3D electrospun PET nano-fibrous mats with plasma-polymer coating for vascular graft applications

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In tissue engineering of vascular grafts, scaffolds that simulate the mechanical and morphological properties of the extracellular matrix beneath endothelial cells and that possess similar 3D nanofibrous structure are required. This inspired the idea to generate 3D nano-fibrous electrospun mats as substrates with similar compliance and morphology [1]. In addition, since the formation of a complete and stable endothelium is required to prevent thrombus formation inside small diameter vascular prostheses, a suitable surface treatment is needed to provide the requisite strong cell-adhesion. Here, functionalization by cold plasma appeared to be ideal [2]. The abovementioned substrates were prepared from poly(ethylene terephthalate) (PET) by electrospinning, then coated with a thin plasma polymer film prepared from mixtures of ethylene (C2H4) and ammonia (NH3). The surface chemistry, morphology, and mechanical properties of optimized mats were characterized using XPS, SEM, Mercury Intrusion Porosimetry, and tensile tests. The functionalized substrates were then seeded with human umbilical cord vascular endothelial cells (HUVEC) to evaluate *in vitro* cell-adhesion. XPS measurements confirm the presence of plasmadeposited nitrogen-(N)-rich coating on the substrates and show that N concentration decreases with increasing depth into the (ca. 90 μm-thick) mat. This reveals that plasma species penetrate deep inside the porous structure. SEM micrographs show a randomly interconnected open structure of fibers with smooth morphology, even after plasma coating. The average nanofiber diameters were ca. 521 nm and 565 nm for untreated and plasma-coated mats, respectively. The overall porosity was 87 %, ideal for the envisaged application, and it did not change significantly after coating. The tensile strain was reduced somewhat after coating, as expected, but the tensile stress was raised and coated mats appeared somewhat stiffer. *In vitro* experiments show that plasma-coated electrospun mats promote HUVEC adhesion. In summary, nanofibrous plasmacoated PET mats can provide scaffolds with suitable morphological, mechanical and biocompatible properties adapted for cell-adhesion and vascular graft applications.

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