ECE 8930: Selected Topics in Electrical and Computer Engineering

Organic and Hybrid Electronics: Foundations to Applications

Section 001

Spring 2023

CLASS MEETING TIME:

TBA.

CLASS MEETING LOCATION:

TBA.

TIME TO WAIT: If the instructor does not arrive within 15 minutes of the start of class and no prior arrangements have been made, class will be canceled for that day.

COURSE MODALITY:

In-person. Electronic course management via Canvas ONLY.

INSTRUCTOR NAME:

Prof. Lianfeng Zhao

INSTRUCTOR EMAIL:

lianfez@clemson.edu

UNIVERSITY OFFICE PHONE:

864.656.4381

OFFICE ADDRESS:

205 AMRL

OFFICE HOURS AND PROCEDURES:

Arrange individual Zoom session via email. I will try to get back to you within 24 hours, unless I am out of town in which case, I will notify the class in advance.

COURSE DESCRIPTION:

An introduction to organic and organic-inorganic hybrid perovskite semiconductors with application to active electronic and photonic devices. Basic concepts and terminology in these materials, and electronic and optical structure-property relationships are discussed. Charge transport, light emission and photoinduced charge carrier dynamics are examined. Device applications such as light emitting diodes, lasers, photodetectors, solar cells, and transistors are described within a broader application context of lighting, display, communication, computing, sensing, and renewable energy. Aspects related to device fabrication and patterning techniques are also addressed.

COURSE PREREQUISITES:

Consent of instructor

PURPOSE OF COURSE / LEARNING OUTCOMES:

After completing this course, we will be able to:

- Acquire a general background in the field of thin-film electronics and optoelectronics, basic theory, applications, challenges, recent developments, etc.
- Understand relevant fundamental scientific theory, and its relationship to thin-film semiconductors and device concepts.
- Become familiar with relevant terminology and be able to read and understand scientific literature in the field.
- Be capable of critically reading and understanding scientific literature, extrapolating main ideas, summarizing your readings, and presenting your findings in the field.
- Be able to write a scientific document.

REQUIRED MATERIALS:

Textbook is optional. Lecture notes will be provided.

Recommended textbook:

- Stephen R. Forrest, Organic Electronics: Foundations to Applications, 2020, Oxford University Press.

Students do not need to purchase textbook from the campus bookstore. It is okay to purchase a used book, since students do not need any access code or digital content or any other complementary material.

TOPICAL OUTLINE:

1. Overview of metal halide perovskite semiconductors
2. Overview of organic semiconductors
3. Optical properties: Excitons, spin, energy transfer
4. Optical properties: Exciton diffusion and recombination
5. Electronic properties: Energy bands, electron transport
6. Electronic properties: Conduction, mobility, doping
7. Materials growth and device fabrication
8. Light emitters
9. Lasers
10. Light detectors
11. Solar cells
12. Transistors
13. Emerging application-related topics

MAJOR ASSESSMENT / GRADING POLICY:

Grading will be based on attendance, a final report and in-class presentation on organic or hybrid electronics relevant topics.
Final report: Choose a topic, either technical or non-technical, with direct relevance to organic or hybrid materials, devices and/or their applications. Write a 5-10-page paper introducing the topic, and discussing the major factors associated to that. Sections should include (but not limited to) introduction

(w/ motivation), results (if technical), discussion, future directions/trends, conclusions. 10-page limit is inclusive of references, figures, tables, equations, etc.
Final presentation: A 15-minute presentation surveying the chosen topic. Sections should include introduction/motivation for choice/study, main results, discussion, future directions/trends, conclusions.

The expected weights for these are:
Attendance 20%
Final report 40%
Final presentation 40%

This course does not have homework assignments or exams.

GRADING SYSTEM:
Final grades will be assigned based on the scale
$90 \leq \text{score} \leq 100 = A$
$80 \leq \text{score} < 90 = B$
$70 \leq \text{score} < 80 = C$
$60 \leq \text{score} < 70 = D$
$\text{score} < 60 = F$

ABSENCES:

In the event of a personal emergency, students should contact the course instructor, preferably before class or the exam. Students should email instructors regarding any scheduled absence as soon as possible. It is the student's responsibility to secure documentation of emergencies. A student with an excessive number of absences may be withdrawn at the discretion of the course instructor.

ACCESSIBILITY STATEMENT:

Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848 or by emailing studentaccess@lists.clemson.edu. Students who receive Academic Access Letters are strongly encouraged to request, obtain, and present these to their instructors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: http://www.clemson.edu/campus-life/campus-services/sds/.

TITLE IX STATEMENT:

Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. The University is committed to combatting sexual harassment and sexual violence. As a result, you should know that University faculty and staff members who work directly with students are required to report

any instances of sexual harassment and sexual violence, to the University's Title IX Coordinator. What this means is that as your professor, I am required to report any incidents of sexual harassment, sexual violence or misconduct, stalking, domestic and/or relationship violence that are directly reported to me, or of which I am somehow made aware. There are two important exceptions to this requirement about which you should be aware:

> Confidential Resources and facilitators of sexual awareness programs such as "Take Back the Night and Aspire to be Well" when acting in those capacities, are not required to report incidents of sexual discrimination.
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> Another important exception to the reporting requirement exists for academic work. Disclosures about sexual harassment, sexual violence, stalking, domestic and/or relationship violence that are shared as part of an academic project, a research project, classroom discussion, or course assignment, are not required to be disclosed to the University's Title IX Coordinator.

This policy is located at http://www.clemson.edu/campus-life/campus-services/access/title-ix/. Ms. Alesia Smith is the Executive Director for Equity Compliance and the Title IX Coordinator. Her office is located at 223 Holtzendorff Hall, phone number is 864.656.3181, and email address is alesias@clemson.edu.

SAFE CAMPUS:

Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

a. Ensure you are signed up for emergency alerts (https://www.getrave.com/login/clemson)
b. Download the Rave Guardian app to your phone (https://www.clemson.edu/cusafety/cupd/rave-guardian/)
c. Learn what you can do to prepare yourself in the event of an active threat (http://www.clemson.edu/cusafety/EmergencyManagement/)

ACADEMIC INTEGRITY:

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity. Further information on Academic Integrity can be found in the *Undergraduate Announcements* and in the *Graduate School Policy Handbook*.

COPYRIGHT STATEMENT:

Materials in this course are copyrighted. They are intended for use only by students registered and enrolled in this course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further. They are provided in compliance with the provisions of the Teach Act. Students should be reminded to refer to the Use of Copyrighted Materials and "Fair Use Guidelines" policy in on the Clemson University website for additional information: https://clemson.libguides.com/copyright

MODIFICATION STATEMENT:

The instructor reserves the right to modify any aspect of the syllabus (including grading) at any time during the semester for reasons including but not limited to COVID-related situations.