ELASTIC, ELECTRICALLY CONDUCTIVE, CYTOCOMPATIBLE AND BIOPRINTABLE COMPOSITES

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Introduction

Elastic materials which are electrically conductive and, at the same time – cytocompatible and formable through 3D printing techniques are of great interest in the today's medicine [1]. First of all, such materials can be used to fabricate wearable sensors for real-life monitoring of biological signals [2,3]. Second of all, they can be used in designing new type of *in vitro* culturing chambers that introduce exogenous signals (such as electrical stimulation, ES) to produce desired cellular response. As numerous studies suggest, exogenous ES can stimulate synthesis and maturation of the extracellular matrix, enhance proliferation and maturation of cells, or even induce differentiation of stem cells into certain lineages [4-8].

As such, it seems that designing novel types of electrically conductive, cytocompatible, easily formable materials is of great importance. Specifically, designing novel ES stimulation chambers which combine an ease of use with the ability to benefit from the specifically designed, biofunctional scaffolds, seems like a stepping stone in the progress of tissue engineering. This is true especially for the tissues with low regenerative potential – muscle tissue (including heart) and neural tissue.

The aim of this study was to optimize the composition and the fabrication procedure for the obtainment of electrically conductive, cytocompatible and bioprintable elastic materials.

Materials and Methods

2-component polydimethylsiloxane (PDMS) was purchased from Dow-Corning, 2 types of mutli-walled carbon nanotubes (CNTs): 3100 and 3150 were supplied by Nanocyl Company. Trimethylsiloxy terminated PDMS was bought from Gelest. The composites with 1% wt. of each type of CNTs were fabricated in accordance to protocol established by Kim, et al. [2], with small modifications.

Dispersion of the CNTs within the matrix was evaluated via Keyence digital microscope (VHX-900F), chemical composition was analyzed through FTIR-ATR spectroscopy (Tensor 27, Bruker). Inspekt Table universal testing machine (Hegewald – Peschke) revealed the effect the CNTs had on the mechanical properties of the PDMS. Ossila 4-point probe was used to evaluate the sheet resistance of the material.

Cytocompatibility of the as-obtained materials was tested through the preparation of liquid extracts, in accordance with ISO 10993-5 standard [9]. Empty cell well served as a blank, and pure PDMS was used as a negative control. The tests were conducted on HEK 293 cells, cytotoxicity/cytocompatibility was established through MTT and LDHA analyses.

Finally, bioprintability of the obtained materials was analyzed via Cellink BioX device.

Results and Conclusion

The undertaken protocol allowed for fabrication of homogenous materials. Presence of CNTs granted the PDMS with electrical conductivity and enhanced mechanical properties.

Tests with cells revealed that the obtained nanocomposites are cytocompatible.

Finally, a good bioprintability of the material was found. The obtained results indicate that the fabricated ink is a promising material for the fabrication of cytocompatible & electrically conductive, 3D-printed materials.

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