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**	现代材料分析技术 Modern Techniques in Materials Characterization
2.	**授课院系 Originating Department**	物理系 Department of Physics
3.	**课程编号 Course Code**	PHY425
4.	**课程学分 Credit Value**	3
5.	**课程类别 Course Type**	专业选修课 Major Elective Courses
6.	**授课学期 Semester**	秋季 Fall
7.	**授课语言 Teaching Language**	英文 English
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）**	王克东副教授，物理系 慧园一栋 404 室 Kedong Wang, Associate Professor, Department of Physics Rm. 404, Building 1，HuiYuan wangkd@sustech.edu.cn 0755-8801-8207
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	待公布 To be announced
10.	**选课人数限额(可不填) Maximum Enrolment （Optional）**	40

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	32		32	复习、考试（2 周） Revision & Exam (2 weeks)	64

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	量子力学 I Introduction to Quantum Mechanics （PHY206-15）
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无 NA
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 NA

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

This course covers the underlying theories and operation principles of some modern materials characterization techniques, including ion beam techniques, surface analytical techniques, mass spectroscopic techniques, etc., which are of prime importance in unveiling and understanding different properties of materials (e.g. chemical composition, electrical properties, and electronic structures).

16. 预达学习成果 Learning Outcomes

After the course, the students are expected to be able to

- Master the basic knowledge (both principle and operation) of commonly used materials characterization and analytical techniques
- Interpret experimental results obtained by the materials characterization techniques covered in the course
- Apply the concepts and methodology in materials characterization in realistic problems and cases
- Analyze, judge and solve realistic problems and cases in relation to materials characterization
- Develop an analytical mind towards materials characterization and
- Develop and establish methodology and experimental techniques for analyses of different properties of 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.)

Lecture 1: Sample preparation and related techniques (1 week) Week1: Lecture 1: Sample preparation and related techniques 1, Sample preparation: An analytical perspective 2, Sample preparation for specific material characterization 3, Vacuum	General experimental procedures and guidelines for sample preparation
Lectures 2-5: Spectroscopic techniques (6 weeks) Week2: Lecture 2 X-ray photoelectron spectroscopy 1. Background 2. Instrumentation Week3: Lecture 2 X-ray photoelectron spectroscopy 3. Spectral Interpretations: The XPS spectrum and the calibrations, and the primary structures Week4: Lecture 2 X-ray photoelectron spectroscopy 3. Spectral Interpretations: secondary structures 4. Quantification 5. Chemical mapping Week5: Lecture 3:Auger electron spectroscopy 1.Background 2. Instrumentation 3. Spectral Interpretations Week6: Lecture4:Photoemission Spectroscopy 1. Nomenclature 2. Principles 3. Instrumentation: UV source 4. UV Photoemission analysis, Angle-resolved UPS, Angle-integrated UPS 5*.Synchrotron radiation Week7: Lecture5:Proton (or particle)-Induced X-ray Emission (PIXE) 1. Background 2. Instrumentation 3. Data interpretation 4. PIXE analysis and applications	Spectroscopic techniques for study on surface composition, chemical environment, and surface electronic properties
Lectures 6-7: Mass spectroscopic techniques (3 weeks) Week8: Lecture 6: Mass Spectrometry (MS) 1. Background 2. Principles: sample introduction and ionization methods Week9: Lecture 6: Mass Spectrometry (MS) 3. Ion separation and detection 4.Data interpretation 5. Applications Week10: Lecture 7 Secondary ion mass spectrometry (SIMS) 1. Types of SIMS 2. Basic principles 3. Instrumentation 4. SIMS analysis	Mass spectroscopic analytical techniques for study on chemical composition (MS) and atomic composition (SIMS)
Lecture 8-9: Diffraction techniques (6 weeks) Week11: Lecture 8: Transmission electron microscopy Part I An introduction to TEM 1. What is TEM 2. The instrument and some basic concepts 3. TEM operation modes Week12: Lecture 8: Transmission electron microscopy Part II, Crystal structures and TED	Diffraction techniques for study on crystal structure (TEM) and surface structure (LEED)

1. Transmission Electron Diffraction (TED) 2. Diffraction pattern and indexing of diffraction patterns Week13: Lecture 8: Transmission electron microscopy Part III, TEM Image Contrast Week14: Lecture 8: Transmission electron microscopy Part IV, High Resolution Imaging Week15: Lecture 9:low energy electron diffraction(LEED) 1. Background 2. Instrumentation 3. Principles 4. Qualitative LEED Week16: Lecture 9:low energy electron diffraction(LEED) 5. Quantitative LEED 6. Example of analysis 7. A brief introduction of RHEED	

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

No textbook.

Supplementary readings:

- P. E. F. Flewitt and R. K. Wild, “Physical Methods for Materials Characterization”, Institute of Physics (IOP) Publishing Ltd., 2nd ed. 2003
- C. R. Brundle, C. A. Evans Jr., and S. Wilson, “Encyclopaedia of Materials Characterization”, Butterworth-Heinemann & Manning Publications Co., 1992,
- J. C. Riviere, “Surface Analytical Techniques”, Clarendon Press, Oxford, 1990
- D. A. Skoog,, F. J. Holler, and T. A. Nieman, “Principles of Instrumental Analysis”, 5th ed.,Saunders College Publishing, 5th ed. 1998
- B. D. Cullity, “Element of X-ray Diffraction”, 2nd ed., Addison-Wiley Publisher, 1978
- P. B. Hirsch, H. Howie, R. B. Nicholson, D. W. Pashley, and M. J. Whelan, “Electron Microscopy of Thin Crystals”, Butterworths, 1965
- H. E. Duckworth, R.C. Barbar, and V.S.Venkatasubramanian, “Mass Spectroscopy”, 2nd ed. Cambridge University Press, 1986
- C. N. Banwell, E. M. McCash. “Fundamentals of Molecular Spectroscopy”, 4th ed. London, New York : McGraw-Hill, 1994
- W. Czanderna, T. E. Madey, and C. J. Powell, “Beam effects, surface topography and depth profiling in surface analysis, Kluwer Academic, New York, 2002

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		20%		Including Lab reports.
期中考试 Mid-Term Test				
期末考试 Final Exam		50%	Fail	
期末报告 Final Presentation		20%	Fail	
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

物理系教学指导委员会
Education Instruction Committee of Physics department