

Materials Science 115a

Principles of Materials Science

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

Fall Quarter 2011

Instructor: Prof. Sossina M. Haile
307 Steele Laboratories, x2958, smhaile@caltech.edu

Class Meetings: M 9-10am; W 11am-12pm; F 9-10am, 214 Steele

Teaching Assistants: Balaji Gopal (BG) Chiranjeevi, 302 Steele, x2777, bgc@caltech.edu
Áron Varga, 326 Steele, x4814, avarga@caltech.edu

TA Office Hours: TBA (likely Tuesdays)

Required 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 26 - Nov 1)
Final: 35% (Dec 7 - 9)

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

Due to an unanticipated scheduling conflict, Wednesday lectures will be held 11am-12noon. To accommodate the students who are unable to attend at this time, the plan is to videotape those lectures and make them available online. In addition, periodic schedule changes due to travel will also be required. The following is the tentative schedule for these adjustments:

Date	Change	Date	Change
09/26/11	<i>begin at 8:30am</i>	10/17/11	TA delivered lecture
09/28/11	<i>begin at 8:30am</i>	10/19/11	9am Wed (TA delivered)
09/30/10	<i>no lecture</i>	10/21/11	TA delivered lecture
10/05/11	9am lecture (Wed)	11/30/11	9am Wed (TA delivered)

An up-to-date calendar of adjustments is maintained at

https://www.google.com/calendar/embed?src=smhaile%40caltech.edu&ctz=America/Los_Angeles

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.*"