

課程名稱 (course name)	(中) 材料熱力學(下) (U002)				
	(Eng.) Thermodynamics in Materials Science (2/2)				
開課系所班級 (dept. & year)	材料系大學部	學分 (credits)	3	授課教師 (teacher)	張立信
課程類別 (course type)	<input checked="" type="checkbox"/> 必修(Mandatory) <input type="checkbox"/> 選修(Elective)	授課語言 (language)	中文	開課學期 (semester)	下學期
課程簡述 (course description)	(中) 接續上學期的課程，首先介紹建構三元相圖的理論基礎與判讀，包含多溫投影圖與等溫圖兩種。接著教授反應平衡的概念，推導多相多元系統之反應平衡條件與平衡常數，並舉例說明其應用，包括 Ellingham 圖與相穩定圖的建立。接著將教導以反應平衡為基礎之電化學原理，包括最重要之 Nernst 方程，並以數種典型電池為例說明以及介紹水溶液反應之 Pourbaix 圖。最後將教導統計熱力學概論，導入統計概念計算輔助函數與晶體熱容等。				
	(Eng.) The theoretical basis and interpretation of ternary phase diagrams including polythermal projections and isothermal sections are taught following the course in the first semester. The concept of reaction equilibrium is taught and the condition of reaction equilibrium and equilibrium constant are derived. Examples are given to show the applications including the Ellingham diagram and phase stability diagram. The principle of electrochemistry based on reaction equilibrium is introduced. The most important Nernst equation and several typical batteries are described as examples, and the Pourbaix diagram for aqueous reactions. Finally, the statistical thermodynamics is introduced and the auxiliary functions and lattice heat capacity are whereby calculated.				
先修課程名稱 (prerequisites)					
課程目標與核心能力關聯配比(%) (relevance of course objectives and core learning outcomes)				教學方法與評量方法 (teaching and assessment methods)	
課程目標(中/ Eng.)		核心能力	配比	教學方法	評量方法
1. 能了解與判讀三元相圖 (To understand the read the ternary phase diagram)		<input checked="" type="checkbox"/> 1. 運用數學、科學及材料工程知識能力	50%	講授	測驗
2. 能了解反應平衡概念 (To understand the concept of reaction equilibrium)		<input checked="" type="checkbox"/> 2. 設計與執行材料實驗及分析數據之能力	30%		
3. 能計算單相系統之反應平衡條件 (To calculate the equilibrium condition for monophase systems)		<input checked="" type="checkbox"/> 3. 執行材料工程實務所需之技術與能力	10%		
4. 計算多相系統之反應平衡條件 (To calculate the equilibrium condition for multiphase systems)		<input type="checkbox"/> 4. 製程整合及元件實作之能力			
5. 能了解並應用 Ellingham 圖 (To understand and apply the Ellingham diagrams)					

6. 能了解並繪製相穩定圖 (To understand and draw the Phase stability diagrams) 7. 能了解電化學原理與 Nernst 方程 (To understand the principle of electrochemistry and the Nernst equation) 8. 能了解電池原理並認識數種典型電池 (To understand the principle of batteries and know several typical batteries) 9. 能了解水溶液之反應與 Pourbaix 圖 (To understand the aqueous reaction and the Pourbaix diagram) 10. 能了解統計熱力學概念並藉以詮釋材料性質 (To understand the concept of statistical thermodynamics and whereby interpret some materials properties)	<input type="checkbox"/> 5. 溝通協調之能力與團隊合作之精神	10%		
	<input checked="" type="checkbox"/> 6. 獨立思考、解決問題、終身學習之習慣與能力			
	<input type="checkbox"/> 7. 培養國際觀及認識綠色材料對全球環境的影響			
	<input type="checkbox"/> 8. 瞭解材料工程人員的社會責任與專業倫理			

