CNTs ALTER THE BIOCOMPATIBILITY OF PAN-DERIVED CNFs

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Introduction

Carbon nanofibers are interesting materials that may find numerous applications in the field of advanced materials engineering. Among these, the most interesting are the ones that exploit their very high aspect ratio, good electrical and thermal conductivity as well biocompatibility [1-4]. Thus, many studies are devoted to applying the CNFs in filtering applications and as scaffolds for tissue engineering of tissues that are hard to regenerate: bone, neural, muscular and chondral.

In order to meet specific requirements for target application (e.g. surface chemistry, structural arrangement, mechanical and electrical properties), physicochemical modification needs to be performed [5-7]. This can be done either by modifying the CNFs precursors or by altering the already carbonized fibers. The former method is more interesting as in this way the modification is more efficient and permanent and is cheaper – no additional fabrication steps need to be performed.

CNTs are interesting candidates for matrix additives due to their biocompatibility, good mechanical properties [8,9] and reported ability to stimulate regeneration of various tissues [10]. Furthermore, by using different chemical modifications of CNTs, different interactions between the CNFs precursor and the additive are expected, yielding materials of varying qualities.

In this study, two types of CNTs were used as matrix additives of the CNFs precursors. The aim was to test the hypothesis whether presence of CNTs in the CNFs is able to alter the material's biocompatibility.

Materials and Methods

Polyacrylonitrile (11% wt.) was dissolved in DMF and to the obtained solution the CNTs were added (0.25% wt.). The obtained solutions were electrospun and the resulting mats were subjected to two-step thermal treatment: oxidation and carbonization. The resulting materials were subjected to physicochemical analysis. Finally, biocompatibility using NHOst cells was evaluated.

Results and Discussion

By using two types of CNTs, varying in the type and amount of functional groups, two types of carbon nanofibers, different from each other, as well as from the unmodified CNFs were obtained. The materials had different fibers' dimensions, surface chemistry and structural arrangement, with higher level of structural arrangement observed of the CNFs modified with highly oxidized CNTs. Presence of CNTs favoured cells' adhesion and directional growth. Again, the more oxidized CNTs were found to yield materials that are more biocompatible. Thus, the CNTs are summarized to be effective modificators of CNFs fibers and can be used to improve their biological properties.

Conclusions

The CNTs are summarized to be effective modificators of CNFs and can be used to improve their biological properties. Osteoblasts are found to favour CNFs modified with highly oxidized CNTs, having higher level of structural arrangement

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