Electrochemistry Laboratory (Credit: 2)

Academic Semester: 2026 Spring

Thr 1:20–5:20 pm or Fri 1:20–5:20 pm/week at R510

Lecturer	Wang, Yu-Heng (王育恒)
Email	wangyh2@mx.nthu.edu.tw (please put the course number CHEM531500 in the subject heading)
Office Location	R401
Office Hour	By appointment TA office: R503 (please make the appointment in advance)

A. Course Description

In CHEM504600, students learn the fundamental theoretical concepts underlying electrochemistry. This lecture course will cover the fundamentals, methods, and applications of electrochemistry in the context of independent research. In this wet lab course, CHEM531500, students will apply their theoretical knowledge in substantial laboratory modules in electrochemistry. CHEM531500 will focus on typical three-electrode electrochemical experiments and laboratory techniques that form the basis for applying electrochemistry in students' own research projects and building basic electrochemistry knowledge and intuition with respect to thermodynamics, kinetics, and mass transport. Electrochemistry laboratories will track theoretical concepts developed in the lecture course for students simultaneously enrolled in both courses.

CHEM531500 will include eight lab modules, focusing on building a potentiostat (the basic analytical tool in electrochemistry), potential-step and potentiometric measurements, advanced concepts in cyclic voltammetry, pulse voltammetry, open-circuit potential measurement, and electrochemical organic synthesis. Learning how to simulate experimentally obtained voltammograms to extrapolate related electrochemical parameters is another important topic in this course. The students will also learn to use modern electrochemistry software (*PSTrace*) to automate data processing and analysis. The students will meet one afternoon a week (4 h) for mandatory laboratory sessions led by the instructor and/or teaching assistant. These laboratory sessions are designed to allow students to work independently at their own pace, with appropriate safety training and oversight as needed.

B. Goals, Objectives, and Core Learning Outcomes

1. Learn how to make common analytical electrochemical measurements (cyclic voltammetry, open-circuit-potential measurement, chronoamperometry), including experimental design, practical cell setup, and instrumentation needs.
2. Learn to use modern electrochemistry software to process the raw data and conduct the required analysis.
3. Learn to simulate the experimentally measured voltammograms and extrapolate related electrochemical parameters to gain insights into the redox processes.

4. Understand basic electrical engineering design of potentiostat circuits and be able to design and troubleshoot basic potentiostat circuits.

Keywords: Cyclic Voltammetry (循環伏安法), Differential Pulse Voltammetry (微分脈衝伏安法), Open Circuit Potential (開路電位), Organic Electrocatalysis (有機電催化), Electrochemical Simulation (電化學模擬)

C. Required Knowledge

Basic knowledge of electrochemistry. Students who plan to enroll in CHEM531500 must also enroll in CHEM504600.

D. Required Materials

Calculator: An inexpensive calculator with logarithmic/exponential/scientific notation capabilities is required. The calculator will be permitted for use on quizzes and exams.

Class Handouts: You should obtain an electronic copy of each handout before the lab session.

E. Recommended Reading

1. Elgrishi, N.; Rountree, K. J.; McCarthy, B. D.; Rountree, E. S.; Eisenhart, T. T.; Dempsey, J. L. A Practical Beginner's Guide to Cyclic Voltammetry. *J. Chem. Ed.* **2018,** *95*, 197-206.
2. Martín-Yerga, D.; Rama, E. C.; García, A. C. Electrochemical Study and Determination of Electroactive Species with Screen-Printed Electrodes. *J. Chem. Ed.* **2016,** *93*, 1270-1276.
3. Rafiee, M.; Mayer, M. N.; Punchihewa, B. T.; Mumau M. R. Constant Potential and Constant Current Electrolysis: An Introduction and Comparison of Different Techniques for Organic Electrosynthesis. *J. Org. Chem.* **2021,** *86*, 15866-15874.
4. Goes, S. L.; Mayer, M. N.; Nutting, J. E.; Hoober-Burkhardt, L. E.; Stahl, S. S.; Rafiee, M. Deriving the Turnover Frequency of Aminoxyl-Catalyzed Alcohol Oxidation by Chronoamperometry: An Introduction to Organic Electrocatalysis. *J. Chem. Educ.* **2021**, *98*, 600-606.

F. Tentative Course Outline

Thursday: ; Friday:

TA: labs 1-2: 郭家愷; labs 3-4: 游正緯; labs 5-6: 莊瑋碩; lab 7: 張凱傑; lab 8: 林景科

Week	*Date*	*Topic*	*Note**
6	4/2	Check-in and Lab Safety Policy An Introduction to Electrochemical Techniques	Chemistry Library Meeting Room
7	4/9 or 4/10	Cyclic Voltammetry of Ferrocene: Diffusion Coefficient (Lab 1)	Labs 1–8: R510
8	4/16 or 4/17	Cyclic Voltammetry of Oxygen: Evaluating Electrochemical Reversibility (Lab 2)	Lab 1 report due
9	4/23 or 4/24	Cyclic Voltammetry of Dopamine: *EC* mechanism (Lab 3)	Lab 2 report due
10	4/28 or 4/30	Cyclic Voltammetry and Electrochemical Simulations (Lab 4)	Lab 3 report due
11	5/7 or 5/8	Electrochemical Study and Determination of Electroactive Species (Lab 5)	Lab 4 report due
12	5/14 or 5/15	Open Circuit Potential Measurement (Lab 6)	Lab 5 report due
13	5/21 or 5/22	An Introduction to Organic Electrocatalysis and Check-out (Lab 7)	Lab 6 report due
14	5/28 or 5/29	Practical Guides to Foot-of-the-Wave Analysis and Catalytic Tafel Plots (Lab 8)	Lab 7 report due
15	6/4 or 6/5	A make-up lab (optional)	Lab 8 report due

*The lab report is due in your lab section at 1:20 pm, one week after performing the experiments.

G. Method of Evaluation

Assignment	*Wet or Dry Experiment*	*Each Points*[2]
Lab 1 report	Wet	90
Lab 2 report	Wet	80
Lab 3 report	Wet	80
Lab 4 report	Hybrid	150
Lab 5 report	Wet	100
Lab 6 report	Wet	80
Lab 7 report	Wet	150
Lab 8 report	Dry	90
Total Points		820

1. A deduction of 20% of the maximum mark available from the actual mark achieved by the student shall be imposed upon expiry of the deadline; a further deduction of 10% of the maximum mark available from the actual mark achieved by the student shall then be imposed on each of the next subsequent working days.

Letter grades will be assigned at the end of the semester based on the following scale:

Total Points	*Letter Grade (GPA)*
≥ 700	A+
660–699	A
620–659	A–
596–619	B+
564–595	B
540–563	B–
516–539	C+
484–515	C
460–483	C–
380–459	D
< 380	E

*Final grades will be based upon an absolute scale. For example, if you earn a total of 750 points, you are guaranteed an A+, no matter how many other students earn that number of points. You are competing against this scale, not against other students; it is to your benefit to help one another.
*The final grade will be round to the nearest whole number.