

# MS/ME 503 Kinetic Processes in Materials

## Spring 2018

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Lectures: M, W: 10.10AM – 11.55AM  
Location: SOC B57  
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	-	35%
Midterm II	-	30%
Final exam	-	35%

### Homeworks:

3 HW sets will be handed out, one for each exam. They will not be collected or graded. Solution sets will be handed out, and will be discussed in class before each exam.

# Syllabus

<b>I</b>	<b>THERMODYNAMICS VERSUS KINETICS</b>	
1	Introduction to chemical thermodynamics	1 lecture
2	Phase diagrams, driving force, flux	1 lecture
<b>II</b>	<b>TRANSPORT KINETICS</b>	
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
<b>III</b>	<b>KINETICS OF CHEMICAL REACTIONS</b>	
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
<b>IV</b>	<b>ROLE OF KINETICS ON MICROSTRUCTURE</b>	
13	Capillarity forces on surfaces, grain growth	1 lecture
14	Surface energy anisotropy	1 lecture
15	Particle coarsening, sintering	1 lecture
<b>V</b>	<b>KINETICS OF PHASE TRANSFORMATIONS</b>	
16	Homogeneous and heterogeneous nucleation, growth	1 lecture
17	Combined nucleation and growth	1 lecture
18	Solidification	1 lecture
19	Spinodal decomposition	1 lecture