

Chem E 486 Skills Acquisition Boot Camp

Purpose of this document:

To let each specialist know what they need to accomplish during the first three weeks of class, and to describe the deliverable items we expect at the end of the three weeks of “Skill Acquisition Bootcamp”.

Summary

This will be a fast paced course that will require students to pick up specific new skills to complement their foundation in chemical engineering. This document lays out the specific activities each specialist is expected to participate in, and the deliverable products we expect from each specialist team.

The second and third week of lab section (plus outside work) will be used to accomplish the following:

- The fabrication specialists will learn to safely operate the laser microfabrication tool and use it to build a prototype microfluidic device. Deliverables include the prototype device, a picture or movie of it operating, and a detailed standard operating procedure for the laser tool.
- The simulation specialist will learn to use FEMLab v.3 to model the same microfluidic device built by the fabricators. Deliverables will include a report describing the model equations, model output and evidence the accuracy of the results have been validated.
- The marketing/finance specialist, working collaboratively with communications directors, will acquire data about the various potential educational markets (customer needs, size, price elasticity). A market survey report will be prepared to detail the finds.

Details for the Fabrication Specialist (Ravi Manghani, Leader of activity)

Objective: To obtain needed skills and expertise in laser fabrication.

Week 2 Lab Sessions

Meet outside Benson 247 at the beginning of your Lab session. During your Week 2 lab session, the fabrication team will learn the basics of laser cutting first hand. Step by step procedures for safe and effective laser cutting will be demonstrated. The use of the driver software will be shown, and the impact of setting different laser power, laser resolution, and cutting speed will be evaluated while making test structures from mylar. Homework will be given at the end of the session.

Week 3 Lab Session

Come to Benson 247 at the beginning of your session. You will come to class with an accurate drawing of the prototype device that is compatible with the laser cutting tool software (see sketch of device below). You will also have the basic skills needed to use the device. The following three layered microfluidic device (Fig. 1 and Fig. 2) will be cut, assembled, and hopefully, tested during this session. Dimensions for the various channels and chambers are included on figure 2. The mylar will be 50 μm thick. The prototype device “sketched” below was inspired by a US patent.

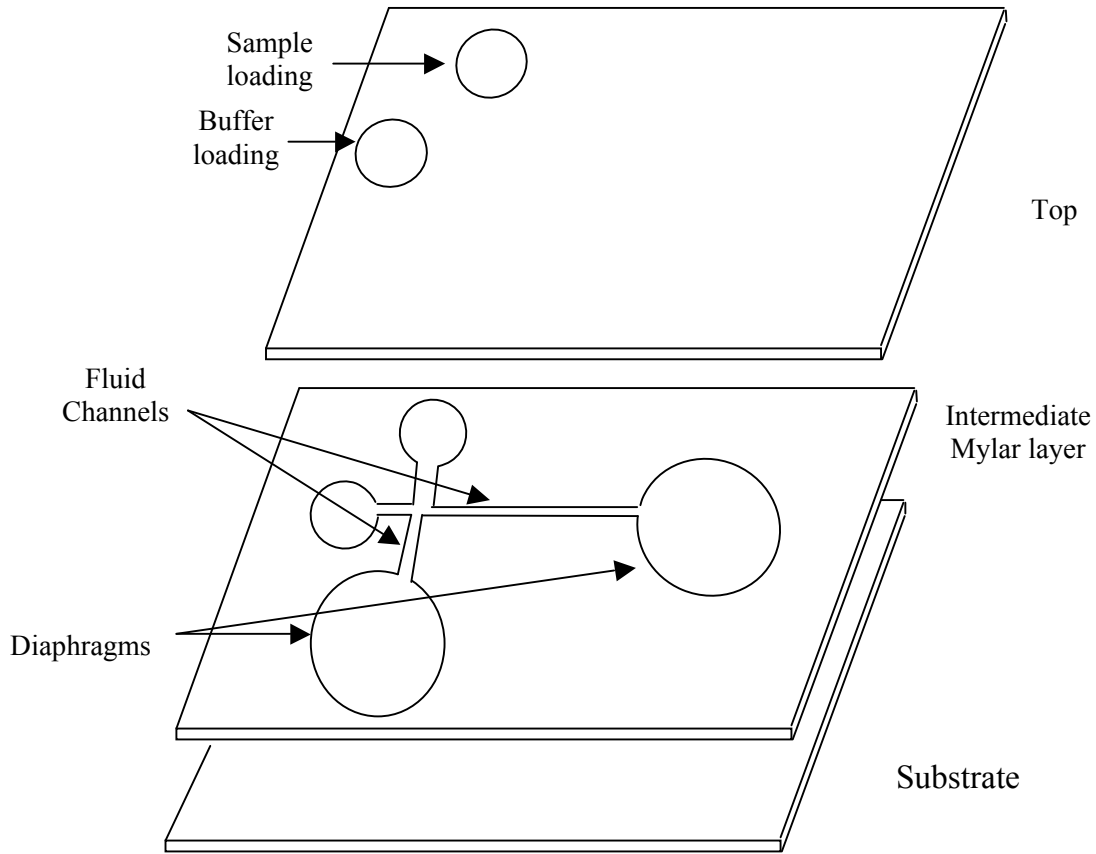


Fig. 1: Fabrication (3-D)

