



Chemistry Department
Fall 2021
Chemistry 270: Advanced Chemistry
Surface Chemical Analysis

Course and Contact Information:

Instructor:	Dr. Roland Barbosa
Email:	roland.barbosa@sjsu.edu
Office Hours:	by appointment
Class Days/Time:	M/W, 18:00-19:15
Classroom:	Online/TBA
Prerequisites:	Completion of one undergraduate course in analytical chemistry and one undergraduate course in physical chemistry, or instructor consent.

Course Description: This course deals with the introduction and overview of various surface chemical characterization techniques including XPS, UPS, Auger, ISS and TOFSIMS. Students will utilize state-of-the-art surface analytical instruments on a small project proposed and present the results towards the end-of-semester.

Recommended Texts:

The course has been developed from several literatures. There is no single textbook that covers it in a manner that is appropriate for this course. Lecture notes from some of the lectures will be made available to students. Here are some books that you can check:

- Elaine M. McCash. Surface Chemistry. Oxford University Press, 2001.
- Gabor Somorjai. Introduction to Surface Chemistry and Catalysis. John Wiley and Sons, 2010.
- Garry Attard and Colin Barnes. Surfaces. Oxford University Press, 2004.
- J. C. Vickerman and I. S. Gilmore, Surface Analysis – The Principal Techniques, Wiley, 2009.

Course Objectives:

Upon completion of the course, the student can:

- Suggest characterization techniques (XPS, UPS, Auger, TOFSIMS and ISS) for the determination of surface structure or surface processes.
- Perform XPS, UPS and ISS techniques and process and interpret data obtained from it.
- Describe the significance of surface chemistry in different industries and should be capable of resolving simple problems occurring in industrial environments.

Topics

1. Structure of Solid Surfaces
2. Preparation and Maintenance of Clean Surfaces
3. Surface Analytical Techniques
 - Auger Electron Spectroscopy (AES)
 - Photoelectron Spectroscopy (XPS, UPS)
 - Secondary Ion Mass Spectroscopy (SIMS)
 - Ion Scattering Spectroscopy (ISS)
 - Temperature Programmed Techniques (TPD, TPR)
5. Technological Impact of Surface Chemical Analysis: Selected Examples
 - Catalysis
 - Semiconductor
 - Coatings
 - Biomaterials

Grading Information:

A+ = 97-100%; A = 93-96.9%; A- = 90-92.9%; B+ = 87-89.9%; B = 83-86.9%; B- = 80-82.9%; C+ = 77-79.9%; C = 73-76.9%; C- = 70-72.9%; D+ = 67-69.9%; D = 63-66.9%; D- = 60-62.9%; F = 0-59%

	Percentage	Date/Time
Exams	35 %	TBA
Proposal (Written Report)	15 %	
Project Report and Presentation	30 %	
Class Participation	20 %	

General Requirements:

- **Web Camera:** A webcam is needed for oral presentations and weekly participation in online zoom meetings. Note that PC laptops and tablets may be checked out for the entire semester from [Information Technology](#) services.
- **Time Commitment:** Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practical. Other course structures will have equivalent workload expectations as described in the syllabus. More details about student workload can be found in [University Policy S12-3](#) at <http://www.sjsu.edu/senate/docs/S12-3.pdf>.
- **Proposal:** The proposal (group of 3-5) should be about a surface phenomenon which may be related to your interests or your anticipated future research. You can choose among the topics

listed above (#5) and not more than two groups can have the same topic. It shall consist of not more than 5 pages, double-spaced and includes at least 3 peer-reviewed literature references. The proposal should state the problem to be addressed, the background of the problem, summary of previous work, the methods to be employed, the expected results, and how you will use the results to address or solve your problem.

- **Surface Characterization.** Each group will perform surface characterization either in person or using Teamviewer to measure, analyze and process data corresponding to the proposal and in consultation with the instructor. This activity allows you to familiarize some of these instruments as well as the interpretation of data from these instruments.

- **Presentation.** Each group will be given up to 30 minutes to present. The talk will be followed by up to 10 minutes of questions from the audience. These time limits will require that you prepare a well-rehearsed, concise and clear presentation of your proposals and expected results. *Students going over time will be cut off and may receive a penalty. It is in your best interest to adhere to the time limits by practicing several times before the real presentation! results to address or solve your problem.*

- **Exams.** The first two exams will be written exams. The final exam will be an interview-type exam wherein the students are asked various questions covered in the class and in the presentations on a one-on-one basis. The time schedule for each student for the exam will be posted a week before the final's week.

University Policies:

Per [University Policy S16-9](http://www.sjsu.edu/senate/docs/S16-9.pdf) (<http://www.sjsu.edu/senate/docs/S16-9.pdf>), relevant information to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' [Syllabus Information web page](http://www.sjsu.edu/gup/syllabusinfo/) at <http://www.sjsu.edu/gup/syllabusinfo/>. Make sure to visit this page, review and be familiar with these university policies and resources.

Health/Safety Protocols:

Please read the updated [SJSU Phased Adapt Plan](#). All members of the campus community are expected to fully comply with the protocols and guidelines outlined in the link provided to ensure the well-being of our campus community.

**Tentative Schedule for
Chem 270 – Advance Chemistry Fall 2021**

Date		Topics	Location
Aug	23, Mon	Introduction	zoom
	25, Wed	XPS: General Overview	zoom
	30, Mon	XPS: General Overview	zoom
Sept	1, Wed	UPS: General Overview	zoom
	6, Mon	Labor Day	
	8, Wed	Auger: General Overview	zoom
	13, Mon	TOFSIMS: General Overview	zoom
	15, Wed	Auger: General Overview	zoom
	20, Mon	ISS: General Overview	zoom
	22, Wed	Comparison of Surface Chemical Techniques	zoom
	27, Mon	1st Exam	in person
	29, Wed	Group meetings: Proposal (4 groups)	zoom
Oct	4, Mon	Group Presentations	in person
	6, Wed	Surface Science Impact on Catalysis	zoom
	11, Mon	Surface Science Impact on Semiconductor	zoom
	13, Wed	Surface Science Impact on Biomaterials	zoom
	18, Mon	XPS Operation	zoom/in person
	20, Wed	XPS Data Processing (survey + high res)	zoom/in person
	25, Mon	XPS Data (Depth Profile)	zoom/in person
	27, Wed	Auger Operation	zoom/in person
Nov	1, Mon	Group meetings: preparation (4 groups)	zoom
	3, Wed	2nd Exam	in person
	8, Mon	XPS Analysis: Group 1	zoom/in person
	10, Wed	XPS Analysis: Group 2	zoom/in person
	15, Mon	XPS Analysis: Group 3	zoom/in person
	17, Wed	XPS Analysis: Group 4	zoom/in person
	22, Mon	Group Presentations (1, 2)	in person
	24, Wed	Group Presentations (3, 4)	in person
29, Mon	Review of Surface Chemical Techniques	zoom	
Dec	1, Wed	Summary	zoom
	6, Mon	Final Exam (interview type)	in person
	13, Wed	Final Exam (interview type)	in person