

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	氮化镓半导体材料与器件导论 Introduction to GaN Semiconductor Materials and Devices				
2.	授课院系 Originating Department	深港微电子学院				
3.	课程编号 Course Code	SME321				
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	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)	李携曦 Li Kwai Hei 南方科技大学深港微电子学院 khli@sustech.edu.cn 17138699137				
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	36	12	0	0	48

Credit Hours

--	--	--	--	--

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	EE203 固态电子学 EE203 Solid-state Electronics
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	无
14.	其它要求修读本课程的学系 Cross-listing Dept.	无

教学大纲及教学日历 SYLLABUS

15. **教学目标 Course Objectives**

本课程旨在培养本科生在实际应用对氮化镓半导体器件设计的兴趣与能力。主要分为三部分实施：1. 讲授氮化镓材料的基础及生长机制；2. 讲授氮化镓器件结构设计、制造工艺、封装对其性能的影响；3. 学生分组展示近年氮化镓器件的应用进展。

This course aims to motivate the interests of students and foster their capability on designing GaN semiconductor devices for practical applications. It can be divided into three parts: 1. Basis and growth of GaN materials; 2. Effect of GaN device structure design, manufacturing process and device packaging on its performance; 3. Group presentation of recent GaN devices and their applications.

16. **预达学习成果 Learning Outcomes**

- 1) 学会氮化镓半导体材料的生长原理和制备方法；
 - 2) 掌握氮化镓半导体器件的工作原理，结构以及应用；
 - 3) 知悉材料特性和器件结构，为分析，研究和设计新型半导体器件打下基础；
 - 4) 知悉氮化镓半导体器件产业的不足和可改进处，探索相关的科研和产业应用。
- 1) Learn the growth principle and method of GaN semiconductor materials;
 - 2) Master the working principle, structure and application of GaN semiconductor devices;
 - 3) Understand the material characteristics and device structure, lay the foundation for the analysis, research and design of new semiconductor devices;
 - 4) Understand the shortcomings and improvements of GaN semiconductor device industry, and explore the latest scientific research and industrial applications.

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.)

Section 1-3 9 学时

III-V 族半导体材料的基础

- 熟悉 III-V 族半导体材料的早期开发
- 了解用于氮化镓器件制造的主要无机材料族
- 了解 III-V 族半导体合金中不同元素的作用
- 熟悉氮化镓的特性，使其适合于制造光学和电子器件

Basics of III-V Semiconductor Materials

- Get acquainted with the early development of III-V Semiconductor Materials
- Know the principal families of inorganic materials used in GaN device fabrication
- Understand the roles of different elements in the III-V semiconductor alloys
- Get familiar with the properties of GaN that make it suitable for manufacturing optical and electronic devices

Section 4-7 12 学时

氮化镓器件的制造

- 了解设备制造中使用的主要设备的结构特点
- 熟悉用于设备制造的衬底材料
- 描述制造中的单位处理步骤
- 集成单元处理步骤
- 讨论在不同基板上的制造工艺

Fabrication of GaN devices

- Know the constructional features of the main equipment used in device fabrication
- Get familiar with the substrate materials for device fabrication
- Describe the unit process steps in manufacturing
- Integrate the unit process steps to sketch process sequence
- Discuss fabrication processes on different substrates

Section 8

期中考试 (Mid-term exam)

Section 9-10 6 学时

氮化镓器件的封装

- 了解包装在可靠的设备操作中的作用
- 了解不同的包装方法

Packaging of GaN devices

- Know the role of packaging in reliable device operation
- Understand different packaging methods

Section 11-13 9 学时

氮化镓器件性能和参数

- 了解评估设备质量的主要参数
- 定义效率参数及其内部功能相关的参数
- 绘制电流-电压特性并讨论其电流控制行为
- 了解电气规格，例如正向压降和击穿电压
- 定义设备参数

GaN device performance and parameters

- Know the main parameters to evaluate the device quality
- Define the efficiency parameters and those associated with their internal functioning
- Draw the current-voltage characteristics and discuss their current-controlled behavior
- Understand the electrical specifications such as forward voltage drop and breakdown voltage
- Define the device parameters

Section 14-16 9 学时

氮化镓器件的热管理

- 了解对设备的即时热影响以及长时间高温运行时设备的退化

- 了解设备寿命与温度的关系
- 对设备的热效应进行分析计算
- 熟悉保护驱动电路不受温度影响

Thermal Management of GaN devices

- Understand the immediate thermal effects on devices as well as the device degradation on high-temperature operation for long periods
- Know about the dependence of device lifetime on temperature
- Perform analytical calculations about thermal effects on device
- Get familiar with protecting drive circuits against temperature

Section 17-18 3 学时

氮化镓器件的应用和未来

- 全面了解氮化镓器件的使用
- 可视化未来氮化镓材料和器件的预期进展
- 确定该领域的研究领域和问题

Application and future of GaN devices

- Acquire an overall perspective of the use of GaN devices
- Visualize the expected progress in GaN Materials and devices in the future
- Identify the research areas and problems in this field

Group project

小组项目内容 (Group project):

小组项目主要目的是让学生总结氮化镓半导体器件的整个制造流程，结合理论和产业实际，激发学生讨论氮化镓半导体器件产业的不足和可改进处，可以结合最新的科研和产业应用。

The main purpose of the group project is to let students summarize the fabrication process of GaN semiconductor devices, and combine the theory and industry reality to stimulate students to discuss the deficiencies and improvements of the GaN semiconductor device industry, which can be combined with the latest scientific research and industrial applications.

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

Handbook of Nitride Semiconductors and Devices [Hadis Morkoc] 9783527408399

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		10%		
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		25%		
期中考试 Mid-Term Test		25%		

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)

	30%		

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

