UNIVERSITY of LOUISIANA LAFAYETTE

COMPARATIVE STUDY OF CHITOSAN SCAFFOLDS VIA 3D PRINTING AND FREEZE-DRYING

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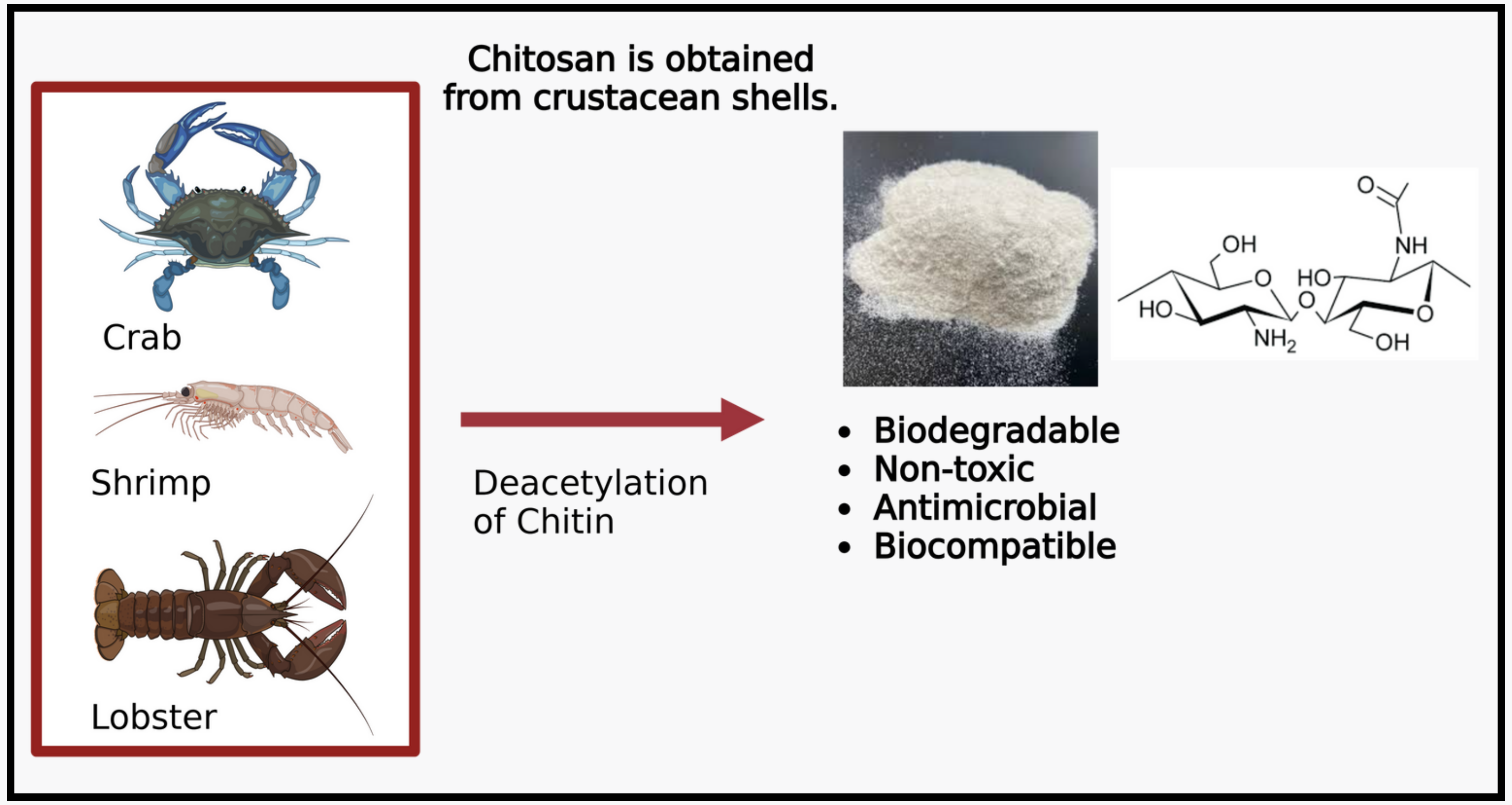
REGENTS

