

## ADVANCED MATERIALS LABORATORY

Welcome to the Advanced Materials Laboratory Course. Our goal is to introduce you to several "state-of-the-art" experimental techniques covering a range of phenomena and material properties. The selected experiments for this class require an interdisciplinary approach by combining basic ideas from materials science, mechanics, and physics.

### Class Hours

Lecture: 2.0 hrs Monday 12:00-1:50 p.m.  
Room: Curtis Hall 344

Laboratory: 2.0 hrs To be scheduled with the TA.

**Web page** <http://nano.materials.drexel.edu/teaching.html>

### Instructor

Prof. Yury Gogotsi 383 CAT x6446 gogotsi@drexel.edu

### TAs

Patricia Reddington pdv23@drexel.edu  
Ioannis Netzel in34@drexel.edu  
Office hours TBD

### Lab Topics

1. Raman and Infrared Spectroscopy
2. Micro- and Nanoindentation
3. Scanning Electron Microscopy and Spectroscopy
4. Transmission Electron Microscopy

### Textbook

Recommended Reading: "A Guide to Materials Characterization and Chemical Analysis", J. P. Sibelia, VCH Publishers, Inc., 1996,  
Course Handouts

The instructor will assign additional reading material and provide handouts for the specific laboratory.

### Course Organization

#### Lectures

Week 1	Overview of Testing and Characterization Techniques and Design of Experiments
Week 2	Raman and Infrared Spectroscopy
Week 3	Scanning Probe Microscopy
Week 4	Depth Sensing Indentation
Week 5	Data Analysis and Presentation. Quiz (Indentation, Vibrational Spectroscopy, SPM)
Week 6	Thermal Analysis
Week 7	Scanning Electron Microscopy and Spectroscopy
Week 8	X-ray diffraction, Electron Diffraction and Transmission Electron Microscopy
Week 9	Characterization of Powders and Porous Solids.
Week 10	Quiz (Thermal Analysis, Microscopy and Spectroscopy)
Week 11	Final Presentation

## Course Organization - Labs

The students will be divided into groups of four. Each group will receive material from the instructor. On the obtained material, each group will perform measurements described earlier: microscopy, material microstructure, spectroscopy, and indentation testing. The specific details of measurements and characterization for each group will be decided in the first laboratory class in consultation with the instructor and TA. Each group will establish a schedule with the TA for performing the measurements/observations and providing a report on each category of measurements. Each group member is expected to give a report on the measurements done. During the finals week, the group is also expected to make a conference style presentation in which they give a complete account of what they studied and describe any connections between the different types of measurements they have conducted.

## Report Format

Laboratory Progress reports are due within a week after the lab. These are in the form of extended abstracts. They should be **NO LESS THAN 1 PAGE AND NO MORE THAN 2 PAGES** in length, not including tables, figures and references. Data should be in tables and/or figures **AND INSERTED AT THE APPROPRIATE POINT IN THE TEXT**. You must include a procedure, but it should be very brief. This report should focus on your results and a discussion of those results. Try to **EXPLAIN** what you saw and prove that your explanation is correct. You should **BEGIN** your report with 3 or 4 short sentences summarizing what you prove in the discussion.

Notes:  
*References* - Make sure you have at least three references and that you reference them properly. Number references consecutively throughout the text. List all references by number under 'References'. If a reference is repeated, it retains the original number. Each reference must include author(s), volume, page, and year. For books, include the title, publisher, and editor (if applicable). The use of EndNote software is strongly encouraged (available to all Drexel students). **WEB SITES CANNOT SERVE AS THE EXCLUSIVE BASIS FOR YOUR REPORT!**

*Tables* - Put a caption at the top and number them I, II, II...

*Figures* - Put a caption at the bottom and number them 1, 2, 3, ...**MAKE SURE ALL THE AXES ARE LABELLED!**

***DUE DATES*** - Progress Reports are due by 10:00 AM one week after the lab. Place the report into Professor's mailbox or give it to TA.

## Presentation Format

The presentation is a group presentation. You will present all the measurements and insights you have developed on the selected materials in this course. The best approach is to think of this as a conference presentation. The recommended format is described below. You will have 20 minutes to present and there will be five minutes for questions.

1. **TITLE SLIDE** - WITH AUTHORS' NAMES, INSTITUTION, OUTLINE OF THE TALK; THEN SAY A QUICK ABSTRACT OF THE TALK. (*In this talk I will show you that the moon is made out of cheese. I determined this by sending mice to the moon and examining the contents of their stomachs upon returning*)
2. **MOTIVATION** - WHY SHOULD ANYONE LISTENING CARE? (*It is important to know if the moon is made out of cheese because it must be protected from mold if this is the case!*)
3. **PROCEDURES** - WHAT TECHNIQUES WERE USED? (Mice were sent to the moon via rocket. They were allowed no food during the flight and were kept entertained with movies of mighty mouse. They were sent down to the moon for two hours and their movements were monitored via camera. Only one mouse escaped, etc.)
4. **SLIDES SHOWING RESULTS IN AN ORDER THAT PROVES YOUR CONCLUSION WELL** - YOU CAN DISCUSS AND SHOW RESULTS AT THE SAME TIME OR SEPARATE THE RESULTS AND DISCUSSION SECTIONS. (*This slide shows the concentration of cheese in each mouse's stomach as a function of size. This shows that the largest mice eat the most cheese. It also proves that there is cheese on the moon, but it seems to be yellow and not green.*)
5. **CONCLUSIONS - ONE SLIDE.** (*1. Mice like cheese, 2. The moon at least has cheese on the surface, 3. The color of the cheese is yellow.*)

## Grading Scheme

Quiz I	30%
Quiz II	30%
Presentation	20%
Lab Reports	20% (5% for each)