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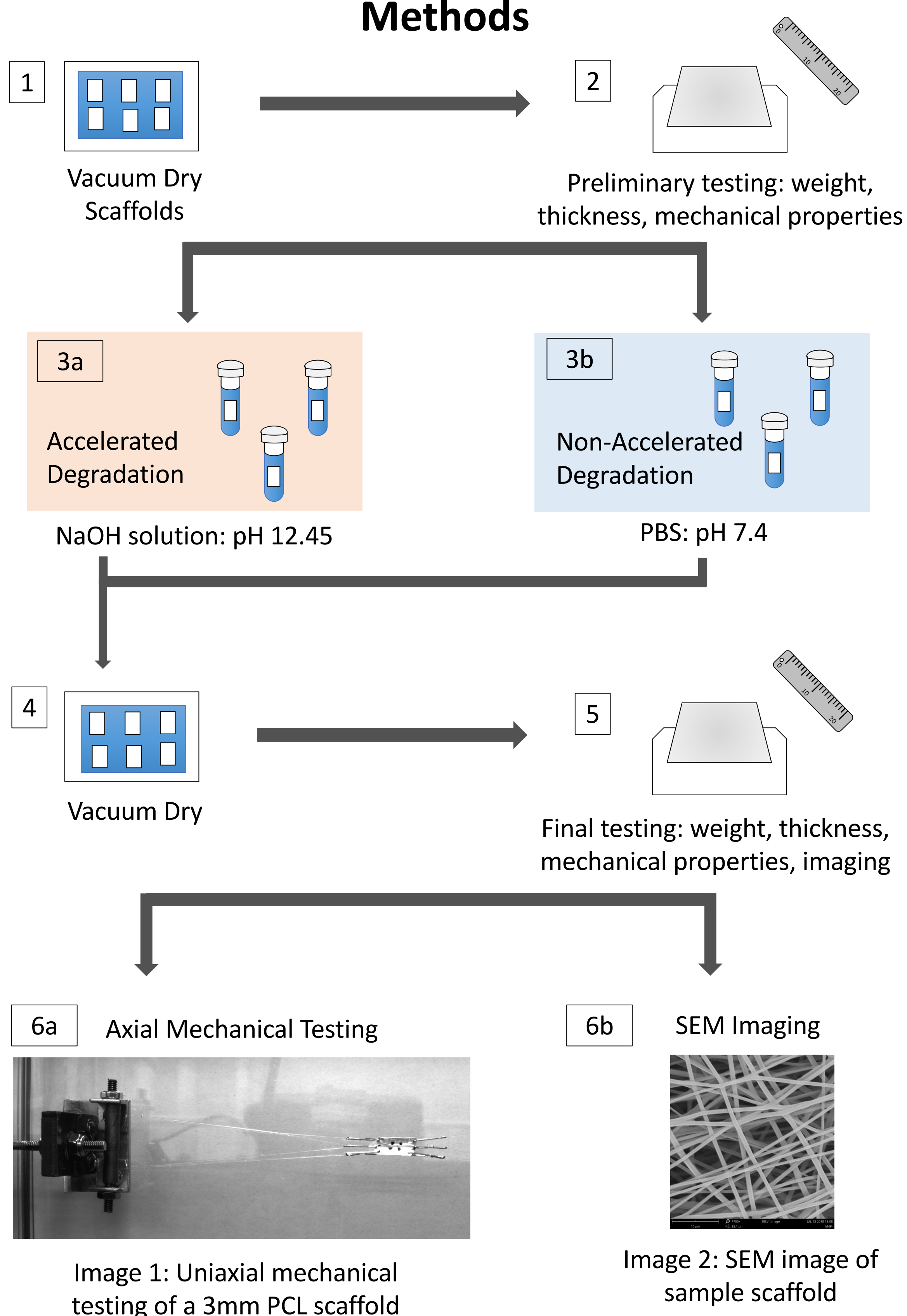# Static Degradation of Electrospun Polycaprolactone Scaffolds

