Memorial University of Newfoundland
Department of Physics and Physical Oceanography
Physics 2053 Laboratory

The Thermistor

Introduction

A thermistor is a thermally-sensitive resistor made from semiconducting material. Unlike many solids, its electrical resistance *falls* as temperature *rises* and this relationship can be expressed mathematically as

$$R = Ae^{B/T} \tag{1}$$

where A and B are constants. The thermistor is particularly useful for measuring low temperatures because the variation of resistance with temperature is greatest in this region, allowing for more accurate temperature determination. This experiment will allow you to examine the relationship between temperature and resistance and determine values for the constants A and B in Eq (1).

Method

Fill a 1-litre beaker with a mixture of crushed ice and water. Use a piece of wire to fasten the thermistor to the thermometer so that the thermistor remains in close contact with the thermometer bulb. Place the beaker on a hot plate and record water temperature and thermistor resistance as the water is brought to boiling. To minimize the effect of temperature gradients you should stir the water continuously throughout the heating process.

Analysis

1. You can fit the data to a straight line by rewriting Eq(1) as

$$\ln(R) = \ln(A) + B\left(\frac{1}{T}\right) \tag{2}$$

   Plot the natural logarithm of R versus the reciprocal of the absolute temperature (in **Kelvin**). Use your graph to obtain values for A and B (with uncertainties). What are their units? What is the physical significance of A?

2. The constant B is related to the *energy gap*, E_g, by

$$B = \frac{E_g}{2k}$$

where $k = 8.617 \times 10^{-5}$ eV/K is the Boltzmann constant. Typical values of E_g at room temperature are 0.67 eV for Ge and 3.6 eV for ZnS. Calculate the energy gap for your thermistor.

3. From your results, write down the equation which relates resistance to temperature and discuss the suitability of the thermistor as a practical temperature measuring device. Expain briefly why a resistance thermometer may be used in place of a mercury thermometer in certain applications.