Development of multilayered chitosan-based nanofibers for tissue engineering

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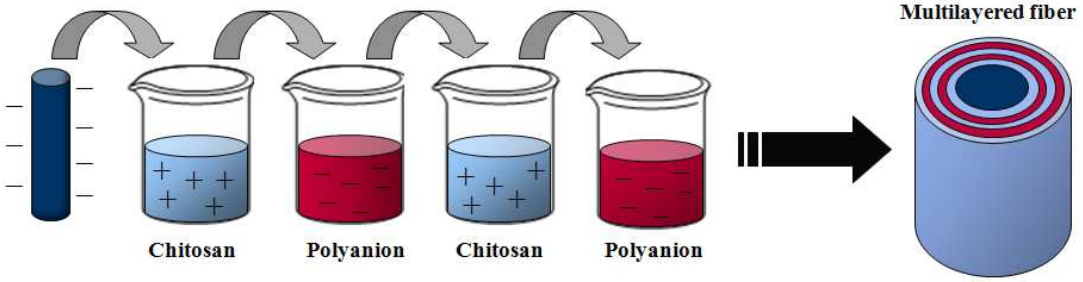
By combining electrospinning and layer-by-layer deposition techniques, new porous material scaffolds of multilayered, chitosan-based nanofibers were produced.

Layer-by-layer (LBL) is a well-known method for surface coating, based on electrostatic interactions [(1)]. It enables the controllable deposition of a variety of polyelectrolytes including synthetic and natural materials, with designable layer structure, defined layer thickness and size [(2)]. Electrospinning (ESP) allows the fabrication of polymer fibers ranging from nanometers to a few microns in diameter, depending on the polymer characteristics (a.o. molecular weight, solution viscosity and conductivity) and processing conditions (electric potential, distance between syringe-capillary and collection plate, concentration, flow rate) [(3,4)]. Mats of nanofibers produced by ESP display a very large surface area-to-volume ratio and high porosity with very small pore size. The nanometric scale of electrospun fibers also proves a positive effect on cellular growth, as fiber mats mimic extracellular matrix structure [(4)].

The association of these two techniques with the use of biocompatible and biodegradable polymers such as chitosan, gives outstanding prospects in the field of biomedical applications, especially for the preparation of wound dressings, artificial skin or tissue engineering scaffolds.

In the present study [(5)], a charged copolymer, poly(methylmethacrylate-block-methacrylic acid), was added to a poly(ε-caprolactone) or poly(D,L-lactide) solution before electrospinning in order to prepare surface charged nanofibers. Oppositely charged polyelectrolytes – chitosan and poly(styrene sulfonate) or hyaluronic acid – were then alternately deposited on these aliphatic polyester fiber "cores" using LBL method. The aliphatic polyester core was also removed selectively to confirm the growth of a multilayered shell, obtaining hollow fibers.



Scheme of the layer-by-layer process

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