Introduction to Microfluidics Technology

June 13 – 17, 2016

2016 MRSEC Summer Course Announcement

Registration for our annual, one-week summer course, "Introduction to Microfluidics Technology" at Brandeis University, near Boston, MA, is now open.

Introduction to Microfluidics Technology is a hands-on laboratory course sponsored by the National Science Foundation's Bioinspired Soft Materials Research Science and Engineering Center (MRSEC) at Brandeis. It will be offered during the week of June 13 - 17, 2016. The course is intended for graduate students, post docs, faculty, and industrial scientists/engineers interested in utilizing microfluidic technology in their work, both in the physical and life sciences. The course does not assume any specific prerequisites.

"Introduction to Microfluidics Technology" (June 13 – 17, 2016) will be taught by Dr. Nathan Tompkins.

The $750 fee covers course tuition, housing in double-occupancy rooms, and breakfast/lunch/coffee from Monday through Friday. Single rooms are not available. Local students who do not need housing will pay a non-resident fee of $500 (cash and check only please).

Please bring this course to the attention of any appropriate scientists and engineers. The application deadline is March 31, 2016.

See the information below for a detailed course description.

Application Instructions

To apply, please email Katie Collings, (katie55@brandeis.edu) by March 31, 2016, with all of following materials attached in one email. Please write "MRSEC Summer Course Application" in the subject line.

- Name and gender (for housing)
- Housing needs (double or no-housing needed)
- Current CV
- Field of research
- Research advisor name (if applicable)
- A short paragraph explaining how your research work will benefit from this course including how you wish to use microfluidics in the future
- A short paragraph explaining your expectations for the course including what knowledge and devices you hope to take home with you

In addition, please have your research advisor write an email in support of your application from his/her university account. This email need only state that she/he approves of your attendance.

If accepted, students are required to take the online environmental health and safety trainings offered by the Boston Consortium (http://goo.gl/SkaXdU) before the second day of the course.

Applications will be reviewed on a rolling basis, and suitable students will be admitted as selected throughout the months of March and April. Further information for those admitted will be provided. If you have questions before applying, please email the course instructor, Dr. Nathan Tompkins, tompkinn@brandeis.edu.

Introduction to Microfluidics Technology
Brandeis MRSEC Summer Course
June 13-17, 2016, Abelson 229, 9:00am-5:00pm

Instructor

Dr. Nathan Tompkins	Abelson 210	781-736-2885	tompkinn@brandeis.edu
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Course Overview

This course is intended as an introduction to the microfabrication technologies available for building microfluidic devices. It was created in response to interest from industry, government, and academia to the field of microfluidics. Over five sessions, we will emphasize hands-on and independent experimentation of microfluidic systems where the forces of laminar flow, surface tension, and molecular diffusion dominate.

By the end of the course, students will be able to *apply* their knowledge of micro-scale properties and *build* microfluidic devices for future and current research applications. All attendees will have individual consultations with experts in the field and leave with a prototype device of their own design.

Prerequisites

Before the course, students should:

- Possess a background in experimental quantitative science and preferably have experience in a chemistry laboratory.
- Have AutoCAD installed on their computer and be able to create a basic shape (i.e. a circle or rectangle) using AutoCAD. There is a free student version: http://goo.gl/qc0Ixv Suggested tutorials are:
    - Carnegie Mellon University: http://goo.gl/OmL7Sjhttp://goo.gl/OmL7Sj
    - Autodesk: http://goo.gl/8j5y14http://goo.gl/8j5y14

- Complete the online environmental health and safety trainings offered by the Boston Consortium (http://goo.gl/SkaXdU). This must be done before the second day of the course.

Attendance

In order to successfully complete the course and earn a certificate of completion, attendance is required for all five days. If an unexpected conflict arises, please contact the instructor.

Suggested Course Reading

- Soft Lithography for Dummies: http://goo.gl/6Qdzmk
- Basic Microfluidic and Soft Lithographic Techniques: http://goo.gl/Le85Wc
- Multi-Height Precision Alignment Techniques: http://goo.gl/3sGuoT
- A Simple and Inexpensive Device to Remove Edge Beads: http://goo.gl/TRrcuu http://goo.gl/6Qdzmk

Course Format

The course will contain lecture, laboratory, and fabrication sessions. During the laboratory and fabrication sessions the students will work in 3 groups (A, B, and C), rotating through the different experimental stations and fabrication steps.

Session	Topics	Intended Learning Outcomes
Welcome and overview of microfluidics Lecture 1: Introduction to Microfluidics	Introduction to the course and instructional staff and discussion on the desired uses of microfluidics in future-research applications Introduction to microfluidics with basic theory and descriptions of micro-fabrication technologies including: • Soft lithography • Etched/milled chips • Hot embossing • Liquid phase photo-polymerization	• Describe the methods of microfluidic fabrication • Restate the steps in different microfluidic fabrication methods • Consider a fabrication method based on the desired usage and functionality
Lecture 2: Introduction to Soft Lithography	Introduction to soft lithography with theory and descriptions of the processing steps: • Mask design • Master fabrication • PDMS casting • Device finishing	• Explain the process of soft lithography • Differentiate between the two polarities during fabrication • Plan how to make a desired device using soft lithography
Workshop 1:	Introduction to using AutoCAD to design photomasks for soft lithography	Use AutoCAD to design a

AutoCAD Design		microfluidic device for their own experiments
Workshop 2: AutoCAD Finishing	Details on finishing a design in AutoCAD and preparing the file to be sent to printing	Use AutoCAD to finish a design and send the file to have a photomask printed
Cleanroom Training Master Fabrication PDMS Casting Device Finishing	Introduction to the steps of soft lithography Creating a silicon master using photoresists Creating a PDMS cast of the silicon master Created a device from the PDMS cast	● Classify the steps of device fabrication ● Construct a finished microfluidic device ● Evaluate and critique the design of a novel microfluidic device
Lecture 3: Current Research Topics	Introduction to and summary of current research utilizing microfluidic devices	Give examples of current research topics utilizing microfluidic devices
Microfluidics Experiments	● Store and create drop generation: Using microfluidics to create isolated drops of solution within a device ● Flow focusing drop generation: Using microfluidics to create a stable emulsion of drops outside of a device ● Concentration gradient generation: Using microfluidics to create a concentration gradient of two solutions	● Recognize the benefits of experiments using microfluidic devices ● Apply microfluidic technology to research questions ● Produce data using microfluidic devices
Photopolymerization	● Photopolymerization: An introduction to photopolymerization	Describe the process of photopolymerization