Sacrificial Gelatin to Pattern Microstructures in Dextran Materials

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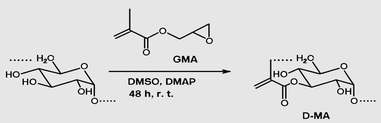
Introduction

- Vascular tissue regeneration for large external wounds is difficult to achieve efficiently often resulting in extensive blood loss, scarring, and permanent damage.
- Current hydrogel models recapitulate ECM properties but lack controlled microporous structures necessary to enhance cell adhesion.
- **This project aims to develop a biomimetic scaffold with high surface area to promote tissue regeneration and accelerate angiogenesis in vivo.**

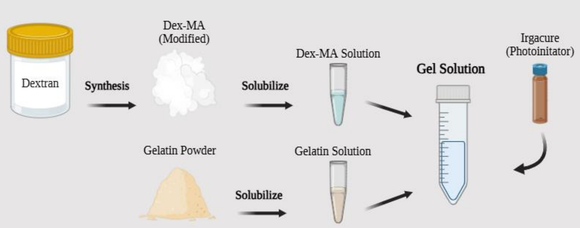
Material Synthesis

- Dextran: A complex sugar easily processed in the human body.
  - Chemically modified to become Dex-MA
  - Dex-MA biocompatibility (scaffold)
- Gelatin: Animal (bovine) derived protein.
  - Melting point human body temperature (37°C)
  - Allows for domain formation in bulk solution



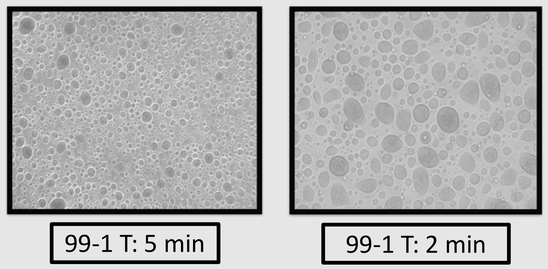
Gel Fabrication

- Fresh gelatin solution is added into the Dex-MA solution as the sacrificial phase.
- The addition of the photoinitiator, irgacure, initiates radical polymerization of Dex-MA under UV light.



Gel Formation Analysis in Varying Conditions

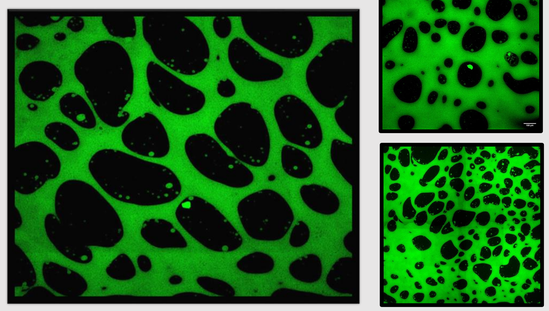
Settled Gel Time Trials



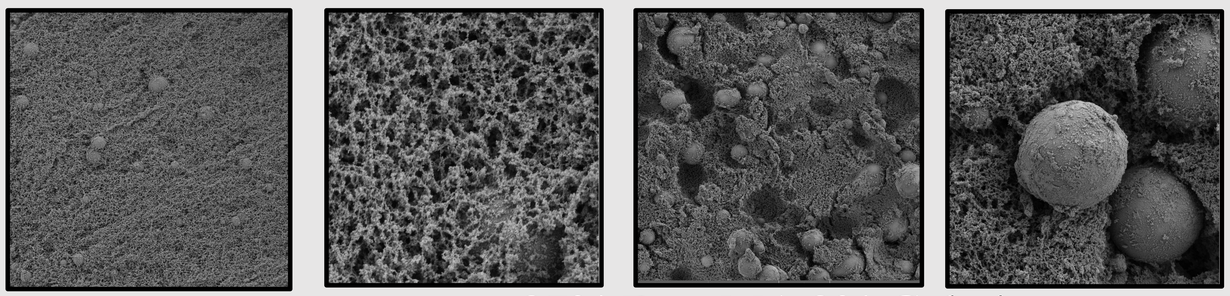
Confocal Microscopy

99-1 Dex-MA

- Auto-Fluorescence
- Continuous Domain
- Cell Adhesion
- Desired Outcome



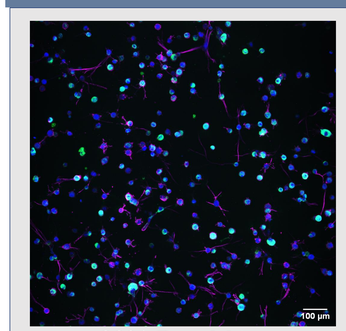
Settled Domain Behavior Analysis (Scanning Electron Micrographs)



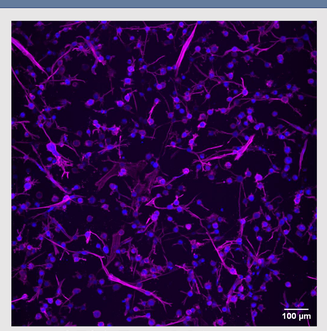
99% Dex-MA 1% Gelatin

97% Dex-MA 3% Gelatin

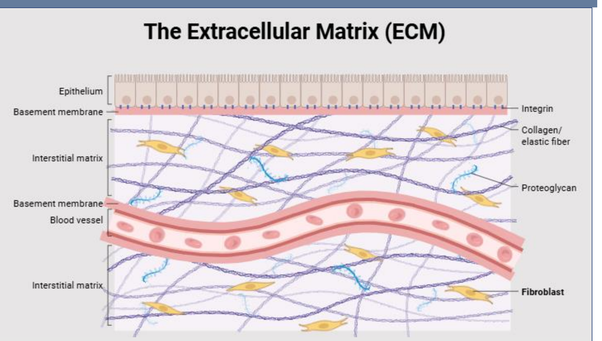
Cell Growth (HDF): DAPI (Nucleus) & Phalloidin 647 (Actin Filaments)



99% Dex-MA
1% Gelatin



97% Dex-MA
3% Gelatin



Conclusions

- Time trial observations of domain structures provided insights regarding the importance of settling time prior to crosslinking.
- The gels demonstrated the ability to support viable cells and promote cellular adhesion.
- Higher dextran concentrations in the gel solution have direct impacts on domain formation and functional behavior.

Future Directions

- Investigate how variations in dextran concentration (before addition into bulk solution) affect settled domains.
- Optimize temperature parameters to enable precise phase separation behavior.
- Achieve accurate and consistent formation of a continuous domain across gels, independent of environmental condition.
- Establish consistent time intervals for gel formation settling to improve pattern reproducibility.
- Apply the gel to an *in vitro* model simulating injury or surface level trauma to observe cell adhesion and growth in a wound-healing assay.

Acknowledgments

Haley Royce; Dr. Linqing Li; Department of Chemical Engineering and Bioengineering; Innovation Scholars Program; UNH University Instrumentation Center (UIC)

References:

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