Paper theme

A fast and simple method to produce microchannels with circular cross section for microfluidic applications.

Abstract

Introduction

- Common microfabrication techniques produce microchannels with rectangular cross sections.
- Why are circular channels needed? (sample applications)
- Existing techniques to produce circular microchannels and their limitations.
- Introducing our technique.

Materials and methods

Results and discussion

Figure 1 Introducing the technique

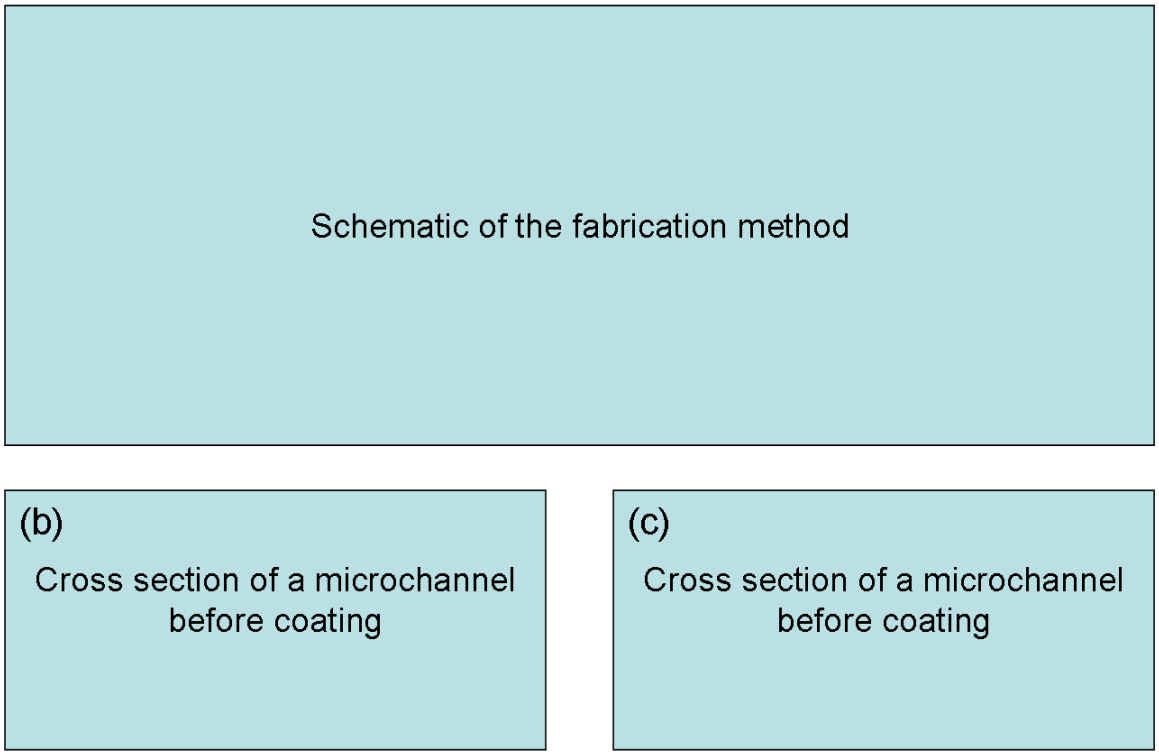
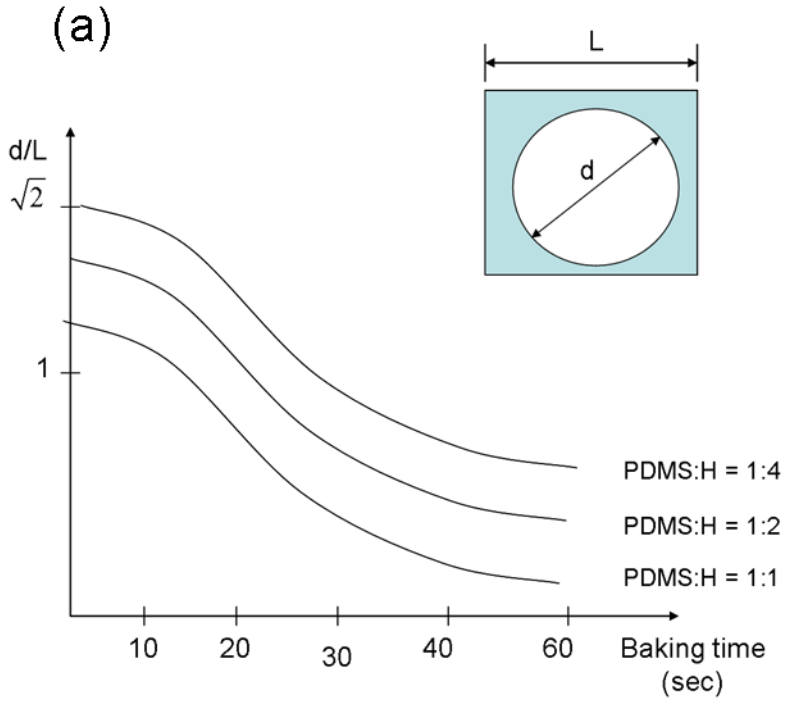
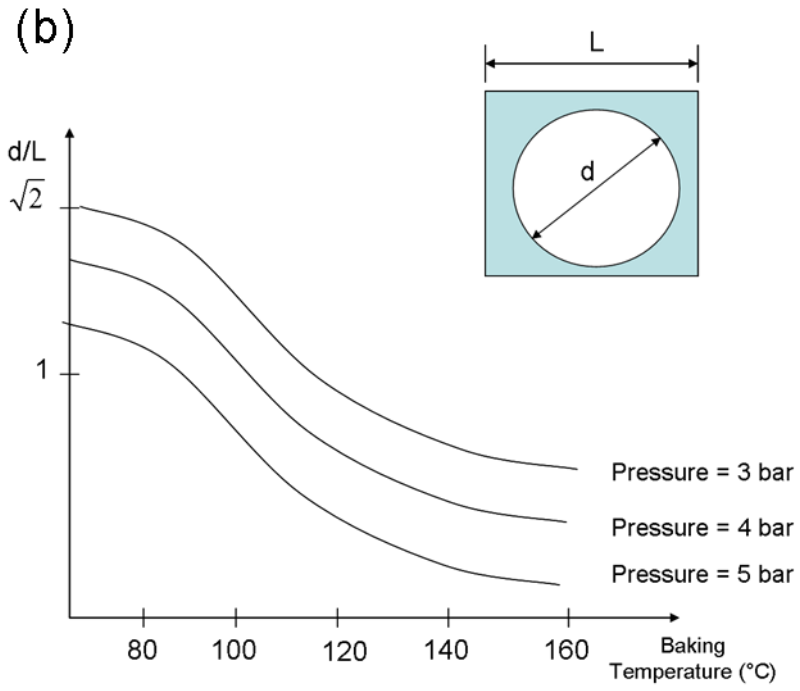


