

**CHEM 463****Chemical Nanotechnology Laboratory****Units:** 2**Term—Day—Time:** Spring 2023—W—13:00-17:50**Location:** GFS 228 (Lecture) and SGM 142 (Lab)**Start date:** February 01, 2023**End date:** April 26, 2023**Instructor:** Prof. Michael Inkpen**Office:** LJS 250**Office Hours:** by appointment.**Contact Info:** inkpen@usc.edu, +1 (213) 821-1910.**Please allow 2 working days for a response to emails/calls.****Teaching Assistants:** Tom Czyszczon-Burton, czyszcz@usc.edu**Office Hours:** TBA**IT Help:** N/A, use Blackboard.

Catalogue Description: Experimental techniques in the synthesis and characterization of nanoscale materials. Emphasis on examining size-dependent properties of various nanoscale materials using spectroscopic techniques.

Course Description

CHEM 463: Chemical Nanotechnology Laboratory is intended for upper division chemistry majors in the Chemical Nanoscience track. It is a laboratory course that explores the principles of chemical nanotechnology through experiments that demonstrate the techniques used in the synthesis and characterization of nanoscale materials. Special emphasis will be placed on examining the size-dependent properties of various nanoscale materials using spectroscopic instrumentation.

Learning Objectives

By the end of this course you should be able to:

- Explain why the properties of materials change upon going from bulk to the nanoscale.
- Recognize the use and importance of nanomaterials throughout modern society.

By demonstrating that you can:

- Apply a variety of experimental methods to prepare different classes of nanomaterials and devices.
- Interpret the size-dependent optical properties of different nanomaterials.
- Assess the impact of combining nanoscale objects on observed/mesoscale material function(s).
- Evaluate different approaches to synthesize and/or design nanomaterials with targeted properties.

(These learning objectives are not comprehensive and subject to change.)

Prerequisite(s): CHEM 322A or CHEM 325A

Co-Requisite(s): N/A

Concurrent Enrollment: N/A

Recommended Preparation: N/A

COVID-19 Statement

If you test positive for COVID-19 during the semester, or experience any symptoms, you must not attend class in person until you obtain a negative test for COVID-19 and/or satisfy any recommended self-isolation requirements. If the lecture instructor tests positive for COVID-19 or experiences symptoms, lectures will be recorded on Zoom until they can safely return to teach in person.

Students are expected to comply with all aspects of USC's COVID-19 policy. Failure to do so may result in removal from the class. For latest information, see <https://coronavirus.usc.edu>.

Course Notes

Letter Grades will be assigned based on the assignments described below. Copies of lecture slides will be emailed to all registered participants.

Technological Proficiency and Hardware/Software Required

N/A

Required Readings and Supplementary Materials

Required Texts: *Chemical Nanotechnology Laboratory Manual*, USC Department of Chemistry

Primary Literature: You should read the first 1-2 papers listed under each experiment (labelled “essential”) prior to starting each lab. The additional papers listed here may be of interest for reference when writing your lab report.

EXPT 1 – Preparation of Dye-Sensitized TiO₂ Solar Cells

- (1) Smestad and Grätzel, *J. Chem. Educ.* 1998, **75**, 752-756; [10.1021/ed075p752](https://doi.org/10.1021/ed075p752) (essential)
- (2) Forslund, *J. Chem. Educ.* 1997, **74**, 962-963; [10.1021/ed074p962](https://doi.org/10.1021/ed074p962) (reference)
- (3) Tanaka and Suib, *J. Chem. Educ.* 1984, **61**, 1104-1106; [10.1021/ed061p1104](https://doi.org/10.1021/ed061p1104) (reference)

EXPT 2 – Synthesis of CdSe Nanocrystals of Various Diameters and Their Optical Characterization

- (1) Landry *et al.*, *J. Chem. Educ.* 2014, **91**, 274-279; [10.1021/ed300568e](https://doi.org/10.1021/ed300568e) (essential)
- (2) Liu *et al.*, *Langmuir* 2008, **24**, 5241-5244; [10.1021/la8005986](https://doi.org/10.1021/la8005986) (reference)
- (3) J. Jasieniak *et al.*, *J. Phys. Chem. C* 2009, **113**, 19468-19474; [10.1021/jp906827m](https://doi.org/10.1021/jp906827m) (reference)

EXPT 3 – Synthesis and Optical Characterization of Plasmonic Noble Metal Nanoparticles

- (1) Vinnacombe-Willson *et al.*, *J. Chem. Educ.* 2021, **98**, 546-552; [10.1021/acs.jchemed.0c01150](https://doi.org/10.1021/acs.jchemed.0c01150) (essential)

EXPT 4 – Self-Assembled Monolayers: Surface Wetting and Charge Transport Properties

- (1) Dausvardis *et al.*, *J. Chem. Educ.*, 2020, **97**, 184-189. [10.1021/acs.jchemed.9b00639](https://doi.org/10.1021/acs.jchemed.9b00639) (essential)
- (2) Cea *et al.*, *J. Chem. Educ.* 2016, **93**, 1441-1445. [10.1021/acs.jchemed.5b00826](https://doi.org/10.1021/acs.jchemed.5b00826) (essential)

Description and Assessment of Assignments

Nanoparticles and other nanoscale structures, which have diameters in the range of 1 to 100 nanometers, are currently the focus of intense scientific research due to a wide variety of potential applications in the optical, electronic, and biomedical fields. You will work through 4 laboratory experiments in this course, utilizing a set of diverse experimental techniques to *synthesize* various types of nanostructures (e.g. semiconductor quantum dots, metal nanoparticles, self-assembled monolayers). These labs will also employ some of the common techniques that are used to *characterize* these nanomaterials. Where possible, they will demonstrate the practical application of chemical nanotechnology (i.e., the conversion of solar energy to electrical energy). The goal is to introduce you to some of the core concepts of this vibrant field of research, through a practical “hands on” approach. Each experiment will run for 1-2 weeks, and you will be graded based on a laboratory report due ≥ 1 week after each experiment completion (see schedule below).

