

Welcome to Chem 9532Q: Analytical Instrumentation, Fall 2023-2024

~ COURSE OUTLINE ~

Course Description:

This course deals with instrument automation, data acquisition and data analysis for working in a modern research lab in chemistry and related interdisciplinary sciences and engineering. Some discussion of the basic principles of instrument operation will be included. The main purpose of the course is to make the student familiar and comfortable with advanced instrument components and the modification of the research setups (rather than to teach circuit or device design).

Course website

Go to <http://owl.uwo.ca/> and log in using your UWO user name and password.

Check this website on a regular basis for updates and important information on the lectures.

Zoom Office hours

Upon request for an appointment.

Required materials: No.

Mobile Device or iClicker:

- Audience response systems (“clickers”) will be used to provide immediate feedback on your understanding of course concepts. You will require a web - enabled device (phone, laptop, etc.) or an iClicker. Participation marks are awarded for the use of “clickers”. You must use your own “clicker” account and may not submit responses for any other student. The data collected using the devices will not be used for research purposes without your consent. In case of online teaching, questions will be integrated in videos.

Accessibility: Please contact the course instructor if you require materials in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Course evaluation: Method 1: There will be no exam. Assignments and problems will be weighted 60%. There will be 3 assignments, each of which is 20% worth. There will be a course project that is counted to be 35%. The final will be a project presentation (15 minutes). “Clickers” participation or equivalent will be counted 5% as below.

“Clickers” or equivalent participation will be counted 4%. Your overall course grade, out of 100, will automatically be the higher of the two grades calculated by the two **methods** shown above.

“Clickers”	Marked on participation only. The score you receive will be based on the percentage of questions answered: 80% or more = 5; 70–79% = 4; 60–69% = 3; 50–59% = 2; 40–49% = 1; Less than 40% = 0
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Illness and missed labs, midterm, or final exam

- Failure to complete or write homework, the midterms, or the final, will result in a mark of zero for the missed item, and potential failure in the course, unless a valid medical or compassionate reason has been approved and an exemption has been granted. The Policy of accommodation for Medical Illness can be found at <https://studentservices.uwo.ca/secure/index.cfm>
- For further policy information please visit http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf (notice the underscore in accomodation_medical.pdf in the above web address).
- If you miss the final presentation, contact your department to obtain an SPC form. Students who are ill, yet choose to present, must accept the mark that they receive.
- We will not authorize SPC exams for students with three exams in 27 (or greater) hours, nor for those with exam conflicts. The Registrar will place those with conflicts in designated conflict rooms. However, we will be pleased to approve your SPC if you have a “three in 24.”

Anticipated behavior

- Students are reminded of the university’s *Code of Conduct* found on the university website. To maintain a high standard of learning environment in our classrooms, laboratories, help rooms, and tutorial rooms for the students, those who are disruptive, rude, or show unacceptable behavior, either to the instructor, or the other students, will be asked to leave.

Tentative outline of topics

This course will give rich case-study experience of instruments such as electrochemistry, spectroscopy, scanning probe microscopy. Each student will learn software in situ on a computer and have ample occasions to practice.

I have more than 30 years' experience on using modern instruments, from my Ph.D. thesis at **Swiss Federal Institute of Technology**, postdoctoral research work at **University of Texas at Austin** to my present independent research at **Western**. I like instrumentation very much because it has been helping me to carry out all fancy experiments with automation. Following are the highlights of the course:

1. Introductions.

1 hr

The course operation.

2. A tandem instrument with a CHI instrument analyzer and an external signal 2 hrs

Through exercises, you will combine an electrochemical workstation that acquires an external signal from a photomultiplier tube and display photoelectrochemistry in one screen (Fig. 1).

