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**	**微纳合成、技术与应用实验** **Laboratory for Micro-Nano Synthesis, Technology and Application**
2.	**授课院系** **Originating Department**	化学系 Department of Chemistry
3.	**课程编号** **Course Code**	CH306
4.	**课程学分 Credit Value**	2
5.	**课程类别** **Course Type**	专业选修课 Major Elective Courses
6.	**授课学期** **Semester**	春季 Spring
7.	**授课语言** **Teaching Language**	中英双语 English & Chinese
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）**	汤小菊　第一教学楼 532　88018730　tangxj@sustech.edu.cn 颜瑗珲　第一教学楼 533　88018733　yanah@sustech.edu.cn 何绮婷　第一教学楼 537　88018741　heqt@sustech.edu.cn Tang Xiaoju　Lecture Hall 1, Room-532, 88018730, tangxj@sustech.edu.cn Yan Aihui　Lecture Hall 1, Room-533, 88018733, yanah@sustech.edu.cn He Qiting　Lecture Hall 1, Room-537, 88018741, heqt@sustech.edu.cn
9.	**实验员/助教、所属学系、联系方式** **Tutor/TA(s), Contact**	无 NA
10.	**选课人数限额(可不填)** **Maximum Enrolment（Optional）**	15

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	0	0	64	0	64

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	物理化学 I（CH301），金属有机化学（CH214），配位化学（CH215）
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	纳米材料合成与技术（CH304）
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

《微钠合成技术与应用》实验课的教学目标是使学生全面了解纳米粒子、二维纳米材料和具有纳米特征的孔材料的合成和表征。课程介绍纳米材料和纳米材料的新型合成方法及潜在的应用。重点是理解纳米材料的合成设计和性能研究。课程还为学生提供各种纳米材料表征技术的原理和实践，包括 X 射线衍射、透射电子显微镜、扫描电子显微镜、原子力显微镜、拉曼光谱仪、全自动气体吸附仪等。

This course aims to provide a comprehensive overview of synthesis and characterization of nanoparticles, two-dimensional nanomaterials and pore materials with nanoscale features. Course modules will cover the fundamental scientific principles controlling assembly of nanostructured materials; synthesis, measurement and computational tools; new properties at the nanoscale, and existing and emerging applications of nanomaterials. It will introduce novel synthesis methods of nanomaterials and nanofabrication ranging from 'top-down' lithography approaches to 'bottom-up' self-assembly and nanopatterning. Emphasis is placed on understanding the synthesis design and properties study of nanomaterials. The course will also provide the students with necessary background for understanding various nanomaterials characterization techniques, including X-ray scattering and diffraction, transmission electron microscopy, scanning electron microscopy, atomic force microscopy, raman spectroscopy and BET method and so on.

16. 预达学习成果 Learning Outcomes

通过课程的学习，学生将了解纳米材料的理论基础、合成工艺和实验技术，并了解纳米技术是材料和器件的跨学科方法。了解制备纳米材料的合成设计方法。 了解各种表征技术的相关方法以及有关不同表征技术的基本知识。通过本课程，学生需要掌握各种工艺技术的知识，以合成纳米结构材料；了解控制纳米材料生长的因素，并能够分析纳米结构材料的结构和性质。

The student will have an understanding of the theoretical basis, synthetic processes and experimental techniques for nanomaterials and an understanding that nanotechnology is an interdisciplinary approach to materials and devices. Understand the different methods to prepare the nanomaterials and technical skill on the process method. Understand the relative methods of various characterization techniques and the basic knowledge about the different characterization techniques. Impart the knowledge about the characterization techniques and study each and every technique and acquire the knowledge to use the technique. Through this course, students need to gain knowledge of the various process techniques to synthesis Nanostructured materials; understand the factors controlling growth of the nanomaterials and be able to analyze structural and properties of nano structured materials.

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.)

实验一、绪论（4 学时）：实验内容、评分标准、实验安全

Introduction to experiments, grade rulers and safety.

实验二、纳米氧化锌的合成（5 学时）：溶胶-凝胶法合成纳米氧化锌

The synthesis of nano zinc oxide: to synthesize the nano zinc oxide by sol-gel method.

