NbTi,etc,...



Type I
−M →
Super
conducting
Normal
H_c
H →
(a)
Type II
−M →
Super
conducting
state
Vortex
region
Normal
H_{c1}
H_c
H_{c2}
H →
(b)

- Type-II super conductors have superconducting electrical properties up to a field denoted by HC2. Between the lower critical field Hc1 and upper critical field Hc2 the flux density B not equal to zero and the Meissner effect is said to be incomplete.
- In the region between Hc1 and Hc2 the superconductor is threaded by flux lines and is said to be in the vortex (mixed) state.
- Type-II superconductors with a large magnetic hysteresis, usually induced by mechanical treatement. Such materials have an important medical application in magnetic resonance imaging (MRI).

THANKYOU