Meissner effect (lec -2)

It is observed that a bulk superconductor in an applied external magnetic field H as if inside the sample of superconductor

$$B = H + 4\pi I = 0 ,$$

Where I is the intensity of magnetisation .

$$H = -4\pi I$$

$$I/H = \chi = -1/4\pi \text{ (CGS unit)} \qquad (1)$$

Where χ is the magnetic susceptibility .

From (1) it is clear that the superconductor shows the perfect diamagnetism .

We will explain that the perfect diamagnetism of a superconductor is an independent character and it is not related to zero resistivity .

We want to establish the relation between the two properties .

According to Ohm's law

$$E = \rho J \qquad (2)$$

Where ρ = resistivity

J = current density

E = electric field intensity

It is cleat from (2) that if ρ goes to zero while J is kept finite , E should be zero .

From Maxwell field equation

$$dB / dt = - C (\nabla \times E) = - C (\text{curl } E) \qquad (3)$$

since for zero resisvity , E = 0 , hence from (3),

$$dB/dt = 0$$

Hence , B = Constant (4)

Hence we conclude that the magnetic flux through the substance can not change on cooling through the transition .

Thus the

Meissner effect contradicts the present results and argues that perfect diamagnetism is the main property of the superconducting state .