A term paper, discussing in more detail a topic in nanochemistry (topic to be announced later). The topic will be directly related to one or more of the experiments performed this semester. The term paper will be due ≥ 2 weeks after the last experiment.

Grading Breakdown

This course will be graded as follows:

- 80% – Lab (four graded lab reports)
- 20% – Term Paper

Points for each lab report will be distributed as follows:

15% – Pre-Lab Report
This report serves as your lab entry ticket.

5% – Pre-Lab Questions OR Pre-Lab Quiz
For experiments with pre-lab questions, there will be no pre-lab quiz.

5% – Lab Notebook Quality

Your completed lab notebook pages also serve as your lab exit ticket.

75% – Post-Lab Report (and Experimental Technique)

Determined from grading of your post-lab report.

An approximate break-down of point allocations for the Pre- and Post-Lab Reports is provided in the “Lab Report Guidelines” section of the manual. This is a guideline provided only to help direct your time and effort and is subject to TA modifications depending on the nature of the experiment. Any Post-Lab questions will be graded as part of the appropriate Post-Lab Report section (e.g., calculations, discussion). All lab reports for a given experiment will be graded by the same TA to ensure consistent grading for each experiment.

Please keep all graded material to verify your point total at the end of the semester. You are encouraged to check your grades on Blackboard to make sure that our grade sheet agrees with yours.

Assessment Tool (assignments)	Due*	% of Grade
Safety Quiz	Week 1	0 (pass/no pass)
4 × Laboratory Reports	≥1 week after experiment	100 each
1 × Term Paper	April 26	100
TOTAL		500

* See schedule below.

Grading Timeline

The instructor aims to grade and provide feedback for all assessments within 1 week of submission.

Attendance and Assignment Submission Policy

Assignments should be submitted electronically (through email/Blackboard/TurnItIn as directed) by 11:59 pm on the specified date.

Lab reports are due on the dates listed in the syllabus at the beginning of the lab period. All written materials must be typed. See laboratory manual for more information on lab reports. Late lab reports will not be accepted. Requests for regrading of any work must be submitted by email to Prof. Inkpen within one week after the graded material is made available to you. Graded material will be photocopied before redistribution. A request for regrading of an altered piece of work is a serious violation of academic integrity.

There will be an introductory lecture prior to the first lab session of each experiment. Students are expected to attend all in-person lectures and participate in all lab sessions. No make-up labs can be given in this course. Absences will be excused only for medical reasons or in the case of extreme necessity. Written excuses or student health center slips must be presented to Prof. Inkpen for approval and should be secured in advance whenever possible. In the case of an excused absence, a grade will be assigned which is based on the average of the student’s class rank. Any unexcused absence will result in a grade of zero for that laboratory. Students who miss two or more experiments may automatically fail the course.

University Holidays (no classes/lab sessions on these dates)

Monday, January 16 – Martin Luther King Day

Monday, February 20 – President’s Day

Sunday-Sunday, March 12-19 – Spring Recess

Policy on Dropping and Incompletes:

February 24, 2023, is the last day to drop this course without a mark of W on your transcript (January 27 is the last day to drop without a W on your transcript, student record, and STARS report, and to receive a tuition refund). University policy requires strict adherence to this deadline. The mark of "Incomplete" (IN) can be given *only* to a student who is unable to complete the course because of documented illness or other emergency. See the following links for more information:

<https://classes.usc.edu/term-20231/calendar/>

<https://undergrad.usc.edu/services/advisor-connect/incompletes-and-withdrawals/>.

Lecture and Lab Schedule

Day	Lecture	Lab	Deliverables
Feb. 1	Introduction to Nanotechnology	Lab Orientation	Lab Safety Quiz
Feb. 8	Lab 1 Introduction	Lab 1a	
Feb. 15	-	Lab 1b	
Feb. 22	Lab 2 Introduction	Lab 2a	Lab 1 Report
Mar. 1	-	Lab 2b	
Mar. 8	Lab 3 Introduction	Lab 3	Lab 2 Report
Mar. 15	(Spring Recess)		
Mar. 22	Lab 4 Introduction	Lab 4a	Lab 3 Report
Mar. 29	-	Lab 4b	
Apr. 5	-	-	Lab 4 Report
Apr. 19	-	Visit to CNI (TBC)	
Apr. 26	-	-	Term Paper

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on [Research and Scholarship Misconduct](#).

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University’s educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.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 Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault

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) - (213) 740-5086
eetix.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.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
osas.usc.edu

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-3340 or otfp@med.usc.edu

chan.usc.edu/otfp

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.