

UNIVERSITY OF ILLINOIS  
College of Engineering  
Department of Materials Science and Engineering

Spring 2022: **MSE 402**  
**KINETIC PROCESSES IN MATERIALS**

Instructor	Pascal Bellon, 312D MSEB, 265-0284, <a href="mailto:bellon@illinois.edu">bellon@illinois.edu</a>
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UG-TA	Seungryeop Kim, <a href="mailto:sk4@illinois.edu">sk4@illinois.edu</a>
Lecture	Tu-Th 9:30 – 10:50 am, Room 103 Talbot Laboratory
Recitation	Tu 5:00 – 6:30 pm (103 Talbot): Quizzes (5-5:45 pm): 2/1, 2/15, 3/29, 4/12, 4/26 Assignments due by 5 pm: 1/28, 2/11 (CM1), 2/25, 3/25 (CM2), 4/8, 4/22 Problem reviews: 1/25, 2/22, 3/1, 4/5, 4/19 Overview for computational modules: 2/8, 3/22
Office Hours	Pascal Bellon: 5 - 6 pm of regular office hours (see below) and by appointment Mitisha Surana and Yifan Yao: 5 - 7 pm, Wednesday, 1302 Everett building Yang Dan: 5 - 7 pm, Thursday, CER 322 and by Zoom (computational modules)
Websites	<a href="https://compass2g.illinois.edu/">https://compass2g.illinois.edu/</a> ; <a href="https://piazza.com/illinois/spring2022/mse402">piazza.com/illinois/spring2022/mse402</a>
Grading	1 midterm exam (Tuesday 3/8, 5-6:30 pm, 1320 DCL) = 20% 1 final exam (Thursday 5/12, 1:30-4:30pm, room TBD) = 35% In-class activities (iClicker, ...) = 10% Homework assignments (6, drop lowest) = 15% Quizzes (5, drop lowest) = 20%

**Note that the course will be online by Zoom on the first week of class. You need to access these Zoom sessions via the Zoom link in Compass after you log into MSE 402.**

**There is no recitation session on Tuesday Jan. 18<sup>th</sup> evening.**

## COURSE OUTLINE (29 SESSIONS)

- I. Introduction (1 session)**
- II. Review of thermodynamics (2)**
- III. Chemical reaction kinetics (3)**
- IV. Diffusion (8)**
  - a. Phenomenological treatment (3)
  - b. Atomistic treatment (2)
  - c. Diffusion in crystalline alloys (1)
  - d. Diffusion in ionic compounds (1)
  - e. Diffusion in polymers and glasses (1)
- V. Interfaces (4)**
  - a. Surfaces and interfaces (2)
  - b. Interfacial reactions (2)
- VI. Phase Transformations (7)**
  - a. Nucleation and growth (3)
  - b. Solidification (2)
  - c. Spinodal decomposition (1)
  - d. Displacive transformations (1)
- VII. Microstructural evolutions (4)**
  - a. Capillarity and coarsening (2)
  - b. Sintering and grain growth (2)

Required textbook: **Materials kinetics fundamentals**, Ryan O'Hayre (Wiley, 2015).

Additional books (Grainger reserves):

**Phase transformations in metals and alloys**, D. A. Porter and K. E. Easterling, 669.94P833p

**Diffusion in solids**, P. G. Shewmon, 531.7SH5D1989

**Atom movements: Diffusion and mass transport in solids**, J. Philibert, 530.415 P536D:E

**Kinetics of materials**, R. W. Balluffi, S. A. Allen, W. C. Carter, 620.11292B214k

**Kinetic Processes: Crystal Growth, Diffusion, and Phase Transitions in Materials**, K. A. Jackson, 530.136J132k2010

**Kinetic theory in the earth sciences**, A. C. Lasaga, 551.9L33k

**Mathematics of diffusion**, J. Crank, 541.341C85M1979

**Physical Chemistry**, R. J. Silbey, R. A. Alberty, 541.3A1148p2001

**Polymer Chemistry**, P. C. Hiemenz, 547.7 H532p2007

## IN-CLASS PARTICIPATION

An iClicker remote is required for in-class participation. iClicker is a response system that helps me to gain real time feedback and gives everyone a chance to participate in class. Your iClicker participation and answers will go toward your grade for in-class activities.

