課程資訊	
課程名稱	尖端材料之基礎與應用 Advanced Materials: Fundamentals and Applications
開課學期	114-2
授課對象	工學院　永續化學科技國際研究生博士學位學程
授課教師	林麗瓊
課號	Phys8150
課程識別碼	222ED5480
班次	
學分	3.0
全/半年	半年
必/選修	選修
上課時間	星期一 2,3,4(9:10~12:10)
上課地點	
備註	本課程以英語授課。本課程以英語授課。上課教室：凝態中心 212 室。(CCMS room212) 總人數上限：25 人
課程簡介影片	
核心能力關聯	核心能力與課程規劃關聯圖
課程大綱	
為確保您我的權利,請尊重智慧財產權及不得非法影印	
課程概述	In this course, students will learn the fundamental properties, synthesis methods and applications of various advanced materials, ranging from semiconductors, to quantum matters and low-dimensional nano-materials. Start from Si technology, you will learn the thermodynamics and kinetics of bulk and thin film growth processes. Especially, the principles and development of the specific process and factors that control the material quality will be

	taught. In addition, some important issues like contact problem, doping and dielectric layer would be discussed. Besides Si, the second and third generation semiconductors, such as GaAs and GaN, would be introduced. Breakthroughs in synthesis of these materials have enabled or enhanced their unique properties, which can change our daily life. After introducing the semiconductor properties and applications, we will take a step forward to a variety of materials, including ferroelectrics, oxide-based superconductor, spintronics materials, followed by energy materials such as thermoelectrics, batteries, perovskites, polymers and metal organic framework (MOF). Low-dimensional materials from 0D, 1D to 2D will be taught in the end of the course. The course is held in Room212, 2F, CCMS(physics department building)
課程目標	This multidisciplinary course will provide the knowledge of the physics and materials science of different advanced materials. Moreover, the course provides a comprehensive overview of a variety of growth methods, ranging from solution-based process, solid state synthesis, ball milling, to vapor phase deposition techniques such as sputtering, CVD, MOCVD, and MBE. The ultimate course objective is to enhance the critical and innovative thinking of students by in depth understanding the relationship between the growth/morphology/structure of the materials and the fundamental properties, which holds the key for realizing practical applications of these advanced materials and devices.
課程要求	General physics and General chemistry
預期每週課前或/與課後學習時數	

<table>
<tr><td>Office Hours</td><td></td></tr>
<tr><td>指定閱讀</td><td></td></tr>
<tr><td>參考書目</td><td>KITTEL, Charles, Introduction to Solid State Physics, 8th edition. Wiley, 2004.
CHUNG, Yip-Wah and KAPOOR, Monica, Introduction to Materials Science and Engineering, 2nd edition. CRC Press, to appear in April 2022. (1st edition published in 2006).
NAKAMURA, Shuji; CHICHIBU, Shigefusa F. (ed.). Introduction to Nitride Semiconductor Blue Lasers and Light Emitting Diodes. CRC Press, 2000.
NAKAMURA, Shuji; PEARTON, Stephen; FASOL, Gerhard. The Blue Laser Diode: The Complete Story. Springer Science & Business Media, 2000.
XIAO, Hong. Introduction to Semiconductor Manufacturing Technology, 2nd edition. SPIE Press E-Books, 2012.
PIERSON, H. O. Handbook of Chemical Vapor Deposition. Noyes Publication, 1999.
JONES, Anthony C.; HITCHMAN, Michael L. (ed.). Chemical Vapor Deposition: Precursors, Processes and Applications. Royal Society of Chemistry, 2009.</td></tr>
<tr><td>評量方式
(僅供參考)</td><td>
<table>
<tr><th>No.</th><th>項目</th><th>百分比</th><th>說明</th></tr>
<tr><td>1.</td><td>Midterm Essay</td><td>15%</td><td></td></tr>
<tr><td>2.</td><td>Midterm Oral Presentation</td><td>15%</td><td></td></tr>
<tr><td>3.</td><td>Engagement in Class</td><td>15%</td><td>(e.g., asking questions, etc.)</td></tr>
<tr><td>4.</td><td>Final Exam</td><td>55%</td><td></td></tr>
</table>
1. 本校尚無訂定 A+ 比例上限。
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	2. 本校採用等第制評定成績，學生成績評量辦法中的百分制分數區間與單科成績對照表僅供參考，授課教師可依等第定義調整分數區間。詳見學習評量專區 (連結)。

課程進度

週次	日期	單元主題
第 1 週	2/23	Si, bulk and thin film growth, semiconductor fundamentals, doping, contact, dielectric, devices, beyond Moore's law (LC Chen) The course is held in Room212, 2F, CCMS(physics department building)
第 2 週	3/2	Si, bulk and thin film growth, semiconductor fundamentals, doping, contact, dielectric, devices, beyond Moore's law (LC Chen)
第 3 週	3/9	GaAs, MBE growth, direct band gap, LEDs, laser diodes, photovoltaic, etc.(LC Chen)
第 4 週	3/16	GaN, MOCVD growth, alloying, blue LED, lighting and HEMT (KH Chen)
第 5 週	3/23	Spintronics & quantum matters (I), sputtering principles & various industrial applications (DR Qu)
第 6 週	3/30	Spintronics & quantum matters (II) (DR Qu) //SiC, AlN, high power devices (LC Chen)
第 7 週	4/6	National Holiday
第 8 週	4/13	Midterm (Oral presentation)
第 9 週	4/20	Bulk crystals, solid state synthesis (& high pressure), X-ray diffraction, ferroelectrics (WT Chen) *Essay due in this week
第 10 週	4/27	Solar cells, polymers and perovskites, molecular designs, solution-based processes (SH Huang)
第 11 週	5/4	CO2 capture and mass transfer in porous materials (DY Kang)
第 12 週	5/11	Thermoelectrics, ball milling (KH Chen)

第 13 週	5/18	Battery materials (BJ Hwang)
第 14 週	5/25	0D & 1D materials for various applications; 2D materials for catalysis (LC Chen)
第 15 週	6/1	2D materials: CVD growth and characterization, electronic and optoelectronic applications (WH Wang)
第 16 週	6/8	Final Exam (Written Test)