OVERVIEW

INTRODUCTION

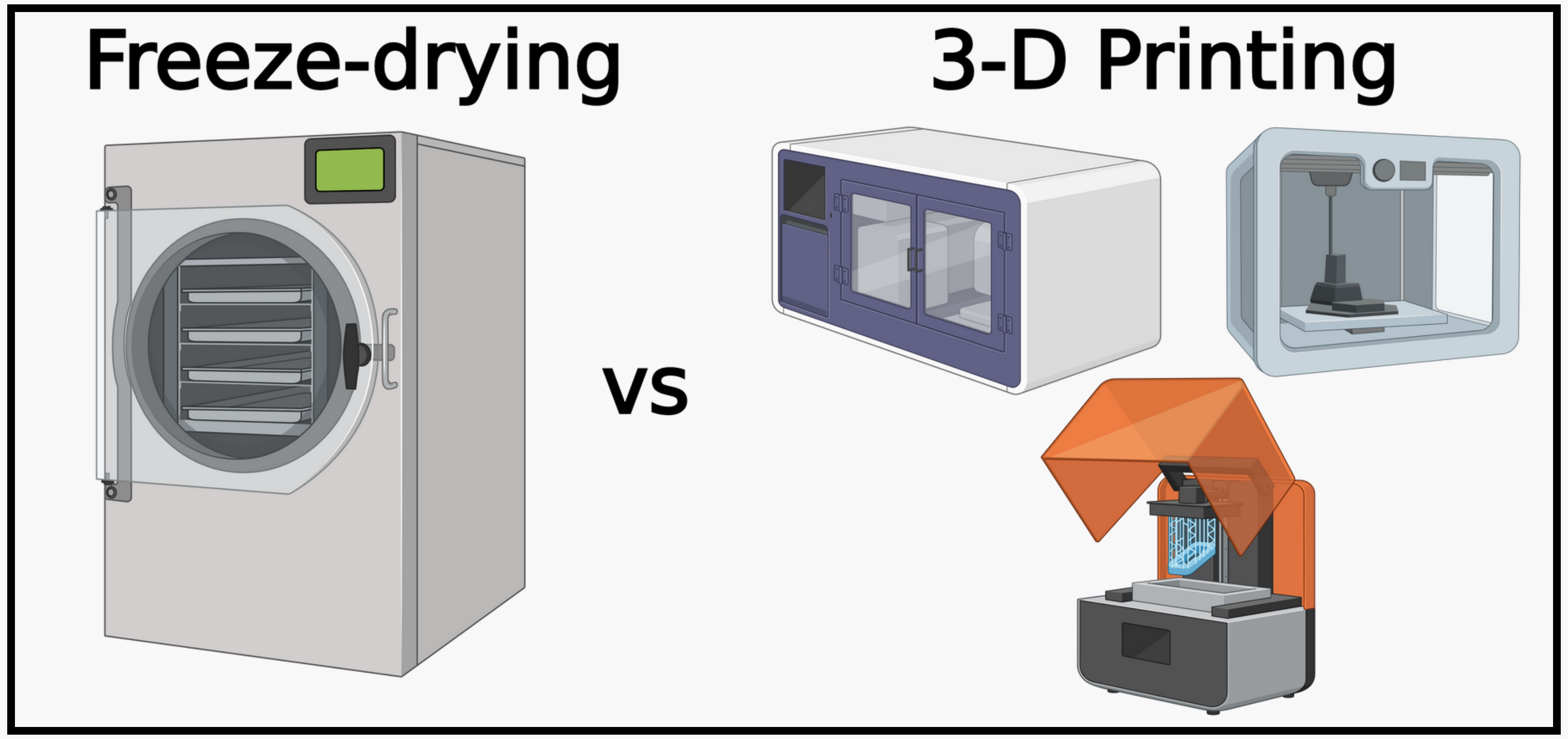
- Chitosan is a natural biopolymer derived from chitin.
- Typically used for chronic wound healing and tissue engineering.
- Conventional fabrication methods (e.g., solvent casting, freeze-drying) lack precision in controlling scaffold architecture.
- Fabrication methods dictate porosity, strength, & degradation rates.
- Emerging 3D printing techniques address these gaps by enabling specific designs with tunable properties.



