

Materials Science 115a

Principles of Materials Science

<http://addis.caltech.edu/teaching/MS115a/MS115a.html>

Fall Quarter 2012

Instructor: Prof. Sossina M. Haile
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Class Meetings: MWF 11am-12pm, 080 Moore

Teaching Assistant: Alex Zevalkink, 317 Steele, x4804, azw@caltech.edu

TA Office Hours: TBA (likely Tuesdays)

Recommended Text: "Understanding Solids: The Science of Materials" Tilley

Recommended Text: "Introduction to Materials Science for Engineers" Shackelford

Reserved Texts: "The Principles of Engineering Materials," Barrett, Nix & Tetelman; "Phase Transformations in Metals and Alloys," Porter & Easterling; "Quantum Chemistry," Levine

Course Content:

Introduction to Materials Science

Length scales of materials structure

Chemistry + Processing → Structure → Properties

Structure

Review: Structure of the Atom & Chemical Bonding

Crystalline Structure

Structural Characterization (X-ray diffraction)

Amorphous Structure

Microstructure

Defects in Crystalline Materials and Connections to Properties

Point Defects and Diffusion & Ionic Conductivity

Dislocations and Mechanical Deformation

Surfaces

Volume Defects and Fracture

Electrons in Solids

Chemical Bonding, Revisited

Band Structure

Electronic Conductivity: Metals vs. Insulators

Thermodynamics

1st and 2nd Laws

Gibb's Free Energy

Phase Diagrams

Some Other Properties Along the Way

Thermal: Thermal Expansion, Heat Capacity, Thermal Conductivity

Optical: Refraction, Reflection; Absorption, Transmission, Scattering, Color

Course Structure:

Homework:	50%	(weekly)
Midterm Homework:	15%	(Oct 31 - Nov 6)
Final:	35%	(Dec 12 - 14)

Grading

Students may take this course either Pass/Fail or for a letter grade

Homework **50%**

Problems are assigned on Wednesdays and are due at 5pm on the following Wednesday. Solutions will be handed out on Friday, or possibly Monday. Assignments turned in late, but before solutions are available, will receive 2/3 credit. Assignments will not be accepted after solutions are handed out.

Students are encouraged to discuss and work on problems together. In the course of this discussion it is acceptable to make notes, however, do not bring and/or exchange written solutions or attempted solutions you generated prior to the discussion. So, if you've worked the problem out and you plan to help a friend, you should know the solution cold.

Do not consult old problem sets, exams or their solutions.

Midterm Homework **15%**

In lieu of a midterm exam there will be homework to be performed on an individual basis. This homework must be completed without collaborative discussion. The problem set will focus primarily on recent lectures, but material from early topics may also be included. Similar to other homeworks, you will have one week to complete the assignment. You are permitted to utilize all available resources, with the exception of previous solutions, including ones from earlier in the year.

Final **35%**

The final will be an open-book, take-home exam, 3 hours in length. You are permitted one 20 minute break sometime after the first hour. Further details will be given at the time of the exam.

The format for the Midterm homework and Final exam as given here are subject to change, with final instructions to be provided at the time of the respective assignment or exam.

Schedule Modifications

Regrettably, there will be dates on which Prof. Haile will not be able to be on campus to deliver regularly scheduled lectures. To make up for missed lectures we will either (1) extend two lectures by half-hour, or (2) have one of the TAs, Alex Zevalking, deliver the lecture. We are hopeful that this approach will provide the best compromise between encroaching on lunch and experienced teaching. The following is the tentative schedule for these adjustments:

Date	Change	Date	Change
10/08/12	<i>extend to 12:30 pm</i>	10/15/12	TA delivered lecture
10/10/12	<i>extend to 12:30 pm</i>	10/27/12	TA delivered lecture
10/12/12	<i>no lecture</i>		

Honor Code

Like all courses at Caltech, course conduct is governed by the honor code. Accordingly, kindly remember your commitment to the principle that "*No member of the Caltech community shall take unfair advantage of any other member of the Caltech community.*"