

**ENU 6937 Special Topics**  
**Characterization and Testing of Materials for Nuclear Reactor Applications**

**Class Periods:** T 9:35-11:30 AM, Th 9:35-10:25 AM

**Location:** Varied (MAE, UFTR, NFMC)

**Academic Term:** Fall 2019

**Instructor:**

Assel Aitkaliyeva

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Office Hours: Tuesdays 1-2:30 pm, Thursdays 1-2:30 pm, Rhines 176

**Course Description**

Graduate nuclear fuels and materials laboratory

**Course Pre-Requisites / Co-Requisites**

ENU6805 Introduction to Nuclear Materials

**Course Objectives**

To provide nuclear engineering students with knowledge needed to conduct irradiation, characterization, and corrosion experiments, and postirradiation examination (PIE) campaigns in the field of nuclear fuels and materials. Through the course of the project, the students will learn to:

- Prepare specimens for microstructural characterization
- Conduct corrosion studies/tests
- Conduct stress-corrosion cracking (SCC) studies
- Design irradiation campaigns
- Examine microstructure and chemistry of the nuclear fuels and materials
- Experimentally establish properties of nuclear materials
- Establish microstructure-property relationships for select materials

**Materials and Supply Fees**

N/A

**Required Textbooks and Software**

None required. Course notes and suggested reading material will be provided through Canvas.

**Recommended Reading**

- Fundamentals of Radiation Materials Science, G. Was
- Fundamental aspects of nuclear reactor fuel elements, D. R. Olander
- Nuclear Reactor Materials and Applications by B. Ma

**Recommended Texts and Support to Assist with Project Report Writing**

- The Mayfield Handbook of Technical and Scientific Writing (available at <http://www.mhhe.com/mayfieldpub/tsw/toc.htm>). *Excellent resource and free.*
- The University of Florida Reading and Writing Center is also available to help students become better readers and writers. More information (including operating hours) can be found at <http://www.at.ufl.edu/rwcenter>.

## **Course Schedule**

- Week 1: - Introduction to specimen preparation, characterization, and postirradiation examination (PIE). Experiment design basics  
- Metallographic specimen prep lab
- Week 2: - Metallographic specimen prep lab, polishing samples for SEM/FIB vs EBSD  
- Lab: SEM/EBSD of samples
- Week 3: - TEM specimen prep lab: FIB milling  
- TEM analysis lab (FIB lamella)
- Week 4: - TEM specimen prep lab: electropolishing.  
- TEM analysis lab (3 mm disks)
- Week 5: - Specimen prep for physical property measurements  
- Physical property measurements lab: mechanical properties  
- SCC lab: load samples for SCC test  
- Report for sample preparation and characterization is due
- Week 6: - Introduction to radiological work  
- Rad work lab
- Week 7: - Corrosion tests lab (RT corrosion using a potentiostat, and a high temperature static autoclave corrosion test)
- Week 8: No class, MiNES conference
- Week 9: - Specimen prep for thermal property measurements  
- Physical property measurements lab: thermal properties
- Week 10: - SEM lab: Microstructural characterization of specimens post SCC
- Week 11: - Off-campus activity: Florida transportation lab tour  
- Report for physical property measurements is due
- Week 12: - UFTR lab: using hot cell manipulators to conduct PIE
- Week 13: - Bridging gap between experiments and modeling:  
- Modeling thermal conductivity of the fuel  
- Report for SCC studies is due
- Week 14: - Design of irradiation and PIE campaign  
- Rad work obstacle course
- Week 15: - Final project report and oral presentations

\*Adjustments to the regular schedule can be made depending on instructor's travel. Any adjustment will be announced in advance in class and through the class website.

### **Laboratory reports**

Students will be required to write a scientific research report at the end of dedicated experimental campaigns, which are stated in the course schedule. A scientific report should share the findings and ideas in an organized and official manner. The format should allow the reader to quickly identify the objectives of the work, and follow in a logical manner the work done by the author. The mandatory parts of the report are:

- Title (indicate exactly what you have studied in a concise manner)
- Abstract (condensed version of the entire lab report, not to exceed 300 words. The reader should be able to understand the purpose, methods, results, and significance of your research without reading the entire paper)
- Introduction (identify the problem/methods and provide the background information that the reader needs to understand your experiment. Provide brief literature review to describe previous research and explain how the current experiment will expand the knowledge).
- Materials and Methods (describe how you did your work, including experimental design, methods for gathering and analyzing data. Remember to include enough detail and write clearly enough to allow readers to duplicate the experiment).
- Results and Discussion (Present and discuss your observations and data. Discuss why you observed what you did, how it happened, and how it relates to the purpose of the experiment)
- Tables and Figures (they should enhance the report and easy to understand. Reader should be able to understand and follow the results even if the tables/figures were removed)
- References (reference ALL information within the report that is not your original work or idea, even if you are paraphrasing or summarizing the thought)

Lab reports must be prepared and turned in in word and pdf formats prior to the deadline. Late submissions will receive 10% penalty.

### **Oral presentations**

The oral presentations will be 12 min long, plus 3 minutes left for questions at the end. Students will be required to present on their experimental campaigns and share their findings in an organized manner.

### **Attendance Policy, Class Expectations, and Make-Up Policy**

Proper behavior in class is always important and leads to a relaxed and productive educational environment. Thus, eating, drinking, texting, reading of newspapers, working on homework for this or other courses, or other activities that are not part of the class are prohibited. Students who do not comply with these requirements or who behave disorderly or disrespectfully will not be allowed to participate in the laboratory-work. Leaving your cell phone on, leaving early or arriving late can be VERY distracting. All electronic devices (PDAs, cell-phones, etc.) should be turned off or in silent mode. If your cell phone rings during class, it will be confiscated for the remainder of the class period. Students MUST participate during the student presentations at the end of the course in order to successfully complete the course. While not directly enforced, attendance is strongly suggested since significant amount of participative as well as individual and collaborative work will be performed during the class sessions. Excused absences must be in compliance with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

### **Evaluation of Grades**

Assignment	Total Points	Percentage of Final Grade
Laboratory report	100 each	35
Presentations	100 each	35
Term project	100	30%
		100%

### **Grading Policy**

The following is given as an example only.

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 requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

### **Course Evaluation**

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

### **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 Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. 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
- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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](mailto: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:** <http://www.counseling.ufl.edu/cwc>, 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](mailto: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/>.

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://www.crc.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://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

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