SUPERCONDUCTIVITY

SOLID STATE PHYSICS - IV

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– What are superconductors?

- *Superconductors are the material havin zero resistivity and behave as diamagne the superconducting transiting tempera*
- *Superconductivity* is the flow of electric without resistance in certain metals, allo ceramics at temperatures near absolute z

Superconductivit

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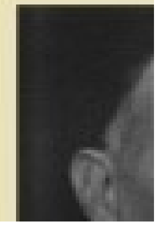
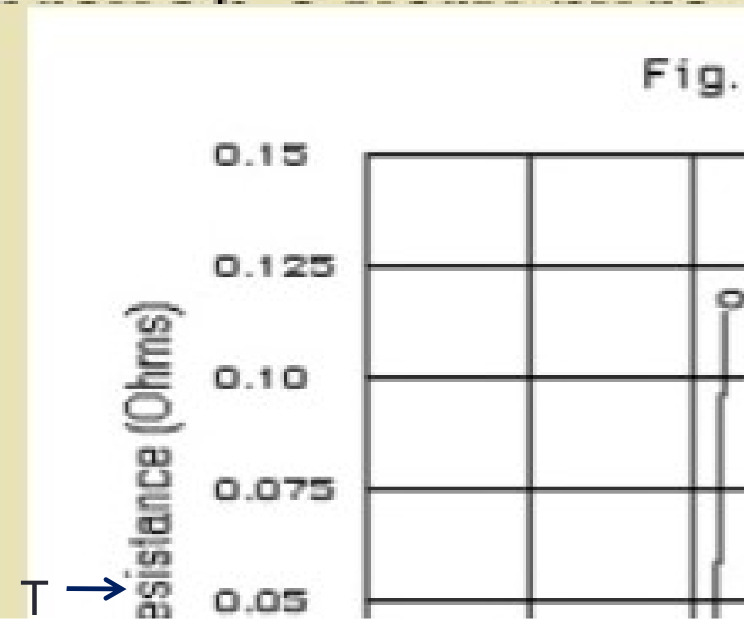


- Superconductivity was first disc
  1911 by the Dutch physicist.Hei

there would be a leveling off as the resistance
some ill-defined minimum value allowing the
flow with little or no resistance.

i.e. Extremely good
conductor of electricity -

- SUPERCONDUCTIVITY



Important Factors to defi Superconducting State

- The superconducting state is defined by three v important factors:

    1. critical temperature (*T*c)
    2. critical field (*H*c)
    3. critical current density (*J*c).

CRITICAL TEMPERAT

- The temperature at which material electrical resistiv drops to absolute zero is the Critical Temperature Transition Temperature.
- Below critical temperatur material is said to be in superconducting and abo is said to in normal state. this temperature the superconductors also exh

