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Biomedical Materials Made of Self-assembly Cellulose

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Brief Report

Owing to its excellent biocompatibility, biodegradability, and low toxicity, cellulose-based materials have sparked an increasing interest in improving biomedicine. Self-assembly is a natural process that allows for the creation of ordered structures with certain functions and qualities without the need for any additional processing. This page includes a full review of representative types of solvents such as NMMO, DMAc/LiCl, some molten salt hydrates, some aqueous solutions of metal complexes, ionic liquids, and the NaOH-water system, among others. Esterification, etherification, ATRP, RAFT, ROP, and other innovative procedures were commonly used to modify the molecules. Stimuli-responsive Temperature-, pH-, light-, and redox-responsive cellulose-based materials have been created because of their exceptional performance. Furthermore, drug/gene delivery, bioimaging, and biosensor uses of cellulose-based polymers that can self-assemble into micelles, vesicles, and other aggregates are explored.

One of the most promising ways for producing micelles from amphiphilic polymers is self-assembly. Amphiphilic block copolymers in solution can self-assemble into a range of nanoscale structures, including micelles and vesicles, despite the presence of both hydrophilic and hydrophobic groups in the backbone of the molecular chain. Polymer micelles also have a wide range of potential applications in biomedicine, involving medication or gene delivery, biosensors, and bioimaging. Many synthetic block polymers, on the other hand, are limited in their use on a broad scale due to their high costs and probable biotoxicity. As a result, there has been a spike in interest in creating amphiphilic polymers from natural polysaccharides due to their numerous advantages, including their abundance, low cost, safety, non-toxicity, biocompatibility, and biodegradability.

Cellulose is a type of polysaccharide that can be extracted from trees, cotton, straw, and other higher plant cell walls since it is produced by photosynthesis. It's one of the most common natural polymer organic molecules on the planet, made up of (1-4)-linked anhydroglucose repeating units ($(C_6H_{10}O_5)_n$, n=10000 to 15000, depending on the cellulose parent material). Cellulose Acetate (CA), Methylcellulose (MC), Ethylcellulose (EC), Hydroxyethylcellulose (HEC), Hydroxypropylcellulose (HPC), Sodium Carboxymethylcellulose (CMC), and other cellulose derivatives are commonly utilised. Furthermore, cellulose and its derivatives have been shown to be harmless in both animals and humans, making it a suitable biomedical material. Meanwhile, the abundance of functional groups in the cellulose molecule allows for modification of cellulose and its derivatives to produce a self-assembling product. Self-assembly as a practical and successful technique for manufacturing cellulose-based materials has recently been extensively investigated, as evidenced by a growing number of papers. Molecules associate into well-defined, functional geometries during the self-assembly of cellulose-based materials through simple interactions with one another. The self-assembly of cellulose and its derivatives is analogous to that of many other biological molecules such as DNA and proteins, which can occur in the aqueous phase under normal conditions to produce materials with superior properties and functionalities.

Until date, self-assembling cellulose-based materials have shown significant promise in the field of biomedicine. We looked at how self-assembled cellulose materials have progressed in biomedicine recently. We first looked at cellulose and its derivatives disintegration and modification. Meanwhile, the self-assembly of cellulose-based polymers was concisely explained. Following that, cellulose-based materials with various stimuli responsive properties, such as temperature, pH, light, and redox, were highlighted. Finally, we talked about how self-assembled cellulose materials can be used in biomedicine for drug/gene delivery, bioimaging, biosensors, and other activities. We hope that by presenting self-assembled cellulose materials from theory to application, this review will provide a comprehensive overview of this intriguing new healthcare material.

The most plentiful and renewable biomass energy is cellulose. Furthermore, amphiphilic cellulose-based polymers have been shown to self-assemble into a range of 3D forms with enormous application potential. More types of functional cellulose-based materials with a variety of benefits are possible thanks to a variety of effective cellulose solvents and practical cellulose modification processes. These cellulose-based polymers offer outstanding possibilities for the fabrication of self-assembled materials that could be exploited in biomedicine and other sectors due to their particular functionality and equilibrated balance of hydrophobic and hydrophilic components. The ultimate goal is for the self-assembling cellulose-based composites to be used in clinical practise [1-5].

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