Towards a Consistent Method to Form PEGDA Hydrogel Microcapsules

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Introduction:

Polyethylene glycol (PEG) has increasingly been used to reliably encapsulate cells within solid microspheres. Although hollow microcapsules have also been demonstrated, there remain challenges for their use. Microfluidics can reliably form empty hollow microcapsules, but tend to clog when cells are introduced. Emulsion methods have shown success with encapsulating cells within microcapsules; however the capsules tend to burst. Here, we compare an emulsion technique with our new dropwise method that combines extrusion with vibration of a device. Light exposure and photoinitiator concentration was varied to probe their effect on the microcapsules.

Materials and Methods:

Microcapsule prepolymer solution was formed as previously described.[1] Briefly, HEPES-buffered saline was combined with 10% (w/v) 10 kDa PEGDA and loaded into a custom extruder comprised of a repeating pipette and a vibration device or subjected to a water-in-oil vortex induced emulsion under white light. Mineral oil was combined with either 3 or 6 µL/mL acetophenone in 1 1-vinyl-2-pyrrolidinone (300 mg/mL). Microcapsules were injected into a column of mineral oil solution exposed to white light (Dolan Jenner Metal Halide Lamp). Empty and cell-encapsulating microcapsules were formed.

Results and Discussion:

Emulsion microcapsules were multidisperse and many, while extrusion microcapsules were fewer and corresponded with the volume ejected. Extrusion microcapsules had a mean diameter of 181.05 ± 59.83 µm. Microcapsules displayed tearing following transfer. Images A and B highlight the torn outer shells of microcapsules. Higher concentrations of photoinitiator in the mineral oil appeared to lead to microcapsules less prone to tear.

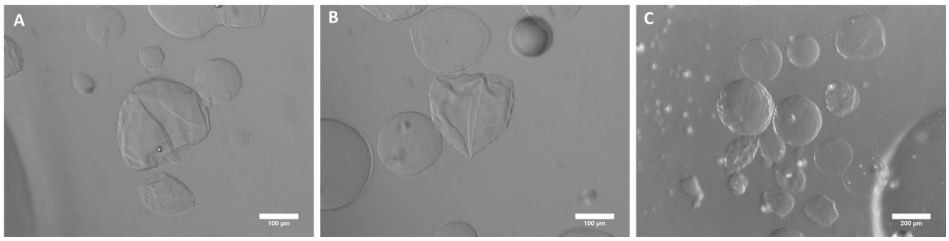

Figure 1: Phase contrast microscopy images of microcapsules generated via extrusion techniques. Images A and B are at 10x magnification and C is at 5x magnification.

Conclusions:

Future work will focus on further characterizing the extrusion microcapsules. Additionally, a goal is to evaluate the effect of photoinitiator concentration on microcapsule wall thickness. Finally, we intend to correlate the volume of prepolymer used with the final volume of the resulting microcapsule.

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References:

1. Franco C et al. Acta biomater. 2011 Sep 1;7(9):3267-76.