High temperature superconductors' electrical and magnetic properties are investigated using a variety of data collecting techniques.

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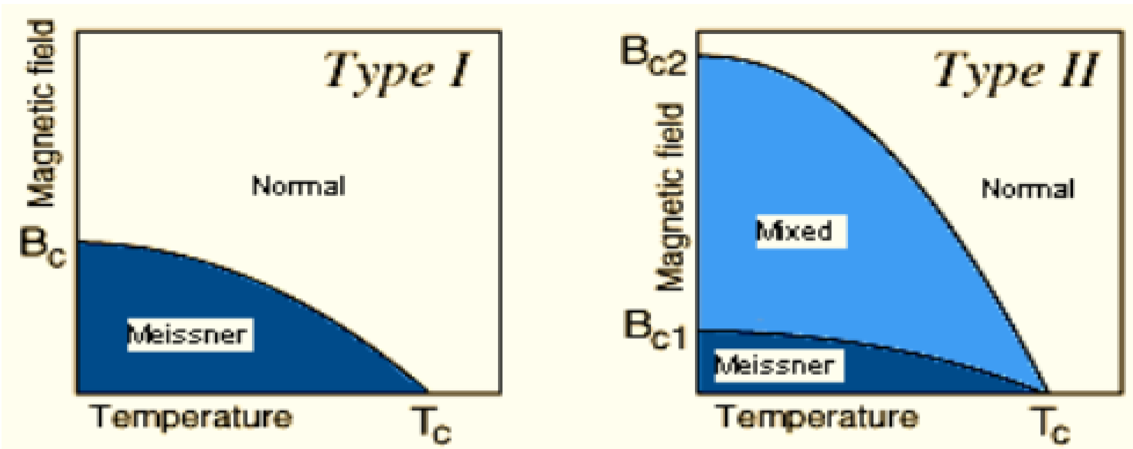
Abstract:

Mercury's superconductivity was discovered in 1911 by physicist Heike Kamerlingh Onnes. 1 The absence of electrical resistance below a certain threshold temperature characterises superconductivity. A current of electricitya superconducting wire loop may last endlessly without any external power.source.Magnetic characteristics of superconductors are very intriguing. The Meissner Methodin 1933 Meissner and Ochsenfeld2 discovered the ejection effect.when the superconductor is cooled below the superconductor's magnetic fieldTemperature at which a person's body can no longer There is no electricity beyond this point.The superconductor's surface generates resistance and electrical currents.As a means of shielding the superconducting material a metal object with an attractive forcea superconductor's surface electrical currents allow it to hover above it.oppose the magnet's magnetic field by generating a magnetic field of my ownFigure 1 depicts the two main kinds of superconductors currently in use

1. Introduction

today. Idiopathic Spontaneous Hyperthermnormal and Meissner phases are seen in superconductors.The superconductor's magnetic field is totally discharged. The second kindThe normal and Meissner phases are also present in superconductors. Nonetheless,magnetic fields and temperatures are in a condition of muddled equilibrium.Vortices (normal cores) are formed by the magnetic field as it penetrates the material.A superconducting current field is around it.



Type I and Type II superconductor phase diagrams are shown in Figure 1. (right). Temperatures above TC and magnetic fields above BC are considered typical for Type I, whereas temperatures below TC and magnetic fields are considered abnormal.Meissner phase material is normal in magnetic fields below BC. Types ofII, the material is in the solid state when heated over TC and subjected to magnetic forces greater thanstate of normality Temperatures below the TC and magnetic fields between BC1 and BC2 are not compatibleAt

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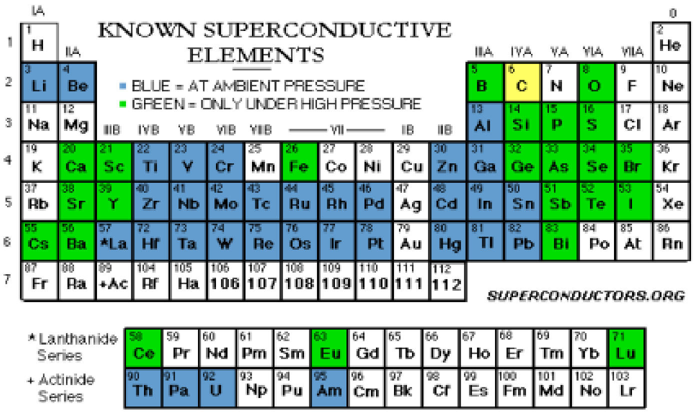
temperatures lower than TC, the material is in the Mixed state, andlower than BC1 magnetic fields are in the Meissner phase of the substance



