

Questions from Ch. 15, Superconductivity

(1) What's the difference between the two originally discovered types of superconductivity?

Answer: Type 1 superconductivity, discovered early in the 20th Century, depends on the formation of very weakly bound pairs of electrons with equal and opposite wave number \mathbf{k} in the lattice of some conductors, when the temperature is just a few K. These are called Cooper pairs. This superconducting state is destroyed if the current in the superconductor creates a significant magnetic field. However, materials have been found in which a different, Type 2 superconducting state survives even at temperatures of 100 to 200 K. In Type 2 superconductivity, not generally known until the middle of the 20th Century, the pairing is due to the spin-spin interaction between electrons, and is not affected even by strong magnetic fields, in many materials. In these materials there is an intermediate state between normal conduction and superconduction, in which both types of conduction occur simultaneously. The mixed state and fully superconducting states exist only for temperatures of a few K, in strong magnetic fields. All superconducting electromagnets used in medicine, technology and particle accelerators are type 2.

(2) If you read on an internet news site that a new superconducting material has been found that superconducts at 150 K, what type would it be? If you read that a new superconducting material has been discovered that can generate and survive a magnetic field of 25 T, what type would it be?

Answer: Both would be Type 2.