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SUPERCONDUCTIVITY

Our fascination in superconductivity comes from our interest in the way the world works, which is why we are students of the physics faculty. Unfortunately, we don’t have the ability to conduct superconductivity experiments in a student lab, because it’s only achieved at very low temperatures, close to absolute zero. We have studied temperature-dependent resistance of metals and semiconductors as a part of the university’s electricity course.

We consider zero electrical resistance as the first superconductivity property and the Meissner effect, or the expulsion of magnetic fields, as the second. Also, the widespread application of superconductivity has attracted our attention. For example, superconductivity is used in large electromagnetic systems. In the 1980s in the USSR the world’s first installation of thermonuclear synthesis T-7 with superconducting coils of toroidal magnetic field was launched. Superconducting coils are also used for hydrogen bubble chambers, for large particle accelerators. The production of such coils for accelerators is difficult, as the requirement of exceptionally high magnetic field uniformity makes it necessary to accurately observe the given dimensions. In recent years, the phenomenon of superconductivity has been increasingly used in the development of turbo-generators, electric motors, unipolar machines, topological generators, rigid and flexible cables, switching and current-limiting devices, magnetic separators, transport systems, etc. It should be noted that production of devices for measuring temperatures, costs, levels, pressures is based on superconductivity. Currently, there are two main directions in the field of superconductivity: first of all, in magnetic systems of different purpose and then - in electric machines (for instance, in turbo generators).

As mentioned above, superconductor represents a combination of two effects: expulsion of magnetic fields and zero electrical resistance. The former (zero electrical resistance) means that inside superconductor there are no collisions and consequently no energy dissipation. It’s quite remarkable. As for the latter (expulsion of magnetic fields) in other words we can say that superconductors “don’t like” magnetic fields and they try to expel the magnetic field from the inside by means of circulating currents. Both properties (zero electrical resistance and expulsion of magnetic fields) exactly define a superconductor.

What is more important the application of superconductors is full of perspectives due to its numerous opportunities for application. Nowadays people are able to transfer enormous ammounts of currents inside superconductors, so they can be used to produce strong magnetic fields such as needed in MRI-machines, particle accelerators and so on. What is more, energy can be stored with the help of superconductors, since there is no dissipation inside them. Here it comes that enormous ammounts of current between power stations can be transfered by superconductive power cables. Moreover apart from this it is impossible not to mention the future of quantum levitation also reffered to as quantum locking. In order to clearly see what amazing opportunities this quantum phenomenon in superconductors provides us with, let’s consider an example. Imagine you would have an extremely thin disk, three-inch diameter, with the superconducting layer, being two millimeters thin, quite thin. With this two illimeteers thin superconducting layer you could hold one thousand kilograms, equivalent to a small car, in your hand.

To sum it up the main idea we’d like to stress is that the significance of superconductivity can’t be overestimated.