

MS/ME 503 Kinetic Processes in Materials

Spring 2020

Prof. S. N. Basu

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Lectures: M, W: 10.10AM – 11.55AM

Location: MCS B29

Office hrs: 1-2 PM Friday, other times by appt.

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. The 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	
1	Introduction to chemical thermodynamics	1 lecture
2	Phase diagrams, driving force, flux	1 lecture
II	TRANSPORT KINETICS	
3	Fick's first and second laws of diffusion, thin film solution	1 lecture
4	Error function solution, thick film solution	1 lecture
5	Solutions using Laplace transforms, diffusion into a sphere	1 lecture
6	Interdiffusion	1 lecture
7	Different types of diffusivities, vacancy vs int mechanism	1 lecture
8	Diffusion in ionic crystals	1 lecture
9	Gas phase diffusion, multipath diffusion	1 lecture
III	KINETICS OF CHEMICAL REACTIONS	
10	Chemical reactions, order of reactions, activation theory	1 lecture
11	Gas/solid, gas/liquid kinetic processes	1 lecture
12	Mixed rate control: etching, CVD	1 lecture
IV	ROLE OF KINETICS ON MICROSTRUCTURE	
13	Capillarity forces on surfaces, grain growth	1 lecture
14	Surface energy anisotropy	1 lecture
15	Particle coarsening, sintering	1 lecture
V	KINETICS OF PHASE TRANSFORMATIONS	
16	Homogeneous and heterogeneous nucleation, growth	1 lecture
17	Combined nucleation and growth	1 lecture
18	Solidification	1 lecture
19	Spinodal decomposition	1 lecture