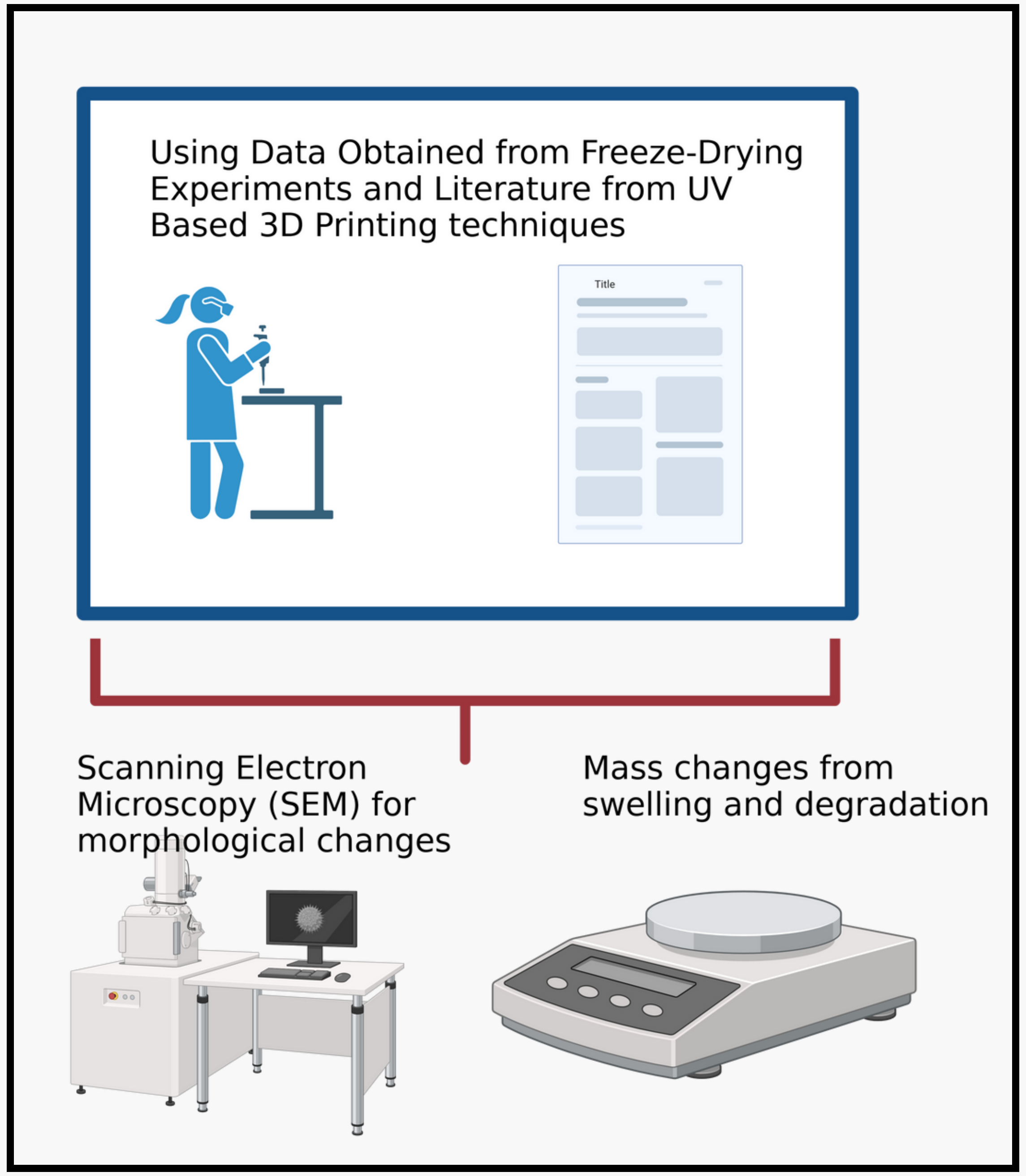
GOALS & OBJECTIVES

This study aims to compare how chitosan performs when conventionally vs additively manufactured by:

- Comparatively analyze degradation behavior, swelling capacity, and scalability of chitosan scaffolds fabricated via freeze-drying and UV based 3D-prinitng, leveraging experimental data and literature.



