Polish-Israeli Conference on Electrospinning and Tissue Engineering

Programme and Abstracts

04 - 05 October 2018
Warsaw, Poland

Organizers

Laboratory of Polymers & Biomaterials at Institute of Fundamental Technological Research Polish Academy of Sciences (IPPT PAN) based on the fundamental knowledge in the area of polymer physics, materials science, chemistry and biotechnology, focuses its recent activity on biomaterials for tissue engineering. Great part of our activity is related to polymeric biodegradable scaffolds, mostly formed by electrospinning as nanofibrous structures, both for tissue regeneration and materials for controlled drug release.

Nano Engineering Group at Technion Israel Institute of Technology is focused on research in the field of molecular engineering of soft matter. The particular activities are related to the electrospinning including optimization of the parameters of the process, deep understanding of the fundamental physical facets of electrospinning as well as designing a composite materials for tissue engineering applications.

Objectives

The goal of PICETE conference is to bring together experts from around the world in order to exchange their knowledge, experience and research innovation in the basics of the electrospinning and the broad area of biomedical materials covering topics related to designing, fabrication, characterisation and tissue engineering applications.

The conference will include the following topics:

- Fundaments of electrospinning
- Optimization of electrospinning
- Properties of electrospun nanofibers
- Functionalization of electrospun nanofibers
- Electrospun nanofibers as scaffolds for tissue engineering/drug delivery systems
- Current trends in designing of polymeric biomaterials for tissue engineering/drug delivery systems

Core-shell fibers, geometrical stability

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Abstract

In recent decades, we may observe high scientific and practical interest in studies on physical properties under confinement, which, with decrease in size, manifest as deviations in the behavior as observed in bulk. One type of confined systems, fibers, characterized by quasi one-dimensional geometry are, so far, least studied.

Coaxial electrospinning proves as very convenient and prospective technique for fabrication of the quasi one-dimensional geometry model system, enabling encapsulation of a model substance for studies of confinement effects. Studies were performed using liquid oligomer polyethylene glycol (PEG, Mn= 400 g/mol) encapsulated in atactic polystyrene (PS) fibers. Studies on the phase transitions of encapsulated PEG by differential scanning calorimetry (DSC) revealed deviations from behavior as observed in the bulk. Firstly, the deviations seem to have geometrical origin, which was described using Avrami formalism and nucleation theory as proposed by Turnbull and Fisher. According to the approach, crystallization in micrometer fibers starts from heterogeneous nucleation with three-dimensional crystal growth - as in bulk - but changes to two and further to one-dimensional, terminated by rapid homogeneous nucleation and three-dimensional growth of tiny crystals. Secondly, deviations in the crystallization kinetics and thermodynamic parameters are observed with decrease in fiber size (fiber cross-section). Post-spinning thermal treatment of fibers, which is performed at elevated temperatures, in vicinity of Tg of fiber shell polymer (PS) leads to change in fiber cross-section area [1]. This property of the fibers was applied in order to systematically study the fiber size effect on the phase transitions. Electro-spun core-shell fibers were annealed at 80 ^{o}C in vacuum oven for various time. Using DSC, it was observed, as expected, a systematic shift of crystallization thermal effects towards lower temperatures (Fig.1a), due to decrease in crystallization rate (Fig.1b), which was accompanied by systematic changes in the melting temperature (Fig.1c). As revealed by scanning electron microscopy (SEM) analysis, the area of fiber cross-section changed from 20 μm^2, for fibers as spun, to 10 μm^2, for fibers annealed for 65 hours. The latter sample showed no crystallization, no melting, only glass transition (bottom DSC scans in Fig.1a and c), indicating complete inability for crystallization of the encapsulated oligomer. However, unexpectedly, systematic, thorough and detailed analysis of SEM images of other samples annealed for shorter times, did not reflect systematic changes in crystallization kinetics, as observed by DSC. Fig.1d shows for these fibers values of the area of fiber cross-section scattered in quite broad range, what indicates that they cannot be considered as reliable. The reason for this seems to be connected with geometrical instability of the fiber cross-section, what requires further studies.

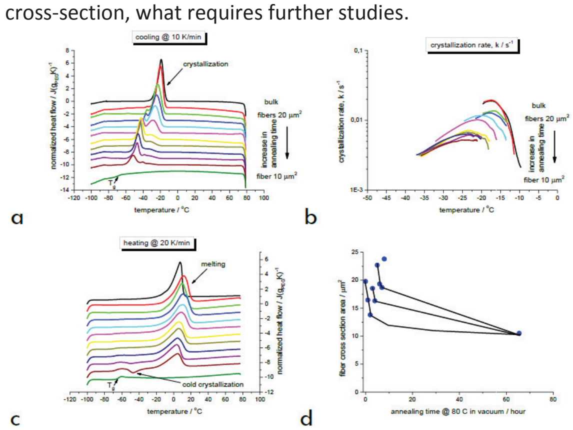

Fig 1. a) DSC cooling scans (crystallization), b) crystallization rate, c) DSC heating scans (melting) of oligomer PEG encapsulated in PS fibers annealed for various time at 80 ^{o}C in vacuum and d) average area of fiber cross-section as determined from SEM images.

References

1. A. Gradys, Geometrical effects during crystallization under confinement in electrospun core-shell fibers. DSC study of crystallization kinetics, Polymer, 108 (2017) 383.

Acknowledgments

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Biography

I am assistant professor in Laboratory of Polymers and Biomaterials. An experimental scientist inclined towards fundamental studies in the field of polymer physics. From the beginning of the adventure with polymer physics in 2000 focused on phase transitions, their kinetics and polymorphism. Currently focused on properties of electrospun polymer fibers, especially, on confinement effects, as well as new approach using polarized light for studying behavior of oriented systems.

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