Droplet-Microfluidic Device for Stem Cell Culture

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Primary CNF Tools Used: Heidelberg DWL66FS/2000, SÜSS MJB4 contact aligner, SU-8 hotplates, SU-2 spinners

Abstract:

We are working on a droplet-microfluidic device to generate microscopic beads of poly(ethylene glycol), a biomaterial we use to study the interaction between muscle stem cells and their environment. The device is made from PDMS cast on a SU-8 patterned wafer generated by standard SU-8 photolithography techniques at Cornell NanoScale Facility.

Summary of Research:

Microfluidics have enabled a more high-throughput and comprehensive examination of biological systems. In particular, the interaction between stem cells and their local environment (the niche) can be studied using biomaterial constructs that attempt to recreate physical and biological aspects of the niche. We used a droplet-microfluidic device (designed and built at CNF) to generate hundreds of thousands of beads of the biomaterial poly(ethylene glycol) (PEG) with various physical and biochemical properties. We will be using these ~ 100 μm PEG beads as artificial microenvironments to screen for muscle stem-cell-niche interactions that are characteristic of muscle physiology.

So far, we have created PEG beads with different levels of incorporated laminin and observed myoblast binding in culture.

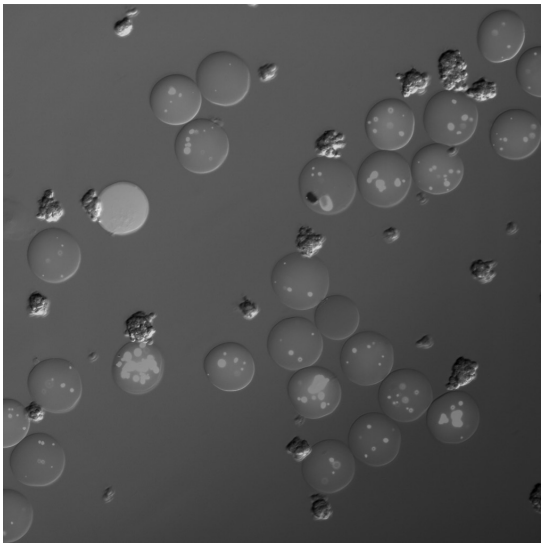

Figure 1: 100 μm PEG beads coated with the fluorescent (Alexa647) protein laminin (red). Clusters of myoblasts can be seen adhering to the beads. See full color version on pages xxviii-xxix

Figure 2: Left: SU-8 wafer with patterned structures. Right: A series of eight PDMS microfluidic devices.

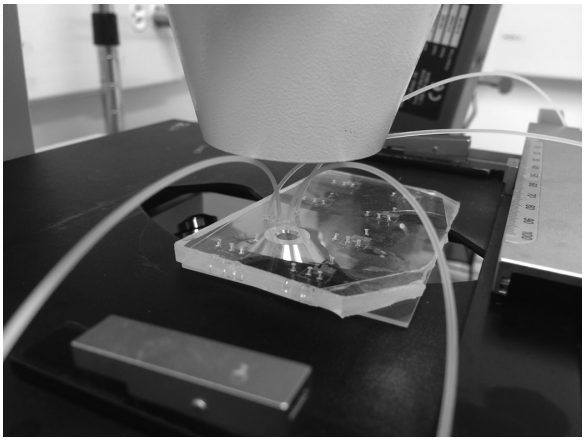

Figure 3: Droplet-microfluidic setup for generating PEG beads. Courtesy De Vlaminck lab.