Surface Wettability and Cell Behavior of Electrospun Patterned Biodegradable Polycaprolactone(PCL) Nanofibers

[1]Jiahui Chen, [1,2]Martin W. King.
[1]Wilson College of Textiles, North Carolina State University, Raleigh, NC, USA
[2]College of Textiles, Donghua University, Songjiang Campus, Shanghai, China

Significance of Study:

Purpose of the study is to design scaffolds for future tissue engineering applications. Recently, electrospinning has developed significantly in nanotechnology field. It has become one of the most popular methods in fabricating the scaffolds for tissue engineering development because of its low cost, simple facility set-ups, and controllable process [1-2]. In addition, gaining a high porosity, small fiber diameters, and three dimensional nanofibrous membrane would better mimic the human tissue and internal environment to promote cell growth[3]. The results could have a better understanding of polycaprolactone (PCL) electrospun mats with its surface wettability and cell adhesion behavior to design future tissue engineering applications [4].

Experimental Design:

Electrospinning Set-up

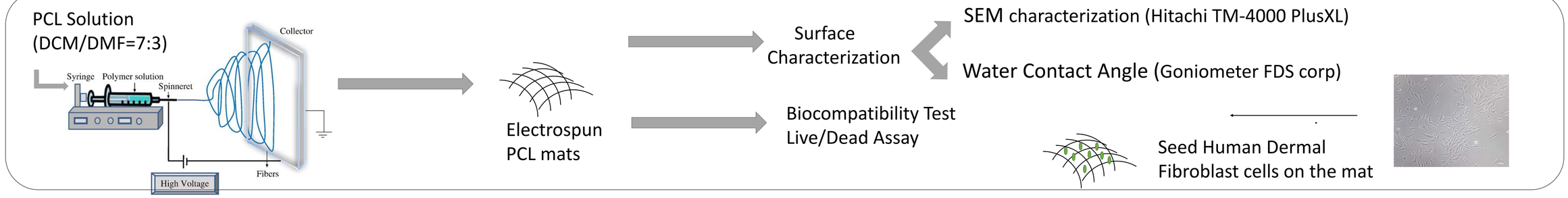
The device consists of an automatic pump to deliver the polymeric solution through a syringe needle to the collector.

No.	ES parameter	Units	Levels
1	Concentration	Wt%	13,15,17
2	Voltages	kV	18,20,24
3	Collectors	Pore Size	No pore, size1, Size2

Material and Methods

PCL (Average Mn=80,000g/mol), Dichloromethane (DCM) and *N,N*-Dimethylformamide (DMF) were provided by Sigma-Aldrich, USA, which will be used for electrospinning the PCL mat in different conditions. Two different pore sizes of collectors with 5*5 cm^2 dimension wire mesh will be used as collectors as well as aluminum foil paper. The three variables of parameters including concentration, voltage, and topography of the collectors. Total 27 samples (**Table 1**) will be produced and analyzed.

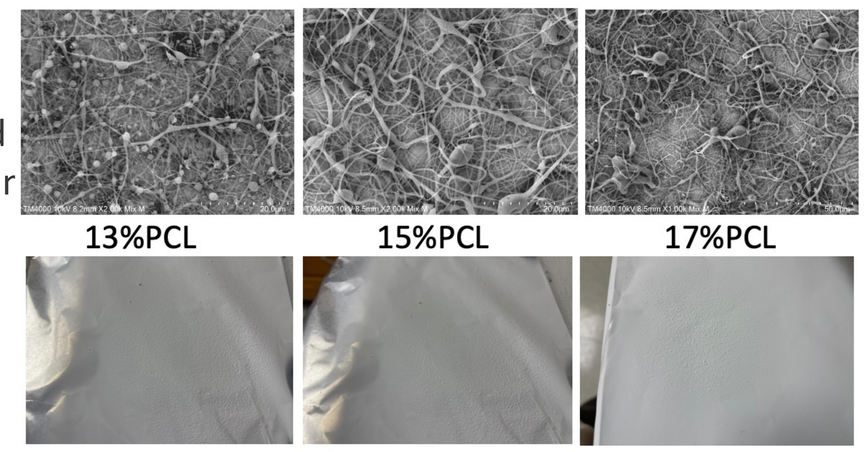
Table 1. The Electrospinning sample groups



Electrospinning Conditions:

- Room temperature and humidity (25°C, 62%RH)
- Collector: flat plates and wire mesh with aluminur foil mounting on top
- Voltage:18kV -22kV
- Feed rate: 1-2mL/h
- Needle: 20-22 gauge
- Distance: 16cm

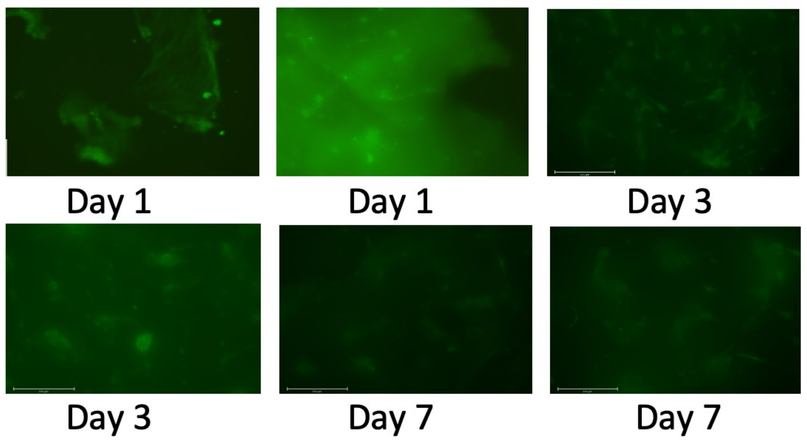
SEM images



Experiment Data

Biocompatibility Test of PCL Electrospun mats

Live/Dead Assay (Green-Live cells, Red-Dead Cells)



Conclusions and Future Work

- The dual solvent system could successfully make PCL solution. The electrospinning condition should be optimized for future work such as concentration, humidity, and single solvent system.
- PCL with DCM/DMF solvents is highly biocompatible, different cell lines will be tested.
- Water contact angle will be measured to understand surface wettability of PCL.

Reference:[1] Neda SH. J Biomed Mater Res Part A 2018;106A-2963-2972; [2] Menemse G J Biomed Mater Res Part A 2011;98A:461-472; [3]Ying M App Surface Sci 2020;146104; [4] Jinshan C.RSC Adv 2020;10,20155

Contact Information:
Jiahui Chen: jchen75@ncsu.edu
Martin. W. King: martin_king@ncsu.edu