METHODOLOGY



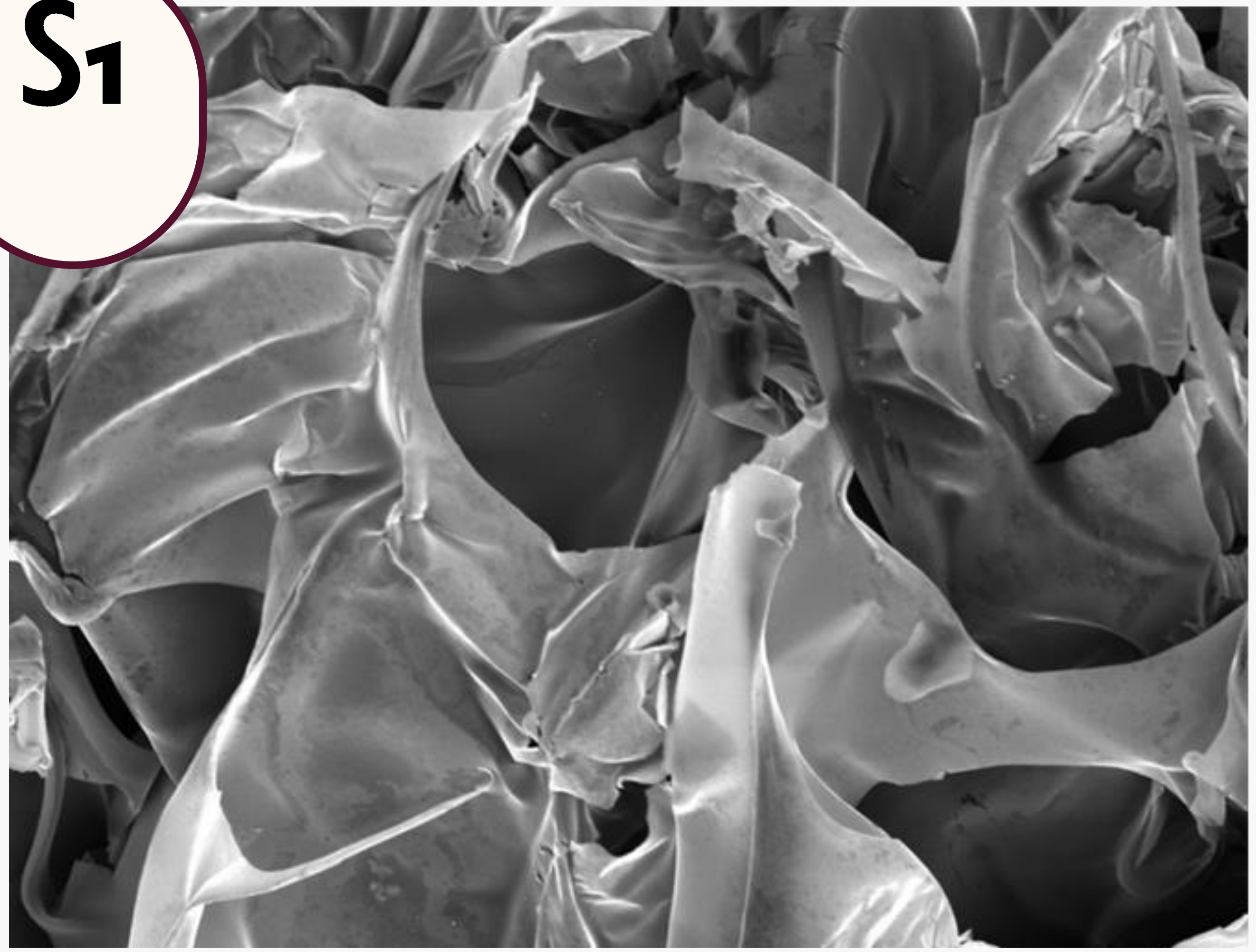
Process	Details
Freeze Drying	Dissolve chitosan 2% w/v 1% acetic acid (24h).
	Pour chitosan solution into molds, freeze for 36h.
	Freeze dry molds (72h).
3D-Printing	Dissolve chitosan 1% w/v 1% acetic acid (24h) and add methacrylic anhydride dropwise..
	Neutralize with bicarbonate, dialyze (4 days) to obtain Methacrylated Chitosan (CHI-MA)
	Dissolve CHI-MA (1% w/v) in DI water, add 0.2 wt% I2959. then print using a digital light printer or stereolithography printer.

Freeze-Drying
- Random porosity
- Takes longer to produce (132 hours)

3D Printing
- Controllable Porosity
- Faster, more scalable (122 hours) [3]

