

MIE 1706: Manufacturing of Cellular and Microcellular Polymers (2015)

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Lecture Hours: M 9-11 and F 3-5 (see the detailed lecture schedules below. There are no lectures for some weeks.)

Final Exam: Dec 4, 3-5 pm

References

1. A set of technical papers from the webpage
<http://www.mie.utoronto.ca/labs/park/lab/publication.htm> (account: mpml and password: cbpweb)

Grading scheme:	Reading Assignment:	17 marks (1 mark for each paper, due on the next lecture day. 20%/day deduction for late submission)
	1 st homework:	2 marks (to be issued on Sep 14, due on Sep 18)
	Take-home Exam:	10 marks (to be issued on Oct 23, due on Oct 26)
	Term Project:	20 marks (5 marks for the mid-term report due on Oct 23, 2015 and 15 marks for the final report due on Nov 30, 2015)
	Final Exam:	51 marks (Dec 4, 2015)

Contents

1. Fundamentals
 - Introduction to Foams, Foam Structure
 - Foaming Agents, (PVT and) Solubility
 - Cell Nucleation, Homogeneous and Heterogeneous Cell Nucleation
 - Cell Growth, Cell Stability, Simultaneous Model of Cell Nucleation and Cell Growth
 - Visualization of Foaming
2. Foam Extrusion
 - Control of Cell Nucleation
 - Control of Cell Growth
3. Foam Injection Molding
 - Low-Pressure Structural Foam Molding
 - Advanced Structural Foam Molding
 - High-Pressure Foam Injection Molding
 - Applications
4. Bead/Particle Foaming
 - EPS and EPP
 - EPLA
 - Effect of Crystal on Foaming
5. Foam Compression Molding

- Crosslinking and Foaming
 - Crystallization and Foaming
6. Open-Cell Foaming
 7. Surface Tension and Viscosity
 8. Searching for Structure-Properties Relations

Lecture Contents and Reading Assignments

Day	Date	Lecture Contents	Reading Assignments
M	09/14	Introduction to Foams, Foam Structure	Draw v_f vs size
F	09/18	Foaming Agents, (PVT and) Solubility	J216
M	09/28	Cell Nucleation, Homogeneous and Heterogeneous Cell Nucleation	J144
F	10/02	Cell Growth	J92
M	10/05	Cell Stability, Simultaneous Model of Cell Nucleation & Cell Growth	J86
F	10/09	Visualization of Foaming	J190, J191
M	10/19	Foam Extrusion: Control of Cell Nucleation	J52
F	10/23	Foam Extrusion: Control of Cell Growth; Mid Term-Project Report due; Take-home exam to be issued	J60 (or J130)
M	10/26	Foam Injection Molding: Low-Pressure Structural Foam Molding; Take-home exam due	J135
F	10/30	Foam Injection Molding: High-Pressure Foam Injection Molding	Vahid's paper
M	11/09	Bead/Particle Foaming: EPP	J203
F	11/13	Bead/Particle Foaming: EPLA	J246
M	11/16	Foam Compression Molding	Nan's paper
F	11/20	Open Cell Foaming	J80
M	11/23	Surface Tension and Viscosity	J164, J29
F	11/27	Searching for Structure-Properties Relations	J217
M	11/30	Final Term-Project Report due	N/A
F	12/04	Final Exam	N/A

INSTRUCTION FOR THE TERM PROJECT

1. Purpose

The purpose of the term project is to deeply understand the fundamentals of the foaming phenomena. You have to demonstrate that you have completely understood the cell nucleation theories, the equations used in the cell growth phenomena, and the coupled nature of the cell nucleation and growth phenomena, and the associated cell stability issue.

2. Topic

Any topic in the areas of cell nucleation, cell stability, cell coarsening, cell coalescence, cell growth, and simultaneous modeling of cell nucleation and growth, is acceptable. It does not have to have any *unique and new contributions*, but if you present any innovative ideas that do not violate the basic principles of the papers listed below, you will get some bonus mark. But

please note that you need to first clearly demonstrate that you have fully understood the contents of these 8 papers. If you include the analysis of the cell nucleation phenomena in any of the actual foam processes such as foam extrusion, foam injection molding, bead foaming, or foam compression molding, it will be a feather in your cap. But again, too much emphasis on the application may not be impressive. I want to make sure that you fully understood

Essential papers: J86, J92, J144, J169, J190, J191, J205, J211

3. Reports (20 marks)

- 1 page report due on Sep 28, 2015. No marks.
- Interim report due on Oct 23, 2015. 2-page limit including the title and references. 2 column format (see the attached example). 5 marks.
- Final report due on Nov 30, 2015. 5-page limit including the title and references. 2 column format (see the attached example). 15 marks.
- Grading scheme

Technical contents:	70%
Communication skills:	30%
- Pay attention to the due date. Marks will be severely deducted for the late reports (20% for each day).
- Make sure to include a formal bibliography at the end of the report.
- The report will not be returned. Make your own copy before you submit it.
- Times New Roman font, the font size 10. Single line spacing. Please use the template format circulated by email.
- Type the report. Marks will be severely deducted for hand-written texts, figures, and tables. Equations, tables, and figures should be properly numbered. Proper captions should be attached to each table and figure.