PCL/graphene scaffolds fabricated by additive manufacturing for bone regeneration

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Scaffolds are important physical substrates for cell attachment, proliferation and differentiation. Multiple elements could influence the optimal design of scaffolds for a specific tissue, such as the geometry, the materials used to modulate cell proliferation and differentiation, its biodegradability and biocompatibility. Previous studies of human adipose-derived stem cells (hADSCs) seeded on poly(ε-caprolactone) (PCL)/graphene scaffolds have proved that the addition of small concentrations of graphene to PCL scaffolds have positive impact on stimulating cell proliferation [1,2]. In this research, biological assessments have been performed to further assess the biological performance of PCL/graphene scaffolds loaded with higher graphene concentration.

PCL (Capa 6500, Perstorp, Warrington, UK), a biocompatible, biodegradable synthetic polymer, was used as the base material for scaffold fabrication. Different concentrations of graphene nanosheets (0.78, 2, 3 and 5 wt.%) were mixed with PCL through melt blending process, as previously reported [1]. An extrusion-based additive biomanufacturing system (3DDiscovery, RegenHU, Villaz-St-Pierre, Switzerland) was used in this work to fabricate scaffolds with 0°/90° lay-down pattern, allowing high reproducibility and good control over scaffold topology.

HADSCs were used for cell viability/proliferation tests. Around 50,000 cells were seeded to each scaffold sample, and Alamar Blue assay (also termed Resazurin assay) was used to assess cell viability/proliferation rate at 1, 3, 7, and 14 days. Samples cultured up to 14 days were fixed to further assess cell morphology and qualitative attachment by laser confocal microscopy.

Cell viability/proliferation results on both PCL and PCL/graphene scaffolds are shown in Figure 1 in terms of fluorescence intensity. Results suggest all scaffolds could provide a proper environment to support the proliferation of hADSCs. The biological performance improves by increasing the graphene concentration. Figure 2 represents the cell morphology and attachment ststus on scaffold surface.

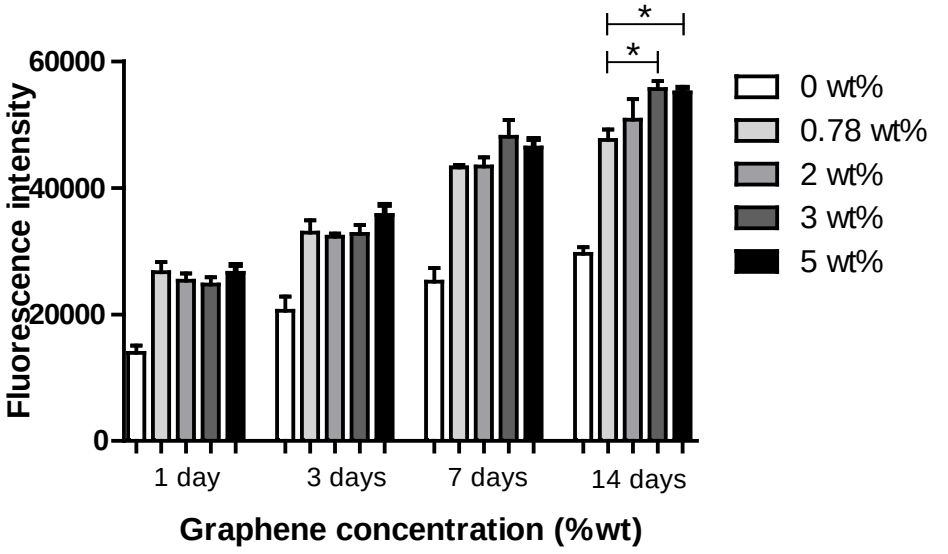

Figure 1: Cell viability/proliferation test result

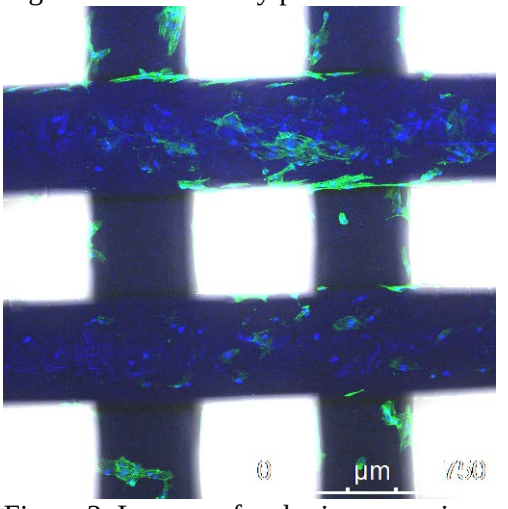

Figure 2: Laser confocal microscope image of cell seeded scaffold

References: (Single space, 10 points, AIP style, left-justified in numbered order**)**

[1] Wang, W., Caetano, G. F., Chiang, W. H., Braz, A. L., Blaker, J. J., Frade, M. A. C., & Bartolo, P. J. D. S. (2016). Morphological, mechanical and biological assessment of PCL/pristine graphene scaffolds for bone regeneration. International Journal of Bioprinting, 2(2), 204-213.

[2] Wang, W., Caetano, G., Ambler, W. S., Blaker, J. J., Frade, M. A., Mandal, P., ... & Bártolo, P. (2016). Enhancing the hydrophilicity and cell attachment of 3D printed pcl/graphene scaffolds for bone tissue engineering. Materials, 9(12), 992

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