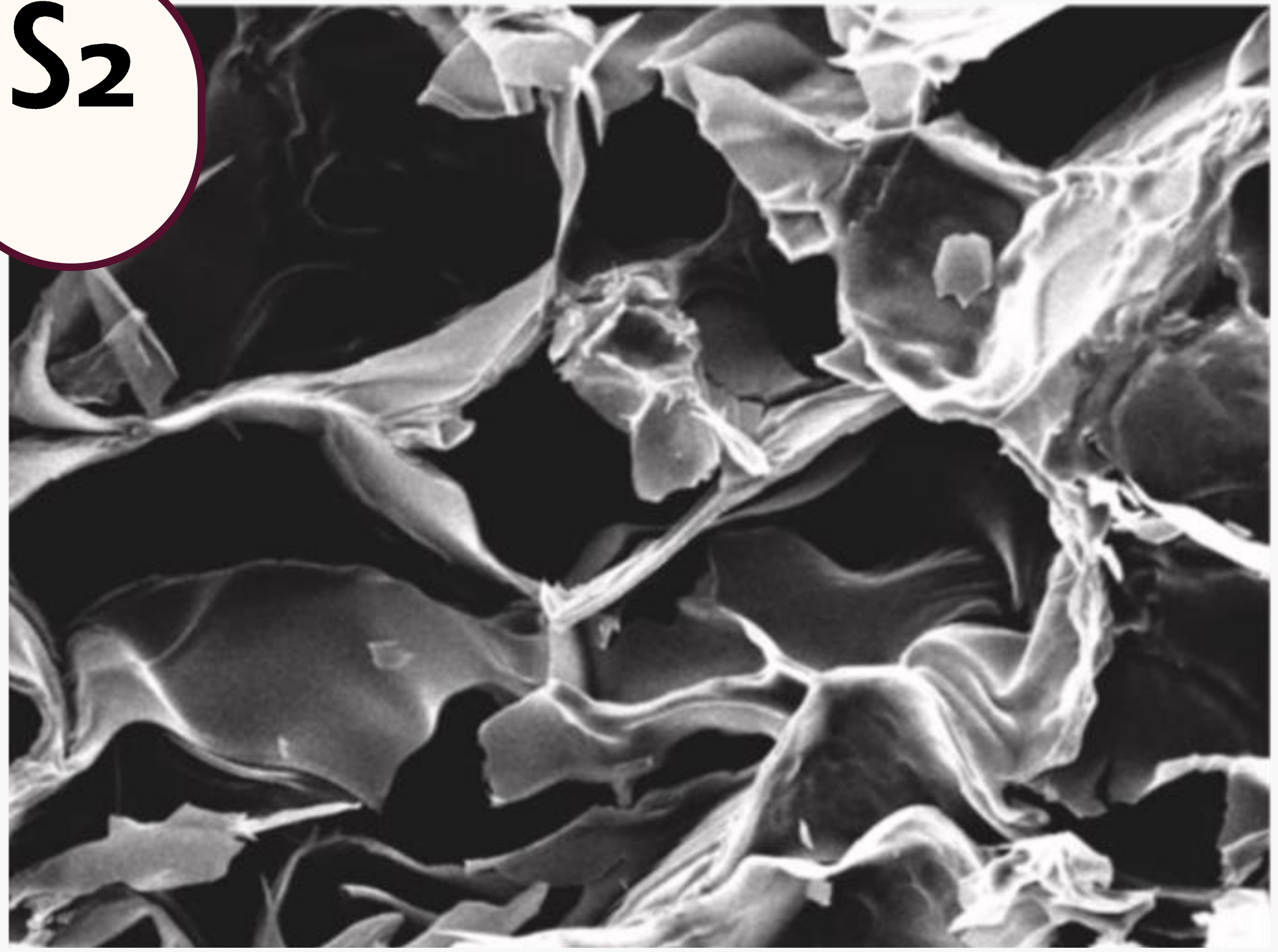
SEM RESULTS (Post Fabrication)

