Journal of Fiber Bioengineering & Informatics 5:1 (2012) 33–40
http://www.jfbi.org | doi:10.3993/jfbi03201202

# Study on Cell Adhesion Detection onto Biodegradable Electrospun PCL Scaffolds

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**Abstract**

The polycaprolactone (PCL) known for its slow biodegradability shows potential applications in the field of skin scaffold production. In the current study PCL mats with micro scaled structure were produced via electrospinning and treated with NaOH solution for enhanced cell adhesion. The scaffolds were evaluated as an efficient stem cell growing material by human skin keratinocytes and fibroblasts culture. The cell viability assay (CellTiter-Blue) of the as spun scaffolds was compared with previously prepared PU electrospun scaffolds, fibrin scaffolds and amniotic membrane scaffold. Significant difference in cell adhesion was evident between the natural and synthetic scaffolds. As far as the electrospun scaffolds were concerned the significance between, as well as for the NaOH treated, samples was less evident. The repetition of different donor cells fluorescence within the same scaffold material was also present.

*Keywords*: PCL; NaOH Treatment; Keratinocytes; Fibroblasts; Cell Culture

## 1 Introduction

Concerning tissue regeneration (e.g. human skin, or any other vital organs failure), medicine faces huge problems due to shortage of adequate transplant donors, possible recipient's immunological system rejection, with potential risk of infection, tumor development or any other unwanted side effects. From this point of view tissue engineering, as biological substrates developer that can restore and maintain the tissue function, has received impressive attention in the medical science

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and wider [1]. Synthetic biodegradable biomaterials designed as scaffolds for cell culture are already known for successful functionality and special attention in the past decades has been paid to electrospun scaffolds. The advantage of these types of scaffolds is in their architecture influencing cell attachment due to the larger surface area of the nano-scaled structure to absorb proteins that will promote more binding sites [2].

Human embryonic stem cells (hESCs) cultivated on polyurethane electrospun scaffolds showed successful attachment and neuronal differentiations. The authors reported on a significant increase of cell growth after day 5 until day 18 where the cell number stabilized [3].

In a study of electrospun PCL and PCL/PEO scaffolds, seeded human dermal fibroblast showed dependence upon the scaffold architecture. Significant influence on cell proliferation was reported by the pore size, as bigger pore sizes, obtained by PEO removal due to its solubility in water, provided cells bridging instead of aligning upon single fibers [4].

By modulating the in-plane elasticity of an electrospun scaffold by means of Cu electrodes, orienting the electrospun fibers into orthogonal directions, adult stem cells adhesion and proliferation were obtained for cardiac tissue engineering, confirming material cytocompatibility. These types of fiber oriented scaffolds are particularly promising in the engineering of skeletal muscle tissues, ligaments, blood vessels and articular cartilages, where one prefers improved tissue organization and function [5, 6]. Studies reported on the successful implementation of electrospun (via nanospider technology) copolymer PA 6/12 scaffolds for limbal (LSC) and Mesenchymal Stem Cells (MSC) growth for treatment of ocular surface injuries. The cell morphology, proliferation and metabolic activity were reported as comparable with cells grown on plastic surfaces [7].

PCL scaffolds revealed to be suitable for trilaminar, cell growth for composite tissue engineering. The study discussed simultaneous culture of fibroblasts, keratinocytes and periosteal cells for bone, tissue and periosteum reconstruct. A drawback reported of the coculture was inability to provide temporary barrier between the cell layers until separate tissue type organization [8].

In this study PCL scaffolds were developed on the bases of studies reported previously [9], with the main focus on cell growth detection.

## 2 Materials and Methods

Polycaprolactone (PCL) was purchased from *Aldrich Chemistry*, with molecular weight Mn = 70 000-90 000. The polycaprolactone solution was prepared by 2 g of polymer dissolved in a solvent mixture of N, N dimethyl formamide and tetrahydrofuran with a volume ratio of 1:1. The PCL fibrous mats were produced by electrospinning on a high voltage electrospinning system NT-ESS-300, following the processing conditions of 1 ml/h, 15 cm and 12 kV, of volume flow rate, needle tip to collector distance and electrical voltage respectively. As spun PCL fibrous mats were dried in vacuum desiccators 48 h for residual solvent removal. The PCL morphology was delivered using a scanning electron microscope type: SEM-FE MIRA II LMU with Pd/Au sample coating preparation, 3 series for 180 sec. *Image J (NIH)* software was used for the fiber diameters and pores area measurement. The SEM photo micrographs of the cell cultured PCL scaffolds were obtained on a scanning electron microscope type ESEM Philips XL30 with no sample coating preparation.