УДК 544

OPTICALLY ACTIVE HYBRID MATERIALS BASED ON NATURAL SPIDER SILK

E.S. Maltseva (ITMO University, Saint Petersburg, Russia),
V.O. Nikolaeva (ITMO University, Saint Petersburg, Russia),
D.D. Aleksandrova (ITMO University, Saint Petersburg, Russia)
Scientific advisor – PhD, E.F. Krivoshapkina (ITMO University, Saint Petersburg, Russia)

Currently, Spider silk attracts significant attention because of its outstanding mechanical and biological properties, such as high strength (~1.5GPa), biocompatibility and regenerative activity. The possibility of creating optically active material with aforesaid features reveals new opportunities for research and its application in regenerative medicine. This work describes 3 principal approaches of engineering such material based on optically active carbon dots and natural spider silk.

Introduction

Nowadays, tissue engineering is the most promising and rapidly developing branch of medicine. The importance of tissue engineering is growing and this requires creating new biocomposite materials for tissue repair. A key approach in treatment of damaged tissues is regeneration using cells, scaffolds, and appropriate growth factors. Spider silk can serve as a matrix for cell regeneration due to the special proteins included in its composition. Moreover, spider silk causes a significantly lower inflammatory response and supports proliferation of different cell types in comparison to other biopolymers.

During treatment, it is necessary to constantly monitor tissue repair, it can be achieved by using optically active materials. One of these materials is carbon dots - a nanostructure, which is biocompatible and has a strong photoluminescence effect.

Main part

In this work three principal approaches for the production of the optically active hybrid materials were applied. These approaches include *in situ*, *ex situ* methods and biosynthesis. Spider silk was collected from *Linothele Fallax* spiders, which were kept in a clean environment, where the relative humidity was maintained between 70 and 90%, and the temperature was about 25°C.

Thus, we have synthesized 3 types of the hybrid materials, which demonstrated strong photoluminescence effects as well as carbon dots. All obtained materials were investigated by scanning electron microscope (SEM), FTIR spectroscopy, fluorescent microscope, and spectrofluorometer. Tensile tests and the determination of Young's modulus were also performed.

Based on the results, modifying Spider silk with Carbon Dots nanoparticles has a promising option for bioimaging due to its optical activity.

Conclusions

Carbon dots (C-Dots) nanoparticles and natural spider silk composite can successfully be obtained by several approaches. Hybrid materials C-Dots/Spider silk demonstrated a strong photoluminescent effect under the biotissues. Hence, creation of such material can solve several problems at once: the implementation of regeneration with its simultaneous tracking in real time.

This work supported by the Ministry of Science and Higher Education of the Russian Federation (Project №075-15-2019-1896)