Superconductors Essay, Research Paper

Super conductivity is a natural phenomenon in which certain materials such as metals, alloys, and ceramics, can conduct electricity without resistance. These materials are what we call superconductors. In a superconductor, once the flow of electrons begins, it essentially goes on forever, making it an important material to humans.

Superconductivity was discovered by a Dutch scientist by the name of Heike Kamerlingh Onnes in 1911. While researching properties of materials at absolute zero, this man found out that certain materials lost its resistance to the flow of electrons. For years to come, his discovery was at the head of theoretical interest. The only problem though, was that people at that time could not even think of a way to produce such a temperature, to allow materials to be superconductors at all times. This all changed in 1986 when Karl Muller and George Bednorz were working at the IBM Research Division in Zurich, Switzerland. They found a material that reached superconductivity at around 35 degrees Kelvin or 238 degrees Celsius. In the next year, a team of Chinese-American physicists declared that they had found a material that reached superconductivity at 92 degrees Kelvin. This was a big improvement. 92 degrees Kelvin is not a very high temperature, in fact, it is the equivalent of 181 degrees Celsius. Locating superconducting material above 77 degree Kelvin is a good thing because it means that the material will be easily produced and used. A theoretical understanding of superconductivity was advanced in 1957 by American physicists John Bardeen, Leon Cooper, and John Schrieffer. Their Theories of Superconductivity became know as the BCS theory (which came from each mans last name) and won them a Nobel prize in 1972. The BCS theory explained superconductivity at temperatures close to absolute zero. However, at higher temperatures and with different superconductor systems, the BCS theory has consequently became insufficient to fully explain electron behavior.

The Type 1 category of superconductors is basically made up of pure metals that normally show conductivity at room temperature. They require really cold temperatures to slow down molecular vibrations enough to facilitate unrestrained electron flow in agreement to the BCS theory. BCS theory suggests that electrons team up in cooper pairs in order to help each other overcome molecular obstacles. Type 1 superconductors were discovered first and require the coldest temperatures to become superconductive. They are characterized by a very sharp transition to a superconducting state. Ironically, copper, silver and gold, three of the best metallic conductors, do not rank among the superconductive elements.

Except for the elements vanadium and niobium, Type 2 superconductors consists of metallic compounds and alloys. The recently discovered superconducting “perovskites” or superconducting ceramics belong to this Type 2 group. Type 2 superconductors differ from Type 1 in that their transition from a normal to a superconducting state is regular across a region of mixed behavior. A Type 2 superconductor will also allow some invasion by an outer magnetic field into its surface. A Type 1 superconductor won t.

Super conductors have many uses. They are used in trains as magnetic-levitation devices, which makes certain trains appear to float while in motion. Superconductors are also used medically in MRI s and commonly in electric generators, making them more efficient.