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Superconductivity: The Future of Us

Within the scientific community, there remains efforts to advance our knowledge on superconductors and apply them for future usage such as high speed bullet trains, bio magnetism for surgical procedures and more efficient electrical generators. Superconductivity is defined as a special phenomenon where at very low temperatures, materials can effectively lose all electrical resistance. This was first discovered and developed in 1911 by Heike Kamerlingh Onnes as he cooled liquid helium and observed its electrical resistance steadily decreasing. This remains an issue for power generation as electrical resistance causes energy loss and decreases productivity while increasing costs. This can have impacts on everyone as within all cities that generate power must increase voltages to overcome energy loss and may cost the much city more money to generate its own power. In terms of an analogy, you can imagine electrical resistance as the force of friction on your car’s wheels. Over a certain amount of time, you will have to spend money to replace your wheels and use more gas in roads with greater friction. By using superconductors, you are effectively removing friction (electrical resistance) and the amount of gas used as well as never having to change your wheels, decreasing the overall cost thus increasing efficiency.

Superconductors in order to reach property of zero electrical resistance, must have extremely low temperatures such as -234 ° Celsius. Each superconductor may reach a critical point in which is the temperature required to become a superconductor. We define Electrical resistance as collisions between atoms as they flow through a conductor which cause friction and thus energy loss as heat. As temperature increases, kinetic energy within the material increases and atoms begin to move at a more rapid pace, increasing the likelihood of collisions and more energy loss. This can also be explained through the BCS theory in which electrons move through crystalline lattice and change the spacing of these electrons. The lattices operate at low energy levels thus decrease the amount of collisions that can occur. Although it is understood that while superconductors generally retain their electrical resistance under low temperatures, its properties can be negated by magnetic fields and excess electricity. These conductors have properties where they will repel inner magnetic field, a process of which requires energy to occur (Joe Khachan, 1). This makes it difficult for real world applications as it may not be compatible with systems that require large amounts of electricity such as power generation facilities and thus will again result in energy loss and decreased efficiency. Since all superconducting material has its own critical temperature, we are trying to find the most efficient superconductor which has the highest critical temperature which may be easy to maintain.

Increasing amounts of technical advancements and discoveries within superconductors have led to brighter prospects for applicable, real world uses for superconductors. Take for example the research of USC professor Vitaly Kresin in which he discovered the formation of cooper pairs of electrons at 100 kelvin. This indicates that materials may exist which have similar qualities of decreased electrical resistance at even higher temperatures. Currently, the major impediment for the usage of superconductors is extremely low critical temperatures in which are not always feasible for extended usage and application as it needs to be constantly regulated. Since there is evidence of superconductors operating at higher temperatures, this means that there may be possible ways to either find high temperature superconductors or find a way to alter the critical temperatures of any superconductor.

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