



CHEM 5730: Advanced Inorganic Lab
Fall B 2016

Instructor: Prof. Caroline Saouma
Email: caroline.saouma@utah.edu
Office Hours: Friday 10:00 – 11:00 (HEB 3152)
Admin: Trevani Wolfgramm (HEB 3220)

Note, all of the course material will be posted on canvas, and I will communicate with you via canvas. It is your responsibility to have the correct canvas notification settings/email for this course.

TAs

Moumita Bhattacharya (mou.kol.2011@gmail.com)
Fang Wang (fang.wang@utah.edu)
John Wisniewski (wisni2ja@gmail.com)

Lectures (HEB 2006)

Time: TH 9:40 – 10:30

Lab Sections (HEB 4215)

Section 2 (Moumita): MW 12:55 – 17:00
Section 3 (Fang): TH 12:55 – 17:00
Section 4 (Moumita): MW 17:00 – 21:00
Section 5 (Fang): TH 17:00 – 21:00
Section 5 (John): F 12:45 – 16:45 and S 08:00 – 12:00

Canvas: <https://utah.instructure.com/courses/392924>

Canvas subpages: Section 2: 407720
 Section 3: 407721
 Section 4: 407722
 Section 5: 407723
 Section 6: 407724

Communication

I will send out notifications via canvas (main page, section 1!), so be sure to have this forwarded to your email. As students ask questions about labs, I will answer via canvas, as I assume they are not alone in asking these questions. Please contact me via canvas (main page, section 1!) for all communication for this class to ensure a prompt response! Data sharing and discussion will also be done through canvas, in the lab section canvas pages.

Course Description

Inorganic chemistry is the chemistry of the periodic table, and this course will focus on transition metal chemistry, particularly as it applies to sustainable energy. Each lab will either directly (or indirectly) be linked to current research being done in the field. Though this is a lab course, in addition to techniques, concepts pertinent to the research will be learned (or emphasized). Scientific communication will also be stressed.

Course Outcomes

By the end of this course, you will:

- Be familiar with inorganic synthesis and using Schlenk techniques
- Be skilled in electrochemistry, and in particular, know how to evaluate electrocatalysts
- Understand the basics of photochemistry
- Have an appreciation for how inorganic chemistry ties into sustainable energy research
- Be more confident in your ability to write scientifically
- Be able to analyze, interpret, and discuss data

- Be more confident in speaking up in class
- Propose a research idea and address it through experiments

Prerequisites

CHEM 3100 should be taken concurrently or already completed.

Textbook

None. Reading assignments and experimental protocols will be provided on Canvas.

Required Equipment

1. Laboratory goggles or approved safety glasses
2. A cotton labcoat
3. A bound lab notebook with carbon copies of each page (to be turned in to your TA at the end of each lab)
4. Dishwashing gloves (for cleaning glasswear, hoods, and benchtop).

Attendance and Makeup Policy

You must attend your scheduled laboratory sessions. However, I appreciate that life happens. If you are ill, have a family emergency, etc. notify my ASAP. In extraordinary cases, approval may be given (by Saouma) to carry out experiments outside of your scheduled lab time. This approval must be worked out *before* the lab section you will be missing.

There will be no makeup final exam for this class. Exceptions to this policy must be cleared in advance (only valid University related absences) and/or must be due to certifiable emergencies.

Food & Drink Policy

You are welcome to eat/drink during lecture, but please do so discretely. Under no circumstances should you eat or drink in the lab! You are welcome to take a short break and eat outside of the labs.

Safety (General)

1. Know where the exits are, and where the safety showers/eyewash stations are.
2. Safety glasses and laboratory coats must be worn at all times.
3. Gloves must be worn when working with chemicals. They should NOT be worn when leaving the lab, or writing in your notebook.
4. Wearing contact lenses is not permitted.
5. You may not wear open-toed shoes or sandals.
6. Legs must be covered. Shorts or short dresses are not acceptable. Tank tops and muscle shirts are not permitted.
7. Report any injury to your TA immediately. If in doubt, notify your TA.
8. Students are not allowed in lab without the TA.
9. Eating, drinking, and smoking are prohibited in the laboratory.
10. Solvents, solids, and sharps must be disposed of properly (in the appropriate waste container). If you are not sure how to dispose of something, consult your TA.
11. Many organic chemicals pose potential hazards to the fetus or to young children. Women who are pregnant, nursing, or who suspect they may be pregnant should contact me (Saouma). They are also strongly advised to consult with their obstetrician, and if possible to take this course at a later time.
12. Come to lab prepared. Be neat and courteous to others. Clean up after yourself and dispose of waste in the appropriate waste containers.
13. No running in the lab.
14. Wash your hands every time you leave the lab.
15. Theft: The entire campus including North HEB has suffered from thefts of backpacks, computers, and other personal items. Please do not leave valuables in the hallway.

