Assignment: 2

Thermistor & Diodes

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Course:

PHY324

# Abstract

Thermistors are temperature sensitive resistors that exhibit negative temperature coefficient of resistance, which means that the thermistor experiences decreasing resistance as the temperature goes up. The relationship between Temperature and Resistance of Thermistor can be fitted using the Steinhart-Hart Equation. The fitting data would return the values of the Steinhart-hart coefficients.

Diodes are basic unidirectional semiconductor devices that will allow current to flow through them in one direction only (forward biased condition). Diodes are made of semiconductor materials such as Silicone, have only a few free electrons because their atoms are closely grouped together in a crystal lattice. But by adding controlled amount of impurities such as Phosphorus(P) and Antimony(Sb) to silicone creates an excess of current carrying electrons (N-Type) and controlled amount of impurities such as Boron(B) results in an excess of holes (P-Type). This process is called doping. The silicon diode with P and N poles is a two-terminal device that minimizes current flow in one direction (reverse bias) while easily carrying current in the other direction (forward bias).

# Introduction

The purpose of this lab was to observe the behavior of Thermistors and Diodes. For the behavior of thermistors different temperatures would have been applied to it to observe that as temperature increase resistance of the thermistor decreases. The Diodes react differently based on the direction of the current and for a diode the relation between voltage becomes exponential after a certain point, which means that a small change in current will result in a greater change in current.

# Methods and Materials

**The Following materials were used for this experiment:**

|  |  |
| --- | --- |
| **Thermistor** | **Diodes** |
| * Thermistor * Thermos * Thermometer * Multimeter (resistance) * Ice and boiling water | * Silicone Diode * 2 Multimeter (Ammeter and Voltmeter) * Power source * banana plugs |

**Following Equation was used to Fit the collected data:**

|  |  |  |
| --- | --- | --- |
| **1** | **Thermistor** |  |
| **2** | **Diodes** |  |

# Procedure

This experiment was conducted in two parts, first part was to measure the resistance of the thermistor as the temperature around it changed. The multimeter was connected to the thermistor, which was inside a thermos, with a thermometer attached to it. Boiling water was placed inside the thermos and the temperature and resistance was recorded. Ice was slowly added to cool down the water, each time ice was added the temperature and resistance was recorded. The following data was collected and used to fit the Steinhart-Hart Equation.

The second half of the experiment involved two multimeters (one to measure voltage and one to measure the current), a power supply and a silicon diode. The power supply, diode, and ammeter were connected in series while the voltmeter was connected in parallel across the diode. The power supply had a knob that could increase power gradually. The data was collected for different voltage and the corresponding change in current. The collected data was plotted using Shockley Equation. The data was also collected for the reversed circuit as well.

# Data and Results

The Collected data was too big to fit into this repost, please refer to ‘thermistor data.txt’ for the data collected during the first half of the experiment and ‘Diode Data.txt’ for the data collected during the second half of experiment. The reverse current data was also measured; attached data file ‘Diode Data2.txt’

A python code was written to calculate the Steinhart-Hart coefficients, with uncertainty. *(Check attached python program: thermistor.py)*

Steinhart-Hart coefficients were calculated to be;

The accuracy of the fit is,

Using equation (1) Following graph was plotted:

A close up of a device

Description automatically generated

A python code was written to fit the Shockley equation and obtain to Value of saturation Current and Boltzmann Constant. *(Check attached python program: diode.py)*

The saturation current was,

The Boltzmann constant was,

The accuracy of the fit is,

Using equation (2) Following graph was plotted:

A screenshot of a cell phone

Description automatically generated

# Discussion & Conclusion

This experiment examined the behavior of thermistor and diodes. Based on the calculation and plotted data it can be concluded that thermistors and diodes do follow the predicted behavior. From the reverse current through the diodes it confirms the idea that diodes on allow the flow of the current in one direction.