Chemistry 455
Chemical Nanotechnology
4 units

Prof. Richard Brutchey
Spring 2024
(Lecture = 11:00-11:50 pm MWF)
GFS 213

The technologies that drive smartphones, electric cars, LED lighting, and solar panels all rely upon our ability to discover, create, and develop new materials, with increasingly smaller dimensions, through chemical processes. CHEM 455 is an upper-division undergraduate course in Chemical Nanotechnology. The intent of this course is to describe how properties change when reducing the size of materials to the nanoscale (10^{-9} m), and explain, using concepts of solid-state chemistry and physics, why these changes occur. Representative properties that may be covered include optoelectronic properties, magnetic properties, dielectric properties, and superconductivity. By the end of this course, students will understand the basic concepts of solid-state chemistry by exploring the structure, bonding, and properties of various materials, to achieve a fundamental understanding of structure-size-property correlations, with an emphasis on crystalline solids.
Prerequisite: CHEM 322A or *CHEM 325A*.

Required Text: Woodward, *Solid State Materials Chemistry*

Supplemental Text: Owens & Poole, *The Physics and Chemistry of Nanosolids*

Office/Contact: RLB (brutchey@usc.edu) Office hours = virtual, by appointment only.

Grading:

Final Exam:	40% (May 1, 11 am-1 pm)
Midterm Exam:	30% (March 1)
Solid-State Structure Report:	10% (due February 23)
Problem Sets:	10% (tentatively due February 9, March 29, April 19)
Pop Quizzes:	10% (given periodically throughout semester)

* Grading for CHEM 455 is curved.
** There will be absolutely no make ups, extra time, or special arrangements given for any exams, problem sets, or projects without a valid medical excuse.*

Outline:

I. Introduction, Feynman Lecture
II. Solid-State Structures (1.3-1.5)
III. Ionic Bonding (5.1)
IV. Defects in Ionic Solids (2-3)
V. Phase Diagrams and Phase Transitions (4, 8.4)
VI. Electronic Band Structure of Solids (6)
VII. Optical Properties of Solids (7)

Academic Conduct:
General principles of academic integrity include and incorporate the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by the instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Please familiarize yourself with *SCampus* in Part B, Section 11, "Behavior Violating University Standards" https://policy.usc.edu/scampus-part-b/.

Support Systems:
Counseling and Mental Health
https://sites.usc.edu/counselingandmentalhealth/
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline
https://988lifeline.org/
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention and Services
https://sites.usc.edu/clientservices/
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office for Equity, Equal Opportunity and Title IX (EEO-TIX)
https://eeotix.usc.edu/
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following *protected characteristics*: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations. The university also prohibits sexual assault, non-consensual sexual contact, sexual misconduct, intimate partner violence, stalking, malicious dissuasion, retaliation, and violation of interim measures.

Reporting Incidents of Bias or Harassment
usc-advocate.symplicity.com/care_report
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity, Equal Opportunity and Title IX for appropriate investigation, supportive measures, and response.

Office of Student Accessibility Services
https://osas.usc.edu/
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

Campus Support & Intervention
campussupport.usc.edu
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Learning Experience Evaluations will be conducted toward the end of the semester. This will be your opportunity to provide feedback about your learning experience in the class. This feedback helps the instructor determine whether students are having the intended learning experiences for the class. It is important to remember that the learning process is collaborative and requires significant effort from the instructor, individual students, and the class. Students should provide a thoughtful assessment of their experience, as well as of their own effort, with comments focused on specific aspects of instruction or the course. Comments on personal characteristics of the instructor are not appropriate and will not be considered. For this feedback to be as comprehensive as possible, all students should complete the evaluation.