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Investigating the Relationship between Surface Properties of Polymers and Protein Adsorption

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INTRODUCTION: Electrospun synthetic, biodegradable nanofibrous materials have the ability to mimic the topographical architecture and surface chemistry of native extracellular matrix (ECM)[1]. The aim of this study is to investigate different polymer surfaces regarding wettability and protein adsorption. Protein attachment is an indicator of cell biocompatibility and can be used to determine preferential scaffold materials for maximum cell adhesion[2].

METHODS:

Electrospinning: Poly lactic acid (PLA); and poly-ε-caprolactone (PCL) were dissolved in a mixture of ratio 7:3 of chloroform and dimethylformamide. Polymer solutions were electrospun to coverslips at a low fiber density using the parameters detailed in Table 1. A static ground collector was used to fabricate random nanofiber scaffolds and a rotating mandrel was used to attain aligned nanofiber scaffolds. Additionally; PLA and PCL films were also produced from a solution where the polymer was dissolved in chloroform only.

Table 1. Parameters used to fabricate aligned/random PCL & PLA nanofiber scaffolds.

Parameter	PCL		PLA	
	Aligned	Random	Aligned	Random
Working Distance	20cm	15cm	20cm	15cm
Voltage	4.5kV	4kV	6kV	6kV
Flow Rate (ml/min)	0.01	0.01	0.025	0.025
Volume: ml	0.018	0.018	0.025	0.025

BSA Model Protein & Staining: 50µl of Bovine Serum Albumin (BSA) [500µg] was added to each polymer surface and incubated at 37ºC for 2 hours. After removing BSA solution and rinsing, 400µl of 0.1% (wt/v) Coomassie Dye was added to samples for 10 minutes.

Contact Angle: 10µl of ultra pure H_2O was applied to coverslips using a Hamilton syringe. Images were taken using a CCD camera. Images were assessed using the Image J plug-in.

RESULTS:

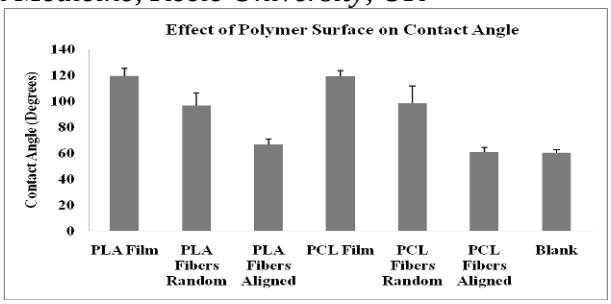

Figure 1. Contact Angles of droplets on different polymer surfaces (n=4)

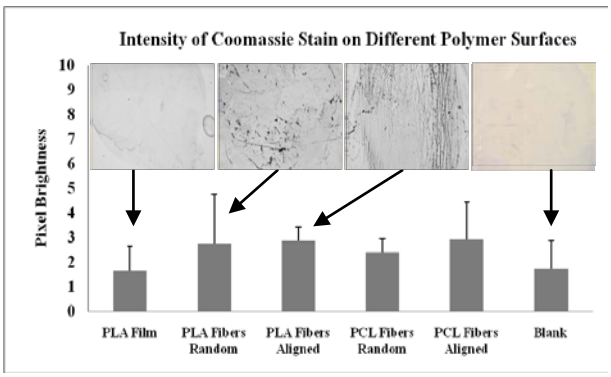

Figure 2. Protein adsorption on different polymer surfaces (n=3). Evaluated using Image J software; where 10=black, 1=white.

Low density of aligned nanofibers does not change much wettability when compared to blank coverslips as shown in Fig 1. However; nanofibres encourage qualitatively greater protein adsorption than films and blank coverslips (Fig 2).

DISCUSSION & CONCLUSIONS:

Aligned topography and high surface area to volume ratio of nanofibers can influence greater protein adsorption despite having similar wettability to blank coverslips. Thus greater protein deposition is expressed on fiber surfaces compared to films and blanks and so are preferable for cell attachment in tissue engineering applications.

REFERENCES:

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