

Chemistry 395/435: Surface Chemistry and Analysis
Department of Chemistry, Loyola University Chicago
Spring 2022

Instructor: Dr. Dan Killelea
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Office Hours: Tu 10:00 – 11:00 am and by appointment (FH 103)
Class: T Th, 8:30–9:45 am, Dumbach 238
<https://luc.zoom.us/j/82762832269?from=addon>

Text: “The Oxford Solid State Basics” by Steven H. Simon, an ensemble of greatest hits, and visitors
Course Prerequisites: Chemistry 302 or concurrent registration. If you have not completed the course prerequisites, you may be administratively dropped from the class.

Course Overview

Chemical reactions on solid surfaces are central to many technologies and catalytic methods. The structure-reactivity paradigm is central to the study of the chemistry and physics of solid surfaces. This course will cover fundamental surface properties. We will start with a bit of an overview, and then look at how solid-state physics and quantum mechanics is used to develop models for surfaces. We will also discuss surface analysis techniques and gas-surface dynamics.

We will start with a brief review of quantum mechanics and how it is important in developing models of the solid state. We will then move onto general properties of solid surfaces and develop models for their structure and how it relates to bulk structure. Next stop will be kinetics and mechanisms of reactions on surfaces. Interspersed with these topics will be methods and techniques for studying surfaces. We will likely do a more thorough review of the physics and chemistry of oxidized platinum surfaces, and use this system as a paradigm for understanding the dynamics of gas-surface interactions. Finally, we will have occasional (virtual) visitors who will deliver a seminar on a topic or their work.

Exams, Homework, and Grading

There will be a two **take home** exams this semester. The latter third of the semester will be topical discussions more akin to seminars than lectures. You will be provided reading material and 1 or 2 volunteers will initiate and facilitate the class discussion. These may be in concert with a guest speaker. Students will be evaluated by their involvement with discussion and preparation as facilitators. There may also be a couple homework assignments before the exam. The expectations are that a Graduate student will lead one session and be secondary for another. For undergraduates, being secondary for one topic is sufficient. But please, be as involved as you like!

Exams: There will be no make up exams and it is unlikely that there will be a final exam.

Supplementary Texts

Concepts of Modern Catalysis and Kinetics, Chorkendorff and Niemantsverdriet
Introduction to Surface Chemistry and Catalysis, Somorjai and Li
Surface Science, Foundations of Catalysis and Nanoscience, Kolasinski
Elementary Statistical Physics, Kittel, Physical Chemistry, 2nd Ed., Rice, Ross, and Berry
Solid State Physics, Ashcroft & Mermin

Grading: The grade will be based on the exams, and involvement with seminar. Again, The expectations are that a Graduate student will lead one session and be secondary for another. For undergraduates, being secondary for one topic is sufficient.

500 Points Total

Exam 1 :	100	points
Exam 2:	100	points
Seminars:	200	points
Homeworks:	95	points
Course Evaluation:	5	points
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	500	points

Grading Scale:

> 90%	A
80-85	A-
75-80	B+
70-75	B
65-70	B-
60-65	C+
55-60	C
50-55	C-
40-50	D
< 40	F

Schedule

Note: The instructor reserves the right to make changes to the schedule, and to move things around. This is simply an outline. ***The first two weeks will be on Zoom.***

<i>Date</i>	<i>Class</i>	<i>Topics</i>	<i>Readings</i>	<i>other</i>
18 Jan	1	Meet & Greet		
20 Jan	2	Classical Wave Eqn		DS
25 Jan	3	Classical Wave Eqn		DS
27 Jan	4	Quantum review	McQuarrie/Levine	
1 Feb	5	Quantum review	McQuarrie/Levine	
3 Feb	6	Drude Theory	A&M, Ch. 1	
8 Feb	7	Drude Theory	A&M, Ch. 1	
10 Feb	8	Somerfeld Theory	A&M, Ch. 2	
15 Feb	9	Intro To Solid State	Kittel, Ch. 1	
17 Feb	10	Intro To Solid State	Kittel, Ch. 1	
22 Feb	11	Crystal Lattices	A&M, Ch. 4	
24 Feb	12	Crystal Lattices	A&M, Ch. 5	
1 Mar	13	The Reciprocal Lattice	A&M, Ch. 7	
3 Mar	14	Brillouin Zones	Kittel, Ch. 2	
8, 10 Mar	No Class: Spring Break			
15 Mar	15	Actual Surfaces	Kolasinski Ch. 1	
17 Mar	16	Surfaces	Kol. Ch.1 / Somorjai Ch. 2	
22 Mar	Special Happenings			
24 Mar				
29 Mar	17	Surfaces	Somorjai Ch. 2	
31 Mar	18	Surface Processes	Norskov. Ch. 2+3	
5 Apr	19	Surface Processes	Norskov. Ch. 2+3	
7 Apr	20	Surface Kinetics	Norskov. Ch. 4+5	
12 Apr	21	Surface Kinetics	Norskov. Ch. 4+5	
14 Apr	22	Seminar 1		
19 Apr	23	Seminar 2		
21 Apr	24	Seminar 3		
26 Apr	25	Seminar 4		
28 Apr	26	Seminar 5	Donna Chen, Dept. Seminar	DS