Emily Clement, [2] Johane Bracamonte,[1] Connor Donlan,[3] Sam Cole,[1] Sarah K. Saunders,[2] Joao S. Soares[1]

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Introduction

- Biodegradable scaffolds must:
  - Provide structural support to developing tissues
  - Degrade at a rate proportional to tissue growth over the course of several months to years

- **Objective:** To assess the effect acceleration techniques on the degradation rates of electrospun PCL scaffolds and demonstrate that:
  1. There is a measurable difference between degradation of polymers under normal and alkaline pH conditions
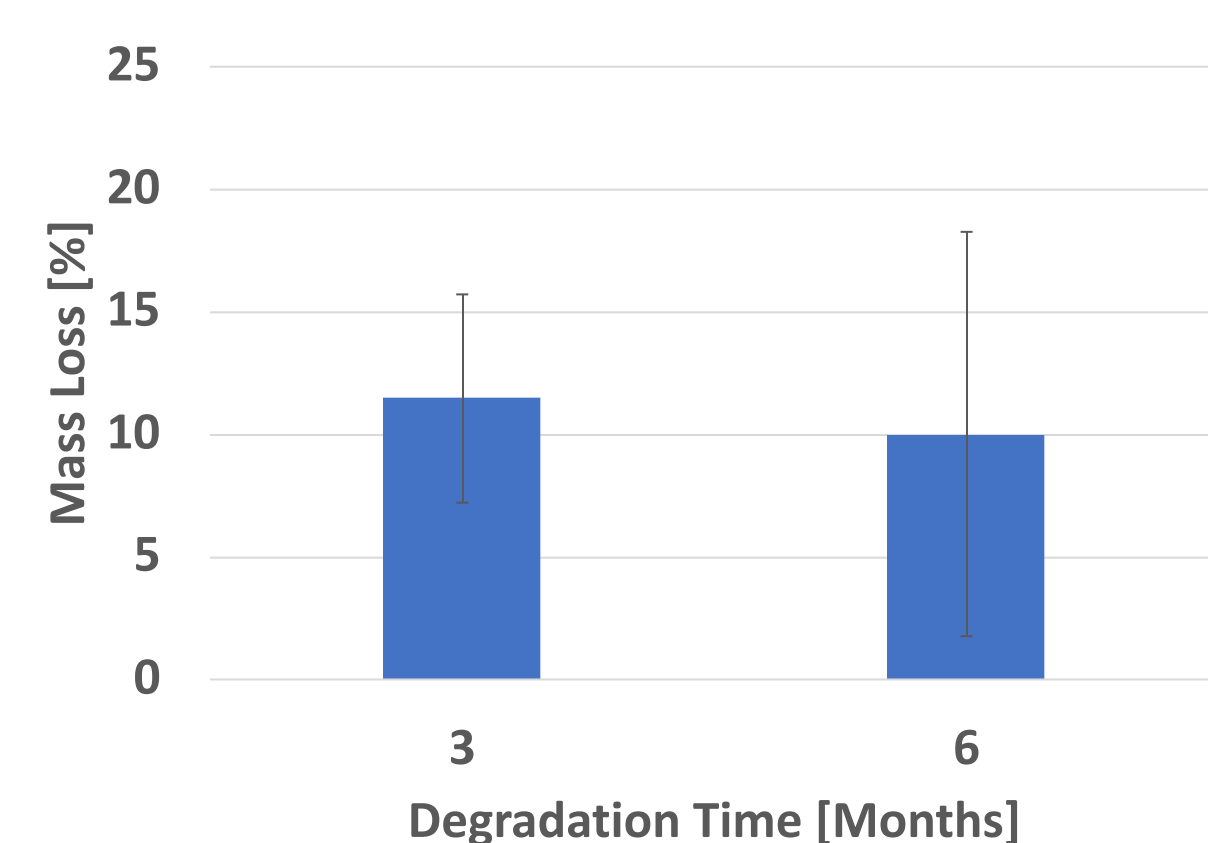 2. Accelerated experiments can be correlated to long term experiments done under physiological conditions
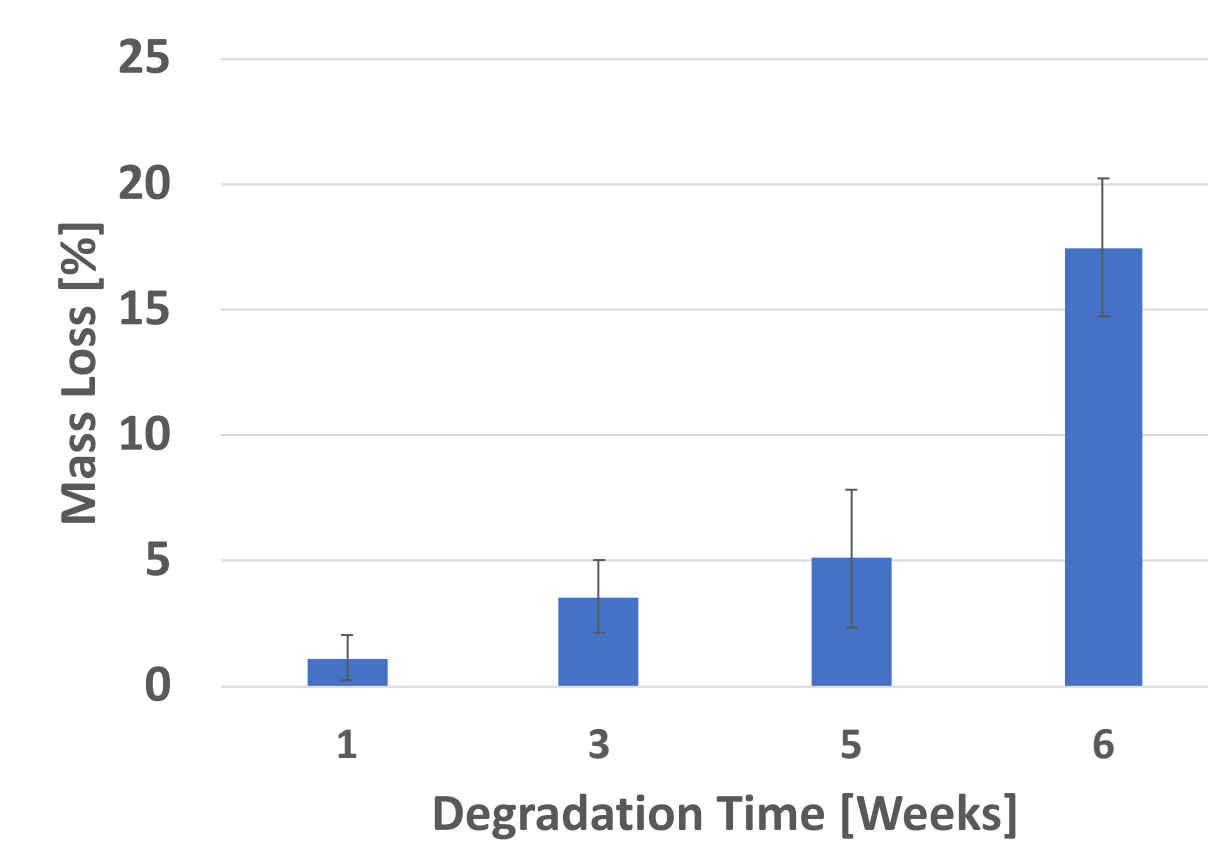
Methods

