Multilayered chitosan-based nanofibers with antibacterial properties

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A new material made of multilayered, chitosan-based nanofibers was produced by combining electrospinning technique and layer-by-layer deposition.

Layer-by-layer (LBL) is a well-known method for surface coating, based on electrostatic interactions [(1)]. LBL enables the controlled deposition of a variety of polyions including synthetic and natural materials, as well as proteins, inorganic species or nanoparticles, with defined layer structure and thickness at nanometric scale [(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) [(3,4)]. 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 fibers 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 was added to a poly(ε-caprolactone) or poly(D,L-lactide) solution before electrospinning in order to obtain charges on fibers surface. Polyelectrolytes – whereof chitosan – were then deposited on these aliphatic polyester fiber "cores" using LBL method. The antibacterial properties of the obtained material were then assessed, and the presence of a multilayered deposit was confirmed by several techniques.

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