Polymer-based Nano/microfibers for Hard Tissue Engineering Applications

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Polymers, both natural and synthetic ones, have found a wide range of applications in the last decades. They are mostly used as biomaterials, which have the aim of tissue regeneration, as they can serve as scaffolds/support for cells during their growth and replace the function of the damaged tissue until a neo-tissue is formed. Dependant on the aim of application, these polymeric scaffolds undergo certain fabrication techniques such as foaming, freeze-drying, 3D printing and electrospinning. Electrospining is a technique that produces various nano/microfibers by means of a high voltage. This work, focuses on preparation of electrospun biodegradable nano/microfibers for hard tissue engineering purposes such as bone and meniscus tissue. In a previous study, a microbial polyester, poly(3-hydroxybutyrate-co-3- hydroxyvalerate) (PHBV) blended with lactide-based polymers were electrospun into fibrous scaffolds for bone tissue engineering use. Process parameters were optimized (Fig. 1A) and the influence of fiber diameter on cell performance was studied. In vitro studies with human osteosarcoma cells revealed that electrospun scaffolds promote cell growth and penetration (Fig. 1B). To increase surface hydropfilicity, surface was modified with oxygen plasma treatment which improved the cell proliferation rates. Consequently, all scaffolds prepared by electrospinning revealed a significant potential for use in bone tissue engineering applications; PHBV-PLLA blend appeared to yield the best results [1]. In another study, collagen type I isolated from rat tails, was used as a support to mimic the 3D structure of a meniscus tissue. Coll-PLGA blend increased the mechanical properties of the fibrous mesh, which was incorporated inside a 3D multilayered structure (Figs. 1C and 1D) [2]. The last research shows electrospun polyethylene terephthalate (PET), recycled from pastic bottles, to be studied for its antibacterial properties due to zeolite incorporation inside the fibrous structure.

References

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Figures

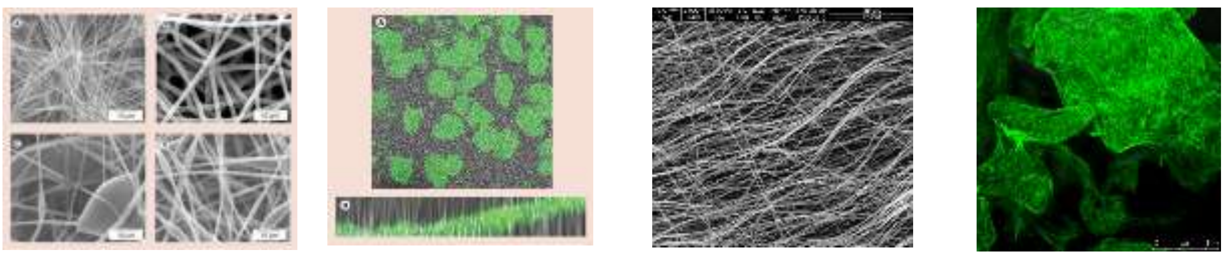

Figure 1. (A) PHBV-lactide based fibers; (B) Interaction of SaOs-2 cells with fibers; (3) Coll-PLGA nanofibers; (4) Interaction of human meniscus cells with collagen-based 3D structure (from left to right).