UNIVERSITY OF ILLINOIS
College of Engineering
Department of Materials Science and Engineering

Spring 2015: **MATSE 442: SENIOR METALS LABORATORY**

Instructor: Prof. Averback, 1007 MRL, 333-4302, averback@illinois.edu
Office Hours: by appointment
Teaching Assistants:
Lab Supervisor: Nicole Robards
Office: 204A Kiln House
Phone: 217-244-7498
Email: nrobards@illinois.edu

Office Hours: By appointment

Rotation I

Experiment I: Austenite Transformations

Objective: Construct a TTT curve for a medium alloy steel (4340) using metallography and hardness measurements

Experiment II: Cold rolling, recovery, recrystallization, and grain growth of brass

Objective: Cold roll a Brass sheet, and quantify its recovery, recrystallization and grain growth kinetics during isothermal annealing. Test the Hall-Petch relationship.

Rotation II

Experiment III: Corrosion

Objective: Study uniform and localized corrosion with and without an applied potential.
Part a) immersion corrosion vs electrodynamic polarization (2 periods)
Part b) sensitization test (2 period)

Experiment IV: Severe plastic deformation

Objective: Measure the effect of severe plastic deformation on alloy stability and grain size and to relate the properties of the alloy to its microstructure.

Rotation III

Experiment V: Eutectic alloys

Objective: Quench Cu-Al liquid alloys at different rates to create eutectic microstructures, characterize the structure by SEM and measure the alloy hardness

Experiment VI: Failure analysis:

Objective: Investigate the premature wear or failure of a part in service. Identify the reasons for this failure and propose corrective actions (visiting lecture: Caterpillar).

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Reports and Grading

Each student will turn in his/her own lab report. Discussions with class members is fine, but once writing begins, it should be an individual effort. Each student should keep a lab notebook. The instructor will inspect the notebook, from time to time, and possibly grade it (not really). Each student will also be assigned an oral presentation (20 minutes). The presentation will be graded, but the grade will be used only to justify raising borderline grades (if warranted). Each lab report has equal weight – but an exceptionally good, insightful report (for example the failure analysis) can earn bonus points.

Late reports will be accepted only with the instructor's prior consent.

Executive Summaries

1. The length should be a maximum of three pages (including figures); *supplementary* figures, tables and such can and should be attached as an appendix.
2. The text should be written in sections, each with a label.
3. The style should be informative but not tutorial; you should assume the reader knows the subject at least as well as you (that's why the reader is an executive), but does not know the details of what you have done or the results.
   Thus, you must include the uncertainties in the measurements;
   you must include a conclusion;
   you should include an outline of the experiment or test and your method of analysis.
4. The style of writing should be formal. This means:
   • entire report written in 3rd person
   • experimental section written in the past tense
   • proper English
5. Micrographs: All micrographs are to have a scale marker, indicating the magnification. Arrows and labels are used to point out specific features you wish to discuss.
6. Captions: All figures, tables, and graphs should be labeled and have an appropriate caption. i.e. "Figure 1. 1040 steel showing sensitization of the grain boundary structure". You can then refer to the figures in the text. i.e., "Carbides form on the boundaries due to heating at 500 ˚C, as shown in Figure 1." – See example. Captions can be of any length.

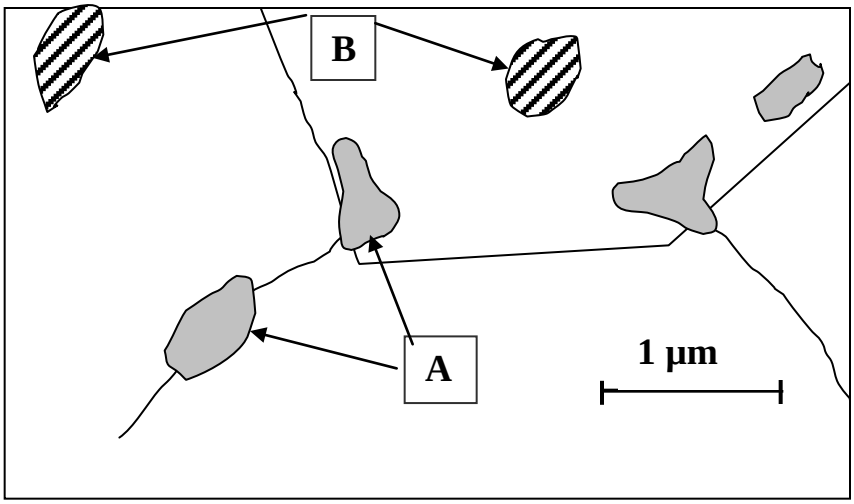

Figure 1. 1040 steel showing sensitization of the grain boundary structure. MnC carbides formed on grain boundaries (A) and undissolved MnC still within the grains (B).

MATSE 442: COURSE OBJECTIVES AND IMPORTANT INFORMATION ABOUT LAB REPORTS.

The purpose of this course is three-fold:

1. To learn specific metal behaviors and principles of physical metallurgy through laboratory investigation but, equally important, to learn proper experimentation and proper use of instruments.

2. To develop the written, graphical and oral communication skills that are essential to a clear presentation of your findings and a persuasive presentation of your thoughts.

3. To practice organization of large bodies of material into logical, concise and accurate reports.

Lab reports

A substantial fraction of the grade in MATSE 442 will be determined by your reporting skills. It has been shown that learning through writing and speaking can be substantial and long-lasting. Moreover, it provides a simple means for evaluating your performance. A writer or speaker is not born "good", and one of the objectives of this course is to improve your writing and speaking skills. *The final words are only part of the reporting experience. Not only grammatical skill, but also organization, background research, judgement of relevance, a clear idea of the message to be transmitted, logical sequencing and motivation of the reader or listener are all important parts of a successful report.* Of course, thoughtful, accurate and complete observations and data-taking must be the basis of any good lab report.

Read carefully the following points:

1. Work safely ! Always wear your safety glasses in the lab. Use appropriate additional personal protective equipment when necessary (thick vinyl gloves for handling acids and etchants). Do not work alone in a room.

2. Clean up once you are done ! This avoids potential hazards and is a most elementary rule of politeness.

3. Read the lab handout thoroughly (if one is provided) and come to lab prepared. If you must acquire data, know what you are measuring. If you must make observations, know what to look for.

4. Understand the objective of the experiment, and ask questions if the experiment handout sheet is not sufficiently explicit.

5. Read the cited references **before** beginning to write or organize a talk. Better yet, read them before doing the experiment.

6. Pay attention while in the lab. Write down observations beyond those required in the lab handout; they might be helpful in understanding your results.

7. Keep a lab notebook: do not take data on scraps of paper or the experiment handout sheet unless this is intended. Be organized and legible. Date all notes and data.

8. Analyze your data during and soon after the experiment. Do not wait until the night before the report is due to find out that you that your data are incomplete, or worse, worthless.

9. Try to **interpret your observations or your data as you are taking it**, but be careful to avoid bias. Record what an instrument reads and not what you think it should read. It is unethical to do otherwise. If corrections are necessary, make them subsequently and justify them.

10. Ask questions if:

- *above all else*: you think that something is unsafe
- you are uncertain about the purpose of the experiment
- you are not sure what you should do
- you do not know how to use the equipment
- you think something has gone wrong

11. Use your instructor, other faculty, and your lab TA as resources during the experiment and for your report.
12. Carefully **proof-read reports** before submission. Careless work will not be tolerated. If you are going to make a mistake, it must be legitimate.
13. Use a word processor and use the word and grammar checker.
14. For some experiments data from the entire class will be pooled. Do not be late in supplying your data, observations or specimens.