Although it was initially thought that the phenomenon of superconductivity is rare, scientists later learned that it is rather common. As shown in Figure 2, about two thirds of the known elements display superconducting properties.3

Figure 2. Periodic table of the elements. The elements with blue background are superconducting at ambient pressure, the ones with green background are superconducting under high pressure, while carbon is superconducting only in the form of carbon nanotubes

Bednorz and Muller developed high temperature superconductors in 1986.

4 Even at 77K, their critical temperatures are greater than liquid water'snitrogen. High Temperature Superconductors (HTS) are among the most investigated materials.There are two types of YBCO: YBCO-YBCO and Bi2Sr2Ca2Ca2Cu3O9-YBCO.As BSCCOThere are several applications for superconductors in our daily lives. You never know.Large Hadron Collider at the University of ChicagoEnergy transfer through transformers, magnetically levitated trains, and CERNand motors5,6

Methods of Experimentation

In this experiment, the superconductors utilised were created byIncorporated by Colorado Superconducting Samples of our superconductor have four points.Figure 3 shows a probe with a thermocouple connected to it.

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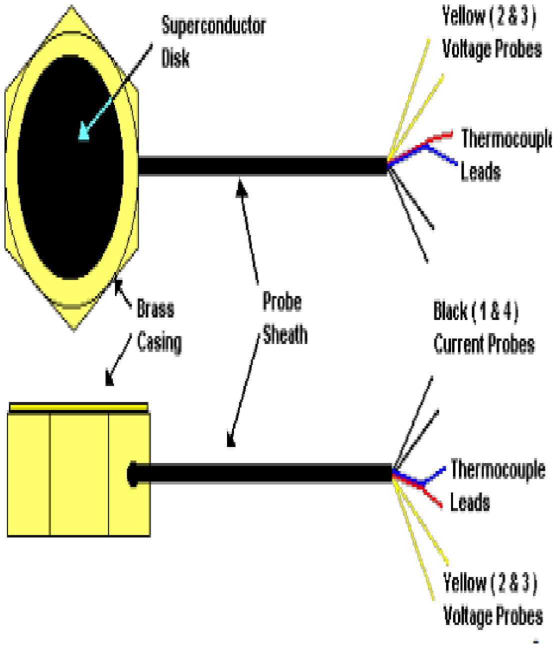
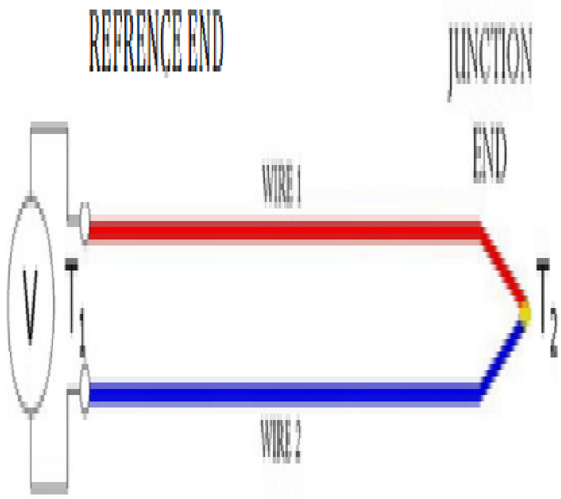


Figure 3. Schematic of the superconductor and the attached wires

Using this four-point probe, we can simultaneously detect voltage across the sample and the temperature of our sample using a thermocouple. " In order for a thermocouple to function, it must have two

A junction is a place where two or more wires of different metals are brought together.7 TheThe reference end is the opposite end. See Figure 4 for an example of this. This is where the juncture will be.internal brass contact with the superconductor Ends may be referencedIf the temperature is known properly, it may be kept at room temperature.put in an ice bath at 0 degreesA temperature discrepancy occurs when two objects are at opposite ends of thebetween the thermocouple junction and the reference end, a voltage is generated OurThe thermocouple in the probe is made composed of copper and silver.constantan. The temperature of the sample changes as it transitions from ambient to liquid nitrogen.The voltage across the thermocouple fluctuates by less than 7 volts at room temperature (77 K).mV. We require a high-resolution voltmeter because of the slight voltage variation.greater than the normal digital multimeter's reading range (DMMs). We, the undersigned,The HP 3478A voltmeter was used.. Tables and values that have been publishedThe four-point probe's manufacturer provides the tools needed to transform the data.Temperature is converted from voltage.