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Metal
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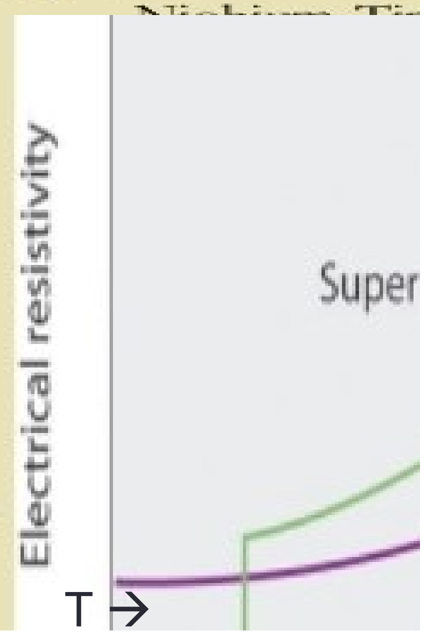
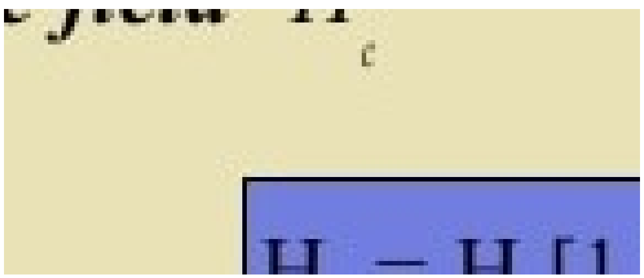
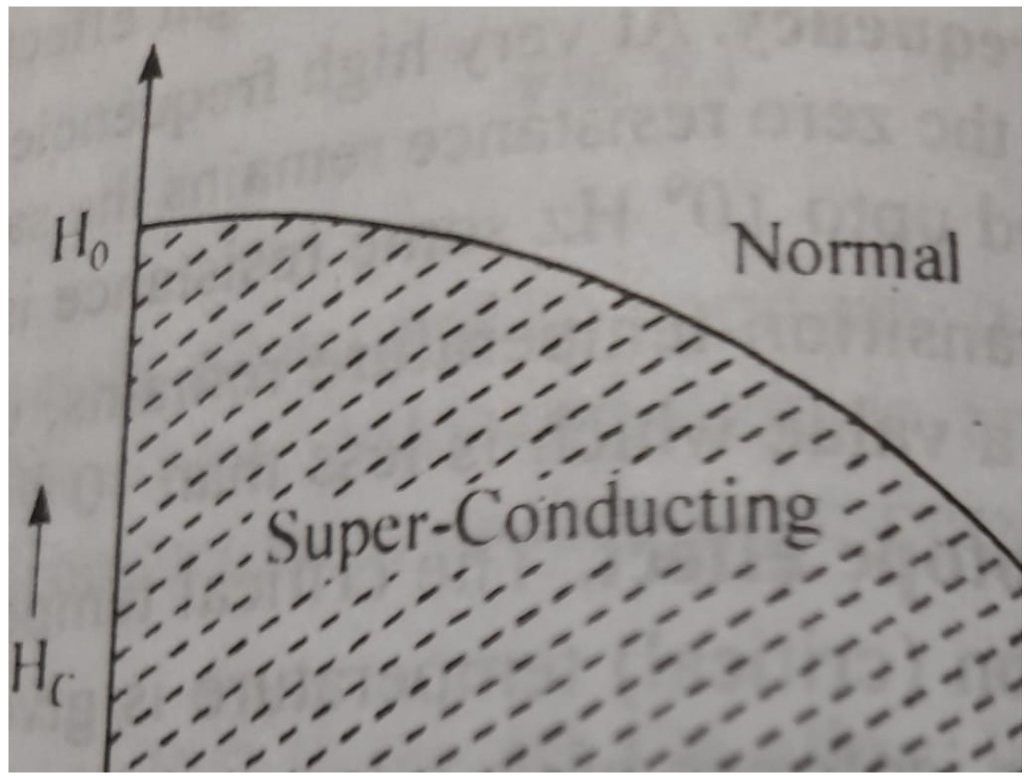