1. Vacuum Dry Scaffolds
2. Preliminary testing: weight, thickness, mechanical properties

3a. Accelerated Degradation — NaOH solution: pH 12.45

3b. Non-Accelerated Degradation — PBS: pH 7.4

4. Vacuum Dry
5. Final testing: weight, thickness, mechanical properties, imaging

6a. Axial Mechanical Testing

Image 1: Uniaxial mechanical testing of a 3mm PCL scaffold

6b. SEM Imaging
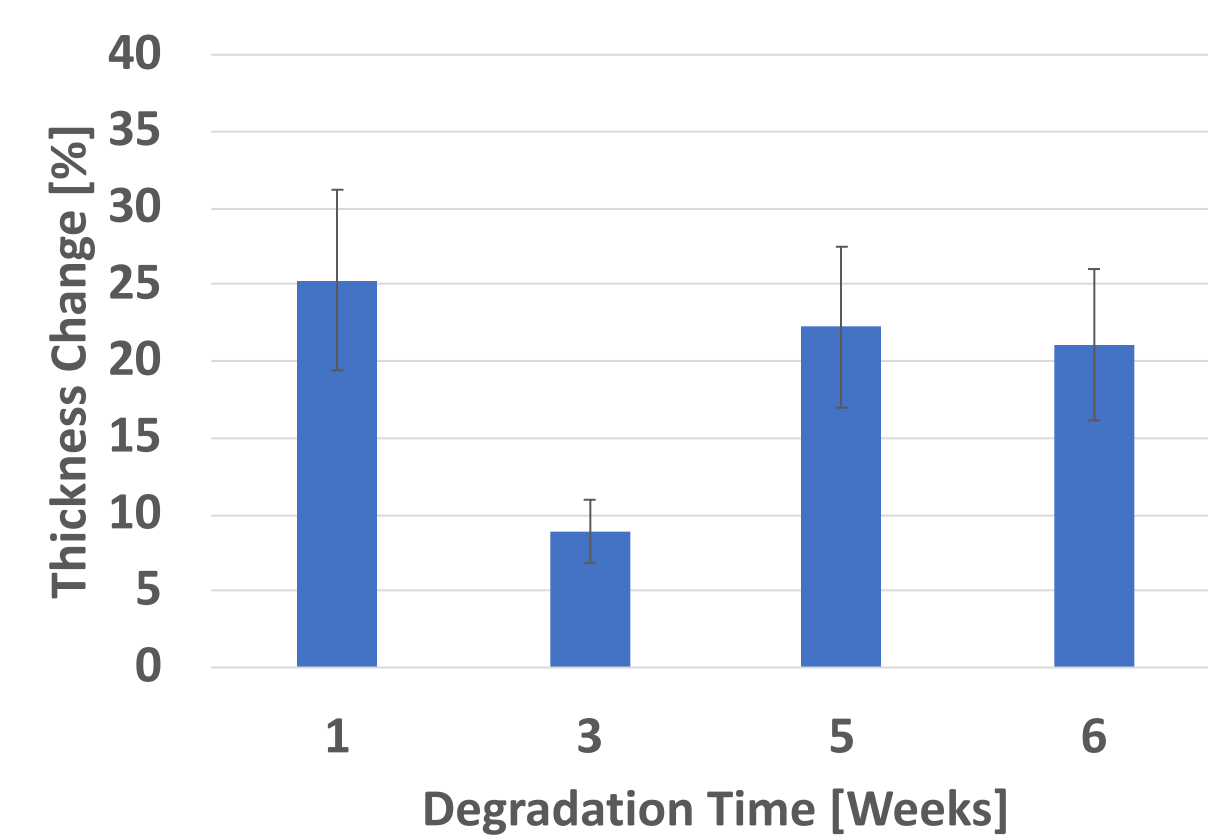
Image 2: SEM image of sample scaffold