### **Register your clicker within Illinois Compass 2g:**

In order to receive credit for your iClicker responses, you will need to register your iClicker remote no later than Friday January 28th. To register your iClicker, go to this course site in Illinois Compass 2g (<https://compass2g.illinois.edu/>), log in the MSE 402 course and click on the link at the left entitled “iClicker Registration”. Enter your iClicker Remote ID in the required field and click Submit. The remote ID is the series of numbers and letters found on the back of your i>clicker remote. If your Remote ID is faded or missing visit the Illini Union Bookstore (<http://www.uofibookstore.illinois.edu/>) – they can look it up for you.

Do not register your clicker on iClicker.com. If you do, I will not be able to match your responses with your name and you will not receive credit.

## QUIZZES

There will be 5 quizzes throughout the semester (roughly one every two weeks), all taking place on Tuesday evening during the recitation session. You will take these quizzes in-person in class, during the first 45 minutes of the recitation session of that day. Your overall quiz grade will be the average of your 4 best scores.

## HOMEWORK ASSIGNMENTS

There will be 6 homework assignments throughout the semester (roughly one every two weeks), each due on Friday by 5 pm. Late assignment will not be graded. You will complete these assignments through the Compass website. Your overall assignment grade will be the average of your 5 best scores.

## EXAMS

There will be a 50-minute mid-term exam on Friday 10/22 during the normal class time, and a final exam on Wednesday 12/16 from 1:30 to 4:30 pm (per University schedule for final exams). These exams will be in-person exams.

## ABSENCES

Absences from quizzes and exams can be excused if supported by an absence letter from the Office of the Dean of Students (<https://odos.illinois.edu/community-of-care/resources/students/absence-letters/>). See also section 3-202 of the Student Code (<https://studentcode.illinois.edu/article3/part2/3-202/>)

## COVID

Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community. Students are also required to follow the campus COVID-19 protocols.

Students who feel ill must not come to class. In addition, students who test positive for COVID-19 or have had an exposure that requires testing and/or quarantine must not attend class. The University will provide information to the instructor, in a manner that complies with privacy laws, about students in these latter categories. These students are judged to have excused absences for the class period and should contact the instructor via email about making up the work.

Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the non-compliant student

will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Accumulation of non-compliance complaints against a student may result in dismissal from the University.

All students, faculty, staff, and visitors are required to wear face coverings in classrooms and university spaces. This is in accordance with CDC guidance and University policy and expected in this class. The university is recommending that faculty, staff and students wear [an N95 mask, a KN95 mask or a Level 3 surgical mask](#). Please refer to the University of Illinois Urbana-Champaign's COVID-19 website for [further information on face coverings](#). Thank you for respecting all of our well-being so we can learn and interact together productively.

In order to implement COVID-19-related guidelines and policies affecting university operations, instructional faculty members may ask students in the classroom to show their Building Access Status in the Illinois App or the Boarding Pass. Staff members may ask students in university offices to show their Building Access Status in the Safer Illinois app or the Boarding Pass. If the Building Access Status says "Granted," that means the individual is compliant with the university's COVID-19 policies—either with a university-approved COVID-19 vaccine or with the on-campus COVID-19 testing program for unvaccinated students.

Students are required to show only the Building Access Screen, which shows compliance without specifying whether it was through COVID-19 vaccination or regular on-campus testing. No university official, including faculty members, may ask students why they are not vaccinated or any other questions seeking personal health information.

#### **EMERGENCY RESPONSE RECOMMENDATIONS**

Emergency response recommendations can be found at the following website: <http://police.illinois.edu/emergency-preparedness/>. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. <http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/>.

#### **ANTI-RACISM AND INCLUSIVITY**

The intent is to raise student and instructor awareness of the ongoing threat of bias and racism and of the need to take personal responsibility in creating an inclusive learning environment.

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (<https://diversity.illinois.edu/2021/08/18/bart-fall-update/>). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If

the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

## ADDITIONAL IMPORTANT TOPICS

### **Sexual Misconduct Reporting Obligation**

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: [wecare.illinois.edu/resources/students/#confidential](http://wecare.illinois.edu/resources/students/#confidential).

Other information about resources and reporting is available here: [wecare.illinois.edu](http://wecare.illinois.edu).

### **Academic Integrity**

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <https://studentcode.illinois.edu/article1/part4/1-401/>. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

### **Religious Observances**

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/> to request appropriate accommodations. This should be done in the first two weeks of classes.

### **Disability-Related Accommodations**

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail [disability@illinois.edu](mailto:disability@illinois.edu) or go to <https://www.disability.illinois.edu>. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

### **Family Educational Rights and Privacy Act (FERPA)**

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.