Academic Integrity

All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, which can be viewed at:

<http://www.luc.edu/cas/advising/academicintegritystatement/>

A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty.

Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, and submitting false documents.

Any instance of dishonesty (including those detailed on the website provided above or in this syllabus) will **immediately result in a grade of F for the entire course** and will also be reported to The Chair of The Department of Chemistry & Biochemistry who will decide what the next steps may be.

Absence Policy for Students in Co-Curricular Activities (including ROTC):

Students missing classes while representing Loyola University Chicago in an official capacity (e.g. intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes.

Students should discuss with faculty the potential consequences of missing lectures and the ways in which they can be remedied. Students must provide their instructors with proper documentation (develop standard form on web) describing the reason for and date of the absence.

This documentation must be signed by an appropriate faculty or staff member, and it must be provided as far in advance of the absence as possible. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to give the student the opportunity to take the examination at another time.

(<https://www.luc.edu/athleteadvising/attendance.shtml>)

Accommodations for Religious Reasons

If you have observances of religious holidays that will cause you to miss class or otherwise effect your performance in the class you must alert the instructor **within 10 calendar days of the first class meeting of the semester** to request special accommodations, which will be handled on a case by case basis.

Online Class Specifics

Any and all material shall not be shared; all intellectual property remains with me and/or the university.

Recording of Lectures: I will record our lectures (not discussions) on Zoom and share with the class. These will not, and may not, be shared outside the class.

You may not have another person or entity 'take your place' for any course-related activity.

Privacy Statement

Assuring privacy among faculty and students engaged in online and face-to-face instructional activities helps promote open and robust conversations and mitigates concerns that comments made within the context of the class will be shared beyond the classroom. As such, recordings of instructional activities occurring in online or face-to-face classes may be used solely for internal class purposes by the faculty member and students registered for the course, and only during the period in which the course is offered. Students will be informed of such recordings by a statement in the syllabus for the course in which they will be recorded. Instructors who wish to make subsequent use of recordings that include student activity may do so only with informed written consent of the students involved or if all student activity is removed from the recording. Recordings including student activity that have been initiated by the instructor may be retained by the instructor only for individual use.

Course Repeat Rule

Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W).

After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry & Biochemistry website: <http://www.luc.edu/chemistry/forms/> and personally meet and obtain a signature from either the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

Student Accommodations

The Student Accessibility Center (formerly known as Services for Students with Disabilities), Sullivan Center (773-508-3700), <https://www.luc.edu/sac/> has the mission “to serve students with documented disabilities by creating and fostering an accessible learning environment,” including “support[ing] faculty, staff, and administrators on matters such as ADA and Section 504 compliance, as it relates to individuals with disabilities.” Please direct all questions concerning accommodations of disabilities to the Student Accessibility Center. Academic accommodations afforded to students require documentation and review. The Student Accessibility Center will issue accommodation letters for registered students to present to their instructors: accommodations are not active until students present these letters to their instructors. If students’ accommodations involve attendance or deadlines, instructors and students will jointly complete and execute an Agreement Form articulating their terms. See <https://www.luc.edu/sac/faculty/facilitatingaccommodations/> for guidance about implementing various kinds of accommodations in a way that is appropriate to your class. The Student Accessibility Center stands ready to work with you.

Your well-being

If there are events occurring in your life that cause school to diminish in its priority, please discuss this with me or contact the Wellness Center (<http://www.luc.edu/wellness/index.shtml>) or the dean of students (http://www.luc.edu/studentlife/dean_of_students_office.shtml) for assistance. These are services that **your** tuition pays for and can be invaluable for your personal health and maintaining progress towards your degree. I am always willing to discuss how I can adapt the class and its materials so that you are successful.