Results

Non-Accelerated Degradation

Accelerated Degradation

Weight Mass Loss

Thickness Difference
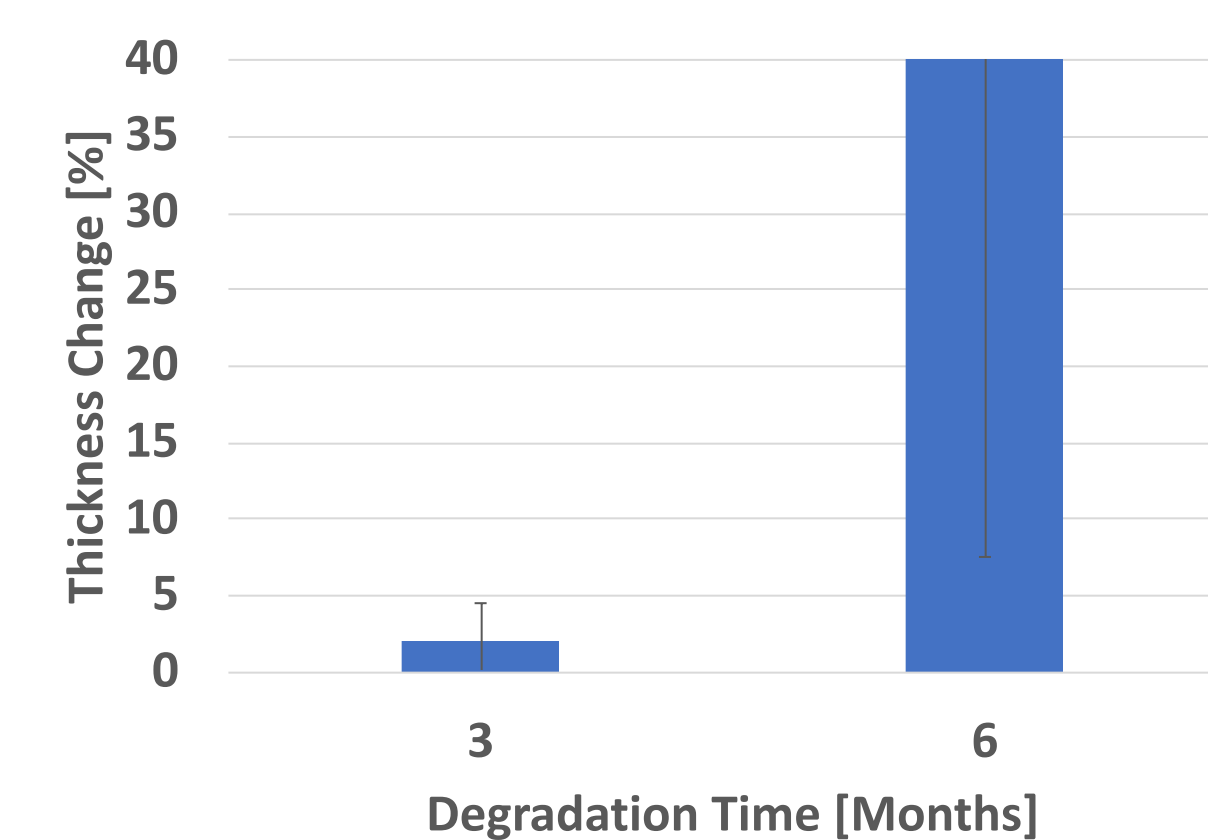