- **Critical magnetic field (Hc)** Above this value externally applied magnetic field a superconduc non-superconducting .*This minimum magnetic f to destroy the superconducting state is called th*





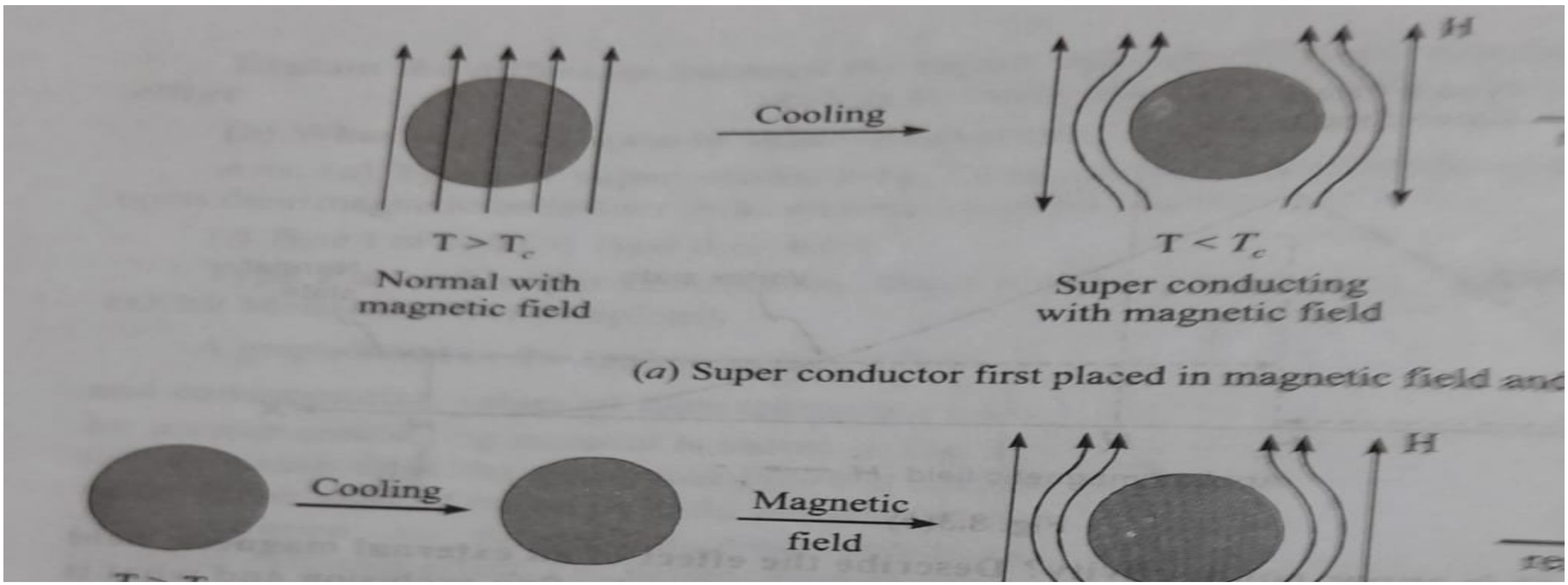
Critical Current Density:

An important consequence of the existence of critical magnetic field is that there is also a critical strength of current flowing in the super conductor. If the strength of the current is exceeded, there is a disturbance of super conductivity.

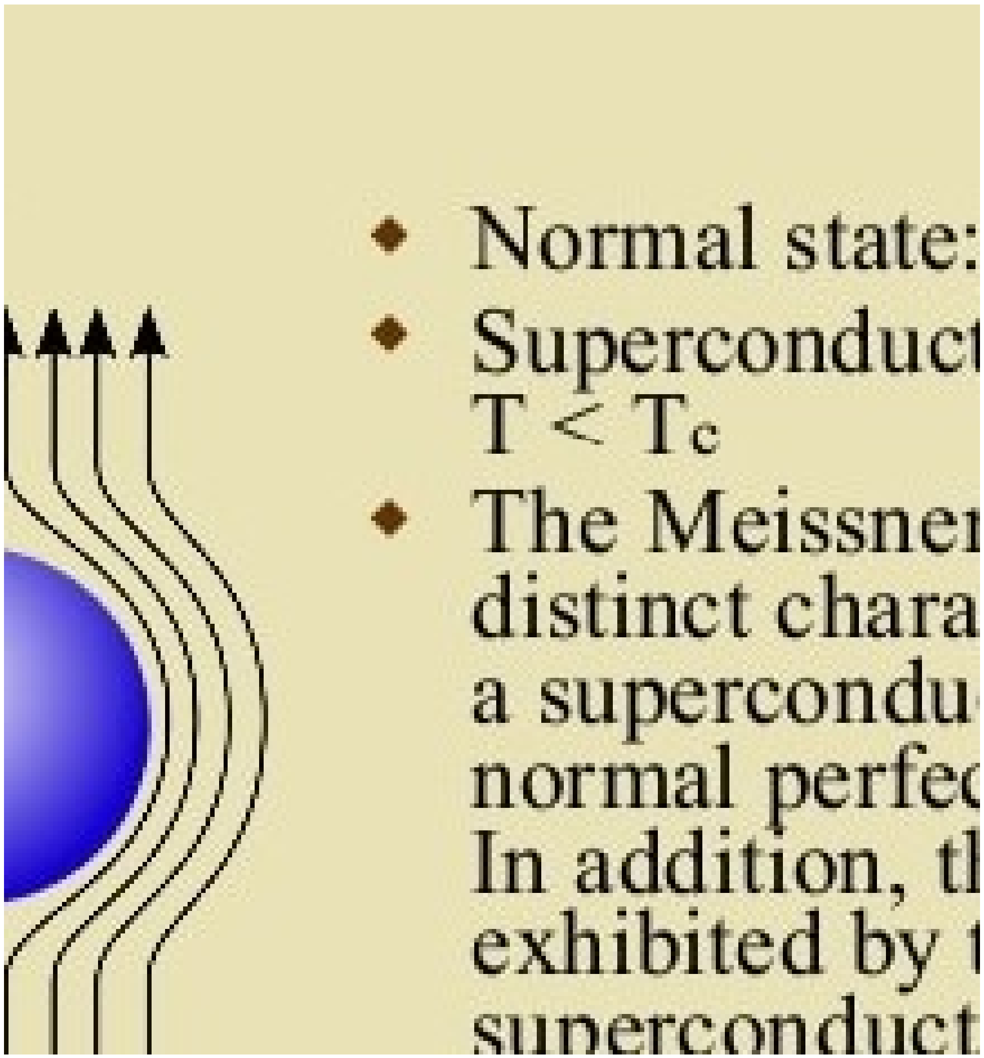
Meissner

If a super conductor ($T>T_c$) is cooled in a magnetic Field H below the Transition Temperature T_c, then at the transition the lines of magnetic flux are pushed out of the specimen. The flux does not penetrate the material and super conductor behaves as perfect diamagnetc.

As soon as the magnetic field is removed the super conductor resumes its normal state.



Meissner


Normal state:
Superconduct
T < Tc
The Meissner
distinct chara
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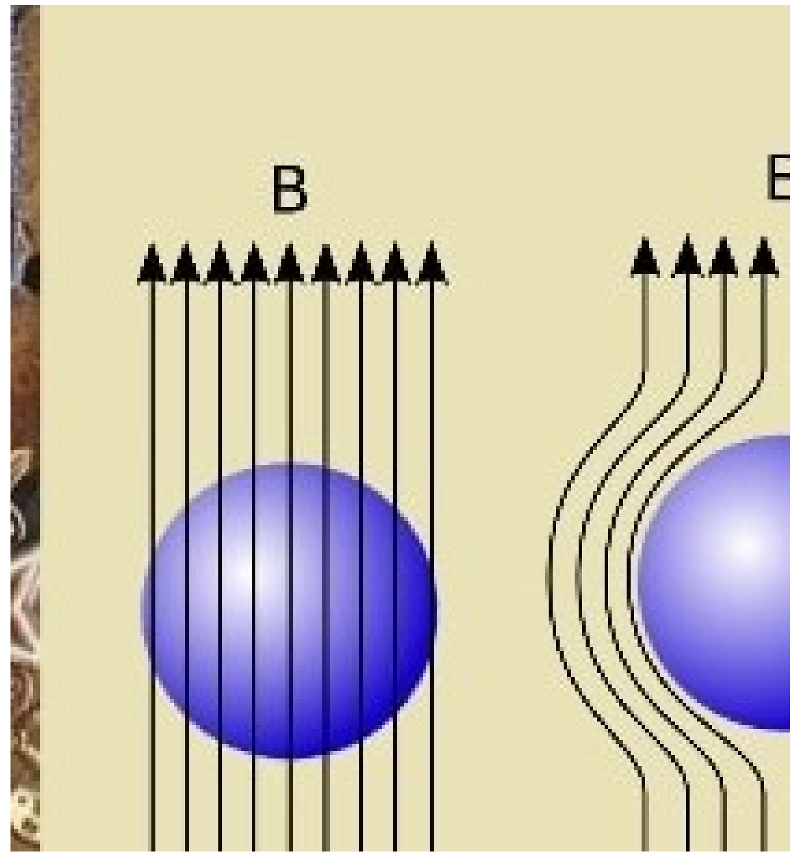
In addition, th
exhibited by t
superconduct


B

Meissner

We know that if an external magnetic field **H** is applied and intensity of induced magnetic field is **M**, then the total magnetic field inside the material is

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

Meissner effect shows that in an external applied magnetic field H the super conductor behaves as if inside the material the value of B = 0 (at T_c). Thus

$$H = - M$$

Susceptibility, $\chi = M/H = -1$

i.e. the material has a negative susceptibility and behaves as perfect diamagnetic.

