SCI 1410: materials science & solid state chemistry

PROJECT THREE.

modern materials and processes

Novacem carbon negative Cement (novacem.com)

OVERVIEW

For the final few weeks of the course, you will design a self-directed project to study a modern materials science topic of interest to you. There are tons of options here, e.g., advanced ceramics and glasses, composite materials, synthetic polymers, superalloys, shape-memory metals, high performance polymer fibers or gels, natural or biological materials, biodegradable or low eco-impact materials, semiconductors or electronics materials, fiber-reinforced or particulate composites, food science, energy-related technologies (solar cells, fuel cells, etc.) and contemporary materials processing techniques such as recycling, manufacturing, or rapid prototyping. For Project 3, your team will select a materials science topic with modern technological and contextual significance, and you will explore this topic through a self-designed program of research and laboratory experimentation. In keeping with our course theme, select a material or application area that is interesting from a societal or environmental impact angle. The development of modern materials technologies often raises ethical questions, so that may provide an interesting analytical angle for your project.

LEARNING OBJECTIVES

Project 3 will help you develop your learning in these areas:

- **Self-direct**! Project 3 provides a great opportunity to explore a topic without too many constraints. Among other things, you will choose a topic, set goals, select strategies and processes, find resources, collaborate with your peers and instructor, monitor and control your effort and time, and reflect on your learning.
- **Plan your project!** Design and implement an experimental procedure for characterization or testing of a modern material, component, or process.
- **Do some materials science!** Explain relationships among structure, processing, properties, and environment/context in modern materials systems.
- **Connect to design/performance!** Interpret your project findings in the context of a real-world application, and recognize interrelationships between materials selection and design.
- **Explore the impact!** Examine how your materials topic links to broader concerns (e.g., environmental, social, cultural, political, regulatory, ethical factors).

ASSIGNMENTS

The assignments in Project 3 include the following:

Reading. Project 3 is self-directed. Oh, yes. You and your teammates are responsible for identifying reading materials to support your project. You may consider reading in your materials textbook, or you may decide to support your investigation with reliable information you find in the library, on the web, or elsewhere. You take control, and let me know how I can help. But don't get sloppy with the sources – find some good supporting information!

Project. There are many possibilities for this project. Let your imagination run wild to generate some compelling project ideas, but keep in mind (1) the type of analytical instrumentation and testing equipment we have available, (2) your budgetary constraints, and most importantly, (3) the time constraints. As with our previous projects, the details of this project are largely up to your team, but the primary goal of the project is to build connections among materials chemistry, microstructure, processing, properties, performance, and impacts. Your team should decide on a suitable project deliverable, but it should include a discussion of your technical results and some analysis of the modern contexts and impacts of your topic.

A general framework for the project is as follows:

Laboratory Experiment

1. Team. You must form a team. Do so at once, if not sooner (actually, we'll do this in class).
2. Project topic. Select a modern materials science topic and design an experiment to explore this topic. Your final project should focus on modern materials or processes, and it should be of appropriate scope for the time remaining in the semester. The project possibilities are quite extensive and limited only by your creativity, our lab facilities, your budget, and time. As you generate and develop your project ideas, please keep in mind these project constraints:
   - **Time**. We have only a few weeks left in the semester, so choose an appropriate project scope.
   - **Money.** We'll need to keep the average cost of projects to ~$100 (yours might be higher or lower, depending on your specific needs).
   - **Hands-on experimentation**. Your project should involve some lab-based processing or testing, or both.

3. Select learning strategies and design your project experiments. The details are up to you and your team.
4. Implement your strategies and experiments. Build connections among modern materials and contexts.
5. Report your findings and the significance of your investigation.

Project Deliverables

1. One-page project proposal

Due: Wednesday, April 15, in class

Briefly describe your topic, materials, experimental approaches, and information resources. Identify the types of materials science connections you hope to explore, and briefly explain the significance of your materials system or process in our modern context.

2. Teaching-oriented presentation or demonstration

Due: Oral presentations will take place in class during the final exam period – Tuesday, May 5, 4-7 pm

Your team will have about 10 minutes for your presentation, plus 5 minutes to answer questions from the class. The goal of this assignment is *education*: you must teach something to the class. Oral presentations will be assessed according to the following criteria:

- Did everyone speak clearly and engagingly?
- Were visual materials clear and informative?
- Was the technical content both understandable and worthy of a college class?
- Were the results understandable and educational?
- Was the contextual framing informative and connected to the technical findings?
- Was the presentation creative and enjoyable without sacrificing intellectual content?

3. Team-defined final deliverable

Due: Final exam period – Tuesday, May 5, 11:59 pm

Your team-defined final deliverable could be a poster, written report, short film, web site, educational video, story, etc. If appropriate, the team-defined deliverable may be used as the final presentation. The final deliverable should adequately present your experiments, findings, and analyses, and it should connect context with your technical information. Be sure to include formal citations of sources.

Unless you negotiate otherwise, assume that the audience for this deliverable is your instructor and your technically educated classmates.

The final deliverable will be assessed according to the following competencies:

- Communication
- Qualitative analysis
- Quantitative analysis
- Diagnosis and experimental inquiry

PROJECT 2 CONTINUATION OPTION

If you have compelling questions, hypotheses, or analytical angles from Project 2 that you would like to continue to explore, you may elect to continue your metals project through the end of the semester. Note that you may choose to do this with your same Project 2 teammates, or you could work individually or with a new group. Talk to Jon for details on continuing your Project 2 investigation for a few more weeks.