

## PZLA FILM PREPARATION

Simple uniaxial stretching is sufficient to render PLLA piezoelectrically (PZ) active: PLLA→PZLA.

- PLLA pellets impacted to powder
- Melt-pressed @ T=210°C, P=10tons
- Ice-Quenched for 0% Crystallinity
- Uni-axial drawing to 2:1, 3:1, 4:1 @ .025mm/min, T=80°C
- Final **PZLA film** thickness 20-40 μm

## FILM CHARACTERIZATION

PZ-activity is dependent on crystal content and alignment.

-**Rheograph** measurements Elastic Modulus, Dielectric Constant, and Piezoelectric Strain Coefficient @ T=25°C, 100Hz.

-**Wide-Angle X-Ray Diffraction** (WAXD) for crystal content & orientation @ T=25°C,

## CELL CULTURE ASSAYS

-Rat dermal GFP-expressing **fibroblast cells** were seeded onto TCPS, and PZLA for 72 hours @ physiological conditions.

-SV40-Transformed **mesangial cells** were seeded onto glass, PLLA, and PZLA and evaluated in time-lapse microscopy (24 hours 15-minute intervals) @ physiological conditions.

-Cell **feature extraction** was performed from bright-field images with a non-linear Gaussian sliding operator; cell bounding box, centroid, and pixel count were evaluated.

## IN-VITRO DEGRADATION

-PLLA and PZLA films degraded in Phosphate-Buffered saline (PBS) @ T=37°C, pH=7.4, with samples removed bi-weekly for 8 weeks. Buffer pH maintained @ 7.4 with weekly adjustments. -Films were evaluated for weight loss and acid release.

# Development of a piezoelectric substrate for organized tissue growth.

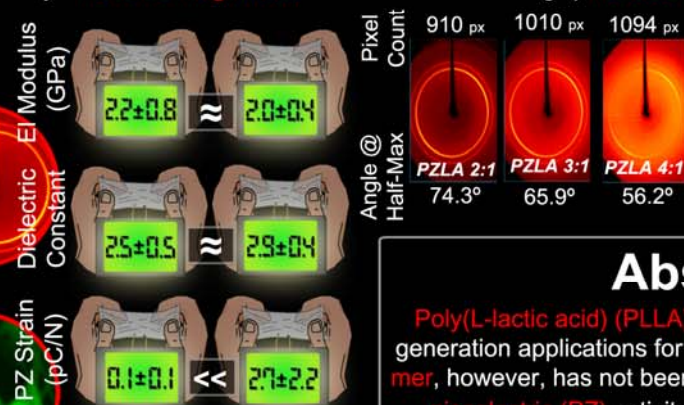
Winger, M.T.<sup>1</sup>, Monteiro, G.<sup>1</sup> Shreiber, D.I.<sup>1</sup>, Sheriff, H.<sup>2</sup> Palant C.<sup>2</sup>, Scheinbeim, J.I.<sup>1</sup>, Craelius, W.<sup>1</sup>

<sup>1</sup>Rutgers, The State University of New Jersey, New Brunswick, N.J., USA <sup>2</sup>Veterans Affairs Hospital, Washington, D.C., USA



## Material Characterization

PZLA exhibited **comparable moduli and dielectric constant** to PLLA. **PZ strain** was greater by an **order of magnitude**. With **increasing draw**, PZLA **crystal content** (px count) and **crystal size** (decreasing ½-max angle) **increase**.

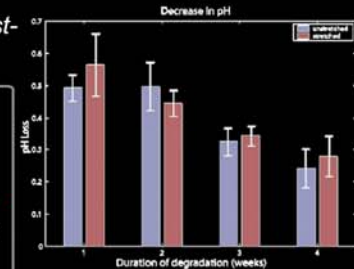
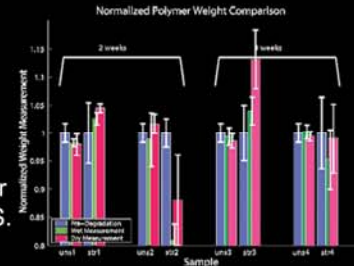


## In vitro Degradation

Preliminary results show **comparable degradation** between PZLA and PLLA.

**pH release and gravimetric weight loss** over 1 month were **statistically similar** over 1 month in pH-adjusted PBS.

**Next Step:** Rheograph measurements pre- and post-degradation.



## Abstract.

Poly(L-lactic acid) (PLLA) has been employed in tissue regeneration applications for decades. This **biodegradable polymer**, however, has not been characterized for the effects of its **piezoelectric (PZ) activity** on **cell growth and alignment**.

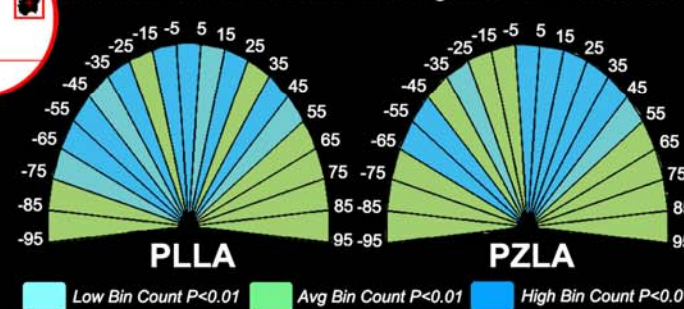
We characterize **PZ-active PLLA (PZLA)** for its **influence on rat dermal fibroblasts, SV40 transformed mesangial cells**, as well as its **rheological and in-vitro degradative** properties.

Preliminary results indicate that **PZLA exhibits similar material properties to PLLA**, while incurring a greater cell process **alignment and substrate adhesion**.

## Fibroblasts

Fbb cells seeded onto **PLLA** showed **random process alignment**, whereas cells on **PZLA** aligned **±45°** to the direction of draw with **P<0.01**.

Distribution of Fbb Processes: Degrees from meridian



## Mesangial Cells

**PZLA** yielded **comparable adhesion time and migration velocity** to **glass controls**.

