ENGR 240 – Science of Materials Laboratory

LAB D
IONIC CONDUCTION

As opposed to metals, in which conduction occurs by the movement of free electrons, many ionic solids conduct electrical current primarily via the diffusion of positive and negative ions. (This is a considerably more difficult transport mechanism, and ionic solids generally have much lower conductivities than metals.) In this experiment, you will measure the conductance (reciprocal of resistance) of an ionic solid as a function of temperature, and will check to see if your data are consistent with a diffusion mechanism for conduction.

Procedures

Before beginning the experiment, use the ohmmeter to measure resistance of standard resistors so that you become familiar with the operation of the meter.

Using an ohmmeter capable of measuring very high resistances, measure the resistance and temperature of a sample of NaCl salt as you heat it in a small pot furnace. (It is our experience that the meter is capable of obtaining consistent reading only at salt temperatures above approximately 150 °C.) You should collect data to at least 500 °C.

Report

Diffusion in solids is a *thermally activated process*. *If* conduction in your sample is caused primarily by diffusion, conductance as a function of temperature will also be thermally activated, and will follow an Arrhenius expression. Plot your data to see if this is the case. If your data indicate that conductance in your sample is in fact a thermally activated process, calculate the activation energy for conduction in the solid.

If you have already carried out the electronic conduction laboratory, compare in your report the temperature effect on conduction for each case (electronic vs. ionic).

Reference

Callister, Sections 19.4, 19.15, 5.5