Plasma deposited Poly Lactic Acid- like films containing elastin by means of an aerosol assisted DBD

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The ability to impart desirable mechanical, physical and chemical properties makes natural and synthetic polymers well-suited for biomedical purposes. The main obstacle in engineering optimal biomaterials is to match and to align the required properties in shape and composition using one specific material or strategy. As an example, biocompatible synthetic polymers (*e.g.* PLA, PCL, etc.) lack of specific binding sites for cells attachment and tissue regeneration and therefore several approaches have been developed to introduce bio-related functionalities. Among these, elastin-based materials are becoming popular thanks to the remarkable biomechanical and biological properties of elastin in cellular activity [1]. Various technologies for surface modification, including physical adsorption and dry low pressure (LP) plasmas [2, 3], have been tested to bind peptides or proteins to the material surface. Nonthermal plasmas at atmospheric pressure (AP) can represent a feasible alternative approach with some advantage over low pressure plasmas [4]. An expensive and time consuming vacuum system is not necessary and the technology has the ability to be scaled-up and integrated in inline processes.

Our approach consists in a one-step immobilization process in an atmospheric pressure plasma. In this process, elastin is dissolved in a water solution of lactic acid (LA) used as the precursor for the coating. The system for coating deposition consists of a parallel plate dielectric barrier discharge coupled with an atomizer for the LA/elastin aerosol generation. The liquid precursor acts as a protective shell for the biomolecules preserving its structure and functionalities from the plasma active species [5]. The effect of the aerosol amount in the gas feed was found to be the key parameter influencing the retention of the monomer chemical structure in the coating, i.e. the highest content of carboxylic (and/or ester) groups directly involved in the (bio)degradation process is obtained at high aerosol concentration. The aim of the work was also to combine the (bio)degradation properties of the organic matrix with bioactivity promoted by the presence of elastin, which is able to interact with polar functionalities of the growing coating thanks to its hydrophilic domain. Several complementary surface analysis techniques, e.g. ATR-FTIR, XPS and UV-VIS, were used to investigate the chemical composition of the deposited films. When the highest elastin concentration is used during coating deposition, the protein is clearly embedded in the PLAlike film. Amino and amide functionalities (found in both ATR-FTIR and XPS measurements) are in fact ascribed to the presence of the protein since the PLA-like film deposited without elastin is nitrogen free.

References

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