

课程大纲

COURSE SYLLABUS

1.	课程代码/名称 Course Code/Title	氮化镓半导体材料与器件 GaN Semiconductor Materials and Devices
2.	课程性质 Compulsory/Elective	专业选修课 Major Elective Courses
3.	课程学分/学时 Course Credit/Hours	3/48
4.	授课语言 Teaching Language	中英 Chinese&English
5.	授课教师 Instructor(s)	李携曦 Li Kwai Hei
6.	先修要求 Pre-requisites	EE203 固态电子学 EE203 Solid-state Electronics
7.	教学目标 Course Objectives	<p>本课程的主要目标为培养学生了解氮化镓半导体材料的原理和制备方法，掌握氮化镓半导体器件的工作原理、结构以及应用，了解最新的材料和器件，为分析、研究和设计新型半导体器件打下基础。本课程分为四个部分：氮化镓材料的基础及生长、氮化镓器件结构设计及制造、氮化镓器件封装及检测、氮化镓器件的性能及应用。</p> <p>After the completion of this course, students should know the following items. (1) Familiar with the basic of GaN materials (2) Design and fabrication GaN devices (3) GaN device packaging and inspection (4) GaN device performances and applications.</p>
8.	教学方法 Teaching Methods	讲授 Lectures, 习题/辅导/讨论 Tutorials
9.	教学内容 Course Contents	<p>Section 1-3</p> <p>III-V 族半导体材料的基础</p> <ul style="list-style-type: none"> ▪ 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 <p>Basics of III-V Semiconductor Materials</p> <ul style="list-style-type: none"> ▪ 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 <p>Section 4-7</p> <p>氮化镓器件的制造</p> <ul style="list-style-type: none"> ▪ 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

	<p>Fabrication of GaN devices</p> <ul style="list-style-type: none"> ▪ 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	<p>氮化镓器件的封装</p> <ul style="list-style-type: none"> ▪ 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 <p>Packaging of GaN devices</p> <ul style="list-style-type: none"> ▪ Know the role of packaging in reliable device operation ▪ Understand different packaging methods
Section 11-14	<p>氮化镓器件性能和参数</p> <ul style="list-style-type: none"> ▪ 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 <p>GaN device performance and parameters</p> <ul style="list-style-type: none"> ▪ 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	<p>氮化镓器件的热管理</p> <ul style="list-style-type: none"> ▪ 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 <p>Thermal Management of GaN devices</p> <ul style="list-style-type: none"> ▪ 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	<p>氮化镓器件的应用和未来</p> <ul style="list-style-type: none"> ▪ 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 <p>Application and future of GaN devices</p> <ul style="list-style-type: none"> ▪ 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

<p>Group project</p>	<p>小组项目内容 (Group project):</p> <p>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。</p> <p>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.</p>										
<p>10. 课程考核 Course Assessment</p>											
<p>请再此注明: ①考查/考试; ②分数构成。</p> <p>考试 Test</p> <table data-bbox="220 667 715 846"> <tr> <td>出勤 Attendance</td> <td>10%</td> </tr> <tr> <td>课堂表现 Class Performance</td> <td>10%</td> </tr> <tr> <td>平时作业 Assignments</td> <td>20%</td> </tr> <tr> <td>期中考试 Mid-Term Test</td> <td>20%</td> </tr> <tr> <td>期末报告 Final Presentation</td> <td>40%</td> </tr> </table>		出勤 Attendance	10%	课堂表现 Class Performance	10%	平时作业 Assignments	20%	期中考试 Mid-Term Test	20%	期末报告 Final Presentation	40%
出勤 Attendance	10%										
课堂表现 Class Performance	10%										
平时作业 Assignments	20%										
期中考试 Mid-Term Test	20%										
期末报告 Final Presentation	40%										
<p>11. 教材及其它参考资料 Textbook and Supplementary Readings</p>											
<p>Handbook of Nitride Semiconductors and Devices</p> <p>[Hadis Morkoc]</p>											