Scanning Probe Microscopy 545– Fall 2020

Rutgers, The State University of New Jersey-Newark

Syllabus

Lecture: Monday, 6:00-8:50 pm, Blackboard Collaborate Ultra (+ Course Recording)

Professor: Dr. Huixin He (LSC II, Room 219 B)

Email: huixinhe@newark.rutgers.edu

Office Hours: By appointment (Collaborate office hours via Blackboard)

(Note: If you have no or limited access to high-speed internet, please see the resources listed under "Free Internet Access for Students" found at this link: https://coronavirus.rutgers.edu/technology-resources-for-students/

Technology Resources for Students – Universitywide COVID-19 Information
The following webpage outlines technology resources for Rutgers students, including information about web conferencing, learning management systems, and getting help with technology services and systems.
coronavirus.rutgers.edu

The course Synopsis

This course will cover the operation principles of several basic imaging modes in the family of scanning probe microscopy (SPM) and their application in various frontiers research. Topics will cover: 1) Overview of scanning probe microscopy, working principles of STM and AFM and some important parts in the instruments. 2)Toward imaging with the theoretical resolutions. 3)Imaging in liquid 4)More working principles for novel imaging mode beyond morphology and their applications 5)In-situ electrochemistry of AFM and STM, 6) Application beyond imaging (I) — Nanoelectronics and molecular electronics 7) Application beyond imaging (II) — Nanofabrication 8) Application beyond imaging (III) — Single molecular force spectroscopy 9) Application beyond imaging (IV) — Nanomechanics/chemical and biochemical detection.

Learning goals of this course

This course is truly interdisciplinary. After taking this course, the students should be able to

- Understand the basic concepts of SPM based imaging AFM and STM.
- Understand the commonly used imaging modes of SPM, some important associated enabling techniques or behind physics/engineering principles, and applications of these functionalities/capabilities of SPM in various research field.
- Extended application (clever and creative usages of SPM to enable novel measurements)

Recommended textbooks and references

- No preferred text book
- Literatures will be provided.

Prerequisites: Undergraduate physical chemistry I and II, general physics, Electrochemistry or Electroanalytical chemistry.

Tentative Class Schedule:

Week	Date	Lecture	Topic
1	Sept 8	Lecture 1	Introduction: Basic Concepts
2	Sept 14	Lecture 2	STM working principle and application
3	Sept 21	Lecture 3	AFM working principle and its application
4	Sept 28	Lecture 4	Different imaging modes of AFM (1)
5	Oct 5	Lecture 5	Different imaging modes of AFM (2)
6	Oct 12	Lecture 6	**Midterm**
7	Oct 19	Lecture 7	In-situ electrochemistry of STM
8	Oct 26	Lecture 8	In-situ electrochemistry of AFM
9	Nov 2	Lecture 9	Application beyond imaging (I) — Nanoelectronics and molecular electronics
10	Nov 9	Lecture 10	Application beyond imaging (II) — Nanofabrication
11	Nov 16	Lecture 11	Application beyond imaging (III) — Single molecular force spectroscopy
12	Nov 23	Lecture 12	Application beyond imaging (IV) — Nanomechanics/chemical and biochemical detection
13	Nov 30	Lecture 13	Student Presentation
14	Dec 7	Lecture 14	Overview
Final Exam	Dec. 14	6:20-9:20 pm	**Final Exam**

The last lecture for this course will be Dec. 7.

Exam:
Quizzes and Exams will be based on the lecture covered materials and the associated assigned reading materials. All the quizzes and exams will be given as open book format via Blackboard. Quizzes will be given at random bases (normally at the end of a lecture, considering we have some students in China). No make-up quiz, presentation and exams. In case the midterm exam is missed for any reason, the score on the final exam will be used.

Grading:

Random Quizzes: 20 %
Midterm: 30%
Presentation: 10%
Comprehensive final: 45%

The final letter grades will be based on the following scale

A = 100-85
B+ = 84-80
B = 79-70
C+ = 69-65
C = 64-55
D = 54-45
F = 0-44

Academic Integrity Policy:

As an academic community dedicated to the creation, dissemination, and application of knowledge, Rutgers University is committed to fostering an intellectual and ethical environment based on the principles of academic integrity. Academic integrity is essential to the success of the University's educational and research missions, and violations of academic integrity constitute serious offenses against the entire academic community. The entire Academic Integrity Policy can be found here: http://academicintegrity.rutgers.edu/academic-integrity-policy/

Attendance Policy:

Rutgers University attendance policy should be followed, which can be found at:

http://policies.rutgers.edu/view-policies/academic-%E2%80%93-section-10#2

Responsible behavior and commitment:

1. Regular attendance (or listening to the recorded lecture videos for students are still abroad) is the minimum demonstration of responsibility and commitment on your part.

2. Absences: Per the University's Course Attendance policy (10.2.7), students are responsible for communicating with their instructors regarding absences. The Division of Student Affairs is available to verify extended absences: (973) 353-5063 or DeanofStudents@newark.rutgers.edu.

3. **In case of inclement weather, students should find out on their own whether the University will be closed. Scheduled exams will NOT be cancelled if the University does not cancel class**.

4. All students must have a valid Rutgers e-mail account and access to blackboard. **Class-related information will be provided via blackboard. Students are responsible for checking their Rutgers e-mails so that important class-related information will not be missed.**