

MATSE 421
Ceramics Processing and Microstructural Development
Fall 2025

CRN: 30436. and CRN: 46510

<https://courses.grainger.illinois.edu/MSE421>

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Teaching Assistant: Prof. W. Kriven

Office Hours: TBD

Prerequisite: MSE 420 or consent of instructor.

Credit: 3 or 4 undergraduate hours or graduate hours.

Grading:

Homework	15%
Project and presentation	10%
Midterm	30%
Final	45%

Grading Scale:

A	85 - 100
B	75 - 84
C	65 - 74
D	55 - 64
E	45 - 54

Grading scale will not be raised at any point during the semester, but may be lowered at instructor's discretion.

Course Outline:

Basic principles and understanding of microstructure development and processing of ceramic materials will be addressed, with an emphasis on processing - microstructure-property relationships. Knowledge of a variety of processing methodologies and their effects on microstructural development will be gained. Geopolymer-derived powder synthesis and processing of composites. Examples of several ceramic components will be illustrated and discussed within this context.

Course Objectives:

- Develop a knowledge of methods of powder synthesis and characterization
- Develop working knowledge of the unit operations involved in processing ceramic materials
- Develop knowledge of characterization methods used to determine microstructural features and effect of process variables
- Develop understanding of sintering and microstructural development of ceramic materials
- Develop foundation for reading and critically evaluating published literature in the ceramics field
(e.g.,
 - Journal of the American Ceramic Society
 - Journal of the European Ceramic Society
 - International Journal of Applied Ceramic Technology
 - Journal of Ceramic Processing Research
 - Journal of Materials Research
 - Ceramics International

For your continuing education, keep in touch with :

- The American Ceramic Society Bulletin
- Ceramic Industry
- The MRS Bulletin

Text and References

Text: M. N. Rahaman, "Ceramic Processing", 2nd Edition, published by CRC Press (Taylor and Francis Group), (2017)

Reference books placed on Reserve:

Reed, James: "Principles of Ceramic Processing," 2nd Ed., Wiley Interscience (1995)

W. D. Kingery, H.K Bowen, D. R. Uhlmann, "Introduction to Ceramics" published by John Wiley and Sons, (1976)

C. B. Carter and M. G. Norton,
"Ceramic Materials Science and Engineering"
Published by Springer Science and Business Media, LLC (2007)

D. A. Richerson, "Modern Ceramic Engineering – Properties, Processing and Use in Design," published by Taylor and Francis (2006)

M. Barsoum, "Fundamentals of Ceramics," McGraw-Hill (1997)

T. A. Ring, "Fundamentals of Ceramic Powder Processing and Synthesis," Academic Press (1995).

J. W. Evans and L. C. D Jonghe, "The Production of Inorganic Materials," Macmillan Publishing Co. (1991)

D. Segal, "Chemical Synthesis of Advanced Ceramic Materials," part of a series in Chemistry of Solid State Materials. Series Editors A. R. West and H. Baxter.
Cambridge University Press, (1989)

R. E. Mistler and E. R. Twiname, "Tape Casting – Theory and Practice," publ. by The American Ceramic Society (2000)

- Group Project -

Assignment:

You will form teams of students each to perform the following. Each team is responsible for collecting a total of four articles -- one per each topic listed below:

Topic #1 - Powder Synthesis

Topic #2 - Powder Characterization

Topic #3 - Powder Processing

Topic #4 - Forming of Ceramics

Topic #5 - Densification of Ceramics

Each person in each group is responsible for writing an 10-page (**1.5 spacing, typed**) summary of each article collected. In addition, each person will be required to give a 12 minute oral presentation to the class on one of their articles during the course of the semester. We will schedule these talks for the later part of the semester.

Additional Information for the Assignment:

- Articles should have been published in the list of journals mentioned earlier.
- The article summaries must be written INDIVIDUALLY!!! They should contain the following points and do not simply copy word for word from the article:
 - Read the article, and think about it.
 - Why did they perform this research?
 - What were they hoping to accomplish?
 - How did they determine this -- i.e., what techniques were used, etc?
 - You may not understand all of the terminology?
 - What limitations are there in this work?
 - Finally, what is the impact of their research?
- The oral presentation should encompass 12 min with 3 mins for questions. You will be graded for clarity, degree of understanding, quality of visuals used, and ability to answer questions from the audience (including myself).

*[Total Points = 10% of your final grade]