**授課內容(單元名稱與內容、習作/考試進度、備註)
(course content and homework/ tests schedule)**

01	課程回顧	Review	
02	三元相圖	Ternary Phase Equilibria	
03	三元相圖	Ternary Phase Equilibria	
04	反應平衡	Reaction Equilibria	測驗 1
05	單相反應	Monophase Reactions	
06	多相反應	Multiphase Reactions	
07	多相反應	Multiphase Reactions	測驗 2
08	多相反應	Multiphase Reactions	
09	期中考	Midterm	
10	電化學	Electrochemistry	
11	電化學	Electrochemistry	
12	電化學	Electrochemistry	
13	電化學	Electrochemistry	測驗 3
14	電化學	Electrochemistry	
15	統計熱力學	Statistical Thermodynamics	
16	統計熱力學	Statistical Thermodynamics	測驗 4
17	總複習	Total Review	
18	期末考	Final Exam	

**學習評量方式
(evaluation)**

- 學期成績計算項目及權重標準如下：
(The percentages of items concerned :)
 A. 期中考(Midterm exam) 30%
 B. 期末考(Final exam) 30%
 C. 測驗(Tests) 40%
- 期考(Examinations)
 期中、期末考均配合學校考試時程。內容包含所有講授與教科書中內容。
(The midterm and final exam are carried out according to the semester schedule. The content taught in the course is the target of the exams.)
- 測驗(Tests)
 課程每一單元結束後，將規定課後練習題要求學生完成。課程內容進行到一定份量，將進行測驗，定期評量學生學習表現。本學期安排四次，期中考前後各兩次。

(Some exercises of each chapter are assigned as the homework after finishing the chapter. Tests are carried out as certain contents are lectured for evaluating the academic performance of students. Four tests are arranged in this semester, twice before and after the midterm.)

教科書&參考書目 (書名、作者、書局、代理商、說明)
(textbook & other references)

教科書 Textbook

書名(Title) : Chemical Thermodynamics for Metals and Materials, 2006

作者(Author) : Hae-Geon Lee

出版社(Publisher) : Imperial College Press

代理商(Agent) : 無、中興大學電子書(None, e-book in Netlibrary in NCHU)

說明(Description) : 本書是針對材料相關科系之大專生所寫。作者以化學的觀點講授古典熱力學的原理以及應用於材料科學上所需具備的知識。本書章節以重點敘述的方式安排，可強化學習效果。選擇本書作為教科書的另一原因是本書較為精簡的內容，可使學生較快具備熱力學概念，預期將較能接受同時進行的物理冶金課程。

(This book is written for students in material-related departments. The author lectures the principles of classic thermodynamics and the knowledge of their applications on materials science in the chemical aspect. The sections of this book are arranged by the way of key statements which can enhance the effect of learning. Another reason of choosing this book as the textbook is its simplified content which enables students to possess thermodynamic concept more quickly and to comprehend anticipatively the course of physical metallurgy that is hold spontaneously.)

參考書目(References)

1. D.R. Gaskell, "Introduction to the Thermodynamics of Materials", 4th ed., Taylor & Francis, NY, 2003 (偉明圖書、Wei-Ming bookstore)

說明(Description) : 本教科書是材料熱力學書籍中最常被台灣學界所指定之教科書，再版次數相當多，亦是授課教授求學時之教科書。本書之內容與編排已經過數十年之更新，難度與廣度皆頗適宜大學部學生研讀。

(Among all books concerning thermodynamics, this book is mostly designated as textbook for lessens of thermodynamics in materials in Taiwan. This book has been re-edited for many tomes and is well written for undergraduates.)

2. R.T. DeHoff, "Thermodynamics in Materials Science", McGraw-Hill, Singapore, 1993 (民全書局、Ming-Chiang bookstore)

說明(Description) : 本書在熱力學關係之推演上頗有獨到之處，值得學習。

(Good supplement to the textbook for some unique interpretations.)

課程教材 (教師個人網址請列在本校內之網址。)

(teaching aids & teacher's website)

請進入中興大學圖書館網頁 <http://www.lib.nchu.edu.tw/> 查詢、線上閱讀或下載教科書之電子書

(Please enter the webpage of NCHU library to survey, read on-line or download the e-book of textbook)

課程輔導時間(office hours)

學期間每週二下午 04:00-05:00 (04:00-05:00 pm Tuesday in semester)