BIOE 594: Microfluidic Biochip Laboratory

Fall 2007

Lectures	Tu and Th 11-12 am, 301 Lincoln Hall
Labs	F- 1 - 5:00 pm, 205 B SES

Instructor	Dr. Dave Eddington
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Textbook

1. Class notes and handouts.
2. Articles from research journals and select sections from reference books listed below. I will post lecture notes in PDF on Blackboard. When available, supplementary materials will be posted on the Blackboard as well.

References & Useful MEMS Books

1. N.-T. Nhuyen and S. T. Wereley, *Fundamentals and Applications of Microfluidics*, Artech House, Boston, MA, 2002.
2. G. Karniadakis and A. Beskok, *Micro Flows: Fundamentals and Simulations*, Springer-Verlag, 2001.
3. J. Cheng and L. K. Kricka, *Biochip technology*, Taylor & Francis, 2001.
4. A. Manz and H. Becker, *Microsystem Technology in Chemistry and Life Sciences*, Springer-Verlag, 1999.
5. M. Madou, *Fundamentals of Microfabrication*, 2nd ed., CRC, 2002.
6. G. T. A. Kovacs, *Micromachined Transducers Sourcebook*, McGraw Hill, 1998.

Grading

Lab Reports	30%
Presentation	35%
Final Report	35%

Lab Reports Assigned succinct reports will be due before the start of the following week's lab.

Final Report Each lab group will prepare a final 10 page report on their design and findings. The report guidelines will be forthcoming. The report will be due either the last week of class or during the finals week.

Presentation Each lab group will prepare and give a 30-min presentation describing their design and findings. The presentations will take place during the final's week. In addition to my evaluations, the presentations will be judged by your classmates and two faculty experts in the field.

No.	Lecture	Lab	Description
1.	Introduction to Biomems	-	Overview of the field of Biomems: Methods, Materials, Applications
2.	Intro to Biomems Applications	-	Overview bioMEMS devices used in research
3.	Microfluidic Applications	-	Overview of microfluidic devices
4.	Microfluidic mixers	-	Overview of microfluidic mixers
5.	Microfluidic Modeling I	Microfluidic modeling I: CFD-GEOM	Familiarization with modeling and meshing using the CFD-ACE+ software. A TA will help students through the tutorials and will be available for questions.
6.	Microfludidic Modeling II	Microfluidic modeling II: CFD-ACE+/VIEW	Simulation of models using CFD-ACE+ software. Student groups will be taught how to visually represent their models and how to analyze the results.
7.	Device Modeling I	Device Modeling I	Each group will chose a design to model and fabricate.
8.	Device Modeling II	Device Modeling II	Additional time to complete designs and analyze modeling results.
9.	Device Modelling III	Device Modeling III	Additional time to complete designs and analyze modeling results.
10.	Mask Design	Mask Design in AutoCAD	AutoCAD will be used to layout mask plates. At the end of the lab session, each group will be required to submit their AutoCAD designs in either the .dwg/.dxf format to be checked by TA and to be sent out for fabrication.
11.	Fabrication I	Fabrication I: SU-8 Master	This lab will take place in the cleanroom. SU-8 photoresist will be patterned on clean silicon wafers by UV lithography. The TA will guide students through the entire process of fabricating the SU-8 masters for the various microfluidic device designs.
12.	Fabrication II	Fabrication II: PDMS Casting, Bonding & Packaging	PDMS will be cast on photoresist molds from the previous week. Cured PDMS molds will then be prepared and characterized with optical microscopy. PDMS molds will be cleaned, inlets/outlets carefully punched, and bonded to glass slides using plasma bonding to complete the microfluidic devices.
13.	Characterization I	Device Characterization I	Devices will be packaged using the custom Plexiglas interconnect with built-in tubing for inlets/outlets. Microfluidic characterization will be carried out using a fluorescent dyes on an inverted epi-fluorescence microscope.
14.	Data Analysis	Data Analysis	The experimental data from the previous class will be analyze using *ImageJ* software and compared with the modeling results. Additional time will be used for further microfluidic testing, as necessary.
		Final Report and Presentations	Results will be presented in a final report and presentation during the finals week.