教學大綱(Syllabus)-研究所

系務會議通過修訂日期：2007/9/12

updated: 2007/10/04

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| 課程編碼  **(course no.)** | M025 | | | | | 學分  **(credits)** | ３ |
| 課程名稱  **(course name)** | (中) 薄膜科學 | | | | | | |
| (Eng.) Thin Film Science | | | | | | |
| 開課系所班級  **(dept. & year)** | 材料科學與工程學系碩士班一年級  (Dept. of Mat. Sci. & Engr.,Master) | | | | | 授課教師  **(teacher)** | 杜正恭 教授  (Prof. Jenq-Gong Duh) |
| 課程類別  **(course type)** | 選修  (Elective) | | 授課語言  **(language)** | | 中文  (Chinese) | 開課學期  **(semester)** | 上學期  (Fall) |
| 課程簡述 **(course description)** | (中) 薄膜科學之進步及應用相當迅速及廣博。對在原子尺寸成長機制與微結構 之了解為本學科主要目的 | | | | | | |
| (Eng.) The development and application of thin film science is extremely fast and important. The main objective of this course is to know how to control the nucleation  & growth of thin film in atomic scale. | | | | | | |
| 課程目標 **(course objectives)** | (中)  1. 薄膜材料科學簡介  2. 真空科學技術簡介  3. 氣相沉積  4. 基材與薄膜成核  5. 均質磊晶  6. 異質磊晶  7. 薄膜沉積及結構 | | | | | | |
| (Eng.)   1. Introduction of materials science of thin film 2. Introduction of vacuum science 3. Vapor deposition 4. Thin-film nucleation and substrate surfaces 5. Homo-epitaxy 6. Hetero-epitaxy   7. Film deposition and structure | | | | | | |
| 先修課程**(prerequisites)** | | | | | | | |
| 課程編碼  (course no.) (course name) (relation to the current course) | | 課程名稱 | | 與課程銜接的重要概念、原理與技能 | | | |
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| 教學模式**(teaching methodology)** | 模式  (methodology) | 講授  (teaching) | 討論/報告(discussion &  report) | 實驗/參訪  (exp./fab visit) | 遠距/網路教學  (remote/web teaching) | 合計  (sum) |
| 學分分配  (credit distrib.) | 2 | 1 |  |  | 3 |
| 授課時數分配  (hour distrib.) | 2 | 1 |  |  | 3 |

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| 授課進度與內容（週次、單元名稱與內容、習作**/**考試進度、備註）  **(course content and homework/tests schedule)** | | | |
| 週次  (week) | 單元名稱與內容  (subject and content) | 習作/考試進度  (homework and tests) | 備註  (remark) |
| 01 | Overall Introduction |  |  |
| 02 | Review of materials science |  |  |
| 03 | Vacuum science & technology: kinetic theory  of gases, gas transport & pumping |  |  |
| 04 | Vacuum science & technology: vacuum  pumps & vacuum systems |  |  |
| 05 | Practice |  |  |
| 06 | Midterm |  |  |
| 07 | Physical Vapor Deposition: physics &  chemistry of evaporation; uniformity & purity |  |  |
| 08 | Physical Vapor Deposition: evaporation hardware & techniques; glow discharge & Plasmas |  |  |
| 09 | Physical Vapor Deposition: sputtering &  sputtering process |  |  |
| 10 | Chemical Vapor Deposition: Introduction;  reaction types |  |  |
| 11 | Chemical Vapor Deposition:  Thermodynamics; transport; kinetics |  |  |
| 12 | Computer simulation |  |  |
| 13 | Film formation & structure: introduction;  capillarity theory |  |  |
| 14 | Film formation & structure: capillarity theory |  |  |
| 15 | Film formation & structure: atomistic nucleation process |  |  |
| 16 | Film formation & structure: cluster  coalescence & depletion; grain structure |  |  |
| 17 | Final presentation |  |  |
| 18 | Final presentation |  |  |
| 學習評量方式 | | | |
| **(evaluation)** | | | |
| (1) Midterm presentation: 50% | | | |
| (2) Final presentation & Term paper: 50% | | | |
| 期中考（Midterm）： | | | |
| 目的在評估學生對課堂講授資料的了解程度。 | | | |



