MEEG 867, Solid State Electrochemistry
Spring 2012
J.L. Hertz, B.Q. Wei

I. Course Objectives

Upon successful completion of this course, you will be able to:
• relate thermodynamic defect equilibria to charge and mass transport kinetics in both crystalline and amorphous/polymeric materials;
• explain the electrochemical equilibrium and rate limiting steps for reactions that occur at the electrode-electrolyte interface;
• describe the operating principle behind batteries, fuel cells, and other solid state electrochemical devices; and
• use common measurement techniques used to understand solid state electrochemical systems and analyze relevant experimental results.

II. Instructors

Professor Joshua Hertz
Spencer Labs 329
302-831-2778
hertz@udel.edu
Office hours: Mon. 1 – 2, Wed. 2 – 3; by appointment

Professor Bingqing Wei
Spencer Labs 312
302-831-6438
weib@udel.edu
Office hours: Tue. 4 – 5, Thu. 4 – 5; by appointment

III. Class Sessions

Wednesdays from 5:00 – 7:30 in Drake Hall Room 004.
Attendance and active participation is expected at all sessions.

IV. Communications

A class email list and website is set up using Sakai. You must log in to the course site to gain access. Official announcements will be communicated and resources will be distributed using these tools. In-person and electronic communication with the instructor is strongly encouraged (email replies are guaranteed within 72 hours, but not necessarily sooner).
V. Grades

Paper presentations (20% written + 20% oral):
During the second half of the course, each class will include 2 student presentations about a recent, important research paper from the literature within the general field of solid state electrochemistry. Each student will forward a paper to the class 1 week before his/her scheduled presentation date along with a technical summary that serves to describe the author’s intent, methods, and results; connect the work with prior research; critique the work’s merits and shortcomings; and suggest what questions are opened or left unanswered by the work. The student will present the summary to the class in a 15-20 minute presentation and lead the ensuing 15-20 minute discussion.

Final Project (30% written + 30% oral):
During the last class day and the to-be-scheduled final exam period, each student will present to the class a lesson on a topic of solid state electrochemistry not otherwise covered in class. The topic may be a particular device, experimental method, or matter of theory. The oral presentation should be 20 minutes and should be accompanied by a written report that could be used as a reference to the topic in the future.

VI. Academic Honesty

Plagiarism is absolutely prohibited; unattributed use of another’s work is forbidden. Suspected instances of academic dishonesty will be dealt with according to UD policy (see www.udel.edu/judicialaffairs/ai.html).

VII. Texts

Recommended reading:

Journals (with electronic access on campus):
## VIII. Approximate Course Outline

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
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<tbody>
<tr>
<td>Feb. 8</td>
<td>Introduction, General Electrochemistry</td>
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<tr>
<td>15</td>
<td>Solid State Chemistry, Physical Chemistry, Diffusion</td>
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<td>22</td>
<td>Defect Chemistry</td>
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<td>Electrode Equilibrium and Kinetics</td>
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<td>Mar. 7</td>
<td>Intercalation Materials</td>
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<td>14</td>
<td>Crystalline Ion Conductors and Mixed Ionic-Electronic Conductors</td>
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<td>*21</td>
<td>Polymer and Amorphous Ion Conductors</td>
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<td>(28)</td>
<td>(Spring Break)</td>
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<td>* Apr.4</td>
<td>Porous Materials</td>
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<tr>
<td>*11</td>
<td>Fuel Cells and Chemical Sensors</td>
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<td>*18</td>
<td>Batteries and Supercapacitors</td>
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<td>*25</td>
<td>Cyclic Voltammetry and other DC Measurement Techniques</td>
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<tr>
<td>* May 2</td>
<td>Impedance Spectroscopy and Chemical Measurement Techniques</td>
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<td>9</td>
<td>Final Project Presentations</td>
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**Final Exam** Final Project Presentations

*Led by Hertz*

*Led by Wei*

* - 2 student paper presentations