Physical Ceramics

Instructor: Professor Wen-Cheng J. Wei, 韋文誠教授
Office: Engineering Building room 470
Office hour: Tue. and Thu. 3:00-5:00 p.m.

Class meets on every Thu. (9:10-12:00)
at room Engineering building 232
Content of the Class

1. Introduction
   Science of ceramics
2. Structure of Ceramics
3. Defects in Ceramics
4. Mass and Electrical Transports
5. Phase Equilibria
6. Microstructure

Objectives of the Class

1. Familiar with atomic, crystalline and glass structure of ceramics
2. Understand the type and reactions of defects in ceramics
3. Knowing mass and electrical transports in Ceramic Materials
4. Familiar with Phase diagram and equilibria at room and high temperature
5. Understand the origin and fundamental of ceramic microstructure

Chapter 2 Structure of Ceramics (week 2,3,4)
Close packed lattices, FCC & HCP
Stability of ionic crystals, The Madelung constant and Pauling rules
Crystal structures, (24 oxides and non-oxide structures)
Structure-field map
Crystalline silicates
Glass structures

Chapter 3. Defects in Ceramics (week 5,6)
Point defects, Frenkel and Schottky disorder
Simultaneous defect equilibria, Brouwer diagram
Association and precipitation of defects
Interaction between defects and interfaces
Line and planar defects
Chapter 4. Mass and Electrical Transport (week 7,8)
  Continuum diffusion kinetics, general equations
  Atomic diffusion processes
  Electrical conductivity
  Electrochemical potential

Chapter 5 Phase Equilibria (week 10,11,12)
  The Gibbs phase rule
  The binary phase diagram
  Ternary phase diagram
  Operation of ternary phase diagram
  Reaction upon heating and cooling

Chapter 6. Microstructure (week 13,14,15,16)
  Capillarity
  Grain growth and coarsening
  Single phase sintering
  Reactive additive sintering
  Hot pressing
  Glasses and glass-ceramics
  Composite properties
  Strength and toughness
Assignment and Evaluation

1. 35-40 pages reading each week;
2. Questions after each class;
3. A few homework questions; (15%)
4. Oral report on selected topics; (15%)
5. Mid term exam (30%);
6. Final exam (40%)