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| 期末報告及簡易書面報告（Final presentation & term paper）： 每位同學從文獻的回顧中，針對現今薄膜科學的發展及應用選定一主題，從期刊蒐集相關的論文，歸納薄膜科學的發展方向，於學期末提出報告。目的是要培養學生蒐集資料、整理資料與分 析資料的能力，並訓練學生表達與溝通的能力。 |
| 教科書（書名、作者、書局、代理商、說明）  **(textbook)** |
|  |
| 參考書目（書名、作者、書局、代理商、說明  **(other references)** |
| 1. “The Materials Science of Thin Films”2nd ed. by M. Ohring(Academic press, 2002 歐亞書局代 理): rich content 2. “Thin-Film Deposition:principles & practice” by D.L. Smith(McGraw-Hill,1999 歐亞書局代理): advanced level 3. “Thin Film Technology Handbook” by A. Elshabini-Riad & F. D. Barlow III(McGraw-Hill,1997 民全書局代理):overview of technique 4. “Physical Vapor Deposition of Thin Films” by J.E. Mahan(John Wiley & Sons, 2000 歐亞書局代理): details on PVD |
| 課程教材（教師個人網址請列在本校內之網址。）  **(teaching aids & teacher's website)** |
| Power point files. |

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| 與學系教育目標之關聯性**(**材料系**)**  **(relation to educational objective of materials engineering department)** |
| 1. 提供材料性質、製程與應用及跨領域知識與訓練  To provide interdisciplinary know-how and training on materials properties, processing, and applications  2. 培育具獨立思考、創新與實作能力之材料科技人才  To train materials technology students for independent thinking, innovation, and practical skills 3. 培養團隊合作精神與溝通協調整合能力  To cultivate the spirit of teamwork and the capacity of integrated cooperation 4. 建立多元價值與國際觀  To inculcate multifarious values and cosmopolitan worldview 5. 強化綠色材料科技教育  To implement educational programs in eco-materials technology |
| 與學系教育核心能力之關聯性**(**材料系**)**  **(relation to educational core abilities for materials engineering department)** |
| (A) 特定材料之專業知識  Specialized knowledge in Materials science and Engineering  (B) 策劃及執行專題研究之能力  Ability to plan and execute a research project  (C) 撰寫專業論文之能力  Ability to write journal articles  (D) 創新思考及獨立解決問題之能力  Ability to do innovative thinking and independent problem solving  (E) 跨領域協調整合之能力  Ability to work in an interdisciplinary setting  (F) 國際觀及綠色材料意識  A fine international scope and general concept of eco-material  (G) 領導、管理及規劃之能力  Ability in leadership, management, and organization  (H) 終身自我學習成長之能力  Ability for life-long learning  ( I ) 學術專業倫理  Professional ethics in Science and Engineering |

