

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	电化学基础 Fundamentals of Electrochemistry				
2.	授课院系 Originating Department	材料科学与工程系 Department of Materials Science and Engineering				
3.	课程编号 Course Code	MSE332				
4.	课程学分 Credit Value	3				
5.	课程类别 Course Type	专业选修课 Major Elective Courses (请保留相应选项 Please only keep the relevant information)				
6.	授课学期 Semester	秋季 Fall				
7.	授课语言 Teaching Language	英文 English (请保留相应选项 Please only keep the relevant information)				
8.	授课教师、所属学系、联系方式 (如属团队授课, 请列明其他授课教师) Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	李辉 Li Hui, 讲席教授 Chair Professor, Chemistry, 88018987				
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced (请保留相应选项 Please only keep the relevant information)				
10.	选课人数限额(可不填) Maximum Enrolment (Optional)					
11.	授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
	学时数 Credit Hours	48				48

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	化学, 物理化学 Chemistry, Physical Chemistry
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	电化学能量储存与转换 Electrochemical Energy Storage and Conversion
14. 其它要求修读本课程的学系 Cross-listing Dept.	

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

1. 学习电化学基础理论, 掌握电解质溶液的性质与描述方法、电化学热力学、电极/溶液的界面结构与性质原理、电极过程动力学等基础理论知识。
2. 能够应用电化学基础理论知识, 对实际问题如气体电极、金属阳极过程、金属电沉积过程进行诠释。
3. 具备分析和解决电化学应用领域中各种实际问题的基本能力。
4. 通过英语教学, 培养学生的专业英语能力, 掌握课程核心词汇, 能够阅读英语专业文献。
5. 介绍电化学研究热点和发展趋势, 培养学生自主学习和终身学习的意识。

16. 预达学习成果 Learning Outcomes

此课程本课程是介绍电化学及电化学工程的基本原理。本课程旨在让学生掌握电化学和电化学工程的基础理论知识, 掌握电化学分析手段, 了解电化学理论如何应用于电化学能量储存与转换等新能源领域, 从而培养学生在新能源领域的创新能力。

This course will introduce the basic principles of electrochemistry and electrochemical engineering. The course will equip the students with the knowledge of the working mechanisms and characteristics of electrochemical systems and the skill of electrochemical analysis. The course will also introduce the application of electrochemistry and electrochemical engineering in clean and renewable energy areas.

17. 课程内容及教学日历 (如授课语言以英文为主, 则课程内容介绍可以用英文; 如团队教学或模块教学, 教学日历须注明主讲人)

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

- 1. Introduction (weeks1-2)**
 - 1.1 Definition of Electrochemistry
 - 1.2 Examples of electrochemical industry
 - 1.3 History of electrochemistry
 - 1.4 Frontier research areas in electrochemistry
- 2. Basic concepts – a review (review of concepts learned in Physical Chemistry) (weeks2-4)**
 - 2.1 Oxidation and reduction
 - 2.2 Electrodes and electrochemical cells
 - 2.3 Conductivity of electrolyte solution
 - 2.4 Activity and activity coefficient of electrolyte solution
- 3. Thermodynamics of electrochemistry (weeks5-6)**
 - 3.1 Electrode potential and cell potential
 - 3.2 Interfacial potential
 - 3.3 Junction potential
 - 3.4 Free energy and cell emf
 - 3.5 Spontaneity of redox reactions
 - 3.6 Nernst equation
- 4. Electrode/electrolyte interface (weeks7-8)**
 - 4.1 Introduction
 - 4.2 Electrocapillary phenomena
 - 4.3 Double layer differential capacitance
 - 4.4 Double layer structure
 - 4.5 Potential of zero charge (PZC)
- 5. Electrode process in general (weeks9-10)**
 - 5.1 Polarization and overpotential
 - 5.2 Electrode-electrolyte interface (Non-faradic)
 - 5.3 Pathway of electron transfer reaction
 - 5.4 Electron transfer reaction rate
- 6. Mass transfer kinetics (weeks11-12)**
 - 6.1 Modes of mass transport
 - 6.2 Steady-state diffusion process
 - 6.3 Concentration polarization
 - 6.4 Transient diffusion process
- 7. Electron transfer kinetics (weeks13-14)**

- 7.1 Effect of electrode potential on electron transfer rate
- 7.2 Kinetic parameters of electron transfer reactions
- 7.3 Steady-state electrochemical polarization
- 7.4 Effect of double layer structure on electron transfer rate
- 7.5 Kinetics with co-existence of electrochemical and concentration polarization

8. Gas electrode processes (weeks15)

- 8.1 Importance of gas electrode processes
- 8.2 Cathodic process of hydrogen electrode (HER)
- 8.3 Anodic process of hydrogen electrode (HOR)
- 8.4 Difficulty of studying oxygen electrode
- 8.5 Anodic process of oxygen electrode (OER)
- 8.6 Cathode process of oxygen electrode (ORR)

9. Electrode processes of metals(weeks16)

- 9.1 Metal anodic processes - dissolution and passivation
- 9.2 Metal cathodic processes – deposition

10. Batteries and fuel cells (very brief) (weeks16)

18. 教材及其它参考资料 Textbook and Supplementary Readings

- (1) 电化学原理, 李荻, 2008, 北京航空航天大学出版社.
- (2) Electrochemical Methods – Fundamentals and applications, 2th Edition, Allen J. Bard and Larry R. Faulkner, 2001, John Wiley & Sons, Inc.
- (3) Electrochemistry – the Basics, Lefrou C, Fabry P, Poignet J C., 2012, Chemistry in Britain.
- (4) Fundamentals of Electrochemistry, 2nd Edition, V. S. Bagotsky., 2006, John Wiley & Sons, Inc.

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10%		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		30%		
期中考试 Mid-Term Test		25%		
期末考试 Final Exam		35%		
期末报告				

Final Presentation
其它（可根据需要
改写以上评估方
式）
**Others (The
above may be
modified as
necessary)**

20. 记分方式 **GRADING SYSTEM**

- A. 十三级等级制 **Letter Grading**
 B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority

