MSE 403: Synthesis of Materials **Fall 2020**

Prof. Qing Cao

Course Description: This class introduces students to the synthesis of inorganic materials. It will cover solid-state reactions; formation of thin films from the gas phase; formation of solids from solutions and melts; self-assembly and self-organization; templated materials; and nanostructured materials.

Course Objectives: Student will understand the processes, energy balance, and motivation for compound formation. They will be able to practically apply MSE 201, 401, and 402 to specific processes. Students will develop the technical insight into the choice of methodologies for materials synthesis in a variety of systems, and the skills to suggest and evaluate reasonable syntheses for a variety of applications. The goal is to help students develop a background in inorganic materials synthesis for related jobs, and prepare them for future research in this field in graduate school.

Lectures: Tuesday/Thursday 9:30 – 10:50AM

Instructor:

Prof. Qing Cao (Email: qingcao2@illinois.edu)
Office hour: by email appointment

Teaching Assistant:
Fufei An (Email: fufeian2@illinois.edu)
Office hour: by email appointment

Textbook: U. Schubert and N. Hüsing, Synthesis of Inorganic Materials. 4th Edition.

Grading:

Homework:	20% (4% * 5)
Midterm Exam 1	20% (10/08)
Midterm Exam 2	20% (11/19)
Final Poster	20%

Homework Protocol

Homework will due in class after one week. Please submit a stapled hardcopy with your name. Clear handwriting or print please.

For quantitative problems:
Correct Numerical Answer 20%
Correct Reasoning 40%
Correct Units 20%
Legible Work Shown 20%

For Qualitative problems:
Reasoning is clear and logical 40%
Factual statements are correct and based on course material 40%

Response is legible with correct spelling and grammar 10%
If requested, Figures or Diagrams are clear and well labeled (if not requested, these points go to the reasoning category) 10%

Final Poster:

1) You will be assigned to work as a team of four with your classmates.
2) You can pick any topic related to inorganic material synthesis. Submit your topic of choice to TA on or before 11/19.
3) Grading rubric

Relevance: Why is this topic interesting or important?	10
Historical evolution of synthesis OR origin of precursors	10
Thermodynamic background of synthesis	10
Choose one: Kinetics Nucleation and growth Catalysis	10
Cost and safety considerations	10
Current state-of-the-art	10
Processing-properties relationship	10
Choose one: Proposed new material and synthetic route Improvements to existing synthesis Comparison of synthesis with other materials Scale-up viability Proposed new material and synthetic route	10
Text: large enough to be legible, concise. Long paragraphs avoided	5
Figures: neatly presented, and cited if necessary	5
Citations: inline, well-formatted, peer-reviewed, no sketchy web sources	5
Poster Division of Labor: Online form submitted on time	5
Total	100

Syllabus:

Lecture 1: Introduction and Orientation

Lecture 2: Electronic and Ionic bonding

Lecture 3: Thermodynamics

Lecture 4: Phase Diagrams

Lecture 5: Thermal Synthesis

Lecture 6: Intercalation

Lecture 7: Chemical Vapor Deposition Part 1

Lecture 8: Chemical Vapor Deposition Part 2

Lecture 9: Physical Vapor Deposition

Lecture 10: Epitaxy

Lecture 11: Glass

Lecture 12: Single Crystal Growth

Lecture 13: Precipitation

Lecture 14: Biomaterials

Lecture 15: Electrodeposition

Lecture 16: Solvothermal Process

Lecture 17: Sol-gel Process (Part 1)

Lecture 18: Sol-gel Process (Part 2)

Lecture 19: Templated Materials

Lecture 20: Metal Organic Frameworks

Lecture 21: Nanomaterials

Lecture 22: Synthesis of Nanoparticles

Lecture 23: Synthesis of 1D and 2D Materials (Part 1)

Lecture 24: Synthesis of 1D and 2D Materials (Part 2)

Lecture 25: Safety in the Synthesis of Materials

Lecture 26: Poster Presentation