CHE 512: Chemistry of Materials
Spring 2017
Monday, Wednesday, Friday 11:00 – 11:50 am, Talbert 112

Instructor
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Office hours: Thursday 3–4 or by appt.

Course description and goals
This graduate course is intended to provide students with an introduction to crystalline solids and molecular materials in bulk, thin film, and nanoscale forms, as well as their properties and characterization techniques.

Topics to be covered
1. Solid-state structure and crystal chemistry
    a. Simple crystal structures and unit cells: close packing, ionic solids, coordination polyhedra
    b. More complex but common structures
    c. Lattice energetics
2. Diffraction methods: point groups, space groups, Bravais lattices, indexing
3. Chemical bonding in solids
    a. From molecules to solids
    b. Bonding and band theory of solids: free electrons, lattice periodicity
    c. Metals, insulators, semiconductors
    d. Finite-size effects on properties of semiconductors
4. Solid solutions: Defects and non-stoichiometry
5. Phase diagrams and phase transitions
6. Introduction to soft-materials (polymers, colloids, biological materials)
7. The chemistry of interfaces
8. Instrumental techniques: microscopy, spectroscopy, and thermal analysis
9. Low-dimensional materials and nanostructures*
10. Various special topics*

* *Will be covered to the extent that time permits.*

Student learning outcomes and course requirements*

Students who successfully complete this course will be able to understand and/or predict:	*Learning outcomes in the left-hand column will be assessed on the following assignments:*[#]
Common crystal structures adopted by solid inorganic compounds and lattice energetics	Problem set 1; Exam 1; Final exam
Fundamentals of X-ray crystallography and electron microscopy	Problem sets 1, 2; Exam 1; Final exam
Band-structure approaches to describing bonding and the electronic structure of periodic compounds	Problem set 2; Exam 2; Final exam
Phase diagrams and phase transitions	Problem set 2; Exam 2; Final exam
Defects and non-stoichiometry and their influence on materials properties	Problem sets 2; Exam 2; Final exam
Structure-function properties of soft-materials	Problem set 3; Final exam
Properties and thermodynamics of chemical interfaces	Problem set 3; Final exam
Basics of modern instrumental techniques	Problem set 3; Final exam
Finite size effects on the properties of materials	Problem sets 2, 3; Exam 2; Final exam
The role of peer review in the literature	Literature assignment

* Extent of coverage and assessment will depend on the rate at which prior topics are covered.
[#] Specific assignments on which various objectives are assessed may vary.

Academic content: assignments and due dates

Assignment	*Due date**
Problem set #1	February 24
Exam #1	March 10
Problem set #2	March 31
Exam #2	April 12
Problem set #3	April 28
Literature assignment†	May 12
Final exam	May 15

* Tentative

Grading policy

Problem sets: 15%
Data analysis and interpretation: 15%
Midterm exams: 36%
Literature assignment: 14%
Final Exam: 20%

Final grades will be norm-referenced.

Incomplete policy:
The University at Buffalo's Graduate Incomplete Policy is described at the following site:
http://grad.buffalo.edu/study/progress/policylibrary.html#iuchange

Academic integrity policy:
The University at Buffalo's Graduate Academic Integrity Policy is described at the following site:
http://grad.buffalo.edu/study/progress/policylibrary.html#preamble
If, after consultation with the student, an instructor believes the student has committed an act of academic dishonesty, the instructor has the authority to impose sanctions in keeping with this principle. The MINIMUM sanctions to be imposed in Chemistry 512 are as follows: The student receives zero credit for the assignment/examination on the first infraction. A subsequent infraction of academic dishonesty will result in a grade of "F" being assigned for this course.

Intellectual property:
Course materials that I (Prof. Luis Velarde) have prepared, together with the content of all lectures and materials presented and prepared by me in this course, are my intellectual property. Video, audio, and photographic recording of lectures is prohibited without my explicit permission. Use of handouts (and all other material) for any purpose other than studying for this course without first obtaining my consent is prohibited. The selling or dissemination of any exams, quizzes, study guides, homework assignments, and notes presented in this course or derived from my lectures is also prohibited without my explicit permission.

Accessibility resources
Accommodations will be made to provide persons with disabilities equal opportunity to perform in this course. Students requiring accommodations must register with the University at Buffalo's Office of Accessibility Resources in 60 Capen Hall (http://www.buffalo.edu/accessibility/). The University at Buffalo's policy regarding accessibility and accommodations and request is described at the following site:
http://www.student-affairs.buffalo.edu/ods/request.php

Academic content: primary text
Anthony R. West. *Solid State Chemistry and its Applications*, 2nd ed. John Wiley, **2014**.

Academic content: additional reading
1. Lesley E. Smart, Elaine Moore. *Solid State Chemistry: An Introduction*, 3rd ed., CRC Press/Taylor and Francis, **2005**.
2. Charles Kittel. *Introduction to Solid State Physics*, 8th ed., John Wiley, **2004**.
3. Bradley D. Fahlman. Materials Chemistry, 2nd Ed. Springer, **2011**
4. Anthony R. West. *Basic Solid State Chemistry*, 2nd ed., John Wiley, **1999**
5. A. K. Cheetham, Peter Day. *Solid State Chemistry: Compounds*, Oxford University Press, **1992**.
6. Geoff Ozin and A. Arsenault. *Nanochemistry: A Chemical Approach to Nanomaterials*, Royal Society of Chemistry Publishing, **2005**.
7. L. Solymar. *Lectures on the Electrical Properties of Materials*, **1988**.
8. Simon L. Altmann. *Band Theory of Solids*, **1994**.

Articles from the literature will be assigned periodically.

Additional student resource:
A. Ben Wagner, Chemistry Librarian
118 Lockwood Memorial Library, Phone: 645-1333.
Email: abwagner@buffalo.edu
Info: http://library.buffalo.edu/bwagner

Exam make-up and late policy:
Students who are unavoidably absent from an exam week or lecture should be prepared to document the absence if requested to do so. Make-up exams must be scheduled in advance with Dr. Velarde and may be taken only in cases of exceptional urgency— we cannot make any exceptions out of fairness to the other students in the course. Final exam conflicts should be rectified with the instructor in advance.

Problem assignments policy:
Homework will be due by 5:00 pm. Late problem sets will be penalized 20 percentage points per day (so after five days, it's worth nothing). You can, however, submit your problem sets by email if you like (by scanning them).