2008 재료물리화학 강의 syllabus

교과목 번호 : 445.213, 강좌번호 : 002

담당교수 : 유 상 임 (33 동 224 호, siyoo@snu.ac.kr, 880-7443)

강의조교 : 김 영 미 (131 동 407 호, bluecities@snu.ac.kr 880-7443, 전자소자연구실)

강좌관련 홈페이지 : http://sm2l.snu.ac.kr

강의시간 : 월,수 6.5 교시 (14:30-15:45)

강 의 실 : 30 동 401 호

선수과목 : 일반물리, 일반화학

수강대상 : 2 학년 학부생

Physical Chemistry of materials

Mandatory (35hr) + Optional (7hr) + 4hr exams : 1 midterm and 1 final (2hr / each)

Grading

A : 20%, B : 30%, C : 30%, D 이하 : 20%

I. 주교재 (Reference Text) 및 참고문헌

주교재 :

Peter Atkins, Julio de Paula, "Atkins' Physical Chemistry 8th ed.", Oxford University Press

참고문헌 :

-DavidW. Ball, "Physical Chemistry" Thomson Learning Inc.

-J. F. Bredt 저 "A cartoon introduction to classical thermodynamics"

-데이비드 린들리 저, 이덕환 역, "볼츠만의 원자"

-고이데 쇼이찌로, 아비꼬 세이야 저, 21 세기 과학시리즈 편착 역, "엔트로피란 무엇인가"

-사이죠 토시미 저, 김재영 역, "물리상수는 어떻게 생겨났을까" 아카데미 서적

Lecture Contents

II. Mandatory Topics

PART I Equilibrium

: The concepts are needed for the discussion of equilibrium and the direction of spontaneous change in terms of thermodynamics.

1. The properties of gases (2hr)

The perfect gas

1.1 The stats of gases

1.2 The gas law

Real gases

1.3 Molecular interactions

1.4 The van der Waals equation

1.5 The principle of corresponding states

2. First Law : the concepts (5hr)

The basic concepts

2.1 Work, heat, and energy

2.2 The internal energy

2.3 Expansion work

2.4 Heat transactions

2.5 Enthalpy

2.6 Adiabatic changes

Thermochemistry

2.7 Standard enthalpy changes

2.8 Standard enthalpies of formation

2.9 The temperature dependence of reaction enthalpies

State Functions and exact differentials

2.10 Exact and inexact differentials

2.11 Changes in internal energy

2.12 The Joule-Thomson effect

3. The Second Law : the concepts (5hr)

The direction of spontaneous change

3.1 The dispersal of energy

3.2 Entropy

3.3 Entropy changes accompanying specific process

3.4 The Third Law of thermodynamics

Concentration on the system

3.5 The Helmholtz and Gibbs energy

3.6 Standard reaction Gibbs energies

Combining the First and Second Law

3.7 The fundamental equation

3.8 Properties of the internal energy

3.9 Properties of the Gibbs energy

4. Physical transformation of pure substances (3hr)

Phase Diagram

4.1 The stabilities of phases

4.2 Phase boundaries4.3 Three typical phase diagrams

Phase stability and phase transitions

4.4 The thermodynamic criterion of equilibrium

4.5 The dependence of stability on the conditions

4.6 The location of phase boundaries

4.7 The Ehrenfest classification of phase transitions

5. Simple mixture (4hr)

The thermodynamic description of mixtures

5.1 Partial molar quantities

5.2 The thermodynamics of mixing5.3 The chemical potentials of liquids

The properties of solutions

5.4 Liquid mixtures

5.5 Colligative properties

Activities

5.6 The solvent activity

5.7 The solute activity

5.8 The activites of regular solutions

5.9 The activities of ions in solutions

<Midterm Examination>

6. Phase diagram (2hr)

Phases, components, and degrees of freedom

6.1 Definitions

6.2 The phase rule

Two-component systems

6.3 Vapor pressure diagrams
6.4 Temperature-composition diagrams
6.5 Liquid-liquid phase diagrams
6.6 Liquid-solid phase diagrams

7. Chemical equilibrium (7hr)

Spontaneous chemical reactions

7.1 The Gibbs energy minimum
7.2 The description of equilibrium

The response of equilibrium to the conditions

7.3 How equilibrium respond to pressure
7.4 The response of equilibrium to temperature

Equilibrium electrochemistry (4hr)

7.5 Half-reactions and electrodes
7.6 Varieties of cells
7.7 The electromotive force
7.8 Standard potentials
7.9 Applications of standard potentials

PART II Change

: The ground for a discussion of the rates of reactions by considering the motion of molecules in gases and in liquids.

21. Molecules in motion (4hr)

Molecular motion in gases

21.1 The kinetic model of gases

21.2 Collisions with walls and surfaces

21.3 The rate of effusion

21.4 Transport properties of a perfect gas

Molecular motion in liquids

21.5 Experimental results

21.6 The conductivities of electrolyte solutions

21.7 Te mobilities of ions

21.8 Te conductivities and ion-ion interactions

Diffusion

21.9 The thermodynamic view

21.10 The diffusion equation

21.11 Diffusion probabilities

21.12 The statistical view

22. The rates of chemical reactions (3hr)

Empirical chemical kinetics

22.1 Experimental techniques

22.2 The rates of reactions

22.3 Integrated rate laws

22.4 Reactions approaching equilibrium

22.5 The temperature dependence of reaction rates

Accounting for the rate laws

22.6 Elementary reactions

22.7 Consecutive elementary reactions

22.8 Unimolecular reactions

III. Optional Topics

23. The kinetics of complex reactions (3hr)

: the extended discussions of the rates of chemical reactions by showing how to deal with complex reaction mechanisms.

Chain reaction

23.1 The rate laws of chian reactions
23.2 Explosions

Polymerization kinetics

23.3 Stepwise polymerization
23.4 Chain polymerization

Homogeneous catalysis

23.5 Features of homogeneous catalysis23.6 Enzymes

Photochemistry

23.7 Kinetics of photophysical and photochemical process
23.8 Complex photochemical processes

24. Molecular reaction dynamics (4hr)

: The discussion of the quantitative account of reaction rates which can be used for the cases in the gas phase and in solution.

Reactive encounters

24.1 Collision theory
24.2 Diffusion-controlled reactions

24.3 The material-balance equation

Activated complex theory

24.4 The Eyring equation

24.5 Thermodynamic aspects

The dynamics of molecular collisions

24.6 Reactive collisions

24.7 Potential energy surfaces

24.8 Some results from experiments and calculations

24.9 The investigations of reaction dynamics with ultrafast laser techniques

Electron transfer in homogeneous systems

24.10 The rates of electron transfer processes

24.11 Theory of electron transfer process

24.12 Experimental results

<Final Examination>