(Materials) Kinetics (MAT 206)

Spring 2023

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.

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Lecture hours: Tuesdays 12:40-14:30 - FASS 1101 (Zoom: Meeting ID: 996 6572 7787, Passcode: 715992)

Thursdays 12:40-13:30 - FASS G056 (Zoom: Meeting ID: 996 6572 7787, Passcode: 715992)

Office hours: By appointment.

Midterm: 25 April 2022 (Lecture hour)

Disclaimer: *We may have to revise the course plan according to the countrywide reassessment to be made regarding higher education. This is expected to happen at the beginning of April. The content to be delivered is certain but the method of course delivery, the number and dates of exams, and some other details are subject to change.*

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**
27 February 2022	Thermodynamics of solutions
6 March 2022	Equilibrium phase diagrams & chemical potential of solutions
13 March 2022	Equilibrium phase diagrams & chemical potential of solutions
20 March 2022	Diffusion
27 March 2022	Diffusion
3 April 2022	Surfaces and Interfaces
10 April 2022	Surfaces and Interfaces
17 April 2022	Solidification & Nucleation
24 April 2022	Solidification & Nucleation **Midterm:** 25 April 2023
1 May 2022	Solidification & Nucleation
8 May 2022	Motion & Reaction Rates
15 May 2022	Motion & Reaction Rates
22 May 2022	Reaction Dynamics
29 May 2022	Reaction Dynamics
5 June 2022	Term Project Presentations