

MASC 504: Diffusion and Phase Equilibria

Spring 2015

Lectures: Monday and Wednesday 3:30 – 4:50 PM, VHE 214

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Books:

Lecture notes will be provided. The following books are not required but recommended for advanced reading.

Recommended list of books:

1. Kinetic Processes: Crystal Growth, Diffusion and Phase Transitions in Materials by Kenneth Jackson. ISBN: 9783527327362
2. Phase Transitions in Materials by Brent Fultz. ISBN: 9781107067240.
3. Diffusion in Solids: Fundamentals, Methods, Materials, Diffusion-controlled Processes by Helmut Mehrer. ISBN: 9783540714866.
4. Phase Diagrams and Heterogeneous Equilibria by Bruno Predel, Michael Hoch and Monte Pool. ISBN: 9783662092767
5. Diffusion in Condensed Matter: Materials, Methods, Models by Paul Heitjans and Jorg Karger. ISBN: 9783540720812
6. Phase Transformations in Metals and Alloys by David Porter and Kenneth Easterling. ISBN: 9781420062106

Objectives:

The objective of the course is to introduce the science and applications of thermodynamics and kinetics in materials systems, particularly for synthesis, properties and phase evolution. The content will cover a range of materials systems from metals, alloys, ceramics, covalent semiconductors, polymers, quasi-crystalline, and metastable phases.

Grading:

Exams (2):	30% each	=	60%
Presentation (1):	20%	=	20%
Problem Sets (4) and Class participation		=	20%

Topics covered:

1) Introduction:

Kinetics and thermodynamics

2) Phase diagrams:

Theory of phase transitions, classifications, single component phase diagram, binary and ternary Phase diagram.

3) Diffusion:

Reaction rate theory, continuum theory of diffusion, defects and mechanisms of diffusion, mass diffusion in different materials systems (metals, alloys, semiconductors, ionic crystals and amorphous materials), beyond mass diffusion.

4) Crystals and Interfaces:

Nucleation, bulk processing of materials and low dimensional materials processing.

5) Meta-stability and advanced topics:

Non-equilibrium materials processing

Problem sets and Exam policy:

There will be two problem sets made available before the first exam and two more before the second exam. Every problem will be posted roughly after 5 classes (see below for exact schedule). The problem set solutions are due before the next problem set is posted. The scores will be made available typically within 1 week of submitting the problem sets and exams. The problem sets will typically have 4 problems. The exams will be 1 hour each and will have 4-5 problems.

Presentation policy:

Presentations will be held during study week/finals week. The total 20% credit will be split between selection of topic: 5%, explanation/presentation: 10% and Q&A: 5%. The presentations will be 10 minutes long (typically 8 slides max) and 5 minutes of discussion.

Timeline:

Jan 28 – 1st problem set will be posted

Feb 18 – 2nd problem set will be posted (1st due)

Feb 23 – 1st Exam

March 11 – 3rd problem set will be posted (2nd due)

April 8 – 4th problem set will be posted (3rd due)

April 13th – 2nd Exam

April 27 – 4th problem set due

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. SCampus, the Student Guidebook, contains the Student Conduct.

<http://www.usc.edu/dept/publications/SCAMPUS/gov/>

Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at:

<http://www.usc.edu/student-affairs/SJACS/>

Sanctions include but are not limited to: grade sanctions (e.g., "F" in course) and dismissal from the academic department (see following excerpt from SJACS site).

http://www.usc.edu/student-affairs/SJACS/forms/sjacs_appa.pdf

Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with the Office of Disability Services and Programs (DSP, STU 301, [213-740-0776](tel:213-740-0776)) each semester. You must deliver an approved DSP letter to one of the instructors as early in the semester as possible. Please see SCampus (<http://www.usc.edu/dept/publications/SCAMPUS/>) for additional policies that are not covered here (i.e. academic integrity, proper conduct, etc) but that do still apply!