

# Fibrous Scaffolds from Elastomeric Biodegradable PLCL for Cardiovascular Tissue Engineering

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## Introduction

Three dimensional scaffolds play an important role in tissue engineering as the matrix provides the cells with a tissue specific environment and architecture. Especially for cardiovascular applications, developing scaffolds that can maintain their mechanical integrity while exposing cells to long-term cyclic mechanical strains is necessary to engineer smooth muscle cellular constructs.(1, 2) There have been several attempts to develop elastic scaffolds for vascular tissue engineering applications using highly elastic poly(lactide-co-caprolactone) (PLCL) using various methods such as extrusion-particulate leaching and phase separation.(3-5)

The objective of this study is to assess the feasibility of spinning elastomeric PLCL polymer into fibers via melt spinning and/or electrospinning techniques.

## Materials and Methods

Two samples of PLCL (50:50, Mw-350,000 & 110,000) were prepared by KIST using the method reported previously(6), and were characterized to determine the feasibility for spinning. DSC and TGA were performed to analyze the thermal properties. Melt viscosity was measured using Haake MiniLab under air at different temperatures to determine the optimal conditions for melt spinning. Solubility studies were performed to determine the feasibility for electrospinning using acetone as the solvent.

## Results / Discussion

Thermal analysis by DSC of the PLCL polymers showed a Tg at -25°C for both molecular weights. This single Tg, which is in between the values of PCL -60°C and PLA 57°C indicates a continuous amorphous phase. There were twin endothermic peaks at approximately 105°C and 120°C when heated up at 20°C/min, but when the polymer was reheated after quenching, these peaks were no longer present. (Fig.1) This indicates that the copolymers as prepared did exhibit a degree of order, which was lost in the molten state.

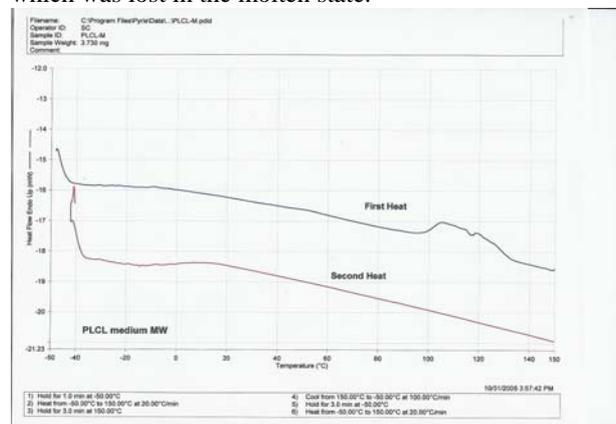


Figure 1-DSC curve of PLCL (Mw-110,000)

TGA results showed that PLCL starts to degrade at approximately 300°C under both air and N<sub>2</sub>.

Melt viscosity that was measured at 140°C under air showed viscosity values up to 250Pa.s, but at 250°C the viscosity range fell to 10Pa.s. This melt behavior suggests that it may be feasible to melt spin these polymers within this temperature range.

The PLCL polymer was readily dissolved in acetone at room temperature. Polymer concentrations were varied from 3 to 5wt% for both molecular weights. All solutions remained clear and stable. This suggests the feasibility for electrospinning. Previous studies have already proven that PLCL can be successfully electrospun using acetone as a solvent to produce nanofibers.(5) (Fig. 2)

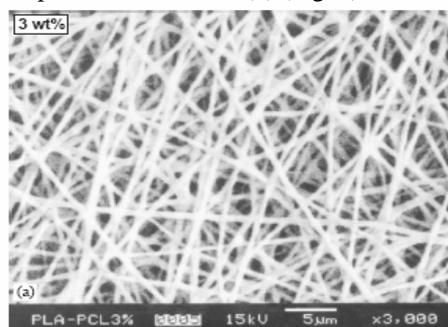


Figure 2-SEM of electrospun PLCL from 3wt% polymer concentration solutions (5)

## Conclusions

This preliminary study to assess the suitability of converting elastomeric PLCL copolymers into fibers via melt spinning and/or electrospinning has shown promising results. By combining melt spinning with electrospinning, it will be possible to vary surface porosity with sufficient mechanical strength.

For future work, the scaffold will be melt spun as a tubular mandrel and nanofibers will be formed around the mandrel to promote large surface area via electrospinning. The morphology, porosity and mechanical properties of the tubular scaffolds will be evaluated and the rate of resorption *in vitro* will be investigated prior to cell culture studies.

## References

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