Membrane Stiffness Difference
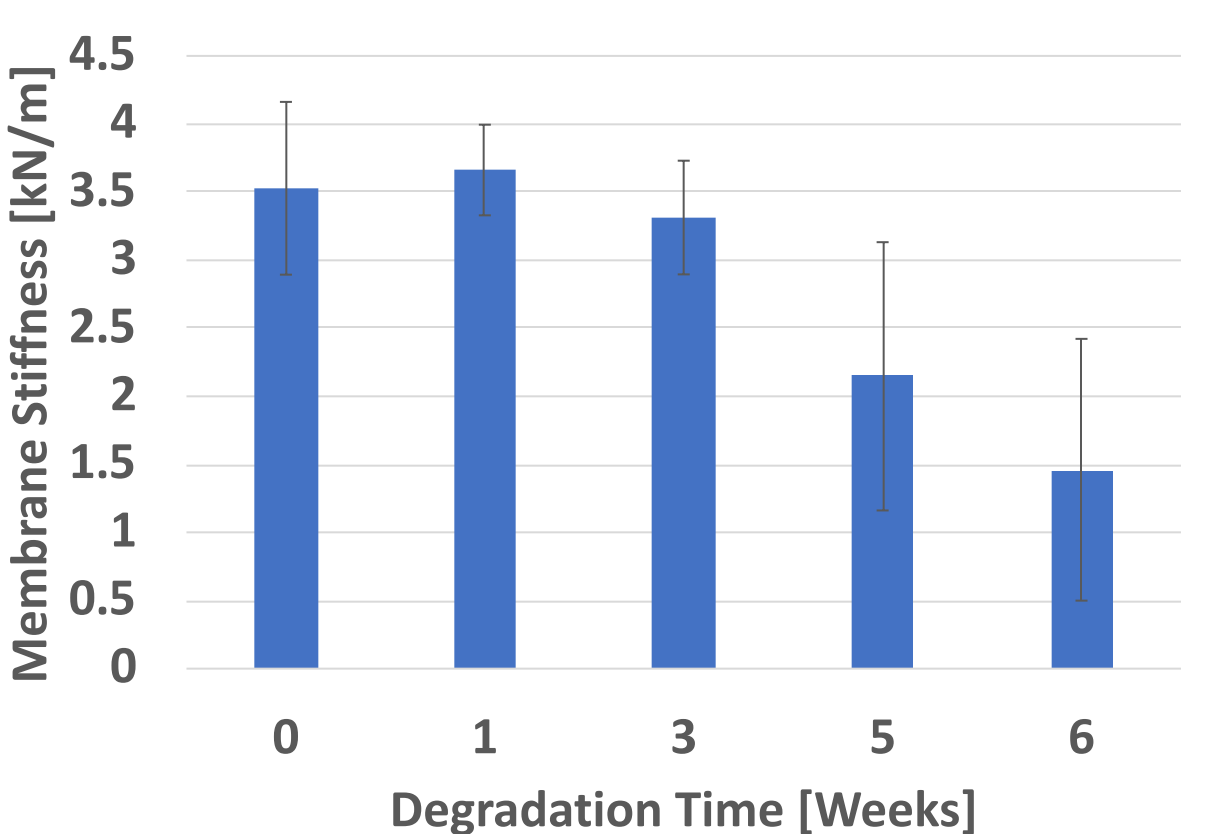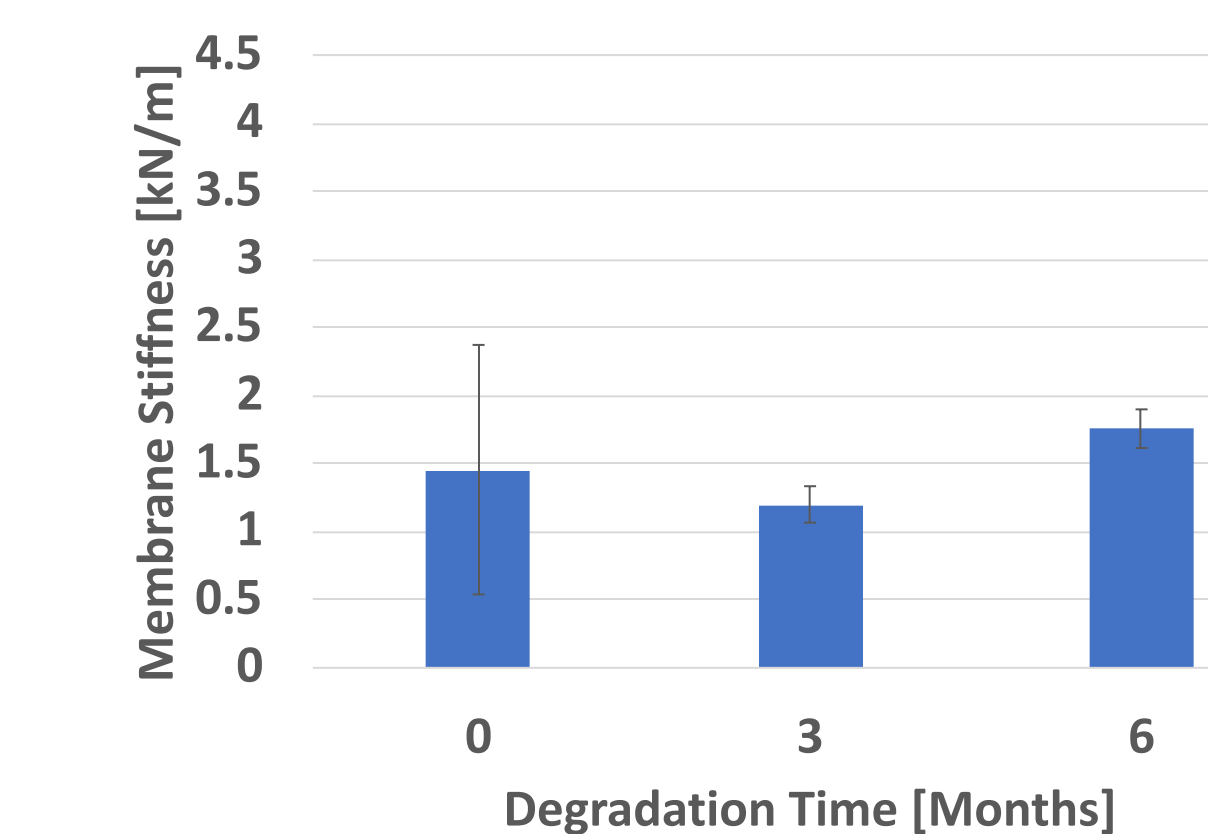
Accelerated Degradation Microstructural Analysis

