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Effect Of Plasma Ion Immersion Implantation Biological Properties of Silk towards Creating On the Biomaterial Platform

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Abstract

Due to its mechanical adaptability, processability, and minimal immunogenic reaction, silk biomaterials are frequently employed in tissue engineering applications. However, additional alterations are frequently needed to improve silk biomaterials for a particular biological application since they lack cell binding sites. A variety of bioactive compounds may be covalently attached to silk surfaces using the surface modification technique plasma immersion ion implantation in order to produce desired biological effects. However, nothing is known about how PIII treatment would affect the surface and bulk characteristics of silk biomaterials. In order to explore PIII-treated silk biomaterials as a platform for biological applications, this study's goal is to do so. The surface and mass of silk films were studied with and without PIII treatment. Features, such as the in vivo immunological response, mechanical, chemical, and degrading properties. The insertion of oxygen and nitrogen functional groups as well as the densification of the silk's surface layer was seen to change the surface chemistry of silk after PIII treatment.

Keywords: Silk; Surface modification; Biomaterials; Plasma treatment; PIasma immersion ion implantation

Introduction

The surface stiffness was subsequently significantly increased as a result, although there were also slight variations in the tensile characteristics of clinically important silk forms and the characteristics of in vitro degradation [1]. HCAEC adhesion on PIIIsilk increased significantly after PIII treatment compared to untreated silk, but fibrous encapsulation and macrophage response did not change significantly when implanted in vivo in a subcutaneous mouse model [2]. These findings demonstrate that silk treated with PIII barely impairs its bulk characteristics and may be utilised [3]. To encourage cellular connections as well as a method of covalently immobilising biomolecules without the need of reagents [4]. In tissue regeneration procedures, the morphological, mechanical, and chemical qualities of biomaterials significantly influence the destiny of the cells [5]. Despite the fact that many biomaterials have outstanding mechanical qualities, they frequently lack the molecular traits needed to cause desired cell reactions and guide tissue regeneration [6].

Discussion

For instance, thrombus development or neo-intimal hyperplasia frequently cause the current generation of clinical synthetic vascular graft biomaterials to fail when employed as small-diameter artery replacements [7]. These mechanisms of failure are frequently linked to the synthetic vascular replacements' surface shape and chemistry, which usually promote platelet adhesion and their incapacity to control the growth of smooth muscle cells [8]. Surface engineering is therefore necessary to ensure long-term patency and encourage effective tissue regeneration [9]. Physiochemical surface modification methods and/or bio functionalization using bioactive compounds have been used to modify biomaterials with mechanical qualities comparable to those of natural tissue in order to elicit desired biological responses without sacrificing the bulk material characteristics [10]. Due to its high degree of mechanical tenability, processability, and relatively minimal immunogenic reaction when compared to other biomaterials, silk fibroin is an extensively utilised biomaterial. Due to their abundance and well-established farming practises in the textile industry, domestic Bombyx mori silkworms are the source of the most often used silk fibroin. Even though silk is frequently used as a medical suture, it may also be dissolved to create an aqueous silk solution. As a result of the aqueous, regenerated silk solution's resistance to various processing methods and environmental factors, development of a broad variety of material forms, such as hydrocryo- and lyogels, micro- and nanoparticles, electrospun fibres, free-standing films, and porous scaffolds. Its utility in several tissue engineering and regenerative medicine applications is due to its wide processibility range and the ability to complete all fabrication steps using water-based procedures without the need of hazardous solvents or the introduction of chemical pollutants.

Conclusion

Silk biomaterials made today have a great degree of mechanical tuneability that may be used to replicate the mechanical characteristics of biological tissues. For instance, electrospun silk vascular conduits with mechanical qualities similar to those of natural arteries were created, and encouraging pre-clinical outcomes were obtained. Although silk is a flexible material that has been investigated for a variety of tissue engineering applications, it lacks specialised cell binding sites and needs further processing to elicit desired biological reactions. Techniques for dry surface modification, such irradiation and gas plasma treatment, can change the surface's chemical, mechanical properties, and biological characteristics without affecting the bulk of the material. These techniques have benefits over wet-chemical ones, including great adaptability, simple scaling, and little waste production. It has been studied how dry surface modification affects silk materials and how useful it is for biomedical applications. Plasma immersion ion implantation, one of the dry surface modification techniques, has been

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utilised to give covalent attachment of biomolecules to silk biomaterials as well as onto a variety of other surfaces.

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None

Conflict of Interest

None

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