MS/ME 503 Kinetic Processes in Materials Spring 2022

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Lectures: M,W: 10.10AM – 11.55AM Location: LSE B03 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. Solution sets will be handed out, and will be discussed in class before each exam.

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