**Syllabus**

Course Title: Organic Materials Engineering

Course Number: 445.426 Credits: 3

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Student: Undergraduate Pre-requisites: None

Schedule: 14:30~15:45 PM (Tue and Thu) Classroom#: 30-422

Assistant: .

Homepage: http://simsung.snu.ac.kr/

Office hour: 13:30-15:00 PM (Mon and Wed)

▩ Course Purpose

The primary object of this course is acquiring the chemical, physical, engineering knowledge to design and fabricate new nano-organic materials. Based on this knowledge, students learn how to design and develop new nano-structured organic materials as the application arises themselves.

▩ Course outline and application

- Outline:

Fabrication methods and application of nano-organic materials and basic concepts needed to design and control properties of the materials are given in this lecture. Especially physical properties of nano-sized solids, micro emulsion physics, sol-gel chemistry, and physical chemistry of vapor deposition process are dealt in detail, in order to design and improve nano-organic materials students have presentations about fabrication methods, physical properties, and application of the materials which are studied recently.

- Application:

The property of nano-organic material varies with its size, shape, function, etc. Therefore, the knowledge given in this lecture helps to understand features of existing nano-organic materials and provides the ideas to develop new materials that have new structures and properties.

▩ Textbooks and Reference

- Textbook:

Charles P. Poole Jr. and Frank J. Owens, "Introduction to Nanotechnology", John Wiley & Sons, New Jersey, 2003.

- Reference

1. Klabunde, K.J., "Nanoscale Materials in Chemistry", Wiley-Interscience, New York, 2001.
2. Ozin, G, "Nanochemistry", Royal Soceity of Chemistry, 2006.
3. Zhong Lin Wang, Yi Liu and Ze Zhang, "Handbook of Nanophase and Nanostructured Materials, vol. 1: Synthesis", Kluwer Academic/Plenum Publishers, New York, 2003.
4. Krister Holmberg, Bo Jönsson, Bengt Kronberg and Björn Kinman, "Surfactants and Polymers in Aqueous Solutions", 2nd Ed., John Wiley & Sons, New York, 2002.
5. Milton J. Rosen, "Surfactants and Interfacial Phenomena", 3rd Ed., John Wiley & Sons, New York, 2004.
6. C. Jeffrey Brinker and George W. Scherer, "Sol-Gel Science: The Physics and Chemistry of Sol-Gel Processing", Academic Press, New York, 1990.
7. Hari Singh Nalwa, "Handbook of Nanostructured Materials and Nanotechnology", Academic Press, San Diego, 2000.
8. Volker Abetz, Arnal Purroy and María Luisa, "Block Copolymers Ⅱ", Springer, Berlin, 2005.
9. Arthur T. Hubbard, "Encyclopedia of surface and colloid science", Marcel Dekker, New York, 2002.

▩ Evaluation

1. Quiz 100% 2. Presentation 100% 3. Assignment and attendance 100%

▩ Subject results and contributions

- Learning fundamental principles to design nano-organic materials (학습성과 (가)-3)

- Comprehension of physical and chemical features of nano-organic materials (학습성과 (나)-3)

- Developing ability able to design new enano-organic materials (학습성과 (라)-2)

- Study about influences of nano-organic materials on human bodies and find solutions (학습성과 (바)-2)

- By finding examples of nano-organic materials which contribute to recent scientific progress, help students to have a pride as material scientist and discuss how to contribute to the nation (학습성과 (차)-2)

▩ Lecture plan

Chapter 1. Physical Properties of Organic Nanomaterials

1.1. Introduction to nanomaterials

1.2. Size-dependant Properties

1.2.1. Melting points

1.2.2. Magnetism

1.2.3. Optical properties - Color

1.2.4. Conductivity

1.3. Applications

1.3.1. Colors

1.3.2. Catalysis

1.3.3. Nanoelectronics

Chapter 2. Design of Nanomaterials based on Microemulsion Physics

2.1. Introduction

2.2. Stability of microemulsions

2.3. Formation Mechanisms of micelles and microemulsions

2.4. Synthesis of inorganic nanomaterials from w/o microemulsions

2.5. Synthesis of organic nanomaterials from o/w microemulsions

Chapter 3. Design of Nanomaterials based on Sol-gel Chemistry

3.1. Introduction

3.2. Theories of Sol-gel Chemistry

3.2.1. Classical theory

3.2.2. Percolation theory

3.2.3. Kinetic models

3.3. Experimental Approach

3.3.1. Silica sol-gel

3.3.2. Metal alkoxide

3.3.3. Pechini processing

3.3.4.Sol-gel thin film 3.4.Examples

Chapter 4. Design of Nanomaterials based on Vapor Processing

4.1. Introduction

4.1.1. NanophaseProcessing Technique

4.1.2. Classification of Vapor Processing Techniques

4.2. Physical Vapor Deposition

4.2.1. Process Principle

4.2.2. Advantages & Disadvantages

4.2.3. Evaporation2.4.Sputtering

4.3. Chemical Vapor Deposition

4.3.1. Process Principle

4.3.2. Advantages & Disadvantages

4.3.3. Atomic Layer Deposition

4.4. Carbon Nanotubes

4.4.1. Introduction

4.4.1.1. Carbon allotropes

4.4.1.2. What are CNTs?

4.4.1.3. Discovery of CNT: misunderstanding and truth

4.4.1.4. Classification of CNT

4.4.2. Structures of CNTs

4.4.3. Properties of CNTs

4.4.3.1. Electronic properties of CNTs

4.4.3.2. Mechanical properties of CNTs

4.4.3.3.Magnetic properties of CNTs

Chapter 5. Design of Nanomaterials based on Macromers and Block Copolymers

5.1.Microstructure Based on Block Copolymers

5.1.1.Definition of Copolymers

5.1.2.Synthesis Methods for Block Copolymers

5.1.3.Block Copolymer Aggregate and Self-assembly

5.2.General Theories of Block Copolymers

5.2.1.Copolymer Composition

5.2.2.Reactivity Ratios

5.2.3.Resonance and Reactivity

5.3.A Closer Look at Microstructure

5.3.1.Block Copolymer Phase Behavior

5.3.2.AmphiphilicBlock Copolymers in Mixtures with Water and Oil

5.4.Applications of Copolymers

5.4.1.Commercialized Applications

5.4.2.Potential Applications

▩ Remark

- Quiz will be given in the week after the end of each chapter.

- All students should prepare three presentations in a semester: Two individual presentations at the middle of a semester and one team presentation at the end of a semester.