

Survey of Materials Analysis Techniques

EMA 6510 Section CAMP, OVER, 1FE2, 2FED

Class Periods: T 4 (10:40am-11:30am), R 4-5 (10:40am-12:35pm)

Location: CSE E107

Academic Term: Fall 2022

Instructor:

Jiangeng Xue

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846-3775

Office Hours: Mondays 1-2pm (RHN 237A/online via Zoom), or by appointments

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Please contact through the Canvas website

- N/A

Course Description

Principles and techniques used in characterization of materials. Chemical, microstructural, electronic structure, and surface analysis of materials; metals, ceramics, polymers, and semiconductor systems. 3 credits

Course Pre-Requisites / Co-Requisites

EMA3010 or equivalent

Course Objectives

- Grasp the principles and theory for general materials characterization techniques
- Understand the instrumentation requirement, set-up, and performance capabilities and limitations of these materials characterization techniques
- Develop characterization solutions to practical materials characterization needs

Materials and Supply Fees

\$48 (CAMP), \$57.99 (all online sections)

Required Textbooks and Software

- Encyclopedia of Materials Characterization: Surfaces, Interfaces, Thin Films, Ed. C. Richard Brundle, Charles A. Evans, Jr., and Shaun Wilson, 1992 by Butterworth-Heinemann (ISBN 978-0750691680). Electronic book available from ScienceDirect (with UF user authentication):
<http://www.sciencedirect.com/science/book/9780080523606>
- Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, by Y. Leng (2nd Ed.), 2013 by Wiley & Sons (ISBN 9783527334636). Electronic book available (with UF user authentication):
<https://ebookcentral.proquest.com/lib/ufl/detail.action?docID=1333091>

Recommended Materials

- Characterization of materials, by John B. Wachtman, with chapters on X-ray methods by Zwi H. Kalman (Course Reserve item in Marston Science Library: TA410.W23 1993)
- Characterization of materials, by Elton N. Kaufmann (Course Reserve item in Marston Science Library: TA404.2.K38 2003)
- The Physics and Chemistry of Materials, by Joel I. Gersten and Frederick W. Smith, Chapter 22 – Characterization of Materials (available online: ftp://ftp.wiley.com/public/sci_tech_med/materials)

Course Schedule

Tentative schedule and topics to be covered (subject to change):

Week 1: Introduction, Optical Microscopy (OM)

| | |
|----------|--------------------------------------------------------------------------------|
| Week 2: | Scanning Electron Microscopy (SEM) |
| Week 3: | Transmission Electron Microscopy (TEM, incl. EDS/WDS, EELS) |
| Week 4: | Atomic Force Microscopy/Scanning Probe Microscopy (AFM/SPM) |
| Week 5: | Electron Spectroscopies (XPS, UPS, AES) |
| Week 6: | Optical Spectroscopies (Absorption/Transmission/Reflection, PL), Exam 1 |
| Week 7: | Optical Spectroscopies (CL, FTIR, Raman, Ellipsometry) |
| Week 8: | Ion Techniques (SIMS) |
| Week 9: | Ion Techniques (ICP-MS/ICP-OES, RBS, ISS) |
| Week 10: | X-ray Techniques (XRD) |
| Week 11: | X-ray Techniques (SAXS, GIXD), Exam 2 |
| Week 12: | X-ray Techniques (XRR, XRF, EXAFS) |
| Week 13: | Neutron Techniques (Diffraction, Reflection) |
| Week 14: | Other Techniques (LEED/RHEED, electrical/Hall) |
| Week 15: | Exam 3 |

Attendance Policy, Class Expectations, and Make-Up Policy

- Class attendance is strongly encouraged. Students are encouraged to actively participate in various in-class interactive activities. Questions from students are also encouraged.
- E-mail communications with the instructor should originate through Canvas (preferred) or via direct email from your authenticated UF email account. For direct emails, make sure you include “EMA 6510” in the subject line of your email to ensure timely response.
- Excused absences must be consistent with university policies in the Graduate Catalog (<https://catalog.ufl.edu/graduate/regulations>) and require appropriate documentation. Additional information can be found here: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>. Other than in emergency situations, you must notify the instructor of your scheduled absence for exams and discuss make-up options **at least one week prior to your absence**; failure to do so may not allow you to make up for the missed exam.

Evaluation of Grades

| Assignment | Total Points | Percentage of Final Grade |
|--------------------------------------------------------------------------|--------------|---------------------------|
| Homework Sets (7)* | 20 each | 20% |
| Exams (3)** | 100 each | 20% each |
| Student Presentation (Mini-Lecture) and Peer Evaluation ^{&} | 100 | 20% |
| Total | | 100% |

*Homeworks will be assigned on bi-weekly basis. The lowest graded (or non-submission) homework will be discarded in computing the final grade.

**There will be three (3) in-class exams, 50 min each.

[&] Each student will give a mini-lecture (15-20 min) on a materials characterization technique that is not covered in lectures. Students also participate in peer evaluation of other students' presentations.

Grading Policy

The final letter grade will be assigned based on student's overall performance in the course. The following scale will be used as a guideline:

| Percent | Grade | Grade Points |
|--------------|-------|--------------|
| 90.0 - 100.0 | A | 4.00 |
| 87.0 - 89.9 | A- | 3.67 |
| 84.0 - 86.9 | B+ | 3.33 |
| 81.0 - 83.9 | B | 3.00 |
| 78.0 - 80.9 | B- | 2.67 |
| 75.0 - 79.9 | C+ | 2.33 |

| | | |
|-------------|----|------|
| 72.0 - 74.9 | C | 2.00 |
| 69.0 - 71.9 | C- | 1.67 |
| 66.0 - 68.9 | D+ | 1.33 |
| 63.0 - 65.9 | D | 1.00 |
| 60.0 - 62.9 | D- | 0.67 |
| 0 - 59.9 | E | 0.00 |

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluer.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Conduct

Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

COVID-19

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.