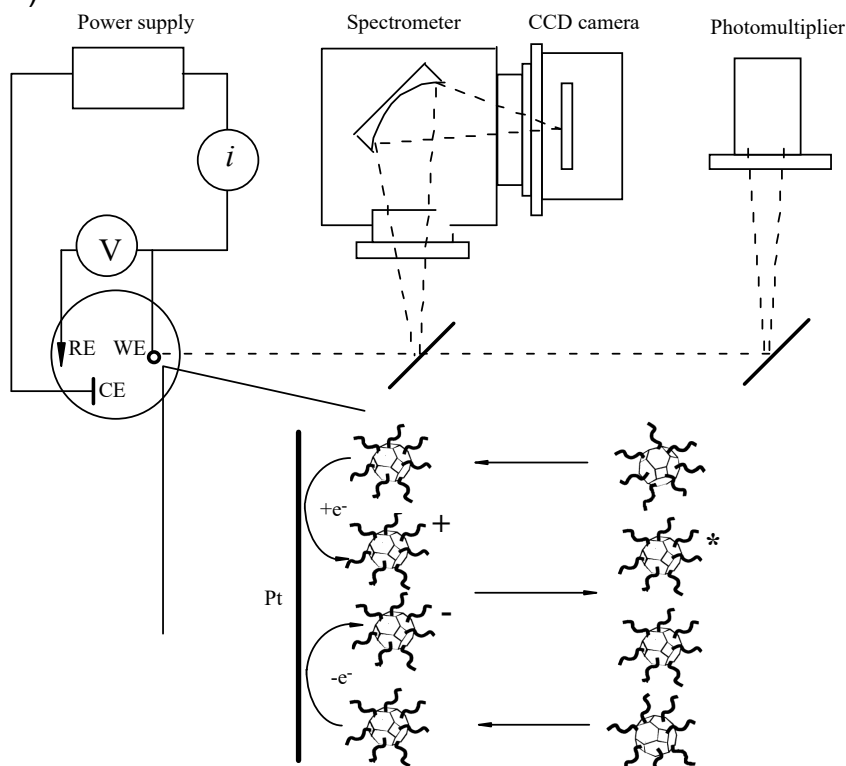


Fig. 1

3. Spooling chemiluminescence spectroscopy

2 hrs

This chapter teaches you how to use Ocean Insight spectrometer to perform a basic data acquisition of a chemiluminescence and how to save the analyzed data to a file. Through in-class exercises, you will determine the absolute quantum efficiency (Figs. 2-3)

