

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	集成电路工艺实践 Integrated Circuit Fabrication Laboratory
2.	授课院系 Originating Department	Department of Electrical & Electronic Engineering 电子与电气工程系
3.	课程编号 Course Code	EE320-15
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	春季及秋季 Spring and Fall
7.	授课语言 Teaching Language	中文 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)	于洪宇, 教授, 电子与电气工程系, yuhy@sustech.edu.cn Hongyu Yu Department of Electrical and Electronic Engineering 755-88018508 yuhy@sustech.edu.cn
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	刘欢, 教学实验员, 电子与电气工程系, liuh3@sustech.edu.cn Huan Liu, Teaching Technician, Department of Electrical & Electronic Engineering, liuh3@sustech.edu.cn
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	18

11. 授课方式 Delivery Method	讲授	习题/辅导/讨论	实验/实习	其它(请具体注明)	总学时
	Lectures	Tutorials	Lab/Practical	Other (Please specify)	Total
学时数 Credit Hours	24		48		72

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	EE204 半导体器件导论 EE204 Introduction to semiconductor devices
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

本课程介绍硅超大规模集成电路芯片生产制造相关的实际工艺技术，讲解这些工艺技术背后的科学工艺过程的物理图像以及测量方法。包括 CMOS 工艺技术，光刻，刻蚀，薄膜沉积，真空技术，离子注入，化学物理沉积，等离子体技术，薄膜分析等。并通过实验操作，让学生掌握半导体工艺制造的各项实践能力，实现理论与实践的融合。

This lecture focuses on the basic features of the silicon integrated circuits manufacture, including their distinctions and common underlying principle. Such as: CMOS Technology, lithography, etching, various deposition techniques, vacuum technology, evaporation, ion implantation, epitaxy, chemical vapour deposition, plasma, film analysis. Through experimental operation, students can master various practical abilities of semiconductor process manufacturing, and realize the integration of theory and practice.

16. 预达学习成果 Learning Outcomes

1. 学习集成电路版图设计方法，并完成器件版图制作
 2. 掌握集成电路工艺中常用检测设备的使用方法，例如：电子显微镜、椭偏仪、光学显微镜
 3. 掌握集成电路工艺中部分常用制备的原理及制备方法，例如：湿法刻蚀、干法刻蚀、光刻、磁控溅射、LPCVD、原子层沉积、晶圆切割等
 4. 掌握集成电路器件常用电学测量方法及数据分析手段，例如：探针台等设备的使用
 5. 掌握电容器制备的工艺流程
 6. 养成良好的实验习惯，具备良好的安全规范意识。
- 1、 Master the layout method and completed semiconductor devices layout.
 - 2、 Master the use of testing equipment for integrated circuit processes, such as: Spectroscopic Ellipsometer, Optical Microscopy, SEM, etc.
 - 3、 Master the integrated circuit processes and operational principle, such as: LPCVD, Wet Etching, Dry Etching,

Photolithography, Sputter, ALD, Dicing, etc.

- 4、 Master the methods of electrical measurement and analysis for semiconductor devices, such as: 4-points probe station, etc.
- 5、 Master the integrated circuit processes of capacitor.
- 6、 Develop good habits of experimental and a good sense of safety and regulation.

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.)

第 1 周：简述集成电路工艺流程、洁净间安规培训、半导体器件版图设计

Week 1: Introduce integrated circuit process, Safety Training of Clean room, Semiconductor device layout

第 2 周：讲解集成电路工艺制备及原理、完成激光打标实验

Week 2: Introduce integrated circuit process preparation and operational principle, complete laser marking experiment

第 3 周：讲解集成电路工艺制备及原理、完成低气压化学气相沉积制备二氧化硅薄膜实验

Week 3: Introduce integrated circuit process preparation and operational principle, preparation of SiO₂ film by LPCVD

第 4 周：讲解集成电路工艺制备及原理、完成半导体标准清洗工艺流程及光刻实验

Week 4: Introduce integrated circuit process preparation and operational principle, complete the standard cleaning process of semiconductor and photolithography

第 5 周：讲解集成电路工艺制备及原理、完成湿法刻蚀并学习椭偏仪的使用

Week 5: Introduce integrated circuit process preparation and operational principle, complete wet etching and learn the use of ellipsometer.

第 6-7 周：讲解集成电路工艺制备及原理、使用原子层沉积及金属溅射设备完成钽金属镀层实验

Week6-7: Introduce integrated circuit process preparation and operational principle, complete Tantalum planting by ALD and Sputter

第 8 周：讲解集成电路技术及应用、完成光刻（套刻）实验

Week 8: Introduce integrated circuit technology and application, complete the overlay

第 9 周：讲解集成电路技术及应用、使用感应耦合等离子体刻蚀机完成干法刻蚀工艺实验

Week 9: Introduce integrated circuit technology and application, dry etching by ICP

第 10 周：讲解集成电路技术及应用、完成 900 度高温热退火工艺实验

Week 10: Introduce integrated circuit technology and application, rapid thermal processing with 900°C high temperature

第 11 周：讲解集成电路技术及应用、完成晶圆切割工艺实验

<p>Week 11: Introduce integrated circuit technology and application, wafer saw by dicing system</p> <p>第 12 周: 讲解集成电路技术及应用、使用金属蒸镀设备, 完成晶圆背面铝金属镀层工艺实验</p> <p>Week 12: Introduce integrated circuit technology and application, Al planting by E-Beam Evaporator</p> <p>第 13 周: 讲解集成电路电性能测试原理及方法、使用 4 探针台完成对电容器件电性能测试实验</p> <p>Week 13: Introduce the testing methods of semiconductor device, electrical performance testing of capacitor by 4-points probe stations</p> <p>第 14 周: 讲解集成电路测试原理及方法、使用扫描电镜完成对电容器表面情况的检视实验</p> <p>Week 14: Introduce the testing methods of semiconductor device, visual check of capacitor by SEM</p> <p>第 15 周: 讲解集成电路环保指令、完成通过分析物质成分表、第三方检测报告判断芯片或器件是否符合不同应用领域的环保要求的实践活动</p> <p>Week 15: introduce the environmental directive of integrated circuit, such as ROHS and REACH, analysis of MSDS, SGS Report etc</p> <p>第 16 周: 总结回顾集成电路工艺流程, 讲解集成电路工艺的品质管理要求, 并通过对电容器电性能及外观检查结果、分析工艺实验种各环节中所出现的品管问题及解决方案, 完成分组问答等形式的课堂实践活动</p> <p>Week 16: introduce the safety standard of integrated circuit, learning quality management</p>

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

<p>超大规模集成电路工艺技术: 理论, 实践及模型。</p> <p>Silicon VLSI Technology, Fundamentals, Practice and Modelling</p>
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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		30		
小测验 Quiz				
课程项目 Projects		40		
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final		20		

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

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