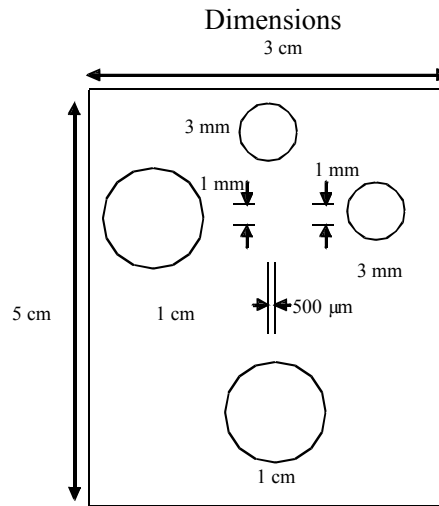


Fig. 2: Dimensions (Mylar layer)

Report:

Please e-mail a pdf version of your report by 4:00 pm Friday, April 16 for Tuesday sessions, and 4:00 pm Monday, April 19 for the Thursday session. The report should include the following items:

- 1) Standard operating procedure that details the following items:
 - a. Safety Considerations
 - b. Tool Set up
 - c. Step-by-step instructions that allow someone with a drawn file to enter the room and perform a cut.
- 2) Pictures or movie of the device in action.
- 3) Conclusions.

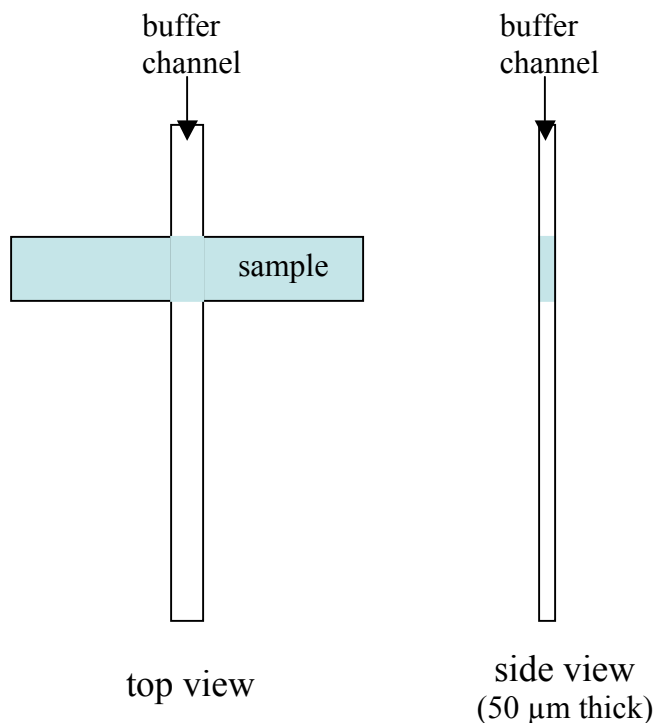
Please put the device you made and tested in Prof. Schwartz's mailbox.

Details for the Simulation Specialist (Xiyong Chen, Leader of activity)

Objective: To obtain the skills and expertise needed to perform useful simulations that are validated.

The figure below shows a top view of the junction region between the sample channel and the buffer channel, as well as a crosssection view running down the buffer channel. This device is going to be fabricated as a test structure by the fabrication specialists. In this illustration, we see that the colored sample has already been loaded onto the device, and is ready to be run down the buffer column by flowing buffer in the direction shown by the arrow. In the actual device, the buffer channel is much wider (500 μm) than it is thick (50 μm), see the page above for all the geometric data for the device to be fabricated.

In this FEMLAB Boot Camp, we are going to simulate the “run” mode, and look at the spreading of the sample as it flows down the buffer channel. Since the buffer channel is wide compared to its thickness, we only need to perform a 2-D simulation of the side



view geometry. The viscosity of the buffer and sample are similar as those of water ($\mu=0.01 \text{ cm}^2/\text{s}$). The sample's concentration is 1 mM, and its diffusivity in water is $7 \times 10^{-5} \text{ cm}^2/\text{s}$.

A **REPORT** is required. The following contents should be included in your report:

- (1) Assumptions, dominated equations (may include the non-dimensionized forms), geometry, initial/boundary conditions, mesh refinements, etc.
- (2) The effect of different mesh refinements on your simulation quality (This helps you to find out the optimal mesh construction which leads to better

results).

- (3) Analyze and discuss the influences of different buffer flow rates on the sample concentration profile.
- (4) Conclusions.

E-mail a pdf version of the report by 4:00 PM Friday, April 16 for Tuesday sessions, and 4:00 PM Monday, April 19 for the Thursday afternoon session.

Details for the Market/Finance Specialist (Dan Schwartz, Leader of activity)

Objective: To obtain the data necessary to assess customer needs, size, and price elasticity in potential educational markets for Lab-on-Chip experiments.

In the lab session for week two, we will brain storm to identify possible markets for our products and try to identify different classes of stakeholders who would be involved in making our product a success. Once we have identified plausible markets, we will need to formulate a coordinated effort to collect data about the various potential markets.

Working together with the Communications Directors, you will use the week that follows to acquire the data needed to begin understanding the various markets available to us.

In the lab session for week three, we will look at the data acquired over the intervening week, and identify areas where we have sufficient information to make justifiable decisions, and where more information is needed.

A brief market survey report, including:

- Markets considered in this report
- Data collected and rationale for seeking that data
- Presentation of data
- Discussion and synthesis of the data

is be due by 4:00 pm, April 16, 2004 for Tuesday sessions, and Monday 4:00 pm April 19, 2004 for the Thursday session. Please send the file as a PDF version.

Details for the Communications Directors

You are responsible for helping the market/finance people collect data. See above.