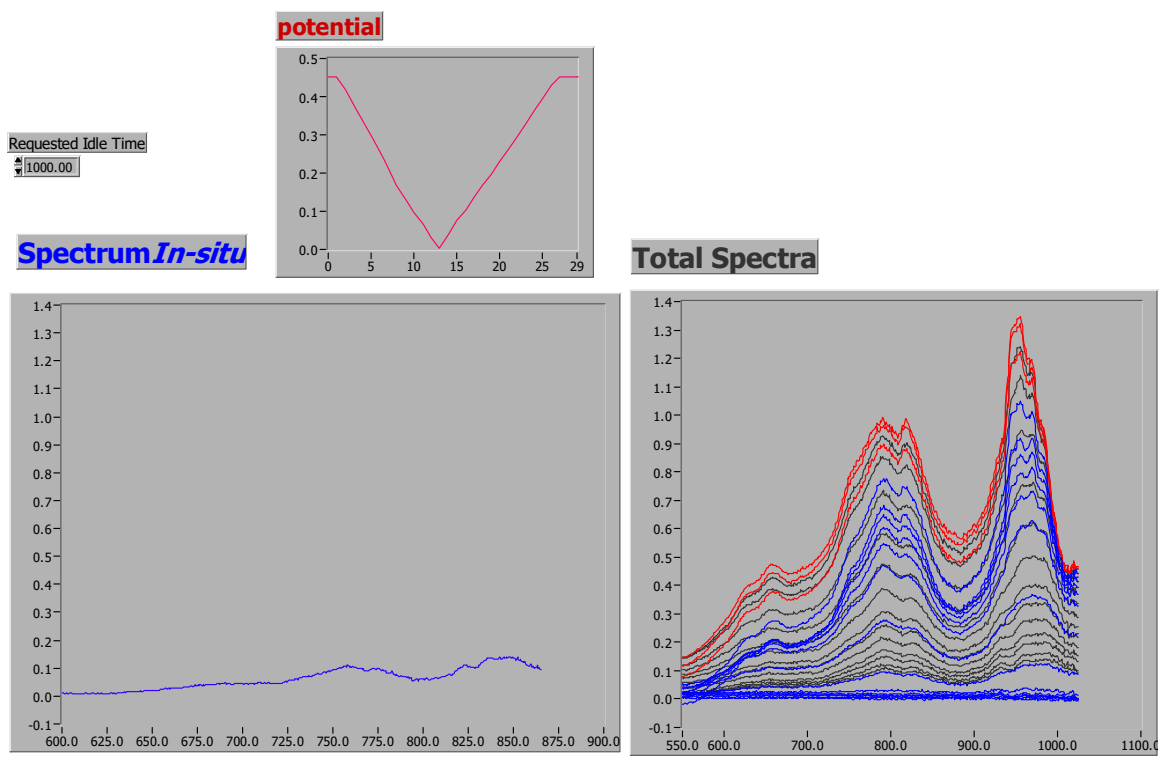


Fig. 2

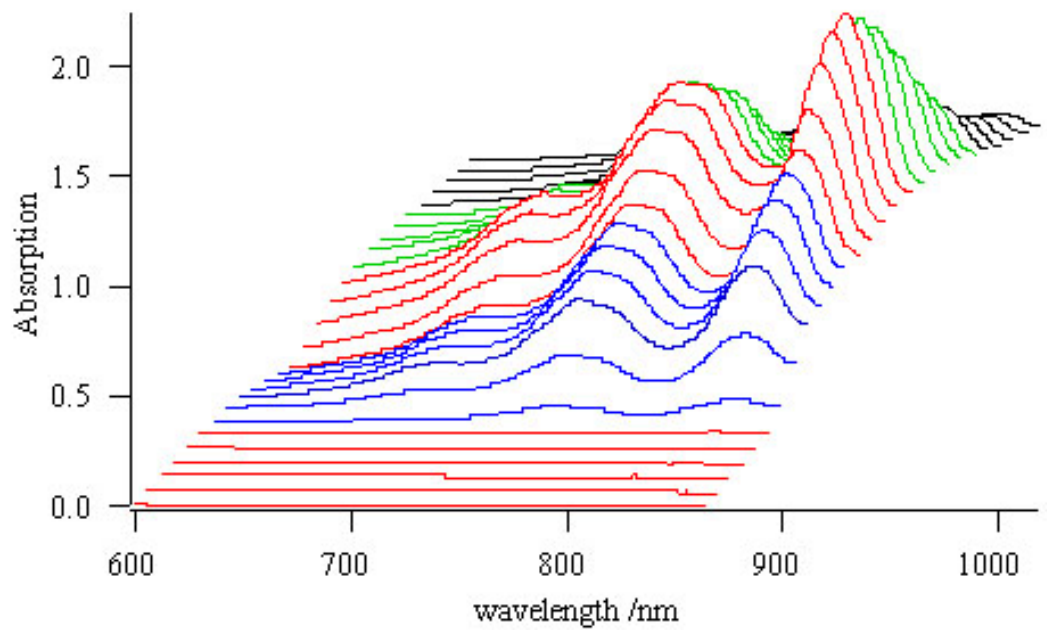


Fig. 3

4. Scanning Electrochemical Microscopy(SECM)

4 hrs

This chapter discusses the following aspects:

- Using platform-specific protocols.
- Using the Call Library Function Node to call the following types of shared libraries:
 - Dynamic Link Libraries (DLL) in Windows; Active X

