RECOMMENDATIONS FOR THE REPORT FOR THE EQUILIBRIUM PHASE DIAGRAMS EXPERIMENT

This experiment gave you the opportunity to learn first-hand how equilibrium phase diagrams a basic tool in materials science, are constructed, and to use it to demonstrate of one of their many applications. This experiment involved weighing out and preparing samples, using thermocouples to measure temperature, data acquisition using computers, and extracting essential information from the cooling curves. The recommendations given in this document should help you analyze the data from this experiment and to write a good report.

Cooling Curves

Your cooling curves contain a lot of information, including the phase transformation temperatures, the undercooling due to nucleation of the first particles of the new phase, the type of phase transformation and even the amount of energy released during each phase transformation. Obviously, showing these cooling curves in your report can help you explain your results to the reader. Here are a few suggestions to help you with your plots of the cooling curves:

- If you plan to use the cooling curves printed out by the Scanner software you'll want to put them at the end of the report. If your report does not direct the reader to these graphs then they should go in the appendix.
- The scanner software can save the data as a comma-separated ASCII file (*.csv) or as a standard text (*.txt) file. If you chose the former then simply double-clicking the file's icon should start Excel (or whichever spreadsheet you use) which will import and parse the data. The organization of the data makes plotting the cooling curves easy. These graphs can be easily cut and pasted into your report. Figure 1 is an example of such a plot.
- The primary basis for your analysis of the cooling curves is change in the cooling rate. Since the cooling rate is equal to the slope of the cooling curves, it would be easy to produce a second graph that plots cooling rate versus time, or one could plot the cooling rate on the above graph but plotted using the second (right-hand) y-axis. See figure 1 for an example.
- If you plot your cooling curves or cooling rate curves on separate graphs then be sure to use the same scaling for each. This will be very helpful to your reader who will probably want to lay the graphs side-by-side to compare them.

Tables

In this experiment we are primarily interested in determining the temperature at which each phase transformation takes place. This data is used to generate your own equilibrium phase diagram. This data can also be shown in a table along with the nominal composition, actual composition, temperatures from reference equilibrium phase diagrams and even the differences between measured and reference temperatures. This table will probably look a lot like those in your worksheets, but with a little resourcefulness more can be done with it, saving you and the reader some work in the process. Here are a few suggestions for creating your tables:

- Create the table in a spreadsheet first, then copy-paste it into your report. With the data in a spreadsheet you can easily create the phase diagram and perform other calculations such as the

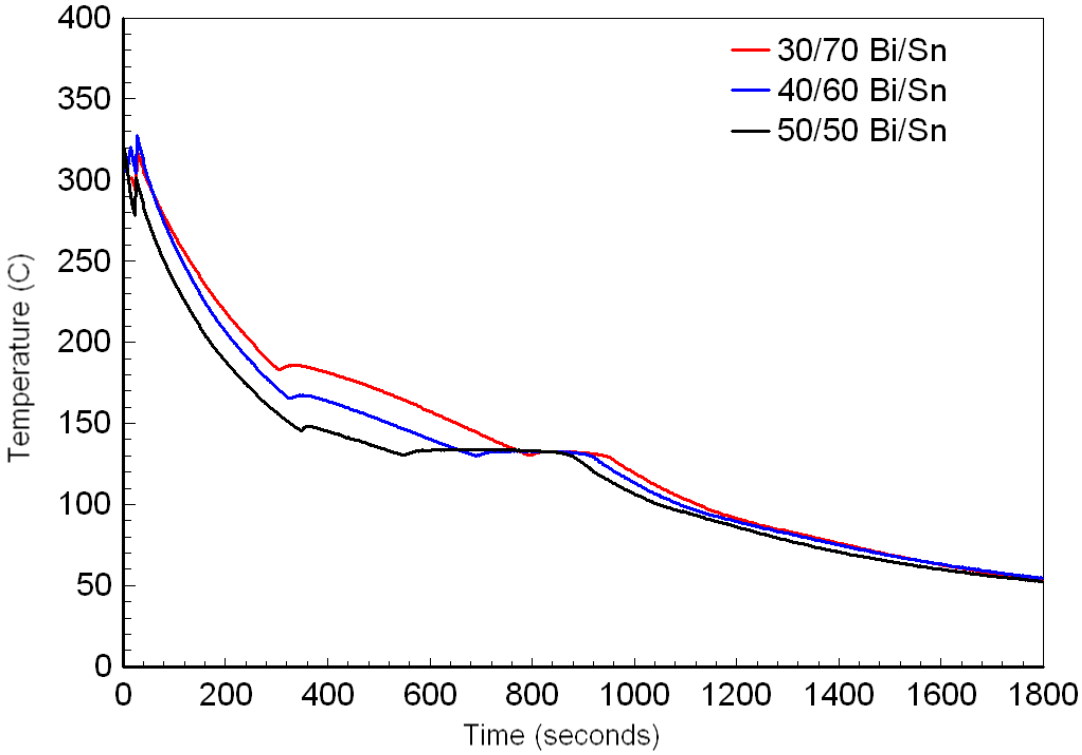

Figure 1 Cooling curves for three compositions in the Bi/Sn system.

differences between the measured and reference values.

