Atmospheric pressure non-equilibrium plasma for the production of composite materials

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In the evolving field of tissue engineering, continuous advances are required to improve scaffold design and fabrication to obtain biomimetic supports for cell adhesion, proliferation, penetration and differentiation. Both electrospun fibrous scaffolds and hydrogels are used in this field since they well reproduce the structure of the extracellular matrix (ECM) of many biological tissues. Limitations of these two types of materials can be overcome through their combination, by developing composite structures combining enhanced mechanical properties (provided by the fibrous components) and improved cell penetration (provided by the gel phase) in a superior ability to mimic natural ECM that is constituted by both a fibrous protein network and a hydrogel matrix. Here we develop new composite materials made of electrospun PLLA scaffolds and poly(amidoamine) hydrogels with different degrees of crosslinking. To promote compatibilization and good adhesion between the two materials, surface chemical reactions between hydrogels and PLLA mats are induced by inserting amino functional groups on electrospun PLLA mats by means of atmospheric pressure non-thermal plasma. Results will be presented concerning the exposure of PLLA substrates to the plasma region generated by a Dielectric Barrier Discharge at atmospheric pressure, driven by a HV Amplifier connected to a function generator operating with a microsecond rise time and operated in N2. Surface and solid-state thermo-mechanical characterizations of plasma treated substrates and of resulting composite materials at different crosslinking degrees are presented. Results of mechanical tests show a high adhesion between hydrogel and plasma treated PLLA electrospun mats, underlining the opportunity to use atmospheric non-thermal plasmas to fabricate a composite starting from two materials otherwise physically incompatible. Potential effects of nanofibrous-hydrogel were evaluated by investigating pluripotent stem cells response.

Keywords
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