PLLA SCAFFOLD WITH GRADIENT PORE SIZE IN MICROPHYSIOLOGICAL TISSUE SYSTEM BIOREACTOR FOR OSTEOCHONDRAL REGENERATION

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Cartilage and bone tissues in the joints are intimately linked and form the osteochondral unit. A better understanding of disease and regenerative processes of bone and cartilage requires the simultaneous investigation of both tissues together, as part of the osteochondral unit to account for their mutual interactions. However, the production of scaffolds for osteochondral tissue regeneration is a challenging task, as scaffolds must mimic the differents morphologies of cartilage and bone[1].

Thermally Induced Phase Separation (TIPS) is one of the most adaptable techniques to produce porous scaffold for Tissue Engineering applications. A wide range of morphologies in terms of pore size and distribution can be obtained by tuning TIPS processing parameters, primarily thermal history[2]. In this work we used TIPS to produce scaffolds for osteochondral tissue engineering with a pore size gradient along the sample thickness. The average pore dimension on one side of the sample was about 70 micron and increased steadily until it reached about 220 micron on the opposite surface.

These scaffolds were tested in a microphysiological tissue system bioreactor. Consisting of a dual chamber system to maintain separate chondrogenic/osteogenic specific differentiation media. A removable insert hosted the scaffold seeded with human bone marrow-derived mesenchymal stem cells. The insert with the pore gradient scaffold was positioned so as to accomodate the “small pore” side was in the chondrogenic medium chamber and the “large pore” size was in the osteogenic medium chamber. An O-ring around the insert ensured the separation of the media streams in the dual chamber system[3]. This setup provides separate tissue-specific growth media for the cartilaginous/osseous differentiation of MSCs in the osteochondral scaffold. Preliminary tests showed a good efficiency of cell seeding and growth, and the bioreactor with the TIPS scaffold allows to reproduce the physiological conditions to better mimicking osteochondral tissues.

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