实验三、纳米氧化锌的表征-透射电子显微镜（TEM）（4 学时）：学习透射电子显微镜的原理和技术；用 TEM 表征纳米氧化锌的大小和结构

The characterization of nano zinc oxide by transmission electron microscopy: to learn the principle and technology of TEM; to characterize the size and structure of the nano ZnO particles.

实验四、纳米氧化锌的表征-X 射线衍射（XRD）（4 学时）：学习 X 射线衍射仪的原理和技术；用 XRD 表征纳米氧化锌的物相信息

The characterization of nano zinc oxide by X-ray diffraction: to learn the principle and technology of XRD; to characterize the phase information of the nano ZnO particles.

实验五、纳米氧化锌的表征-原子力显微镜（AFM）（5 学时）：学习旋涂法在硅片上制备纳米氧化锌薄膜；学习原子力显微镜的原理和技术；用 AFM 表征纳米氧化锌膜

The characterization of nano zinc oxide by atomic force microscopy: to gain a fim of nano ZnO on silicon wafer through spinning coating; to learn the principle and technology of AFM; to characterize the height information of the nano ZnO film.

实验六、氧化石墨烯的合成（5 学时）：采用 Hummers 法，在溶液中对石墨进行氧化得到氧化石墨烯

The synthesis of graphene oxide: to synthesize graphene oxide through oxidation of graphite in solution with Hummers' method.

实验七、还原氧化石墨烯的合成（5 学时）：采用 Hummers 法，对氧化石墨进行还原得到还原氧化石墨烯

The synthesis of reduced graphene oxide: to synthesize reduced graphene oxide through reduction of graphene oxide with Hummers' method.

实验八、石墨烯的表征-透射电子显微镜（4 学时）：学习透射电子显微镜的原理和技术；用 TEM 表征氧化石墨烯和还原石墨烯的结构

The characterization of reduced graphene oxide and graphene oxide by transmission electron microscopy: to learn the principle and technology of TEM; to characterize the structure of the graphene oxide and reduced graphene oxide.

实验九、石墨烯的表征-X 射线衍射（4 学时）：学习 X 射线衍射仪的原理和技术；用 XRD 表征氧化石墨烯和还原氧化石墨烯的物相信息

The characterization of reduced graphene oxide and graphene oxide by X-ray diffraction: to learn the principle and technology of XRD; to characterize the phase information of the graphene oxide and reduced graphene oxide.

实验十、石墨烯的表征-拉曼光谱仪（4 学时）：学习拉曼光谱仪的原理和技术；用拉曼光谱仪表征氧化石墨烯和还原氧化石墨烯的结构

The characterization of reduced graphene oxide and graphene oxide by raman spectroscopy: to learn the principle and technology of raman spectroscopy; to characterize the structure of the graphene oxide and reduced graphene oxide.

实验十一、介孔二氧化硅的合成（4 学时）：采用模板法合成介孔二氧化硅

The synthesis of mesoporous SiO2 through supramolecular templating method.

实验十二、介孔二氧化硅的表征-扫描电子显微镜（SEM）（4 学时）：学习扫描电子显微镜的原理和技术；用 SEM 表征介孔二氧化硅的形貌

The characterization of mesoporous SiO2 by scanning electron microscopy: to learn the principle and technology of SEM; to characterize the morphology of the mesoporous SiO2.

实验十三、介孔二氧化硅的表征-X 射线衍射（4 学时）：学习 X 射线衍射仪小角衍射的原理和技术；用 XRD 小角衍射表征介孔结构

The characterization of mesoporous SiO2 by low-angle X-ray diffraction: to learn the principle and technology of low-angle X-ray diffraction; to characterize the mesoporous structure with low-angle X-ray diffraction method.

实验十四、介孔二氧化硅的表征-气体吸附仪（BET）（8 学时）：学习气体吸附仪的原理和技术；用 N2 吸脱附等温线和 BET 方法表征比表面积和介孔的孔径分布

The characterization of mesoporous SiO2 by N2 adsorption-desorption BET method: to learn the principle and technology of static volumetric absorption analyzer; to characterize the BET specific surface area and pore size distribution by N2 adsorption-desorption isotherm and BET method.

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

None

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	5 min	5		
课堂表现 Class Performance	4-6 hours	45		
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam				
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)**	4-8 hours	50		实验报告 Experimental Report

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

化学系教学指导委员会
Teaching committee of the chemistry department