南方科技大学 SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

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**	纳米探针在化学、物理及材料科学中的应用 Nanoprobes in Chemistry, Physics and Material Science
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**	MSES105
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**	夏季 Summer
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）**	
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）**	

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

12.	先修课程、其它学习要求 **Pre-requisites or Other Academic Requirements**	
13.	后续课程、其它学习规划 **Courses for which this course is a pre-requisite**	
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**

This course contains the application of nanoprobes in material science, physics and chemistry. The course will prepare the students to evaluate nanoprobes for specific analytical tasks. Beside lectures explaining the fundamental aspects of the techniques, seminars will be used to discuss actual literature on the respective techniques.

16. **预达学习成果 Learning Outcomes**

After the course learning, the students will understand the application of nanoprobes in material science, physics and chemistry and be able to use suitable ones in practical study.

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.)

Courses 1 & 2 (6 Credit hours)

Introduction /Motivation: Length scales, physical properties, quantization effects, nano-objects (nanoparticles, anisotropic nanocrystals, core-shell structures) – specific applications. Quantization in different dimensions, preparation: "bottom-up" / "top-down" approach; thin film systems, epitaxy, growth modes; clusters (magic numbers, shell model), molecular Nanosystems.

Courses 3 & 4 (6 Credit hours)

Nanoprobes: General requirements, potential techniques; resolution limit, imaging techniques vs. studies in reciprocal space. Visible Light Microscopy (VLM): experimental setup, concept of magnification, numerical aperture, contrast mechanisms and contrast enhancement, image distortions, correction methods; optical spectroscopy and its combination with microscopic imaging (e.g., Raman imaging). Specific optical imaging techniques: confocal microscopy, two-photon excitations; single-molecule spectroscopy, STED; 4π-imaging; digital imaging; inline holography.

Courses 5 & 6 (6 Credit hours)

Scanning probe techniques: Atomic-Force Microscopy (AFM) – basic considerations, forces at surfaces, piezo-scanners, experimental setup, modes of operation, sample environment. Scanning Tunneling Microscopy (STM), tunneling effect, theoretical considerations, tunneling spectroscopy (STS), I-V-characteristics, tip-sample interactions; vibrational spectroscopy.Specific scanning probes: magnetic force microscopy vs. spin-polarized STM; SNOM; Nanophoto lithography, Electrochemical Force Microscopy; Scanning Thermal Microscopy, Scanning Capacitance Microscopy, Kelvin Probe Analysis – Literature seminar on recent scanning probe analysis.

Courses 7 & 8 (8 Credit hours)

Electron probes: emitted electrons – field electron microscopy, field ion microscopy, photoelectron emission microscopy (PEEM). Incoming electron techniques: Scanning electron microscopy (SEM); electron optics, electron-sample interactions, electron cascades, secondary detectors. Low-energy electron microscopy (LEEM), modes of operation, bright vs. dark field imaging, real-time imaging; phase transitions. Transmission electron microscopy (TEM); experimental setup, comparison with VLM; modes of operation, diffraction imaging, HR-TEM; STEM; aberration correction; TEM-EELS as spectroscopic tool.

Courses 9 & 10 (6 Credit hours)

X-ray based techniques: x-ray sources, holography radiation, x-ray microscopy with lenses, lenses imaging: Imaging with coherent sources: holography, coherent diffraction imaging, ptychography, laminography; magnetic imaging (XMCD), time-resolved x-ray microscopy. Imaging in reciprocal space: XRD, small-angle x-ray scattering, basic considerations, shape analysis. Comparative discussion of all relevant nanoprobes; which technique is most appropriate for specific applications?

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

课程评估 ASSESSMENT

19. 评估形式　　评估时间　　占考试总成绩百分比　违纪处罚　　备注

Type of Assessment	Time	% of final score	Penalty	Notes
出勤 Attendance		20		
课堂表现 Class Performance		10		
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		70		
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