Day 0   Day 7   Day 21   Day 42
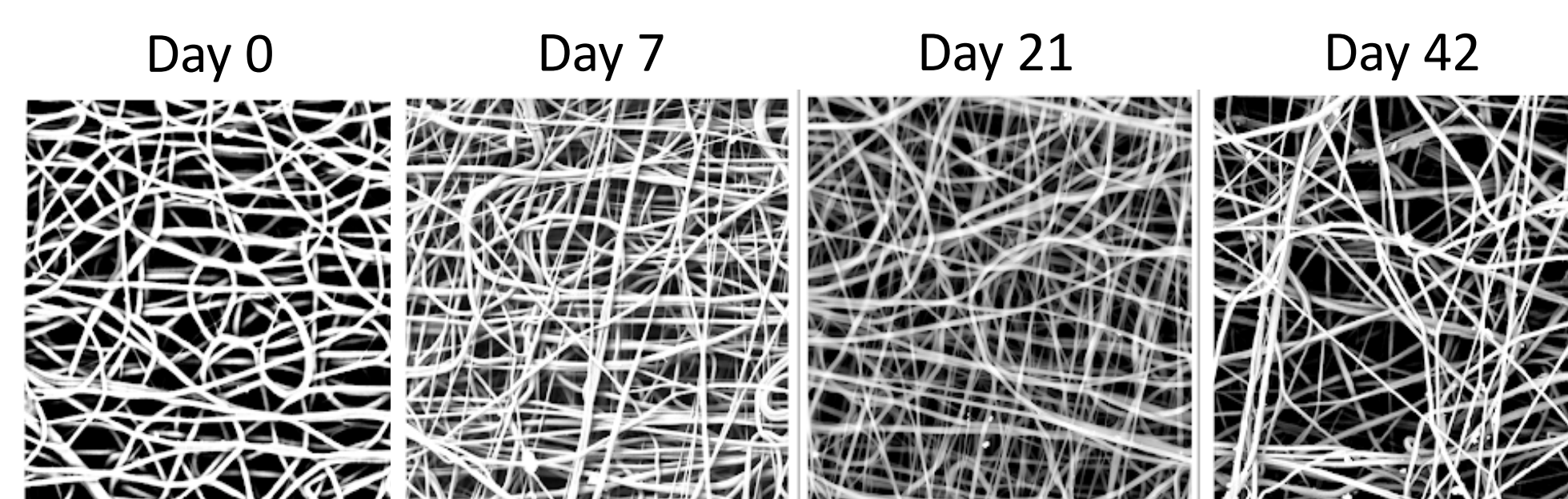
Conclusions

