Effect of topography and cellulose nanocrystals on micropatterned polymeric replicas

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Introduction: Cells make decisions on their responses depending on the stimuli relative to their surrounding environment. The extracellular matrix provides the necessary cues at micro and nano-scale for the cell adhesion, orientation/alignment, and proliferation. Furthermore, cells have the ability to sense the extracellular matrix (ECM) mechanics and spread via transcription regulator proteins. TAZ is characterised as a master regulator of cell–ECM interactions. Ultrafast pulsed laser irradiation is considered as a simple microfabrication method capable of producing anisotropy discontinuous topographical structures with control on geometry and pattern regularity [1, 2]. Soft lithography has been successfully used to transfer well-defined micro-sized patterns from silicon to polymeric [3, 4]. Cellulose nanomaterials (CN) based composites have emerged as promising materials in the field of Tissue Engineering and Regenerative Medicine due to their mechanical and chemical properties. The aim of this study is to investigate the effect of topography alongside the stiffness of the nanomaterials based composite replicas on cell morphology and osteogenic differentiation.

Experimental Methods: Replicas of polymers [Polycaprolactone (PCL) and their composites with Cellulose Nanocrystals (CNC)] have been successfully reproduced from the Si structures via soft lithography. Scanning Electron Microscopy (SEM) was performed for the morphological characterization of the polymeric replicas and their wetting profile was determined by contact angle. The degradation rate of the micropatterned replicas was also studied via SEM images, their weight loss as well as FTIR. The cell morphology, adhesion and differentiation of replicas of mouse Mesenchymal Stem Cells C57BL/6 were evaluated.

Results and Discussion: Cell mechanotransduction was analyzed via the cytoskeleton organization (shape), TAZ localization and cell nuclear profile on the replicas. The surface roughness had an effect on the MSCs morphology as shown in Figure 1. The chemical composition and degradation rate influenced cell responses.

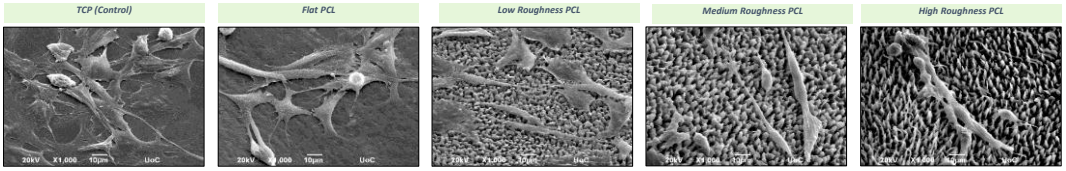

Figure 1: Scanning Electron Microscope (SEM) images of Mesenchymal Stem Cells (MSCs) on Polycaprolactone (PCL) scaffolds with four distinct topographies for 2 days of seeding.

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