S1



- Freeze-Dried: large, interconnected pores

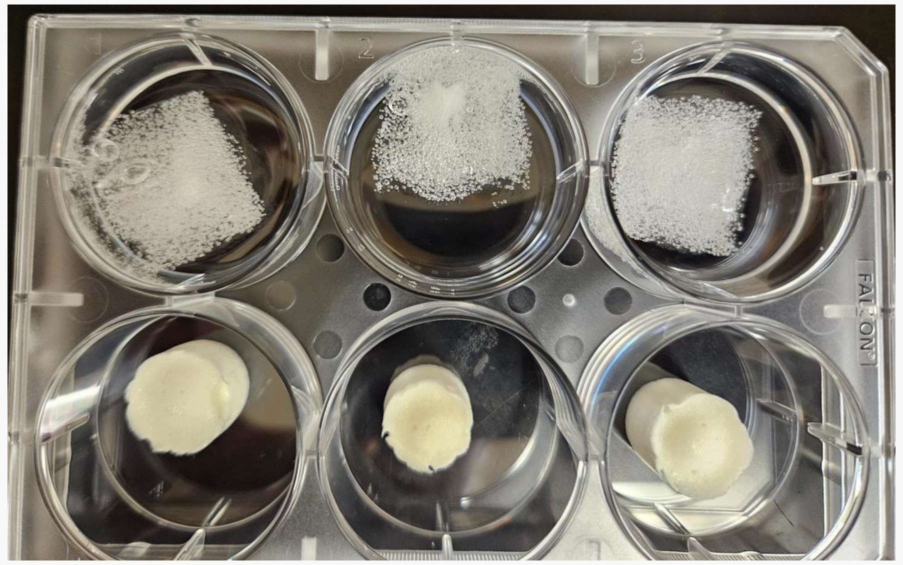
S2



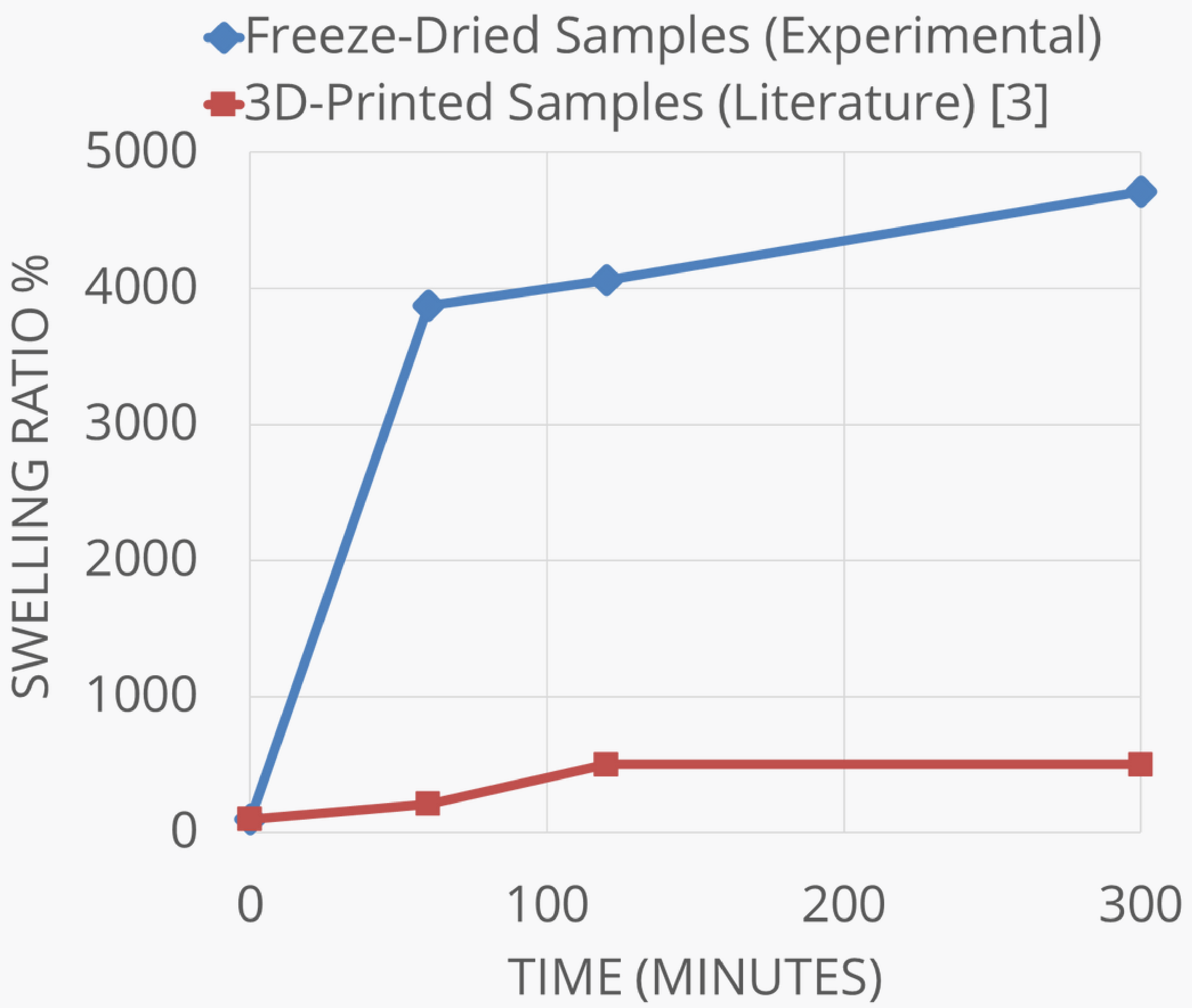
- 3D-Printed: Dense, uniform pores [3]

