강의계획서 Syllabus

Course title:	Course number:	Credit: 3
Phase transformation of materials	445.302 _001	(Design :1)

Professor: Young-Chang Joo
Office #: 33-211
Phone : 02-880-8986
Email: ycjoo@snu.ac.kr
Recommended to:
3rd or 4th year material science engineering students
Pre requisite: 재료공학원리, 열역학
Lecture time: Mon & Wed 11:00-12:15
Lecture room: 33-1 - 225
T.A: 정영란 (30-506, 02-880-5817, yjung01@snu.ac.kr)
Website: http://ndml.snu.ac.kr/ 혹은 eTL
Office hour: After the lecture

□ Course objective
- Understanding the transformation phenomena and mechanisms on materials based on the thermodynamic theory
- Understanding nucleation, growth, diffusion and interfacial phenomena, and applying to various phase transformation phenomena

□ Course description and application field
- Course description: This course targets 3rd and 4th year undergraduate students majoring in materials science and engineering. The purpose of this course is to understand the phase transformation of materials. Based on the thermodynamic theory, studying the atomic diffusion, coagulation principles, nucleation, and some diffusion and non-diffusion transformation phenomena establish phase transformation phenomena and microstructure formation of materials.

- Field application: The physical properties of the material are determined by the microstructure and composition of the material. The phase transformation of materials course provides basic knowledge and principles to understand the changes in materials properties and to design and control materials according to the process. In particular, this course leads understanding of the properties and processing of materials by examining the structure and interfacial reactions, the nucleation theory and growth mechanism, transformation theory and reaction kinetics, which are fundamental principles, based on thermodynamic principles.

□ Main textbook and references

Textbook: D.A.Porter and K.E.Easterling, “Phase Transformation in metals and Alloys,” 3nd ed. Champman & Hall.
References: Paul Shewmon, “Diffusion in Solids,” TMS (1989).
Reed-Hill, “Physical Metallurgy Principles,” PWS (1992)

□ Grading scale and grading components

A 20~30 %, B 40~30 %, C 30% D > 10%

Midterm 1: 25%, Midterm 2: 25%, Final: 40%, H.W. & attendance: 10%

□ Course performance and contribution

- Understanding basic physics, such as thermodynamics and crystallography, to understand phenomena such as nucleation, growth, and diffusion, and to express them mathematically to understand and interpret various transformation phenomena (학습성과 (가-3)).
- Students will study the principles that apply to actual phenomena by understanding the effects of nucleation, growth, diffusion, and interfacial effects, which are the basic principles of phase transformation of materials (학습성과 (나-3)).
- Understanding the process variables that affect the phase change and lay the foundation for designing experimental conditions to achieve the desired state of the material (학습성과 (라-2)).
- Through the understanding of the principle of phase transformation, students can develop ability to apply knowledge in the actual industrial field by predicting or controlling the phenomenon occurring in the process (학습성과 (마-1)).
- The ability to interpret phase diagrams will cultivate the ability to effectively carry out practical business processes in the industrial field (학습성과 (카-1)).

□ Lecture plan

Chapter 1 Thermodynamics and Phase Diagrams

Chapter 2 Diffusion
- Diffusion Mechanism
- Diffusion Equation and Its Solutions
- High Diffusivity Path
- Diffusion in Multiphase Binary Systems

Chapter 3 Crystal Interfaces and Microstructure
- Interfacial Free Energy
- Boundaries in Single Phase Solids
- Interphase Interfaces in Solids
- Interface Migration

Chapter 4 Solidification
- Nucleation in Pure Metals
- Solidification of Single Phase Alloys
- Eutectic Solidification

Chapter 5 Diffusional Transformations in Solids
- Homogeneous Nucleation
- Heterogeneous Nucleation
- Precipitate Growth
- TTT Diagrams
- Precipitation in Age-Hardening Alloys
- Spinodal Decomposition
- Ordering Transformation

(Chapter 6) Diffusionless Transformation
- Characteristics of Diffusionless Transformation
- Martensitic Transformation
- Shape Memory Alloy