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THE EFFECT OF POLARITY ON BIOMIMETIC SURFACE MODIFICATION OF PCL/CHITOSAN NANOFIBERS FORMED BY ELECTROSPINNING

O.Urbanek[1], P.Sajkiewicz[1]

[1] *Polymer Physics Laboratory, Institute of Fundamental Technological Research, Polish Academy of Sciences, A. Pawińskiego 5b St, 02-106 Warsaw, Poland*
corresponding author: ourbanek@ippt.pan.pl

Abstract

The processing of polyelectrolytes using electrospinning technique is difficult due to accumulation of charges in the polymer solution. It leads to the instability of the stream due to the large repulsion forces in the polymer jet [1]. Moreover, the polarity applied to the spinning nozzle may influence on fibers surface chemistry [2]. Chitosan is an example of polyelectrolyte, semi-crystalline polysaccharide, which is commonly used in biomedical applications. The positive charge of D – glucosamine residues in chitosan amino groups explains the majority of the material properties. The amino groups are responsible for the formation of polycations, which subsequently form compounds with natural and synthetic anions [3].

The aim of the research was to investigate the effect of the polarity applied to the spinning nozzle on the spinnability, concentration of the amino groups on the fibers surface and its further surface modification with chondroitin sulfate (CS). For this research chitosan/ polycaprolactone (PCL) nanofibers with 5-25% w/w of chitosan were formed by electrospinning technique. This process was followed by a surface modification with chondroitin sulfate using layer-by-layer strategy to create polyelectrolyte complexes. The electrospinning was performed either at the positive or at the negative voltage applied to the spinning nozzle. The introduction of synthetic polymer molecules into the solution decreases the interactions between the chitosan chains, reduces solution viscosity and improves mechanical properties. The contact angle measurements showed that negative polarity significantly improved wettability of nonwovens prepared with 5% and 10% w/w of chitosan in the polymer blend. Contact angle measurements proved that surface modification were carried out successfully. Additional increase of wettability was observed after surface modification with CS for all samples being investigated. SEM images analysis indicates the effect of polarity fiber diameter. DSC analysis showed that only samples with 25% w/w of chitosan demonstrated decrease of PCL crystallinity compared to pure PCL. There was no correlation between PCL crystallinity and the polarity applied to the needle.

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