Preparation of multilayered chitosan-based nanofibers by combination of electrospinning and layer-by-layer deposition techniques

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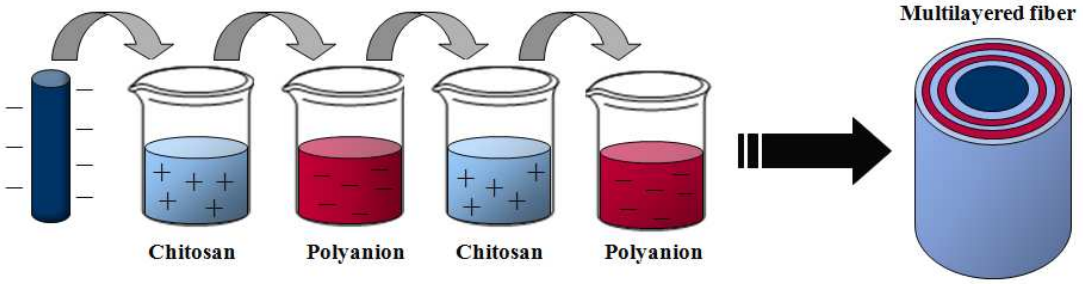
By combining electrospinning technique and layer-by-layer deposition, we produced a new material made of multilayered, chitosan-based nanofibers.

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 polyions including synthetic and natural materials, with designable layer structure, defined wall thickness and size [(2)].

Electrospinning (ESP) technique 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)]. 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 fibers mats mimic extracellular matrix structure [(3)].

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, 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 obtain charges on fibers surface. 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 existence of a multilayered shell, obtaining hollow fibers.



Scheme of the layer-by-layer process

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