PEG NORBONENE AS A VIABLE ALTERNATIVE TO PEG DIACRYLATE FOR DEVELOPING GROWTH RESTRICTIVE HYDROGELS

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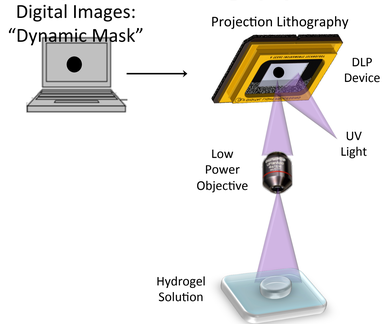
Background – Neve-on-a-Chip Technology

Nerve-on-a-chip

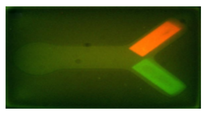
- Dual hydrogel culture system
  - Growth restrictive region – PEGDA
  - Growth permissive region – Heparin
- Designed to constrict neurite growth to channel
- Allow for physiologically relevant 3D growth
- Typically culture E15 rat dorsal root ganglion cells

Dynamic Projection Photolithography

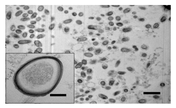


Applications:

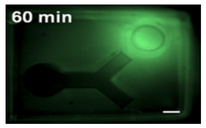
immobilized guidance cues



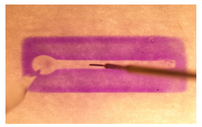
myelinating neuron-glia co-cultures



diffusive guidance cues



electrophysiology



Objective

Goal: Investigating the photopatterning potential of a new hydrogel system, PEG Norbonene (PEG NB) and lithium acylphosphinate (LAP)

- Optimizing manufacturing time/parameters
- Characterizing shape formation

Hypothesis: PEG NB will undergo gelation faster and be able to create smaller voids with higher fidelity.

Importance:

- Increase manufacturing speed
- Enable investigation of applications that require smaller features.

Comparison of Hydrogel Systems

PEGDA + I2959	PEG NB + LAP

• PEGDA
  • Linear molecule
  • Heterogeneous network formation
• I2959
  • Type II photoinitiator
  • Chain growth
  • Oxygen inhibited
  • Can be cytotoxic
  • Low water solubility (<2 wt%)
  • Initiated with UV light
	• PEG NB
	  • 4-armed molecule
	  • High degree of network ideality
	• LAP
	  • Type I photoinitiator
	  • Step growth
	  • Not oxygen inhibited
	  • Highly cytocompatible
	  • Higher water solubility (<8.5 wt%)
	  • Initiated with UV and visible light

Methods

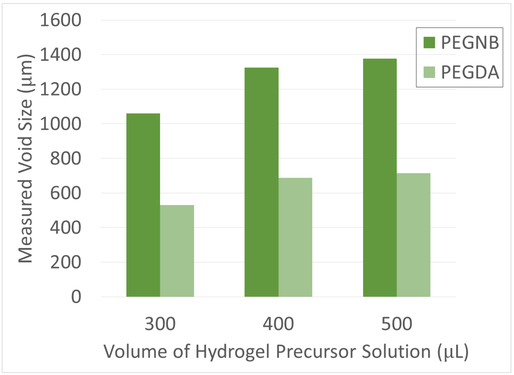
- Synthesize LAP
- Mix hydrogel precursor solutions in PBS
- PEG NB (10 wt%), LAP (0.011 wt%), DTT (0.076 wt%)
- PEGDA (10 wt%), I2959 (0.5 wt%)
- Determine parameters for shape gelation
  - Decrease UV power (% iris)
  - Decrease time
- Determine smallest minimum void size for both PEGDA and PEGNB
  - At 300 µL, 400 µL and 500 µL
  - Used circular masks with decreasing radius
  - Looked for clear formation of void
- Use confocal imaging and imageJ analysis to determine void size
  - Incorporated fluorescein o-acrylate into hydrogel for visualization
  - Measured x-axis and y-axis diameter

Results

Manufacturing Parameters

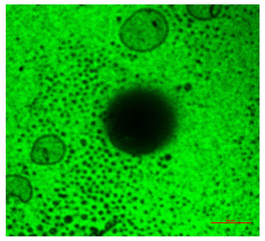
	Gelation Time	Power (% Iris)
PEG NB	4 seconds	32
PEG DA	40 seconds	72

Smallest Void Sizes Formed

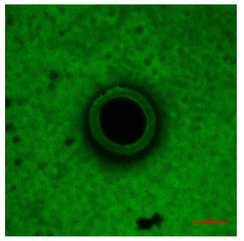


Shape Fidelity

PEGDA



PEG NB



Conclusions

Results

- PEG NB has a much quicker gelation time at lower power than PEGDA.
- At all volumes, PEGDA made smaller minimum void sizes than PEG-NB
- PEG NB has better shape fidelity

Future Work

- Incorporate radical scavenger to allow for smaller minimum voids in PEG-NB
- Compare PEGDA + LAP, PEGDA + I2959, PEG-NB + LAP, PEG-NB + I2959 systems

Acknowledgements

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