World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:14, No:10, 2020

The Impact of Electrospinning Parameters on Surface Morphology and Chemistry of PHBV Fibers

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Abstract : Electrospinning is one of the commonly used methods to produce micro- or nano-fibers. The properties of electrospun fibers allow them to be used to produce tissue scaffolds, biodegradable bandages, or purification membranes. The morphology of the obtained fibers depends on the composition of the polymer solution as well as the processing parameters. Interesting properties such as high fiber porosity can be achieved by changing humidity during electrospinning. Moreover, by changing voltage polarity in electrospinning, we are able to alternate functional groups at the surface of fibers. In this study, electrospun fibers were made of natural, thermoplastic polyester – PHBV (poly(3-hydroxybutyric acid-co-3-hydrovaleric acid). The fibrous mats were obtained using both positive and negative voltage polarities, and their surface was characterized using X-ray photoelectron spectroscopy (XPS, Ulvac-Phi, Chigasaki, Japan). Furthermore, the effect of the humidity on surface morphology was investigated using scanning electron microscopy (SEM, Merlin Gemini II, Zeiss, Germany). Electrospun PHBV fibers produced with positive and negative voltage polarity had similar morphology and the average fiber diameter, 2.47 ± 0.21 µm and 2.44 ± 0.15 µm, respectively. The change of the voltage polarity had a significant impact on the reorientation of the carbonyl groups what consequently changed the surface potential of the electrospun PHBV fibers. The increase of humidity during electrospinning causes porosity in the surface structure of the fibers. In conclusion, we showed within our studies that the process parameters such as humidity and voltage polarity have a great influence on fiber morphology and chemistry, changing their functionality. Surface properties of polymer fiber have a significant impact on cell integration and attachment, which is very important in tissue engineering. The possibility of changing surface porosity allows the use of fibers in various tissue engineering and drug delivery systems. Acknowledgment: This study was conducted within 'Nanofiber-based sponges for atopic skin treatment' project., carried out within the First TEAM programme of the Foundation for Polish Science co-financed by the European Union under the European Regional Development Fund, project no POIR.04.04.00-00- 4571/18-00.

Keywords : cells integration, electrospun fiber, PHBV, surface characterization
Conference Title : ICAMME 2020 : International Conference on Advanced Materials, Microscopy and Energy
Conference Location : New York, United States
Conference Dates : October 08-09, 2020