# 課程內涵達成學系【教育目標】比對資料

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| 授課進度與內容 | 教育目標 | | | | |
| 目標一 | 目標二 | 目標三 | 目標四 | 目標五 |
| 提供材料 | 培育具獨 | 培養團 隊 | 建立多 元 | 強化綠色 |
| 性質、製程 與應用及 | 立思考、創 新與實作 | 合作精 神 與溝通 協 | 價值與 國  際觀 | 材料科技 教育 |
| 跨領域知 | 能力之材 | 調整合 能 |
| 識與訓練 | 料科技人 | 力 |
| 才 |
| 請勾選關聯性🗹 | 🗹 | 🗹 | 🗹 | □ | 🗹 |
| Overall Introduction | 1 | 1 | 0 | 0 | 1 |
| Special example: Cu metallization | 1 | 1 | 0 | 0 | 0 |
| Review of materials science | 1 | 1 | 0 | 0 | 0 |
| Vacuum science & technology: kinetic theory of gases, gas  transport & pumping | 1 | 1 | 0 | 0 | 0 |
| Vacuum science & technology: vacuum pumps & vacuum  systems | 1 | 1 | 0 | 0 | 0 |
| practice | 1 | 1 | 0 | 0 | 0 |
| Physical Vapor Deposition: physics & chemistry of  evaporation; uniformity & purity | 1 | 1 | 0 | 0 | 0 |
| Physical Vapor Deposition: evaporation hardware &  techniques; glow discharge & plasmas | 1 | 1 | 0 | 0 | 0 |
| Physical Vapor Deposition: sputtering & sputtering process | 1 | 1 | 0 | 0 | 0 |
| Chemical Vapor Deposition: Introduction; reaction types | 1 | 1 | 0 | 0 | 0 |
| Chemical Vapor Deposition: Thermodynamics; transport;  kinetics | 1 | 1 | 0 | 0 | 0 |
| Computer simulation | 1 | 1 | 0 | 0 | 0 |
| Film formation & structure: introduction; capillarity theory | 1 | 1 | 0 | 0 | 0 |
| Film formation & structure: capillarity theory | 1 | 1 | 0 | 0 | 0 |
| Film formation & structure: atomistic nucleation process | 1 | 1 | 0 | 0 | 0 |
| Film formation & structure: cluster coalescence & depletion;  grain structure | 1 | 1 | 0 | 0 | 0 |
| Final presentation | 1 | 1 | 1 | 0 | 0 |
| Final presentation | 1 | 1 | 1 | 0 | 0 |
| 總計(%) | 100% | 100% | 11% | 0% | 5% |

註： 1. 所有必修課均須填寫此表。

2. 矩陣中請填入關聯性； 1 表示相關，0 表示無相關。

3. 學系教育目標項次請依據表1填寫。

# 課程內涵達成學系【核心能力】比對資料(研究所)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 授課進度與內容 | 核心能力 | | | | | | | | |
| A | B | C | D | E | F | G | H | I |
| 運用數學 | 設計與執 | 執行材料 | 製程整 | 溝通協 | 獨立思 | 培養國 | 終身學 | 瞭解材 |
| 、科學及 | 行材料實 | 工程實務 | 合及及 | 調之能 | 考及解 | 際觀及 | 習之習 | 料工程 |
| 材料工程 | 驗及分析 | 所需之技 | 元件實 | 力與團 | 決問題 | 認識綠 | 慣與能 | 人員的 |
| 知識能力 | 數據之能 | 術與能力 | 作之能 | 隊合作 | 之能力 | 色材料 | 力 | 社會責 |
| 力 | 力 | 之精神 | 對全球 | 任與專 |
| 環境的 | 業倫理 |
| 影響 |
| 請勾選關聯性🗹 | 🗹 | 🗹 | 🗹 | □ | □ | 🗹 | □ | □ | □ |
| Overall Introduction | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| Special example: Cu metallization | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Review of materials science | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vacuum science & technology: kinetic theory of gases, gas  transport & pumping | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vacuum science & technology: vacuum pumps & vacuum  systems | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| practice | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Physical Vapor Deposition: physics & chemistry of  evaporation; uniformity & purity | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Physical Vapor Deposition: evaporation hardware &  techniques; glow discharge & plasmas | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Physical Vapor Deposition: sputtering & sputtering process | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical Vapor Deposition: Introduction; reaction types | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical Vapor Deposition: Thermodynamics; transport;  kinetics | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Computer simulation | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Film formation & structure: introduction; capillarity theory | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Film formation & structure: capillarity theory | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Film formation & structure: atomistic nucleation process | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Film formation & structure: cluster coalescence &  depletion; grain structure | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Final presentation |  |  |  |  |  |  |  |  |  |
| 總計(%) | 100% | 100% | 100% | 0% | 0% | 5% | 0% | 0% | 0% |

註： 1. 所有必修課均須填寫此表。

2. 矩陣中請填入關聯性； 1 表示相關，0 表示無相關。

3. 學系教育目標項次請依據表1填寫。