Figure 2 Coating conditions



This curve is for a 100 x 100 um channel @
100°C and 4 bar pressure

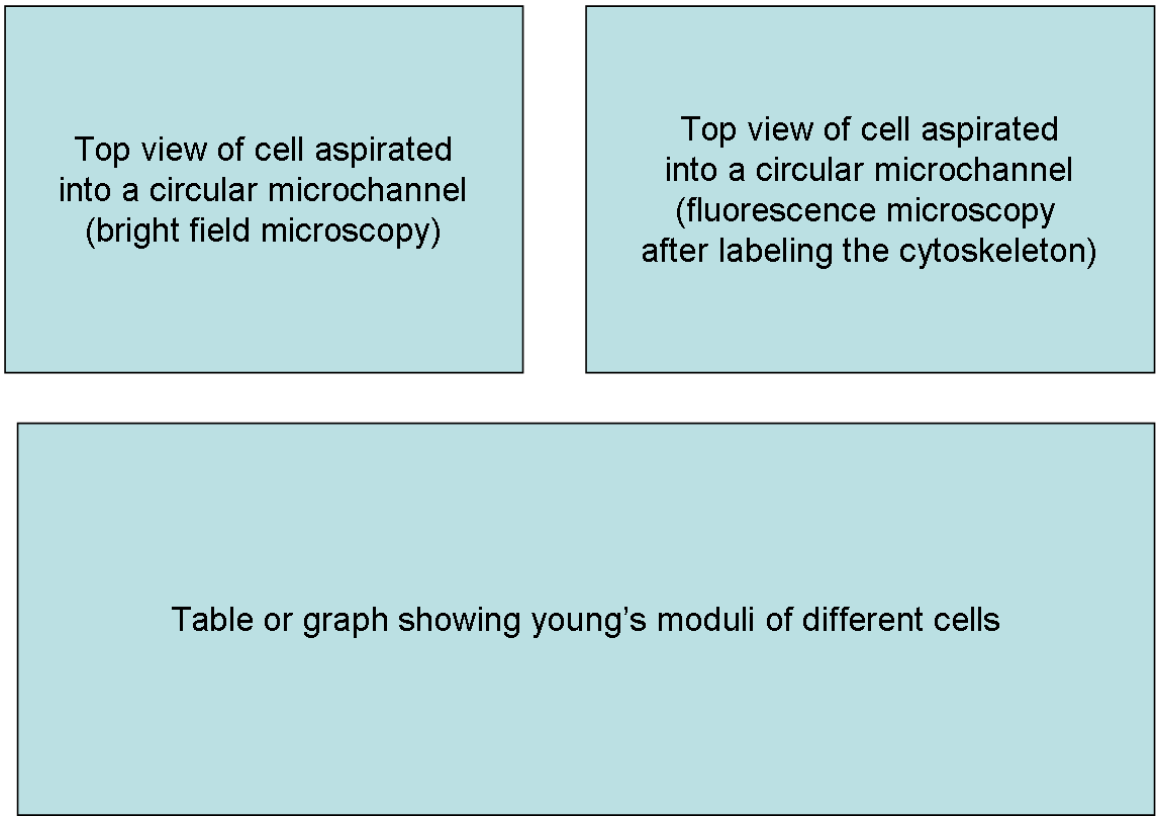


This curve is for a 100 x 100 um channel @
PDMS:H = 1:1 and 20 sec baking time

1- Technique verification and capabilities

1. Reporting design curves for different coating parameters:
    a. Viscosity of liquid PDMS (characterized by the ratio of PDMS and Heptane) used in the coating. We can test PDMS: Heptane ratios of: 1:0, 2:1, 1:1, 1:2, 1:3, and 1: 4.
    b. Baking temperature (100, 125, and 150 °C)
    c. Baking time (10, 20, 30, 40, and 60 seconds)
    d. Flushing air pressure (2, 3, and 4 bar)
2. Showing the wide range of microchannel geometries that could be produced using this technique.
    a. Producing channels with different diameters (5~500 μm).
    b. Testing different starting cross sections (square and rectangular).
    c. Coating channels with sudden enlargements, contractions, and branching connections.
    d. Testing the formation many circular channels inside one wide rectangular channel

Figure 3 Applications



Applications

In this section we have to prove benefits of having circular microchannels instead of rectangular or square ones. Possible applications include:

1. Cell aspiration in microchannels
   This is probably our best shot given that we already have the necessary equipments and there are members in the lab with experience in cell aspiration into micropipettes. Also this will be training for the ultimate goal which is cancer detection by cell aspiration.
2. Culturing endothelial cells inside circular microchannels which should mimic blood vessels more accurately than rectangular ones. We can do some shear stress testing or just report some cool pictures of cells cultured inside circular microchannels. This part will need collaboration with someone experienced with cell culture and cell labeling (probably Suthan from the Simmons lab). We have to note that imaging inside circular microchannels may prove not very straightforward.
3. Other possible applications that I don'f have much info about are: making waveguides (XXX told me that these needs circular channels), multiphase flow (i.e. droplet generation) inside the channels (apparently, there are many theoretical models for many physical phenomena associated with droplet generation inside circular channels but not for rectangular ones).