ELECTROSPINNING AS A FINE TECHNIQUE TO OBTAIN VARIOUS MATERIAL STRUCTURES OF BIO-MEDICAL-PURPOSE POLYURETHANES AND POLYCARBONATES COPOLYMERS

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Introduction

Fabrics, films or mixed structures (specific composites) can be produced on electrospinning unit. This multipurpose-technique has been attracted of scientific attention. The less cost of fabrication nano- scale of fibrous materials and electrosprayed film are main advantages of electrospinning. Electrospun fabrics have found wide-spread use in the biomedical field as carriers in drug delivery system, as scaffolds for cell growth purpose, as materials for wound dressing [1-3].

Among the medical-use polymers, the polyurethane (PU) and its copolymers with carbonates and the carbonates copolymers with silicone (PCS) might be performed on electrospinning unit with a well effect. Their attractive mechanical properties and biocompatibility were found place in wide range of biomedical items, such as heart valves, vascular prostheses, and special coatings [4]. Some of these application demand of the multifunctional materials in which one side of the element should be biocompatible and non-adhesive for cells and other side partially degradable with drug release system. These kinds of materials can be obtained on electrospinning unit. Herein, is described the results of preliminary investigations on copolyurethanes non-woven matts obtained via electrospinning and with use more complexed electrospinning-electrospray method.

Materials and Methods

The two types of copolymers were used: Chronoflex Ar 22%(polyurethane-co-carbonate)(PU) and Chronosil AL80A5%(polycarbonate-co-silicone) (PUS) manufa-ctured by AdvanSource. All materials were dissolved in DMAc at concentrations 8% (electrospray purpose) and 18% (electrospinning purpose). The obtained solution was performed at electrospinning unit model NEW-BM (Nabond). The parameters of processing were optimized and finally the best results were obtained for: flow rate of solution, distance between electrodes, the power supply voltage drum collector, needle) humidity. The fibrous materials were obtained using constant parameters during whole process. In contrast the materials formed by combined electrospraying /electrospinning method were obtained with the variable parameters of this process and different weight ratio formed fibres to spray. The morphology of materials was characterized mainly with scanning electron microscopy observation.

Results and Discussion

The conducted experiments revealed that both of copolymers were easily electrospun to the fibrous structures (FIG. 1A). These structures were obtained on various kind of collectors such as solid metal drum, and drum equipped with perforated metal coat (grating). The both of fabrics characterized gradient of fibres compaction which decreased with increasing fabric thickness. The observed phenomena were promising for next experiment in which the PU fabric during electrospinning process were sealed by electrosprayed PCS copolymer. At the first stage of material production, the electrospray of PCS copolymer was mostly performed and the fibres of PU were in minor ratio. At The second stage of process, the PCS electrospray was in the minor compare to PU fibres. The obtained final fibrous sleeve presented two-layer structure, solid in the inner layer and porous outer (FIG. 1B). This results of preliminary investigations show opportunity to form implants of blood vessels, which should present just such a two-layer structure where inner sealed and impermeable, outer porous. The both layers must have a low cells adhesion. The FIG. 1C presents SEM micrograms with zoom of outer layer.

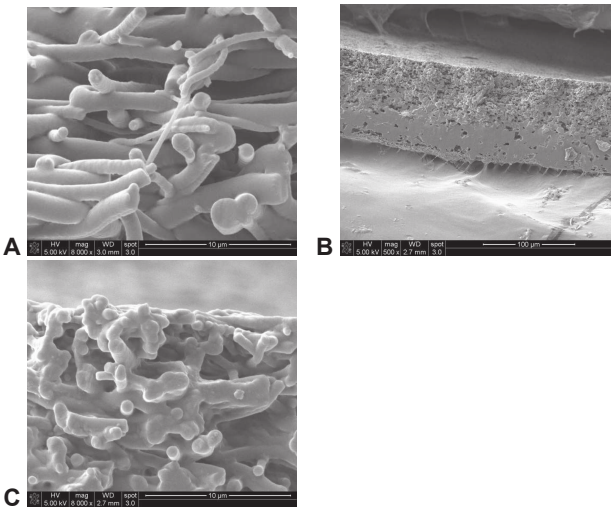

FIG. 1. The SEM micrograms of electrospun and electrosprayed PU and PCS copolymer materials. A) electrospun fabric of PU, B) PU and PCS copolymes materials obtained by mixed method C) the outer porous layer of PU fabric with partially sealed pores formed by electrosprayed PCS.

Conclusions

This previous investigation show opportunity of electrospinning unit and the direction of future experiment. The obtained structure surface will be improved by addition low amount of biodegradable materials fibres. This additive might be a drug delivery system which will work only in possessed direction and controlled time.

Acknowledgments

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