WATER RETENTION

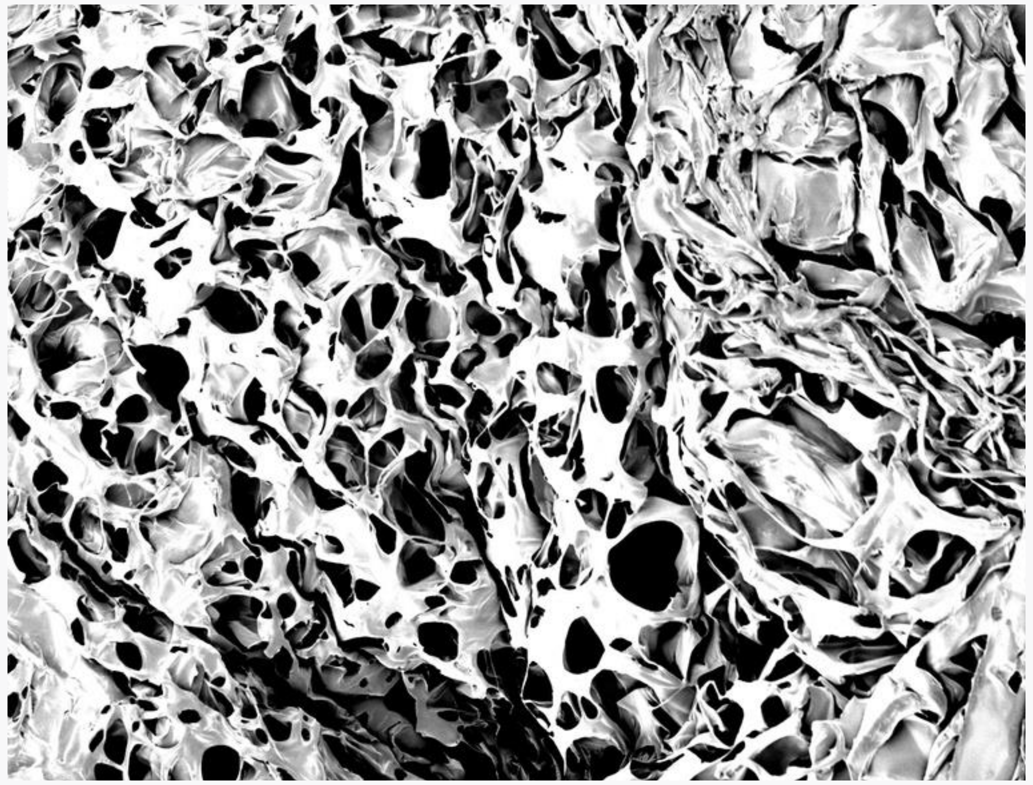
- Freeze Dried Scaffold
  - high swelling capacity from large pores
  - suitable for soft tissue applications



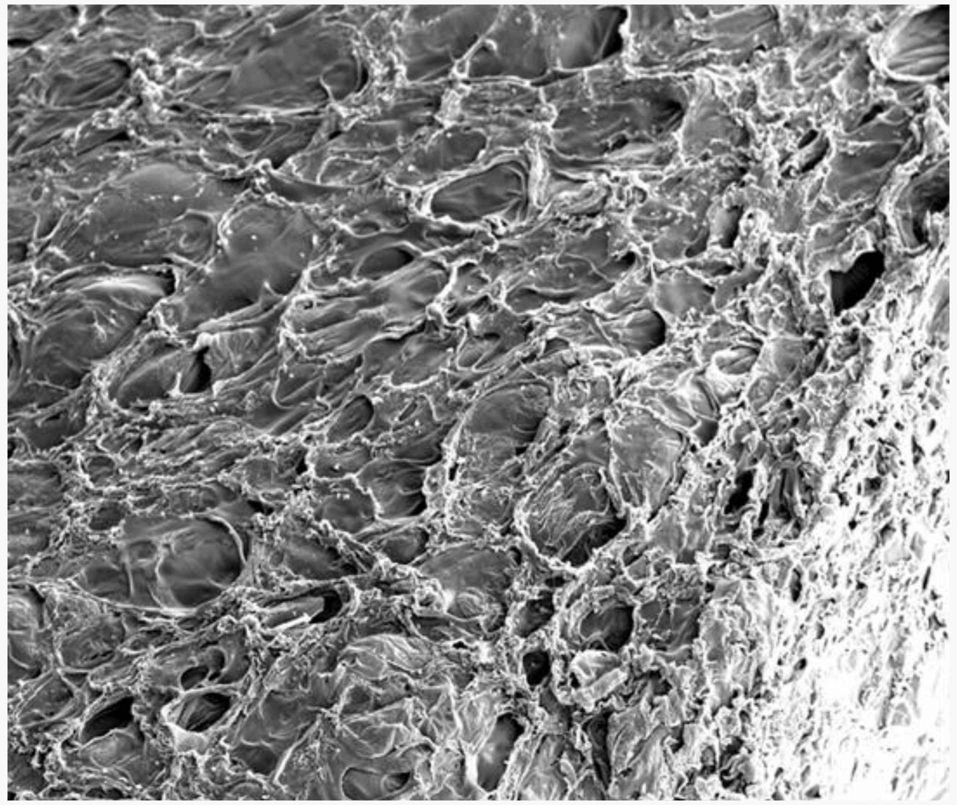
- 3D Printed Scaffold
  - controlled swelling
  - suitable for rigid implants



