

## MSE 540 Phase Transformations

**Main text:** Balluffi, Allen & Carter, *Kinetics of Materials* (Wiley, 2005)

**Supplemental text:** Porter & Easterling, *Phase Transformations in Metals and Alloys*, 2nd ed. (CRC, 1992) or Porter, Easterling & Sherif, *Phase Transformations in Metals and Alloys*, 3rd edition, ISBN: 1420062107 (2009). The 2nd edition contains less typo than the 3rd edition.

**Instructor:** Ju Li ([liju@seas.upenn.edu](mailto:liju@seas.upenn.edu), 215-898-1558, 223 LRSM)

**Office Hrs:** any time, including after lecture

**TA:** Mark Licurse <[mlicurse@seas.upenn.edu](mailto:mlicurse@seas.upenn.edu)>

### Grading Scale:

Homework	15%
Midterm exam:	35%
Final exam (final week):	50%
Final grade will be “renormalized” to historical distribution.	

### How to do well:

- Take good notes on class.
- Do the homework on your own. If you need a hint after some thinking, talk to me. Intermediate steps are more important than the final result. Do not surrender to existing solutions.
- Review the last lecture notes before the coming lecture.
- Read and thoroughly understand the homework solutions. When puzzled, talk to me.

### Course Description

The state of matter is dependent upon temperature, thermal history, and other variables. In this course the science of structural transitions is developed, then applied to show how to produce materials with superior properties. The subjects covered include the methods of structural analysis, solidification, solid state transformations, and transformations involving metastable phases.

### Course Outline

1. Review of Bulk Thermodynamics and Phase Diagrams
2. Linear Response Theory and Long-Range Diffusion
3. Capillary Energy Effects
4. Elastic Energy Effects
5. Interfacial Mobility Effects
6. Nucleation, Growth and Coarsening
7. Solidification
8. Spinodal Decomposition and Gradient Thermodynamics Description of the Interface