

**MSE 582, Spring 2021**  
**Surface Physics**

**Time:** M/W/F 11-11:50 am

**Location:** Zoom online (live), link can be found at compass2g website.

*For students who are not able to join the live zoom sessions, recorded videos will be uploaded to media space (<https://mediaspace.illinois.edu/>). Please search for "MSE582Spring2021" to locate the videos.*

**Website:** compass2g

**Instructor:** Prof. Yingjie Zhang, yjz@illinois.edu

**Office hour:** Wednesday and Friday within half an hour after the lecture.

**Credit:** 4 graduate hours

**Course description:** Theory and characterization techniques of materials surfaces and interfaces, including: surface and interface structure; thermodynamics of interfaces; electronic structure of surfaces; X-ray spectroscopy and scattering; electrochemical interfaces and catalysis; scanning probe microscopy.

**Prerequisite:** Basic knowledge of quantum mechanics & solid state physics. MSE 304, or Phys 460, or Phys 485, or Chem 442 (or other equivalent courses)

**Textbook:**

K. Oura, et al. Surface Science: an Introduction (ebook available online)

**Course Topics:**

<b>DATES</b>	<b>TOPICS</b>
1/25 – 1/29	Introduction to surface science; Surface tension; Nucleation
2/1 – 1/5	Wulf's Theorem; Reconstruction; Surface forces, contact angle, wetting
2/8 – 2/12	Experimental surface science: vacuum, sample preparation
2/15 – 2/19	Surface characterization: AES, XPS, ISS, SIMS
2/22 – 2/26	Surface structure, reciprocal lattice and diffraction
3/1 – 3/5	Surface diffraction
3/8 – 3/12	Electronic structure of surfaces
3/15 – 3/19	Electronic structure and photoemission
3/22 – 3/26	X-ray absorption and emission

3/29 – 4/2	Adsorption, reactions, catalysis
4/5 – 4/9	Scanning Tunneling Microscopy
4/12 – 4/16	Atomic Force Microscopy
4/19 – 4/23	Functional scanning probe microscopy
4/26 – 4/30	Electrochemical interfaces & energy applications
5/3 – 5/5	Student presentation

### Grading:

- 1) Homework assignments, 40%
- 2) Final exam (take-home exam), 30%
- 3) Final project that consists of two parts: in-class presentation (10%), and final report (20%).

### Formats of assignments:

Homework, final project, and final exam will all be posted as "Assignment" in compass2g. They will need to be submitted electronically via compass2g by the deadline specified for each assignment. **All of the files need to be pdf.** They can be either scanned from hand-written papers, or directly generated electronically. In any case, **the submitted pdf files must be clearly legible, in order to receive proper grades.**

### Late policy:

Homework, final project report, and completed final exams turned in within 24 hours after the deadline will be given 50% score. After 24 hours past the deadline, 0% score will be given.

### Policy on conflicts or emergencies:

- (1) For time conflicts with other events (e.g. another scheduled exam), or an official UIUC activity (e.g. varsity athletics, band concert), please show official documentation about the conflict at least **one week** before the homework/report/exam due date. The due date will be extended if the excuses are legitimate.
- (2) If you will not be able to submit assignments or give final presentations on time due to serious illness or other emergent personal crisis (e.g. car accident) that are not described in (1), you must send an email to the instructor ([yjz@illinois.edu](mailto:yjz@illinois.edu)) at your earliest convenience, and submit a statement from the professionals that are authorized to evaluate your situation (e.g. doctors, police officers). The statement needs to clearly explain that you are not physically capable of submitting the HW/report/exam or give the final presentation on time. The due date will be extended if the excuses are legitimate.