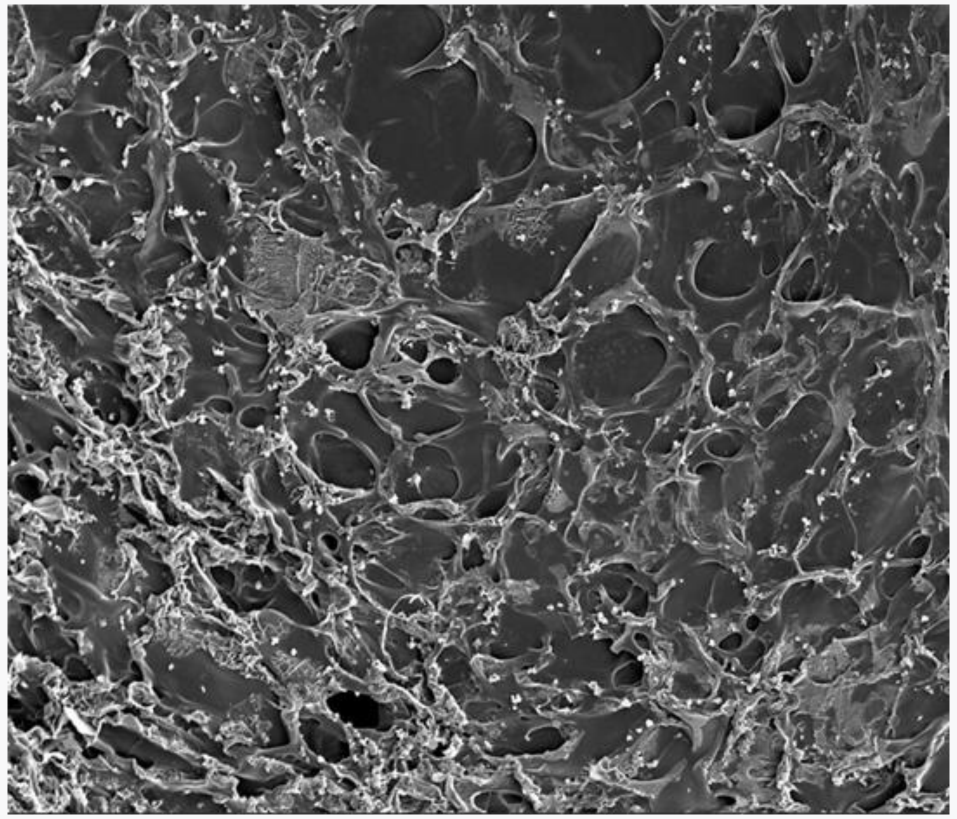
SURFACE MORPHOLOGY (DEGRADATION)



Post Fabrication at 100x



3 weeks accelerated degradation at 100x



6 weeks accelerated degradation at 100x

- Samples were degraded at 60 deg C to accelerate physiological degradation at 37 deg C
- Accelerated degradation (4 days at 60 deg C = 3 weeks at 37 deg C)

CONCLUSION

Freeze-Dried

- Simple fabrication, and higher time requirement
- High water absorption
- Soft tissue wound healing, skin grafts

3D-Printed

- Complex fabrication, and relatively faster production
- Lower water retention
- Bone supports, rigid applications

Porosity in chitosan scaffolds is critical for cell/tissue growth and nutrient flow; degradation must synchronize with tissue repair timelines; swelling ensures hydration and controlled drug release.

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ACKNOWLEDGEMENTS

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THANK YOU

FOR YOUR ATTENTION