General Procedure for working with chemicals

1. *Be smart and prepared.* Follow basic safety rules and be cognizant of the potential hazards. This includes being familiar with the MSDS and any additional safety information provided by the chemical supplier (some of this is only available online). Know of the work occurring around you so that you are prepared to help in case of an emergency.

2. *Minimize your exposure.* Wear appropriate PPE, and do not touch "clean" surfaces with gloved hands or contaminate the office with a labcoat. Work in a fumehood or glovebox when applicable/possible.

3. *Do not underestimate the risks.* Assume the product of your reaction is more toxic/hazardous than the sum of the reagents.

4. *Be prepared for accidents.* Know what you will do in case the reaction explodes, runs away, catches fire, or spills. This includes knowing where extinguishers and spill kits are and the appropriate methods for cleaning up. Write this information on the hood sash, along with the reaction being run, and notebook page/number.

5. *Use and maintain equipment and glasswear.* Glasswear with starcracks can implode/explode under pressure. Glasswear with impurities can catalyze side reactions, which may be dangerous/lead to explosions. Equipment that is not properly maintained can lead to frustration or contamination.

6. *Practice good housekeeping.* There is a correlation between orderliness and the level of safety in the lab. The following should always apply:

- Never obstruct access to exits and emergency equipment.
- Store coats, bags, etc. in the appropriate area, not the lab.
- Do not use the floor as a storage area.
- Keep drawers and cabinets closed when not in use.
- Properly label experiments in progress, and glasswear that is used to store chemicals.
- Store chemical containers in order and neatly.
- Keep chemical containers closed when not in use.
- Secure gas cylinders (double chained).
- Return chemicals to their storage location when not in use.
- Keep containers at least 2 inches away from edge of benches, to minimize knocking hazards.
 - Keep your working area clean and free of clutter. Particularly, keep flammables away, including paper towels.
 - Make sure all hose connections are properly secure, including those to chilled water.

7. *Do not work alone.* If you are the only one present in your lab and are setting up/quenching a reaction, find a friend from another lab to come and watch you. Under no circumstances should undergraduate and first year graduate students be working alone.

8. *Work conducted outside of normal hours.* For experiments that will run when no one is around, make sure the hood sash is labelled with the following:

- Printed experimental protocol taped to the outside of the hood sash, along with group name/contact info.

9. *Store Chemicals Appropriately.* Ensure that chemicals are properly stored.

10. *Transporting Chemicals.* Make sure to transport all chemicals in an appropriate secondary container.

11. *Dispose of waste appropriately.* Make sure to dispose of waste in the appropriate stream. Make sure you are familiar with the incompatibilities of the chemicals, and know all products of the reaction before disposing of it.

Failure to adhere to the safety guidelines will result in lost points!

Grading

Lab 1: $Ru(bpy)_3$ (105 pts)

- Pre-lab: 15 pts (5 each day)
- Lab: 15 pts (5 each day)
- Report: 75 pts

Lab 2: Dye-Sensitized Solar Cells (40 pts)

- Pre-lab: 5 pts
- Lab: 5 pts
- Report: 30 pts

Lab 3: E-chem (70 pts)

- Pre-lab: 5 pts
- Lab: 5 pts
- Report: 50 pts

Lab 4: Hydrogen Evolution Catalysts (215 pts)

- Pre-lab: 35 pts (5 each day)
- Lab: 35 pts (5 each day)
- Proposal: 10 pts
- Report: 135 pts (35 pts part 1, 100 pts part 2)

Final: 50 pts

Total: 480 pts

Prelabs: Are due at the beginning of EACH lab period. If this is not turned in immediately students will automatically get 0 pts for the day. They are graded by your TAs.

Lab Points: You can receive up to 5 points each lab session. Credit will be given for attendance (1), safety (1), carrying out the procedures (1), completion of your lab notebook (1), and cleaning up (1). Lost points is at the discretion of your TA. Repeated violations of any of the above categories may result in more points lost, up to all 5 points for the day!

To ensure consistent grading, each lab report is to be graded by a different TA or myself.

Lab 1: Moumita

Lab 2: John

Lab 3: Fang

Lab 4: Prof. Saouma

The final grades will be assigned approximately as follows (all %'s will be rounded, i.e. 69.4%=69%, 84.5%=85%):

≥90%: some flavor of "A"

≥80%: some flavor of "B"

≥70%: some flavor of "C"

Lab Groups

You will work in groups of three. If there are not enough students to make up groups of three, then there will be groups of four. While you are collecting data together, and it is okay to work together on prelabs and reports, all lab reports MUST be your own individual work (text and figures).

