# Light Sensitive MicroRobots

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## Introduction

Micro-sized robotics such as bacterial propulsion of micro-beads are an revolutionary robotics that can be used in engineering and various areas of the medical field. These bacterial Micro-robots are difficult to manipulate and control however. Attaching the bacteria to the micro-beads in a patterned fashion makes them more efficient than attaching them in a random fashion. Once the bacteria are attached they are difficult to control. Light sensitive bacteria have been engineered to react differently to different wavelengths of light. In this work, bacteria is attached to micro-beads in a pattered fashion and then light sensitive bacteria will be attached in the future to micro-beads in order to see if it is possible to better control and manipulate the bacterial propelled robots after attachment.

## Objectives

- To produce a monolayer
- To attach bacteria to the monolayer
- To locate light sensitive bacteria for future experiments

## Calculating The Monolayer

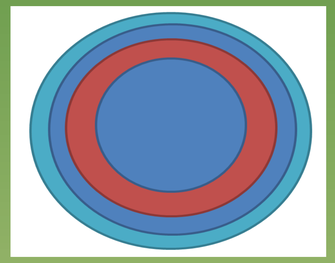
Knowing the concentration of the beads, we calculated the amount of beads needed to make the monolayer. We found the area of the circle inside my PDMS ring and then divided that by the area of a two dimensional micro-bead. We then multiplied that by the packing percentage of hexagonal packing and found the volume of the original concentration of beads needed to be in the monolayer. We calculated that we needed 8.15 microliters of micro-beads.

## Creating the Monolayer

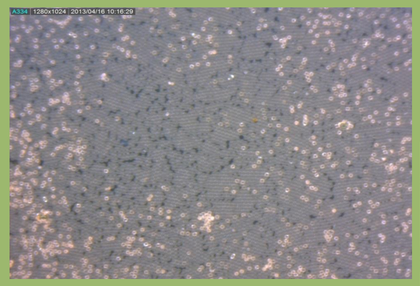
The calculated volume of beads was then cleaned with a centrifuge while diluted to 400 microliters. It was placed into one side of the centrifuge and another plastic container was placed on the opposite side with the same volume to keep the centrifuge balanced.

We centrifuged it for 10 minutes at 12000 rpms. The water separated from the beads and we were able to remove the water from the beads using a pipette. We then introduced 392 microliters of 1:1 DI water to isopropyl alcohol into the beads so that it remained balanced. This mixture was then placed on the shaker to fully mix the beads into the 1:1 water to isopropyl alcohol. The centrifuging and shaking process was then repeated two more times with the 1:1 mixture followed by one time with DI water. After this process was done we introduced 30 microliters of water into the beads, shook it for a few minutes, and put it in the PDMS ring. We had this on the glass slide and inside a 10 cm petri dish. We covered this petri dish with plastic in order that the water would evaporate more slowly. After the water had all evaporated, we removed the PDMS ring so that all that was on the glass slide was a monolayer of beads.

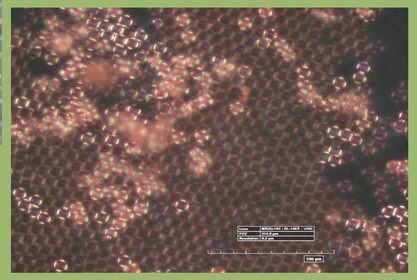
centrifuge



dark blue: monolayer
light blue: patches of no beads
Red: more than 1 layer



monolayer

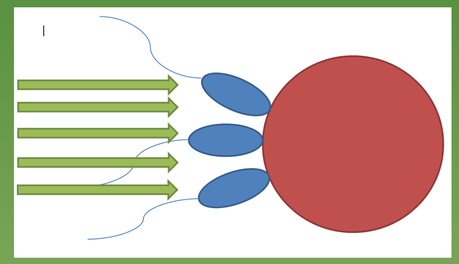


## Attaching bacteria

To attach bacteria to the beads the beads will be placed in an air plasma cleaner for 2.5 minutes and then the bacteria will be introduced to it for 20 minutes. The air plasma will take off a few nanometers from the surface of the beads to activate them for attachment.

## Light Sensitive Bacteria

We will attach light sensitive bacteria to the beads. These types of bacteria react differently to different wavelengths of light. For instance green laser light will make bacteria move faster than red laser light.



## Conclusions

This research was successful in producing a monolayer and locating sensitive bacteria for future experiments. This is very helpful for experiments to come that will involve using light sensitive bacteria to manipulate these beads.

## Acknowledgements

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## References

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