ENGR 240 – Science of Materials Laboratory

LAB C
ELECTRONIC CONDUCTION

In this experiment you will determine how electronic conduction in metals is affected by composition and temperature. The general procedure will make use of a DC current source and a voltmeter to determine the resistance of cylindrical samples. This resistance is dependent on the dimensions of the apparatus and the sample. You need to convert resistance into *resistivity*, which is an intrinsic property of the material.

Procedures

1. Two-phase alloy system (lead/tin):

   At room temperature, mixtures of lead and tin exist as two phases, one of virtually pure lead, the other of virtually pure tin. Determine the resistivities of the 5 lead-tin alloy rods:

Rod	Composition, wt.% Sn
A	100
B	70
C	47
D	13
E	0

2. Single phase alloy system (copper/zinc):

   At room temperature, a copper/zinc alloy containing 35 wt.% zinc can be considered a single phase (copper with dissolved zinc atoms). Determine the resistivities of:

   - Pure copper sample
   - Pure zinc sample
   - Copper/zinc alloy (35 wt.% zinc)

3. Determine the resistivity of two of the pure metals (lead, zinc, or tin) as a function of temperature up to 150 °C.

Report

The following items should be addressed in your report:

- How do your measured resistivities for pure lead, tin, copper and zinc compare with values found in the literature? NOTE: Some of the resistivity values in the appendix of your textbook are wrong, so do not use values from Callister.
- For each system (1 and 2 above), how do the alloy resistivities compare to their corresponding pure component resistivities? Explain differences between the two systems.
- Discuss the effect of temperature on the resistivity of the pure metal.
- If you have already carried out the Ionic Conduction Laboratory, compare in your report the temperature effect on conduction for each case (ionic vs. electronic).

References

1. Callister, Sections 19.2, 19.3, 19.4, 19.7, 19.8
2. *Lange's Handbook of Chemistry* or *Metals Handbook* (for pure element resistivities)