

**Electrochemical Processes and Methods**

**Lecture:** T Th 11:00-11:50 am, Room 8335

**Course Instructor:** Dr. Kyoung-Shin Choi (3233A)  
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**Laboratory Instructor:** Dr. Rob McClain (2330)  
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**Course Credit:** 2 credits (Lecture Only ) or 3 credits (Lecture + Lab)

CHM 624 is intended to be an introductory graduate-level course on electrochemistry and electrochemical methods. This course will blend the theory of electrochemistry with electrochemical characterization methods and modern photoelectrochemical applications (e.g. solar energy conversion, photoelectrochemistry).

**Text Book**

Derek Pletcher, A First Course in Electrode Processes, 2nd ed., RSC Publish, 2009

**Reference**

Bard and Faulkner, Electrochemical Methods, 2nd ed., Wiley, 2009

**Contents**

## 1. Introduction to Electrode Reaction

- Electron Transfer
- Mass Transport
- Reversible and Irreversible Electrode Reactions
- Coupled Chemical Reactions
- Phase Transformation and Growth
- Metal Electrodes
- Electrical Double Layer

## 2. Electron Transfer

- Kinetics of Electron Transfer
- Multiple Electron Transfer Reactions
- Hydrogen Evolution and Oxidation Reactions
- Oxygen Evolution and Reduction
- Electrocatalysis

## 3. Experimental Electrochemistry

IR Drop and Double Layer Charging Current  
Working, Counter, and Reference Electrodes  
Electrolytes  
Separators and Membranes

#### 4. Techniques for the Study of Electrode Reactions

Steady State Techniques  
Electrolysis/Coulometry  
Steady State Current Density vs. Potential  
Rotating Disc Electrodes and Rotating Ring Disc Electrodes  
Non-Steady State Techniques  
Potential Step Experiments  
Cyclic Voltammetry  
AC Impedance

#### 5. Photoelectrochemistry of Semiconductors

Electronic Properties of Semiconductors  
Semiconductor/Liquid Junctions  
Charge Transfer at a Semiconductor/Liquid Junction  
Solar Energy Conversion utilizing Semiconductor/Liquid Junctions

#### **Labs** (Room 2330)

: Students registering for 3 credits will conduct several laboratory experiments, to be conducted at times arranged on an individual group basis. Please note that some labs will require time outside of lab period for data analysis. Computers with the BioLogic EC-Lab program will be available for your use in Room 2330. Or download a demo version from the BioLogic website (<http://www.bio-logic.info/potentiostat/software.html>).

**Exams:** There will be three exams. No make-up exams will be given.

Exams 1 and Exam 2 will be written exams. Exam 3 will be an oral presentation on a given topic (Topics will be announced in the middle of the semester.)

Exam 1: 7:00 PM – 9:00 PM, October 25 (Tue)

Exam 2: 5:05 PM – 7:05 PM, December 20 (Tue)

Exam 3: Oral presentation, evening exams during the week of 12/5-12/9

**Grading Scheme:** The grade in this class will be determined as follows.

Lab Reports: 33%

Exams 1-3 : 20% each

Problem Sets: 7%

| <b>Score</b> | <b>Grade</b> | <b>Score</b> | <b>Grade</b> |
|--------------|--------------|--------------|--------------|
| 100-90%      | A            | 59-50%       | C            |
| 89-80%       | AB           | 49-40%       | CD           |
| 79-70%       | B            | 39-30%       | D            |
| 69-60%       | BC           | 29-0%        | F            |