Chemical Technology
ISSN: 0974-7443

Chemical Technology: An Indian Journal

Perspective | Vol 16 Iss 5

Non mulberry Silk Protein Fibroin Nano biocomposite Reinforced with Carbon Nanofibers for Tissue Engineering Applications

Olivia Smith[*]

Editorial office, Chemical Technology: An Indian Journal, United Kingdom

[*]**Corresponding author:** Olivia Smith, Editorial office, Chemical Technology: An Indian Journal, United Kingdom, E-Mail: chemtech@alliedresearch.org

Received: September 05, 2021; **Accepted:** September 15,2021; **Published:** September 25,2021

Abstract

Due to their aqueous manufacture, slow biodegradability, mechanical durability, low immunogenicity, dielectric characteristics, adjustable qualities, sufficient and simple availability, natural silk protein fibroin based biomaterials are widely used in tissue engineering. Carbon nanofibers have been studied for their conductivity, mechanical strength, and as a small molecule delivery vehicle. The primary challenges for them to be employed as successful biomaterials are a lack of proof about their cytocompatibility and low dispersibility. Many corporations have spent significant sums of money on biomaterials research in order to generate more acceptable, biocompatible goods throughout the last few decades. During this time, the rapid growth of biomaterials necessitates their engineering and advancement for use in tissue bioengineering and the healthcare industry.

Introduction

It has been noticed that pure materials are unable to solve a specific problem on their own. More researchers are enticed to combine their efforts. The multifunctional composite is made up of more than one component biomaterials that are as similar as possible to the requisite human tissue The appealing individual inefficiencies are boosted by the distinct properties of each of the materials. Different types of silk biomaterials, such as suture, sponge, film, hydrogel, micro/nanosphere, nanoparticle, membrane, and tubes, have been studied in the last few decades in the hunt for the optimal artificial tissue support. Silk fibroin is a well-known high-molecular-weight protein polymer derived from silkworms. Superior mechanical strength, ease of fabrication into numerous multifunctional matrices (using aqueous-based processes), high cytocompatibility, and tissue growth are all advantages of natural protein, particularly from nonmulberry sources. Fibroin protein from *Antheraea mylitta* contains its own cell adhesion-promoting tripeptide (-R-G-D-) motif, indicating that it could be used as a scaffold in cell-based tissue engineering and drug delivery. Pure fibroin-based matrices, on the other hand, are insufficiently mechanically strong or electrically conductive to sustain the aforementioned tissue defects/damages when it comes to bone, neuron, and muscle recovery. As a result, numerous doping technologies have been examined to date, including hydroxyapatite, gold nanoparticles, graphene oxide, CNT, and CNF, to improve mechanical modulus, flexibility, and conductivity of fibroin-based matrices for better cell growth, proliferation, and/or differentiation. Carbon Nanofiber (CNF) is a nanoscale carbon fibre that is created using a catalytic chemical vapour deposition process at various temperatures. Several curved nanocones consisting of graphene nanosheets are stacked in a specific angle to make a single carbon nanofiber. CNF has already been mentioned for its high

Citation: Smith O. Non mulberry Silk Protein Fibroin Nano biocomposite Reinforced with Carbon Nanofibers for Tissue Engineering Applications. Chem Tech Ind J. 2021;16(5):155.

flexibility, low mass density, and huge aspect ratio. They have a one-of-a-kind mix of mechanical, thermal, and electrical characteristics. Carbon Nanotube (CNT) is a popular cousin of carbon Nanotube (CNF) that is widely used around the world. They are single graphene sheets that have been rolled up and are either Single Wall (SWCNT) or Spiral Multiwall (SWCNT) (MWCNT). CNF is less costly, less poisonous, and easier to functionalize, organochemically modify, and disperse than CNT. Some attempts are attempted to enhance CNT within mulberry silk protein fibroin, as well as their cytocompatibility. Composite materials, gene delivery vehicles, electrodes, atomic force microscopic tips, synthetic membranes, biosensors, hydrogen and charge capacitors, and electron field emitters are all examples of CNF uses. CNF is a powder that is produced and utilised as a filler material. Within the polymer matrix, this offers reinforcement. Some synthetic polymers, such as poly (lacticcoglycolic acid),18 poly (acrylonitrile), and poly-(carbonate)urethane, as well as natural polymers like chitosan, cellulose acetate, and sodium alginate, have already been used as base materials for engineering a variety of artificial extracellular matrices. The reinforcement gives the base matrix more structural stability, electrical conductivity, and mechanical strength. They can also be used as a delivery system for medications and biological molecules that need to be released over time. The biocompatibility of CNT and CNF-based materials is a perennially debated topic. Several scientific groups are investigating the final fate of these compounds on cells in vitro and in vivo systems to address this issue. Furthermore, the CNF has a hydrophobic tendency. For successful composite material engineering, proper functionalization is necessary to make them hydrophilic and compatible with the base matrix. Carbon nanofibers are nanostructures made of graphene. Because of its hydrophobicity and high surface energy, CNF powder does not disperse well in distilled water or dialyzed or undialyzed protein solutions. Because of the significant shear force and molecular repulsion of the CNF, the protein coagulates and aggregates even after adding the CNF powder to the protein solution and sonicating it. Surface functionalization is required at this time. Acid etching, plasma modification, solgel coating, electro-/electro-less plating, wet etching, photochemical functionalization, thermal treatment, and the addition of linker and polymer molecules are all ways that can be used to functionalize CNF. The majority of these procedures are time-consuming and expensive, thus they are not recommended. Furthermore, harsh chemicals and/or harsh treatments are incompatible with the ultimate goal of cytocompatibility. To functionalize the CNF, we use ultrasonication (mechanical) and noncovalent surfactant absorption (chemical) techniques, which are both inexpensive, environmentally friendly, and simple. Because the surface mimics the natural environment of nanodimentional extracellular matrix, the nanorough surface (roughness 100 nm) has a positive influence on attachment, growth, proliferation, and differentiation of smaller cells (human vein endothelial and mammary epithelial cells) as well as larger cells (osteoblast and nerve cells) (ECM). Neurite outgrowth of neurons is also aided by the roughness. As a result, the manufactured composite matrices are similar to the roughness of the ECM and may aid in the culturing of a wide range of cell types.