MATSCEN 5431 (Approved): Advanced Metals Laboratory

Course Description
Advanced laboratory covering various topics in metallic materials.

Prior Course Number: MSE669
Transcript Abbreviation: Adv Metals Lab
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Junior, Senior, Masters, Doctoral, Professional
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 1.0
Repeatable: No
Time Distribution: 3.0 hr Lab
Expected out-of-class hours per week: 0.0
Graded Component: Laboratory
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: MSE2241, MSE2331, MSE3141, and MSE5441 or permission of instructor.
Exclusions: Not open to graduate students in MSE or WE
Cross-Listings:

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.3101
Subsidy Level: Baccalaureate Course

Programs

Abbreviation	Description
MATSCEN	Materials Science and Engineering

Course Goals

To reinforce principals and topics covered in the advanced metals lecture sequence.
To introduce students to experimental and investigational methods used in the metals field.
To develop skills in data gathering, analysis, and report preparation.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
In this laboratory students will complete four out of the six typical experiments listed below under "Representative Assignments". Each experiment will be completed in two weeks. Additional experiments will be added when appropriate.	3.0		3.0					

Representative Assignments

The hardenability of plain carbon and alloy steels, and a commercial Ti-6-4 alloy. This is measured using the Jominy end quench method, and accompanied by longitudinal hardness measurements and metallographic analysis to correlate mechanical properties (hardness) to microstructure.

Order-disorder in Cu3Au. Order disorder changes are measured using changes in resistivity as a function of specimen temperature during both heating and cooling cycles. Finally, the lattice parameters of the alloy in the ordered and disordered states will be measured using the Debye-Scherrer technique and compared.

The determination of the orientation of a single crystal, using the back reflection Laue technique. The Laue pattern will be solved for the orientation using a stereographic projection and Greninger chart.

Deformation of metal single crystals. The orientation of a single crystal is first determined using the rotating crystal x-ray method. The crystal is then deformed in tension, and a stress-strain curve plotted. The form of this curve is then correlated with the change in orientation of the crystal under deformation, and the various mechanisms involved.

Recrystallization in aluminum and brass will be studied, in the case of Al by qualitative observation of the resulting grain structure, and in the case of brass by quantitative hardness measurements. The alloys will be deformed by amounts ranging from 0 to 20%, and then recrystallized at two different temperatures. The resulting grain structures will provide insight into the relative contributions of nucleation and growth to the recrystallization process. The hardness measurements on the brass samples will be used to plotted Avrami curves of hardness v. log time for three different temperatures, from which an apparent activation energy for recrystallization will be obtained.

Superplasticity of Pb-Sn alloys: tensile testing of metal samples using a computer-controlled load frame; extensive data analysis to extract strain rate sensitivity exponent from true stress and true strain; obtaining superplastic behavior by limiting tensile instability.

Grades

Aspect	Percent
Each of the four laboratory reports will contribute 25% of the student's grade.	100%

Representative Textbooks and Other Course Materials

Title	Author
None required - laboratory notes will be distributed as needed.	

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
***	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
*	c	An ability to design a system, component, or process to meet desired needs.
***	d	An ability to function on multi-disciplinary teams.
**	e	An ability to identify, formulate, and solve engineering problems.
*	f	An understanding of professional and ethical responsibility.

Course Contribution		College Outcome
**	g	An ability to communicate effectively.
*	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
	i	A recognition of the need for, and an ability to engage in life-long learning.
	j	A knowledge of contemporary issues.
***	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Prepared by: William Clark