CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
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Project Number
J1529

Project Title
What Is the Effect of a Magnetic Field on the Critical Temperature of a Type II Ceramic Superconductor?

Abstract

Objectives/Goals
My project was to determine the effect of a magnetic field on the critical temperature (temperature at which a superconductor superconducts) of a type II ceramic superconductor. I believe the critical temperature of the type II superconductor (Bi(2)Sr(2)Ca(2)Cu(3)O(9)) will lower as the Gauss (strength of the magnetic field) increases.

Methods/Materials
A solenoid coil was constructed with 10,000 turns of wire wound around a cryogenic container, suspending the superconductor material in liquid nitrogen. The magnetic field of the coil was calculated from the known dimensions, number of turns, and the impressed current. Each run of the experiment was conducted with an increased strength of the magnetic field. The first and last runs were both made at 0 Gauss as a control check. The temperature of the type II ceramic material was lowered by liquid nitrogen until the ceramic superconductor material reached the state of superconductivity. As the temperature of the superconductor increased, the resistance of the superconducting material was measured at fixed intervals of temperature.

Results
In the first run, with a magnetic field of 81 Gauss, the critical temperature lowered. In the next run with 162 Gauss, the critical temperature again lowered. In the next three runs, 324 Gauss, 486 Gauss, and 648 Gauss, the critical temperature reached a plateau where it was nearly the same as the run with 162 Gauss. The control check, at the end with 0 Gauss, yielded results that were consistent with the first run at 0 Gauss.

Conclusions/Discussion
My conclusion is that a magnetic field does significantly affect the critical temperature of a superconductor. The magnetic field (within the range of the equipment) does not have a significant effect after a specific level of strength. This data indicates that within the confines of this experiment, the magnetic field distorts the lattice of the superconductor or disrupts the Cooper pairs of electrons in the ceramic superconductor, up to a certain quantum level.

Summary Statement
In my experiment I varied the strength of a magnetic field and recorded how it affected the critical temperature of a type II ceramic superconductor.

Help Received
Father mentored and helped in preforming the more dangerous parts of experiment, sister and mother proofread report, Seamar Electronics loaned equipment.