- Accelerated degradation experiments show:
  - The effects of degradation on mass, microstructure, and mechanical properties noticeable after three weeks
  - Decrease in membrane stiffness followed a loss of mass
  - The scaffolds swelled shortly after degradation began, then decreased in thickness following mass loss
  - By six weeks of degradation, about 20% of the original mass was lost with a drop on membrane stiffness of 50%
- The experiments at physiological pH show:
  - That electrospun PCL scaffolds show on average a loss of 10 +/- 7.7% on mass with no significant change of mechanical properties
  - The scaffold swelled about 40 +/- 20%, agreeing with our previous works where we showed that swelling decreases at a larger pH
- Accelerated and non accelerated degradation coloration
  - If degradation at physiological pH follows the same trend as the accelerated degradation, a stage of pronounced decrees in mass will be accompanied by a significant decrease in stiffness and porosity
  - We hypothesize that accelerated and non accelerated degradation profiles are equivalent, so that accelerated degradation could be used as a base to predict the scaffold behavior in physiological conditions

Future Plans

- Static and dynamic accelerated degradation chambers (Fig. 1)
  - Purpose:
    - Perform accelerated degradation experiments in a controlled environment
    - Allow for both static and dynamic degradation conditions
  - Design requirements:
    - Withstand highly alkaline media without producing a chemical reaction between the media and the chamber
    - Degrade 6 scaffolds at a time
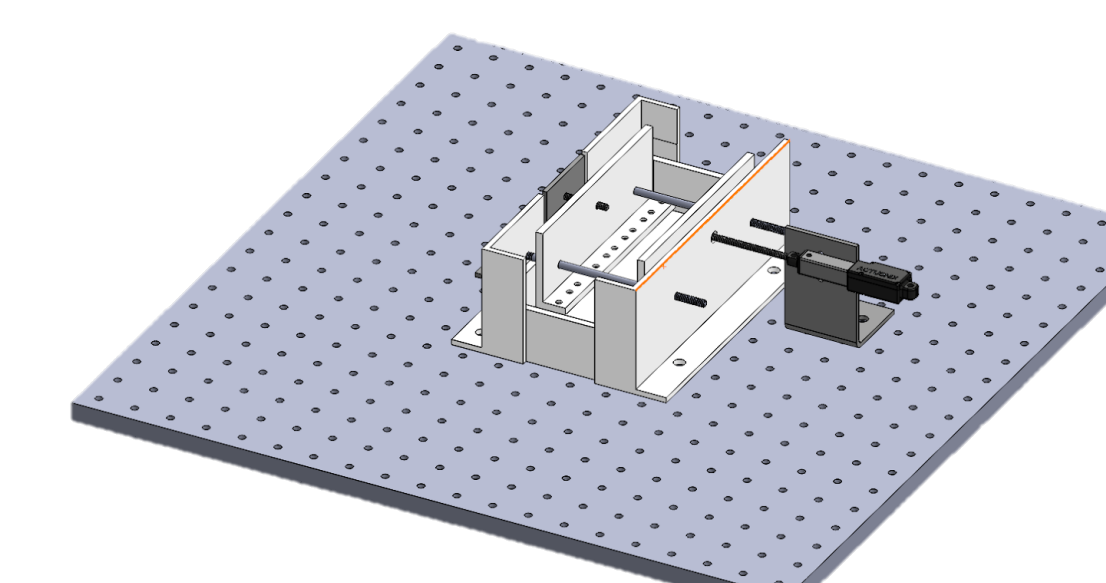   - Allow for the application of cyclic dynamic loads during dynamic degradation experiments

Figure 1: 3D model of accelerated dynamic degradation chamber

- 18 month non-accelerated degradation experiment
  - Further comparison of accelerated and non accelerated degradation conditions
  - Development of complete PCL degradation prof