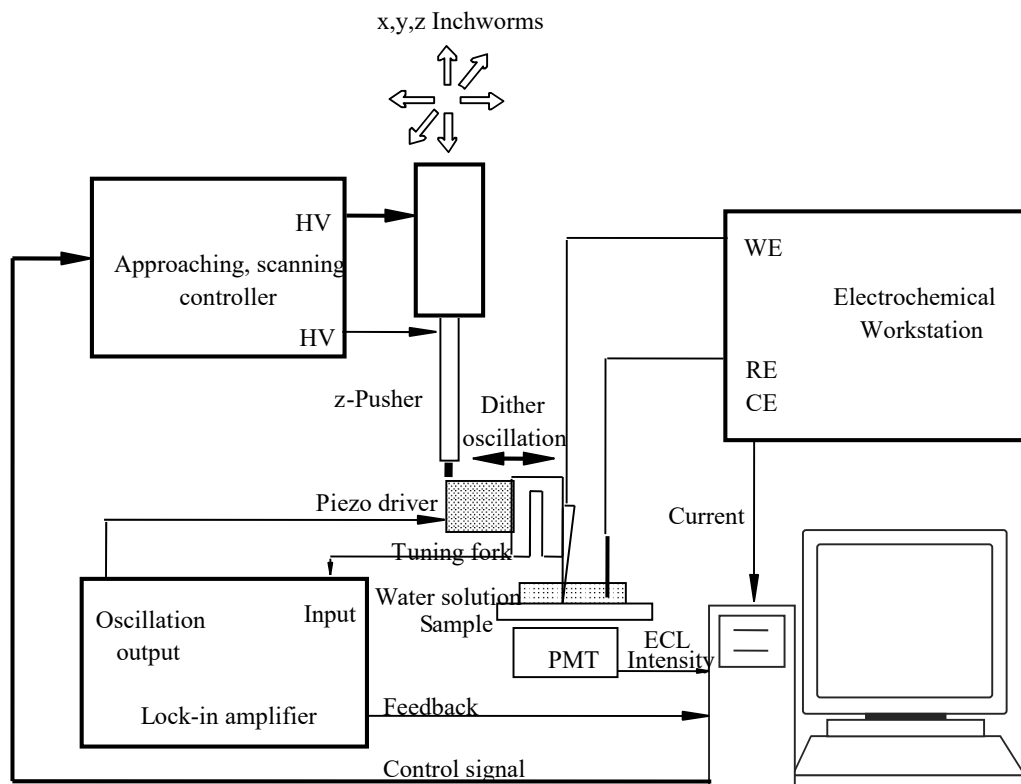


Fig. 4

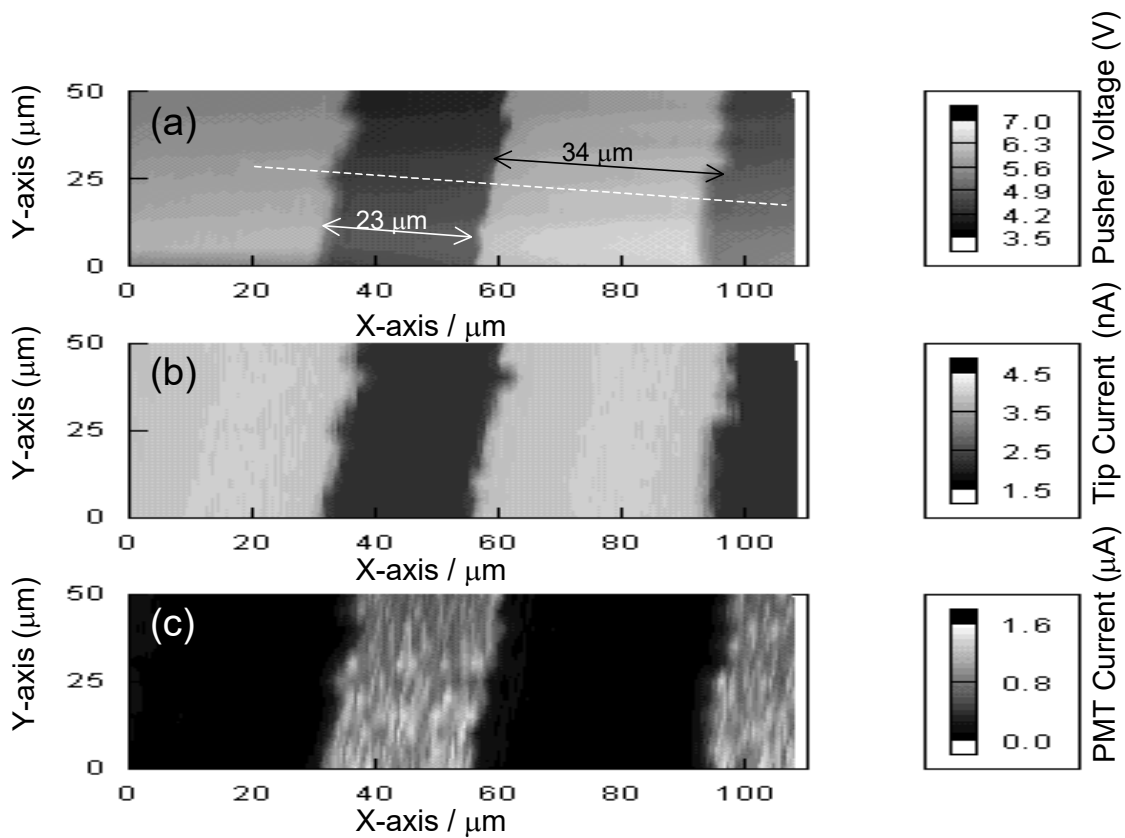


Fig. 5

Recently, a SECM has been set-up in my research lab using interfaces with C++ for a precise xyz piezostage controller. A high scanning speed (25 mm/s) at a high resolution (20 nm) can be easily reached. In addition, the SECM is with close-loop control. i.e. One can first do a scan on a sample and then the probe can be relocated precisely (20 nm resolution) onto an active site, where reaction kinetics can further be studied. A corrosion samples has been studying in this way. Furthermore, a nanoscale piezo stage (with a resolution as high as 0.5 nm) is being integrated onto an inverted microscope in my lab, aiming at transportation study of ions and molecules across membranes of live cells.

5. Presentations:

2 hrs

In-class presentation of the course project related to students' graduate research.

Learning outcomes

1. Solid knowledge of instrument controls.
2. Instrumentation fundamentals
3. Graphic programing essentials

4. Instrument assembly

5. Applications of modern instruments in research