Crystal Structure and Bonding

MSE 210, Winter 2017
Instructor: **Alex Greaney**
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Lect.: MSE 0011, MW 17:10–19:00
Disc.: MSE 0011, M 13:10–14:00
Office hours: MSE 339, T 17:00–18:00 or by appt.

Course Content

From the Course Catalog: "*MSE 210,* Crystal Structure and Bonding*, Covers regular and irregular arrays of points and spheres. Includes lattices (direct and reciprocal); crystallographic point and space groups; and atomic structures. Also addresses bonding in molecules and solids; ionic Pauling rules; and covalent and metallic bonding. Surveys the structure of elements, compounds, minerals, and polymers.*"

This class is intended to provide a unified foundation to students beginning graduate studies in materials science coming from disperate backgrounds in physics, chemistry and engineering disciplins. It will cover: the electronic structure of atoms; how electronic structure gives rise to atomic bonding; states of agglomeration; crystallography and crystal symmetry; tensor properties of crystals; and crystal defects and the material properties they give rise to.

Course Units: 4 units, Lecture, 3 hours; discussion, 1 hour.

Prerequisites: Graduate standing in Materials Science and Engineering or consent of instructor.

Office Hours

Office hours will be held in MSE 339 on Tuesdays from 5–6pm, or by appointment if you can not make this time.

Evaluation of Student Performance

Midterm 1: 30%, Midterm 2: 30%, Final (comprehensive): 40%.

Homework wil be assigned weekly but will not be collected or graded. Homework and reading assignments are an import exersize that helps you understand and apply the concepts covered in class. These homework assignments will form the basis of the discussion sections.

Announcements and Documents

iLearn will be used as the primary means of communication for announcements, and for posting lab instructions, lecture handouts, homeworks, and their solutions. **Students are encouraged to download and print lecture notes and to bring them to class.**

Exam Policy

Every possible effort must be made on the student's part to inform the instructor 1 week prior to missing a midterm exam. Given an appropriate reason, accommodations will be made to provide an alternative time. If the instructor is not informed 1 week prior to the exam, the possibility of a makeup exam will be at the instructor's discretion.

Text Books

The required text for this class is:

- M. De Graef an M. E. McHenry, *Structure of Materials*, 2nd Ed., Cambridge University Press, (2012).

Along with supplemental handouts distributed on *iLearn*. Some alternative books that you might find useful are:

- A. Kelly, G. W. Groves and P. Kidd, *Crystallography and Crystal Defects*, Revised Ed., Wiley (2000): Good for alternative and straightforward viewpoints and a refresher on the basics of crystallography.
- Barrett, Nix and Tetelman, *The Principles of Engineering Materials*, Prentice Hall (1973): A fantastic grounding in principles of engineering properties of materials.
- R. Tilley, *Understanding Solids: The Science of Materials*, 2nd Ed., Wiley (2013): a good general introduction of structure property relations in materials
- W. Borchardt-Ott, *Crystallography*, 3rd Ed., Springer (2011). This is available for download fro free through the UCR library or by following this link (using UCR VPN if off campus).
- J. F. Nye, *Physical Properties of Crystals—Their Representation by Tensors and Matrices*, Oxford (1985).
- D. M. Bishop, *Group Theory and Chemistry*, Dover (1992).

Course Schedule

The course is divides into five main parts that build up theory from the electron, to show how electrons and bonding give rise to materials structure, and from how atomic and crystal structure give rise to properties. The course is brocken down into 5 parts:

1. Review of properties of electrons
2. Bonding and crystal structure
3. Crystallography, symmetry, and tensor properties
4. Survey of crystal structures
5. Crystal defects and the properties they impart

UCR Academic Resource Center

The Academic Resource Center (ARC) is the central resource for academic support at UCR. All students are strongly encouraged to visit the ARC, which is staffed by professional and student employees who are well trained to provide academic support and dedicated to fostering academic excellence. Resources provided by the ARC include Tutoring, Supplemental Instruction, Study Skills Workshops, as well as several peer mentoring programs. Staff work with all students, at all skill levels, in all stages of their undergraduate careers. Participating in these services is most useful to students when used pro-actively for academic enrichment. Visit arc.ucr.edu or call 951-827-3721 for more information about hours, location and the schedule of services.

Academic Integrity

As a respected research institution, UCR values academic integrity. UCR students should uphold this value and avoid academic misconduct and its consequences. Academic misconduct is any act that improperly distorts (or could distort) a student's grades or other academic record. Students caught cheating, plagiarizing, or participating in any form of academic dishonesty may receive an F or other penalty on the assignment or test and possibly in the course. The universities definitions of and policies regarding academic misconduct are clearly described here: conduct.ucr.edu/policies/academicintegrity.html.