Engineering a Co-culture Platform Using Gelatin Methacryloyl (GelMA) and Polydimethylsiloxane (PDMS)

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INTRODUCTION

Engineered models allow the study of interactions between tumor cells and the environment surrounding them.

ABSTRACT

Gelatin Methacryloyl (GelMA)

- Semi-synthetic hydrogel
- Consists of gelatin conjugated with methacrylate groups
- Provides biological environment which can be easily photo-crosslinked
- Presently used for creating 3D cell culture platforms

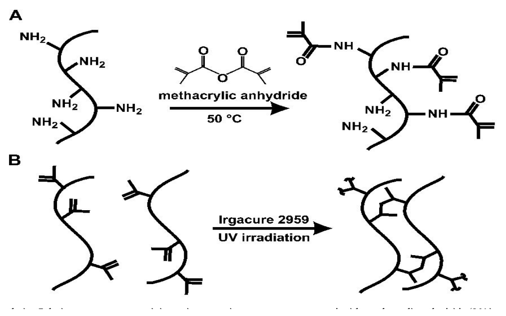

Figure 1, the process of binding of gelatin and methacrylic anhydride and the UV crosslink creating the final version of GelMA

Polydimethylsiloxane (PDMS)

- Silicon-based organic polymer
- An elastomer - both with viscosity and elasticity
- Can be used for medical devices due to it's clear, non-toxic, and non-flammable property
- In liquid state it is a viscous fluid like honey, when raised to higher temperatures, it will act like rubber

MATERIALS AND METHODS

GelMA synthesis

- React gelatin with methacrylic anhydride in PBS at 65℃
- Dialyze the mixture by switching out the water periodically for a week
- Lyophilize the product for a week
- Resuspend the GelMA macromer with PBS and LAP, a photoinitiator

PDMS synthesis

- Mix the PDMS prepolymer and curing agent in a 10:1 ratio
- Pour the mixture into a mold of your design
- Place mold and mixture into the oven to polymerize the PDMS

RESULTS

- GelMA was synthesized and characterized (Fig. 2-4)

Figure 2, liquid form of GelMA after resuspension with PBS and LAP

Figure 3, GelMA after UV crosslinking

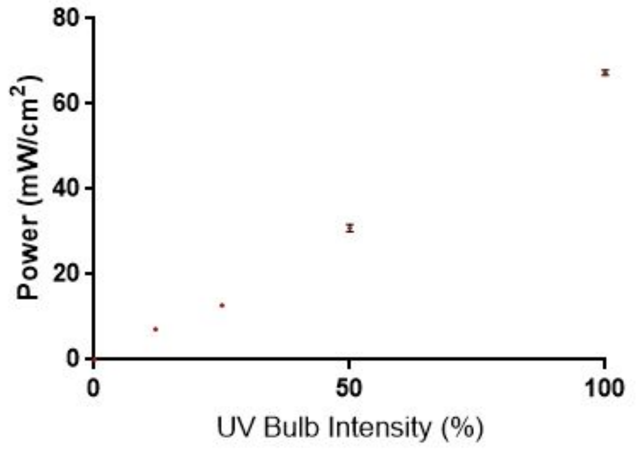

Figure 4, the bulb intensity to the UV power of the UV crosslinking machine was characterized

- PDMS devices were engineered (Fig. 5,6)

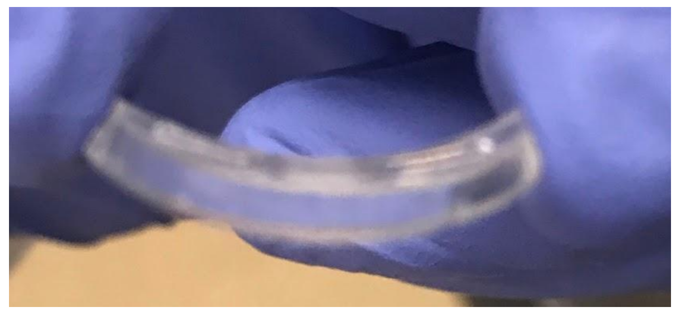

Figure 5, PDMS in the solid form with properties like rubber

Figure 6, the mold designed to pour PDMS

- A platform was created to trap cells within GelMA and expose it to conditions that would be controlled in the surrounding channels (Fig. 7,8)

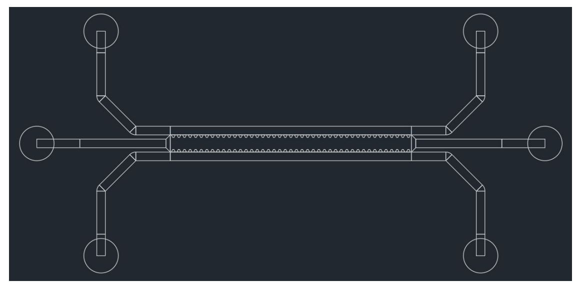

Figure 7, CAD design of the microfluidic device that is going to be edged on to the PDMS mold

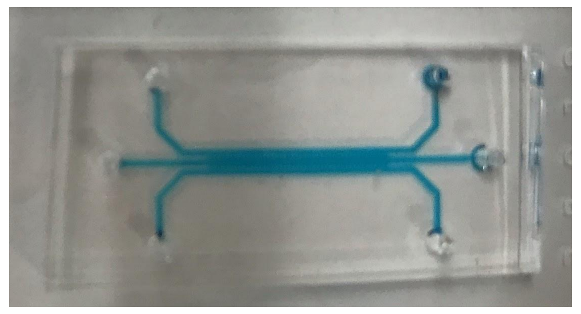

Figure 8, the microfluidic device with GelMA dyed blue through all three channels

FUTURE DIRECTIONS

- Cancer cells will be embedded in GelMA before pipetting into the channels. We can then study how cancer cells interact with the surrounding hydrogel, as well as assess novel therapies that can be delivered through the peripheral channels
- Once successful, this platform will be a useful tool to study cancer biology and novel therapeutics

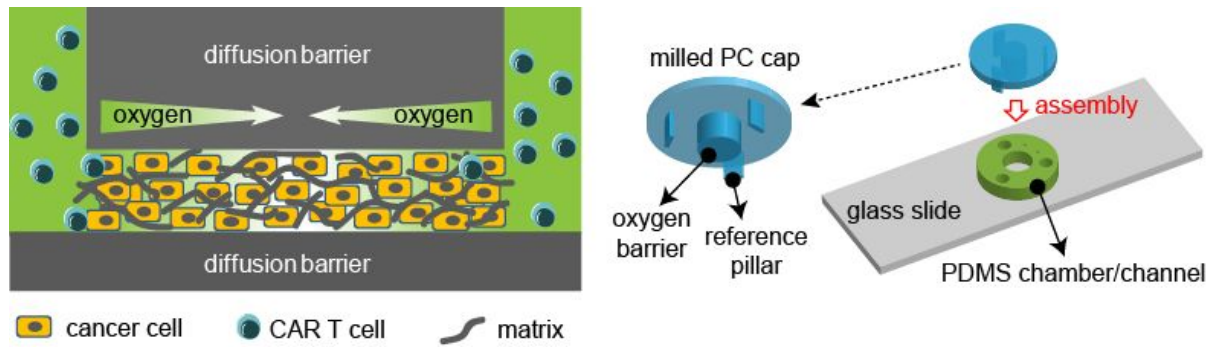

Figure 9, an example of an engineered platform with cancer cells embedded in GelMA with a PDMS device that delivers CAR-T cells, a therapy candidate for cancer

REFERENCES

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