- Use standard table captions. These are located above the table and start out with "Table 1..." and then describe the table's contents.
- Use notes at the bottom of the table to explain anything unusual.
- Don't forget to include the units for each table entry.

Constructing the Equilibrium Phase Diagram

The data compiled in your tables can be used to produce an equilibrium phase diagram that shows both the measured and reference temperatures for each composition. The following suggestions should help you generate these diagrams:

- Method 1 – scan or photocopy the phase diagrams in your laboratory manual and draw in the data points for the measured temperatures.
- Method 2 – sketch the phase diagram as accurately as you can and include your measurements.
- Method 3 – Generate a spreadsheet that will draw the reference phase diagram and let you plot your measured temperatures on this graph. See figure 2 for an example. You will have to read the temperatures from your reference phase diagrams and enter them into your spreadsheet, or you can import these numbers from the file Bi-Sn Phase Diagram.csv located on the teaching laboratory's server and on the course's web site.
- Make sure all phase fields in your diagrams are labeled.

Errors and Comparisons to Reference Data

Obviously you will want to compare your measurements to those in your text and laboratory manual. When doing so consider the following:

- The values reported in the references are well established and are generally very accurate. Precise agreement, after considering typical sources of error, is expected.
- What are the error limits of the thermocouples you are using? Do any of your measurements fall outside of this range?
- Assuming the electronic balance is accurate to the least significant digit, how much temperature error should you allow for?
- There are a number of points in the equilibrium phase diagram where minor errors in the Bi/Sn content do not effect the measured transformation temperatures. Where are these points and how does your data compare to these reference temperatures?
- The cooling rates used in this experiment are generally higher than ideal. How would this effect your results?
- Several points on the equilibrium phase diagram could not be obtained in these experiments, for instance, the solid-solid transformations at each end of the concentration axis. Why weren't we able to detect these transformations using our cooling curves?

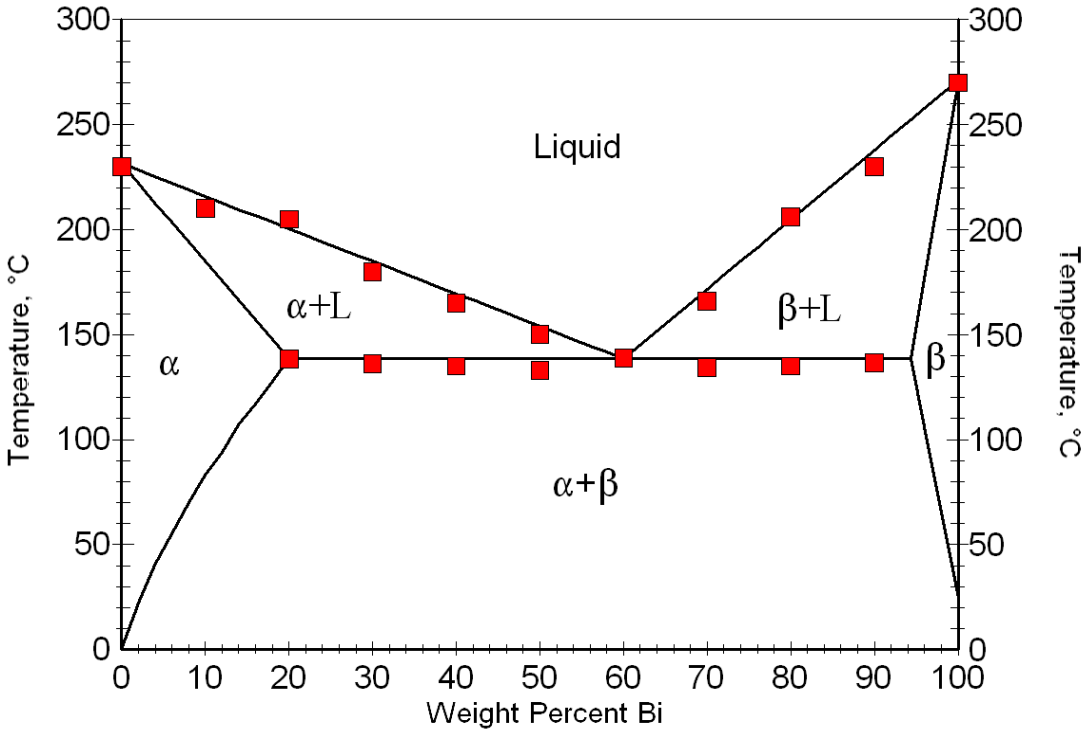

Figure 2 Example of a Bi/Sn equilibrium phase diagram produced in this experiment.