(Materials) Kinetics (MAT 206)

Spring 2024

Course motivation: Understanding the effect of reactions and transformations in evolving material systems. While thermodynamics tell us what the final state should be, kinetics tells us if and how the system will reach its final state. The details for how quickly or in what manner the system evolves would guide you in determining the processing of a material. Such information would also help you predict if the performance of your material would be stable during its operational lifetime. This semester we will apply kinetics in the context of understanding and controlling microstructural evolution in solid state materials.

Instructor: Alp Yürüm – alp.yurum@sabanciuniv.edu

Office: FENS 1031 - 216/483-9597

Lecture hours: Mondays 12:40-14:30 - FASS G050

Thursdays 12:40-13:30 - FENS L058

Office hours: By appointment.

Midterm: 15 April 2024 (Lecture hour)

1. Lecture notes: Take notes during lecture. Only selected parts of my lecture notes will be posted onto SUCourse.

2. Exams: There will be one midterm exam. Additionally, there will be short quizzes in some lectures.

3. Term project: You will have an opportunity to demonstrate a deeper understanding of course concepts in a term project. Topic list will be posted after the Add/Drop date.

4. Grading: 40% of your course grade will be determined from the term project, 30% from in class quizzes and 30% from the midterm exam.

5. Textbook: There will not be an official course textbook. Instead, we will be developing the course from several texts, which are listed in the Course References below.

6. Course References (Supplemental reading): all items are available at the IC

a. Kinetics of Materials, by Dennis W. Readey

b. Thermodynamics of Materials, Vol. 2, by David V. Ragone

c. Phase Transformations in Metals and Alloys, by D.A. Porter & K.E. Easterling

d. Kinetics of Materials, by Robert W. Balluffi, Sam Allen, W. Craig Carter

e. Physical Chemistry, by Peter W. Atkins

7. Learning Outcomes:

a. Be able to describe atomistic models of diffusion, their practical validation, and their use in applied studies

b. Be able to build models of evolving surfaces and interfaces in the context of thermodynamic descriptions

c. Be able to describe the model of nucleation and growth for homogeneous and heterogeneous systems

d. Be able to describe models for diffusionless transformation and apply these models in practical application

Course Syllabus: (Tentative plan)

Week starting with	**Topic**
12 February 2024	Thermodynamics of solutions
19 February 2024	Equilibrium phase diagrams & chemical potential of solutions
26 February 2024	Equilibrium phase diagrams & chemical potential of solutions
4 March 2024	Diffusion
11 March 2024	Diffusion
18 March 2024	Surfaces and Interfaces
25 March 2024	Surfaces and Interfaces
1 April 2024	Solidification & Nucleation
8 April 2024	Break
15 April 2024	Solidification & Nucleation **Midterm:** 15 April 2023
22 April 2024	Solidification & Nucleation
29 April 2024	Motion & Reaction Rates
6 May 2024	Motion & Reaction Rates
13 May 2024	Reaction Dynamics
20 May 2024	Reaction Dynamics
29 May 2024	Term Project Presentations