MS/ME 503 Kinetic Processes in Materials

Spring 2023

Prof. Soumendra Basu

Rm. 204, 730 Commonwealth Avenue

Office Phone: 617-353-6728

Email: basu@bu.edu (preferred mode of contact)

Lectures: **M,W: 10.10AM – 11.55AM** (Lecture notes will be posted on Blackboard)

Location: **CAS 326**

Office/discussion hours: 1-2 PM Friday

Required Textbook:
Materials Kinetics Fundamentals: Principles, Processes, and Applications, Ryan O'Hare, John Wiley and Sons Inc., 2015

Other Suggested Readings:
Essentials of Materials Science and Engineering, D. R. Askeland, and P. Phule
Diffusion in Solids, P. G. Shewmon
Chemical Kinetics, K. J. Laidler
Phase Transformations in Metals and Alloys, D. A. Porter and K. E. Easterling

Grading:
There will be 2 midterms and a final. The final is NOT cumulative. Dates for Exams 1 and 2 will be set during the semester. The date for the Final will be set by the university.

Grading will be as follows:

Midterm I	-	30%
Midterm II	-	30%
Final exam	-	30%
Homeworks	-	10%

Homeworks:
3 HW sets will be handed out, one for each exam. Solutions must be submitted by the deadline to get credit. Discussing strategies to solve HW questions with others is permitted, but direct copying of solutions from others can lead to disciplinary action. Solution sets will be handed out and will be discussed in class before each exam. Graders for this course are **Emily Ghosh** (eghosh93@bu.edu) and **Haoxuan (Kyle) Yan** (hyan910@bu.edu).

Supplementary Instruction (SI) Program:
There are Supplemental Instruction (SI) study sessions available for MS/ME 503 and is led by **Fatima Alowa** (alowa@bu.edu). These regularly scheduled sessions follow the current course material and are open to anyone enrolled in this course. Attendance is voluntary but proven extremely beneficial for those who do attend. Sessions provide a collaborative forum for students to compare notes, demonstrate and discuss pertinent problems and concepts, and share study and test-taking strategies. Students are asked to arrive with their lecture notes and questions to these informal, peer-led study sessions. Times and locations for the study sessions will be determined after the first week of class.

Syllabus

I THERMODYNAMICS VERSUS KINETICS

Introduction to chemical thermodynamics	1 lecture
Phase diagrams, driving force, flux	1 lecture

II KINETICS OF MASS TRANSPORT

Fick's Laws and solutions to Fick's laws	3 lectures
Interdiffusion, types of diffusivities	1 lecture
Diffusion and chemical potential, multipath diffusion	1 lecture
Atomistic models of diffusion, tracer diffusion	1 lecture
Diffusion in ionic crystals	2 lectures

III KINETICS OF CHEMICAL REACTIONS

Order of reaction, kinetics of gas/solid reactions	1 lecture
Mixed rate control, CVD, vapor phase etching	1 lecture

IV KINETICS DRIVEN BY MICROSTRUCTURE

Surface curvature, Gibbs Thompson effect	1 lecture
Grain growth, particle coarsening, sintering	1 lecture
Surface energy anisotropy	1 lecture

V KINETICS OF PHASE TRANSFORMATIONS

Nucleation and growth	2 lectures
Solidification	1 lecture
Spinodal decomposition	1 lecture
Martensitic transformation	1 lecture