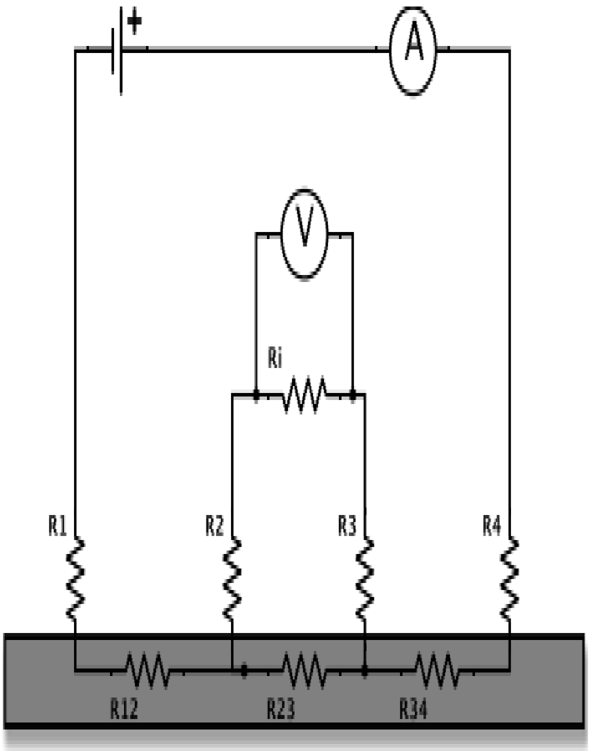


After the superconductor has been cooled below its transition temperature, the first technique of establishing the critical temperature is to observe the levitating effect, and to record the temperature at which the magnet ceases

warming up and changing from superconducting to levitates as it heats up.normal.

Method B for determining electrical characteristics.

For this procedure, the sample is initially placed in liquid nitrogen and chilled to its critical temperature.temperature). After then, the sample is allowed to return to the room temperature.When a current is provided, we measure the voltage across the sample to keep track of its temperature.via a sample The sample would perform better if we merely connected two wires to it.Sample and contact voltages would be recorded using a voltmeter.The resistance of the connections and the voltage are substantially larger than that of the sample.Due to the nature of the connections, we would not be able to record anything.extract the resistivity of the sample. Using a four-point probe solves this issue completely.Fig. 5 depicts the sample, the wires, and the contact as a schematic diagram.attributable to each of the four conductors



A schematic of the sample breakdown and contact resistance is shown in Figure 5.

R1, R2, R3, and R4 are the sample contact resistances after four contacts have been made to it. distinct parts of the sample, in between the points,Contacts have been achieved, with R12, R23, and R34 resistances. Power lines are in place.linked to an input resistance Ri of a voltmeter.A current is established in the system when a power source is connected.circuit. The route consisting of R1, R12, R23, R34, and R35 carries the bulk of the current.

Resistor 4 is required due to the voltmeter's very high internal resistance Ri (on the order of M).The channel via R2, Ri, and R3 has hardly little current flowing through it at all. As a result, a higher voltage is required.Because of the voltage across R23, which is a component of our measurement system, the voltmeter will report thissample. Using the relationship shown in this article, one may determine the resistance.

A BK ToolKit 2704B ammeter and a Hewlett Packard HP 3478A voltmeter are used to record the voltage between points 2 and 3 of the sample in this approach. TheResearchers record their findings in a lab notebook before putting them to use.use of resistance analysis software to produce a plot oftemperature. It's difficult to keep track of all the data with this method.two voltmeters (one to measure the voltage across the sample, the other to measure the current)simultaneously, making it impossible to get an accurate temperature readingresults.Approach B2.The four-point probe is used in combination with this technique by the researchers.LabVIEW is used (Laboratory Virtual Instrument Engineering Workbench),Designed by National Instruments. An application called LabVIEW is a graphical one.symbols rather than lines of text are used to construct programmesapplications. Virtual Instruments, or VIs, are the slang term for LabVIEW applications.It is possible to use several VIs that have previously been produced by National Instruments developersbe put to use in the trials according to their specific needs. As a result of our trial,The NI 9219 DAQ has taken the place of the previous DAQ's ammeter and voltmeter (data acquisition)and the thermocouple input on the board are linked via wires.The DAQ board's pins. The computer receives the data from the DAQ andThe resistance is then calculated and plotted using data analysis tools.in relation to the weather.