Schedule (Tentative)

Oct. 17	18 Lecture: safety, lab notebooks	19	20 Lecture: d-orbital splitting	21	22
				6: check-in, lab 1	6: lab 1
24	25 Lecture: Photochemistry	26	27 Lecture: Dye-Sensitized Solar Cells	28	29
2,4: lab 1	3,5: lab 1	2,4: lab 1	3,5: lab 1	6: lab 1	6: lab 2
31	Nov. 1 Lecture: Electrochemistry	2	3 Lecture: Synthetic Techniques	4	5
2,4: lab 1	3,5: lab 1	2,4: lab 2	3,5: lab 2	6: lab 3 <i>Report 1 due</i>	6: lab 4 <i>Report 2 due</i>
7	8 Lecture: Scientific Writing	9	10 Lecture: Alternative Energy	11	12
2,4: lab 3 <i>Report 1 due</i>	3,5: lab 3 <i>Report 1 due</i>	2,4: lab 4 <i>Report 2 due</i>	3,5: lab 4 <i>Report 2 due</i>	6: lab 4 <i>Report 3 due</i>	6: lab 4
14	15 Lecture: Electrocatalysis	16	17 Lecture: Metal Complexes	18	19
2,4: lab 4 <i>Report 3 due</i>	3,5: lab 4 <i>Report 3 due</i>	2,4: lab 4	3,5: lab 4	6: lab 4	6: lab 4 <i>Report 4-1 due</i>
21	22 Lecture: TBD	23	24	25	26
<i>No lab</i>	<i>No lab</i>	<i>No lab</i>	<i>No lab</i>	<i>No lab</i>	<i>No lab</i>
28	29 Lecture: Scientific Writing	30	Dec. 1 Lecture: Scientific Writing	2	3
2,4: lab 4	3,5: lab 4	2,4: lab 4 <i>Report 4-1 due</i>	3,5: lab 4 <i>Report 4-1 due</i>	6: lab 4	6: lab 4, check-out
6	7 Lecture: Inorganic Chemistry Everywhere!	8	9 <i>In class final exam</i>	10	11
2,4: lab 4	3,5: lab 4	2,4: lab 4, check-out	3,5: lab 4, check-out		
12	13	14	15	16	17
<i>Report 5-1 due</i>					

- The lecture topics are tentative and may change.

- Deadlines in grey apply to everyone; those in white apply to the sections in session those days. In general:
 - Lab 1: Ru(bpy)₃*
 - Pre-lab due day 1 of your scheduled lab
 - Report due 1 week later (day of lab 3)
 - Lab 2: Dye-Sensitized Solar Cells*
 - Pre-lab due at the start of your scheduled lab
 - Report due 1 week later (day 1 of lab 4)
 - Lab 3: E-chem*
 - Pre-lab due at the start of your scheduled lab
 - Report due 1 week later (day 2 of lab 4)
 - Lab 4: Hydrogen Evolution Catalysts*
 - Pre-lab part 1 due day 1 of your scheduled lab
 - Pre-lab part 2 due day 4 of your scheduled lab
 - Report part 1 due day 5 of your scheduled lab
 - Report part 2 due December 12th at noon
- Because of the first/last day of class and Thanksgiving, section 6 is “ahead” of the other sections. Everyone is given the same amount of time to complete pre-labs and reports yet because of the schedule, some of you may have more things due “all at once.” Take note of this and budget your time.

Lectures

All lecture notes will be posted on Canvas the morning of lecture (if not sooner), and when appropriate, hard copies will be given at the start of class.

The lectures will be for the most part traditional, with me lecturing and you listening. I have a “no dumb question” policy, so please be (or get) comfortable asking questions. You are all coming from different backgrounds, and it is very likely that you are not the only one with that question. I encourage you to ask questions in front of your peers because this is a skill that is essential to being a successful scientist. To encourage this and make the lecture more interactive, I will ask questions and hope that you work with those sitting around you to come up with a solution.

Occasionally, I will have “lecture worksheets” whereby I ask you to work in small groups and work through a packet of problems. If this requires any advanced reading, it will be announced in class and posted on canvas at least one week in advance.

- This will help you transition to learning on your own, a critical skill for being a successful scientist.
- Being able to work with others is critical as a scientist, and this will get you comfortable doing so in a non-lab setting. I will randomly assign groups, so that by the end of class, you are comfortable with everyone, not just your friends.
- The small group work will also encourage you to ask questions to your peers.
- At times, you will have to explain a concept or your work to your group, which will help solidify your knowledge.

University Policies

The Americans with Disabilities Act. The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

Addressing Sexual Misconduct. Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you

are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

Wellness Statement. Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

Student Code. By submitting an assignment, you are representing that it is your own work and that you have followed the rules associated with the assignment. Incidents of academic misconduct (including cheating, plagiarizing, research misconduct, misrepresenting one's work, and/or inappropriately collaborating on an assignment) will be dealt with severely, in accordance with the Student Code (<http://www.regulations.utah.edu/academics/6-400.html>). A single instance of academic misconduct may result in a failing grade for the course. Multiple instances of academic misconduct may result in probation, suspension or dismissal from a program, suspension or dismissal from the University, or revocation of a degree or certificate.