Polish-Israeli Conference on Electrospinning and Tissue Engineering

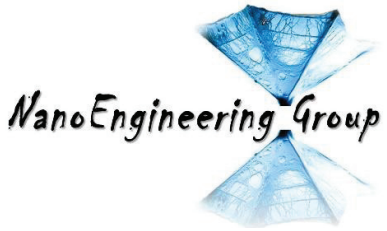
Programme and Abstracts

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

The effect of chemical composition on crosslinking kinetics of methylcellulose/agarose hydrogel

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Abstract

Injectable thermosensitive hydrogels are investigated as scaffolds for tissue engineering applications. They are inserted into the body using minimally invasive way thorough injection, and crosslink within injured tissue providing complete filling of the lesion and effective delivery of therapeutics [1].

Methylcellulose (MC) and methylcellulose/agarose (MC/AGAR) systems were investigated. In this study the kinetics of cross-linking, mechanical properties as well as the heat effects of MC and MC/AGAR were determined. These studies allow to obtain an optimal chemical composition for tissue engineering applications. The crosslinking is the result of hydrophobic bonds formation which is the part of physical crosslinking. The mechanism consists of 2 steps: the 1st is present at 37°C in which hydrophobic domains are formed and organized into 3-D network, the 2nd appears near 60°C degree in which water is took from the solution and entrapped inside the network cells, resulting in enlargement of these cells and increase of materials mechanical properties [2, 3, 4].

The agarose addition is important for MC crosslinking due to greater affinity to water resulting in faster crosslinking of MC. Additionally, agarose chains react with MC chains that increase the mechanical properties of MC/AGAR systems [5, 6].

The cross-linking kinetics of MC and MC/AGAR aqueous solutions were carried out by dynamic mechanical analysis (DMA) at the physiological temperature and under isothermal conditions. The time dependence of the storage modulus (G') was determined and parameters of cross-linking were established as the time position and the height of the maximum of the time derivative of G' (Figure 1.a). After numerical analysis including integration the final modulus of hydrogels was estimated (Figure 1.b), which is crucial from the practical perspective.

Another investigations were focused on heat effects from MC. Measurements were carried out the conditions of constant heating rate 0,5 K/min, in the temperature range 19-70°C using hermetic pans in order to prevent water evaporation.

All of the heat effects comes from MC and are endothermic, all of the heat flows were normalized to MC weight. The Figure 1 c and d present respectively the thermal effects and crosslinking heats from MC aqueous solution. All of the curves show multiple effect- the 1st peak represents the 1st stage of crosslinking (which is shifted toward higher temperature values), the 2nd represents the 2nd stage of crosslinking that according to the literature appears above 60°C [2, 4].

Image

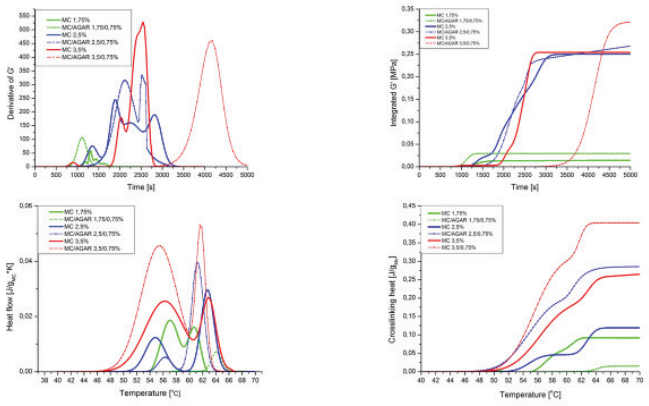

Fig. 1. DMA (a, b) and DSC (c, d) results for MC and MC/AGAR at various concentrations: a) time derivative of the G' at 37 ºC, b) G' vs. time at 37 ºC, c) thermal effects of MC, d) Crosslinking heat of MC and MC/AGAR.

Conclusions

The higher concentration of MC results in faster crosslinking and higher final G'.DMA measurements show that addition of AGAR to MC influences the cross-linking kinetics and increases the final hydrogel stiffness.

DSC results prove 2-stage character of the crosslinking of MC and show that, lower concentrations of MC results in decreased thermal effects, while the higher concentrations of MC show amplified thermal effects of MC.

References

1. Lis A. et al., Polim. Med. 43:302-312, 2013.
2. Nasatto P. L et al. Polymers, 7(5), 777-803, 2015.
3. Kobayashi K et al. Macromolecules, 32(21), 7070-7077, 1999
4. Joshi S et al. J Appl Polym Sci, 101(3), 1620-1629, 2006.
5. Martin B C et al. J. Neural Eng. 5:221, 2008.
6. Rivet C J et al. Biomatter; 5:e1005527, 2015

Biography

Research interest: Hydrogels, polymers, tissue engineering, biomaterials

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