Data may be gathered automatically using this way.properly and quicklyIn LabVIEW, a programme may have more than one window. So, for example,The area in front of the window is referred to as the "front panel." The front panel is both what the user sees and what they touch.data is shown in real time as it is being collected. The block is the name given to the second window.diagram. VIs are used by the programmer to run the programme at this point. WeOur HTS samples were measured using a custom software that we wrote ourselves. Graph 6schematic, whereas Figure 7 depicts the LabVIEW front panel.Our own software. Using our application, we were able to concurrently measure a YBCO and a YBCO.The BSCCO test.

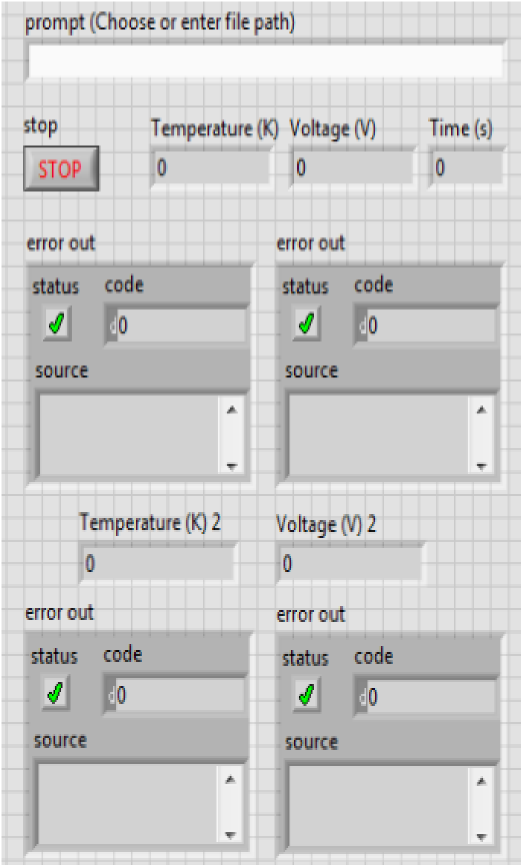


Figure 7. The front panel of the program we built to collect the voltage vs. time data for the two superconductors.

In both B1 and B2, the temperature at which a transition occurs is greater than the recognised value. As indicated in Figure 4, T2 is the temperature of the sample, while T1 is the reference temperature.temperature. For the most part, data from thermocouples assumes that T1 is at room temperature.The data may be offset if the latter is incorrect. In Method B1,T1 was put in an ice bath and the thermocouple was used to measure the temperature.Tables with a zero degree angleA C reference. NI 9219 DAQ board in Method B2 has a chillycompensating for junctions (CJC) that was designed to improve temperature accuracymeasurements. Because Method B1 produced more precise results,We conclude that the CJC did not function as predicted in the cold bath.Even with the cold bath, our findings for the transition temperature are still unsatisfactory.not in accordance with recognised norms It's possible that this disparity is due tothermocouple detects temperature in the absence of external artefacts.The superconductor's surface. Our measurements were taken while the oven was warming up.Take a look around. The surface of the superconductor heats up more quickly than the core.because of this, it is probable that we are seeing greater temperatures than usual, andFor this reason, the transition temperature is a consideration.

Conclusion

Magnetic and electrical measurements were used to evaluate the high-temperature stability (HTS) of YBCO and BSCCO. We were able to automate the recording of our measurement procedure by building a LabVIEW application. WeMeissner effect was also noticed when the conductor was conducting electricitysuperconducting condition. transition from one phase to another was also seen and defined by us.The transition from superconductivity to normality. For the transition temperature, our findings are as follows:close to the generally recognised norms. Accurate upgrades are in the works for the future.An ice bath may be used in combination with a DAQ to detect temperatureboard.

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