AFPM
Advanced Functional Polymers for Medicine 2011
June 15th - 17th, 2011
University of Twente, Enschede
The Netherlands

TITLE: Multilayered chitosan-based nanofibers for wound dressing application

AUTHORS AND CO-AUTHORS: F. Croisier, C.Detrembleur and C. Jérôme
Center for Education and Research on Macromolecules, University of Liège, B-4000, Liège, Belgium.
fcroisier@ulg.ac.be

INTRODUCTION: Chitosan is a natural polymer that intrinsically presents haemostatic, mucoadhesive, antimicrobial and immunostimulant properties. This polysaccharide has shown a great potential for biomedical applications, on account of its remarkable compatibility with physiological medium and its biodegradability. In this respect, nanometric fibers are highly interesting as their assembly mimics the skin extracellular matrix structure. Such nanofibrous materials can be prepared by electrospinning (ESP) and can be used as potential scaffolds, a.o. to form a temporary, artificial extracellular matrix.
In the present study, electrospinning technique was combined with layer-by-layer deposition method (LBL) – a well-known method for surface coating, based on electrostatic interactions – in order to prepare multilayered chitosan-based nanofibers for wound dressing application.

EXPERIMENTAL: Electrospinning of aliphatic polyesters (poly(ε-caprolactone) and poly(D,L-lactide)) was conducted in presence of a charged copolymer (ratio homopolymer:copolymer = 9:1), in order to obtain charged nanofibers. Two copolymers were tested: the poly(methyl methacrylate-*b*-methacrylic acid) and the poly(εCL-*b*-γdimethylamineεCL), which possesses the advantage of being fully degradable. Layer-by-layer deposition (LBL) of poly(electrolytes), whereof chitosan and hyaluronic acid, was then realized on the charged fibers. Fibers were characterized at each step of the process.

RESULT AND DISCUSSION: Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) were used to characterize fibers morphology. Magnetite nanoparticles allowed revealing the presence of negative charges (in the case of the methacrylic acid copolymer) on fiber surface, and chitosan deposition was followed by quartz crystal microbalance (QCM-d). An alternation of the zeta potential of the fiber surface was observed during the construction of a multilayered shell. Fiber core of multilayered fibers was then selectively removed by dipping the fiber in chloroform and hollow nanofibers were obtained. Antibacterial activity and cell compatibility (keratinocytes) of chitosan-based fiber mats were then successfully assessed.

CONCLUSIONS: A novel material made of multilayered chitosan-based nanofibers was prepared, and showed promising prospects in the field of cutaneous regeneration.

REFERENCES:
1) A. Formhals, *US Patent 2187306*, 1940.
2) S. Ramakrishna, K. Fujihara, W.E. Teo, C.T. Lim and Z. Ma, *« An indroduction to electrospinning and nanofibers »*, Singapore, World Scientific Publishing Co. Pte. Ltd., 2005.
3) G. Decher, *Science*, 1997, 277, 1232.

ACKNOWLEDGEMENTS: F.C. is grateful to the Belgian « Fonds pour la Formation à la Recherche dans l'Industrie et dans l'Agriculture » (FRIA) for financial support. This work has been supported by the Science Policy Office of the Belgian Federal Government (BELSPO - IAP 6/27).