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Low Cost, Adhesion Strength Based Cell Sorter

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Low cost, adhesion strength based cell sorter

BME 107 | **Team members:** Emily Burtch, Franck Kamga-Gninzeko, Devin Mair, and Sarah Saunders | **Faculty adviser:** Dr. Christopher Lemmon

Introduction

Many in vitro experiments require primary cells to be taken from a patient or animal model to undergo experimental manipulation. After a sample is taken, the cells need to be sorted in order to isolate the specific cell type needed. Current methods require expensive equipment, a skilled technician, and antibody labeling of the cells in question. This makes for a very expensive process, and enforces a fiscal limitation on the number of researchers able to investigate therapies and treatments for diseases such as cancer and diabetes. We plan to eliminate this limitation and enable more life saving research by designing a low cost, user friendly, antibody-free cell sorting system.

"Spare a dollar for some lab consumables, buddy?"

Objective

To create a low cost, adherence strength based cell sorter in order to enable all researchers to work with primary cell lines and further biomedical research into life threatening diseases and conditions.

Deliverables

1. A detailed design of the shear plane chamber for the cell sorting system
2. Working prototype of the cell sorting system
3. Data showing success of the cell sorting system

Design

Design Requirements

1. Equipment costs much lower than current products.
2. Passive, label-free sorting-decrease future costs.
3. Easy to use-decrease training or skilled technician costs.
4. Familiar, intuitive process and equipment.

Design Solution

Recent research has shown that cells adhere to their surroundings with varying adhesion strengths. The system we devised utilizes these adhesion strength differences to sort cells using flow-induced shear forces. The equipment costs are minimal-plastic for a shear plane chamber, tubing, and a pump. The system does not require labeling, and is essentially plug and play, meaning you install the bottom of the culture dish, turn on the pump, select the correct setting, and let it sort the cells. This will eliminate the use of expensive antibodies from the process of sorting cells, and training will be minimal. The system uses a slightly modified cell culture dish, a product that every cell based researcher is very familiar with, and an easy to use and intuitive shear plane chamber. The result is an easy to use product that costs $2000 dollars with minimal technician costs and no antibody costs. Compare that to current solutions:

Equipment

Extraordinary savings for a limited time

Purchase a BD FACSMelody cell sorter and save up to $30,000.

Skilled Technician

Flow sorting on FACSAria II

- Instrument time - trained user per hour $40
- Instrument time - facility per hour $55
- FACS BSL2 sorts in hood - facility per hour $70
- Instrument time - late arrival or no show per hour $40
- Setup for sorts - $20
- Shutdown or cleanup - $20

Antibodies

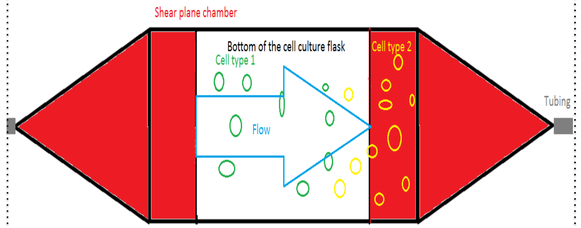
SIGMA-ALDRICH

Anti-Laminin antibody

Pack Size	Price (USD)
100UL	340.00

Final Design

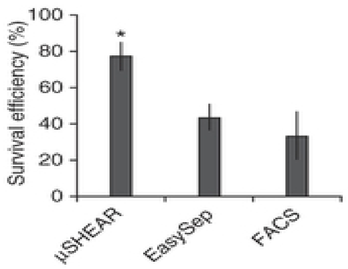
After numerous design iterations, the final design consists of a modified culture dish and a shear plane chamber attached to a peristaltic pump. The bottom of the culture flask is removed once cells adhere and is placed in the shear plane chamber. It is currently sealed with a sealing putty, but the final product will be clasped closed. Tubing is attached to each end of the shear plane chamber and travels through a variable speed peristaltic pump, into the shear plane chamber and out through the other side. Cells with a lower adhesion strength are lifted and deposited into the cell collection receptacle. Below is a diagram showing how the cells are lifted internally and moved out of the system.



The final system will be machined or made of molded plastic, creating a more biocompatible surface that will be even easier to use. Use of 3D printed materials allowed for rapid prototyping, which was a necessity due to the number of different design iterations we went through. The cell culture dish will also be clasped closed, as compared to the putty sealing method currently used.

Evaluation

When testing the system, it was found that the spacing between filaments captured lifted cells or damaged them, decreasing output and minimizing cell viability. However, the final, marketable product would be machined or made of molded plastic, eliminating this problem. Also, the system was capable of lifting cells with different cell adhesion strengths and sorting them based on these adhesion strengths. The figure below shows that an adhesion strength based cell sorting system with compatible materials actually leads to a higher cell viability than current sorting systems. This method also has a 95%-99% purity of sorted cells, according to the research group referenced. This is comparable with current methods.



Singh, et al. Nature Methods, 2013.

Another problem this system has is that some cell types exhibit similar adhesion strengths. To overcome this problem, cell adhesion times and trypsin sensitivity will be utilized in conjunction with adhesion strength in our system to be able to sort any variant of adherent cell based on these three cell properties.

VCU School of Engineering

Mark A. Sternheimer Capstone Design Award