The complete expulsion of all magneti
superconducting material is called “Mei

TYPES OF SUPERCONDUC

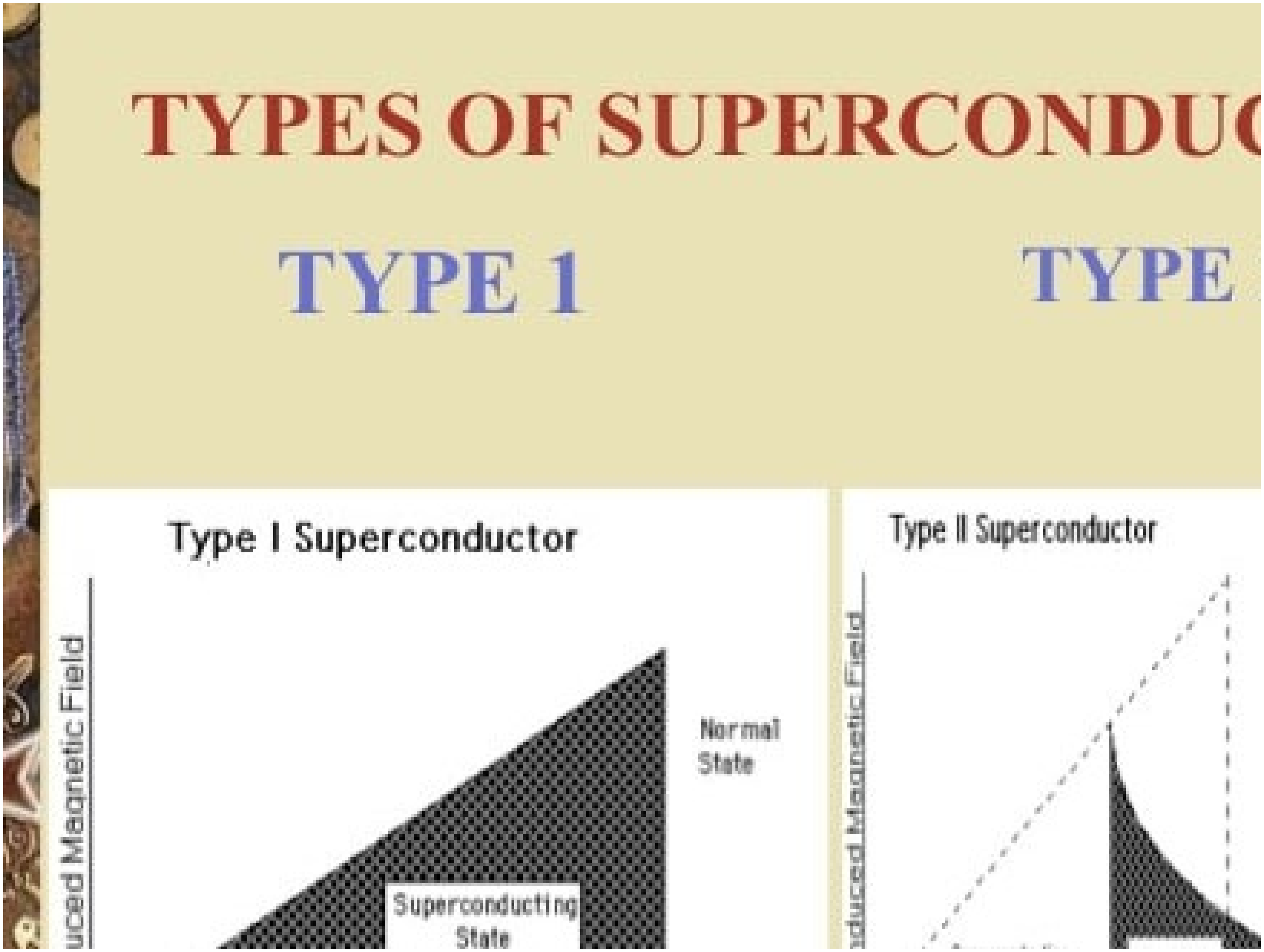
There are two types of super conductors depending upon their magnetic behaviour in an external magnetic field.

a) **Type - I or Soft super conductor**: These super conductors are perfectly diamagnetic and exhibit Meissner effect completely.

b) **Type - II or Hard super conductor**: These super conductors have large magnetic hysteresis.

TYPES OF SUPERCONDU

TYPE I	TYPE
Soft superconductors are those which can tolerate impurities without affecting the superconducting properties.	Hard superconduc which cannot toler i.e., the impurity a superconducting p
Also called SOFT SUPERCONDUCTORS.	Also called HARD SUPERCONDUC
Only one critical field exists for these superconductors.	Two critical fields Hc2(upper) for the
Critical field value is very low.	Critical field value
Exhibits perfect and complete Meissner effect.	Don't exhibit perf Meissner effect.
The current flows through the surface only.	It is found that cu throughout the ma
These materials have limited	These materials ha


TYPES OF SUPERCONDU
TYPE 1
TYPE
Type I Superconductor
Normal State
Superconducting State
Type II Superconductor

THANK YOU

ALL THE BEST