Effects of Antibiotics on an Anaerobic Syntrophic Consortium in a Micro-Bioreactor

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Principal Investigator(s): Largus Angenent
User(s): Kevin Wu, Arvind Venkataraman

Affiliation(s): Biological and Environmental Engineering, Cornell University
Primary Research Funding: National Science Foundation
Contact: LA249@cornell.edu, cw333@cornell.edu, av299@cornell.edu

Abstract:
A microfluidic mixer was fabricated using soft lithography, first forming a negative of the channel design in Figure 1 using a negative photoresist on a silicon wafer and then pouring polydimethylsiloxane (PDMS) onto the developed wafer, leaving depressed channels in the PDMS. The PDMS was then separated from the wafer and plasma bonded to a glass slide, creating a clear microfluidic device. The device contains two inlets and one output well, with nine channels feeding into the outlet well.

Summary of Research:
Microfluidic devices have become increasingly useful tools for analysis of microorganisms. The devices are usually fabricated using soft lithography; silicon wafers exposed with patterns of microchannels can either be used as a template or as part of the device itself. An opposing cover is placed on top of the side with channel indentations, used to seal the channels. In the case of biological applications, PDMS has been used successfully as a material for fabricating these microfluidic devices using patterned silicon wafers as negative templates. The PDMS device can be sealed to a glass slide allow for easy observation while requiring relatively little volume of samples. The microfluidic device can be automated and controlled to allow for continuous flow micromixers.

In this project, a microfluidic device will be used to generate a concentration gradient of antibiotics across an outlet well. The device will be inoculated with an anaerobic syntrophic consortium, and the effect of different concentrations of the antibiotic on the consortium can be observed while still allowing continuous flow of media.
A silicon wafer was spin-coated with SU-8, a negative photoresist, and pre-exposure baked on a hot plate before exposure. A transparency mask was obtained from PageWorks, and we used the flood exposure feature on the HTG System III contact aligner to expose the wafer. We then developed the wafer using SU-8 developer to remove excess photoresist, leaving the channel design as a raised pattern on the wafer. The wafer was post-exposure baked, and then hard baked overnight. PDMS was poured over the wafer and cured overnight, then cut out and peeled off the wafer. Using a Harrick plasma cleaner, both the channel side of the PDMS and a glass slide were plasma treated and then bonded together to create the microfluidic mixer, and baked to ensure adhesion.

The mixer design creates a concentration gradient across the width of the outlet well; splitting and recombination of channels results in the concentration on the left side similar to the concentration of the left inlet channel and the concentration on the right side similar to the composition of the right inlet channel. This generated concentration gradient will be used to study the effects of varying concentration of antibiotics on an anaerobic syntrophic consortium cultured in the mixer.

This project is still ongoing.

References: