Crimson Publishers
Wings to the Research

Mini Review

Oxidized Regenerated Cellulose-Based Biomaterial and Its Application in Tissue Engineering

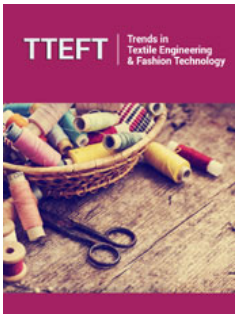
Hongbin Lia[1]*, Feng Chengb[2]*, Zhongyan Wang[3], Lingling Yang[1] and Yuqi Li[1]

[1]College of Light Industry and Textile, China

[2]MIIT Key Laboratory of Critical Materials Technology for New Energy Conversion and Storage, China

[3]The Third Affiliated Hospital of Qiqihar Medical University, China

ISSN: 2578-0271



***Corresponding author:** Hongbin Li, College of Light Industry and Textile and Feng Cheng, MIIT Key Laboratory of Critical Materials Technology for New Energy Conversion and Storage, China

Submission: September 19, 2019

Published: September 27, 2019

Volume 5 - Issue 4

How to cite this article: Hongbin L, Feng C, Zhongyan W, Lingling Y, Yuqi L. Oxidized Regenerated Cellulose-Based Biomaterial and Its Application in Tissue Engineering. Trends Textile Eng Fashion Technol.5(4). TTEFT.000620.2019.
DOI: 10.31031/TTEFT.2019.05.000620.

Abstract

Oxidized regenerated cellulose is wildly used in biomedical textiles which mainly attribute to its mechanics capability, excellent hemostatic properties, good antibacterial activity, non-toxic, good biocompatibility and biodegradable performance, Currently, with the careful research of the composition, microstructure and physicochemical properties of oxidized regenerated cellulose, the application of oxidized regenerated cellulose-based biomaterial with other functional medical materials has gradually extended to hemostatic materials, drug release, bone repair, adhesion barriers, skin repair and other biomedical fields. This paper provides a brief introduction of oxidized regenerated cellulose-based biomaterial application in tissue engineering.

Keywords: Oxidized regenerated cellulose; Biomaterials; Tissue engineering

Mini Review

Injured tissues and organs are an importantly issues in healthcare, which, in some cases, cannot be addressed using traditional medical intervention [1,2]. There is a require for a new kinds of biomaterial with suitable properties for tissue engineering, derived from a sustainable source, and which needs minimal processing to obtain cell viability for biomedical application [3,4]. Oxidized regenerated cellulose-based biomaterials has the potential to be satisfied with these requirements. Regenerated cellulose is a kind of materials processed by the conversion of natural cellulose to a soluble cellulosic derivative and subsequent regeneration, typically forming either a fiber (via polymer spinning) or a film (via polymer casting) [5,6]. Regenerated cellulose can be used as a functionally active biomolecule which primarily due to the abundant hydroxyl groups in the cellulose molecule, oxidized to obtain the oxidation regenerated cellulose-based materials with varying multiple structures and performance to act as a platform for advanced tissue engineering [7,8]. Selective oxidation of regenerated cellulose not only transforms the structure of regenerate cellulose, but also provides many new functions to oxidized regenerated cellulose-based biomaterials [9,10]. Importantly, oxidized regenerated cellulose has aldehyde group and carboxyl group in the molecular chain which can react with other groups of functional materials and biological activity material [11,12] and improve the advantage of the oxidized regenerated cellulose in biomedical field. Furthermore, oxidized regenerated cellulose produce new function like natural degradation greatly expand the application field of the cellulose (green renewable materials). Oxidized regenerated cellulose-based biomaterials can be made to the biomedical textiles such as suture [13], hemostatic gauze [12] and wound dressing [14,15]. In order form the absorbable biomaterial, the regenerated cellulose need be oxidized nitrogen tetroxide (N_2O_4) or nitroxyl radicals, such as 2,2,6,6- tetramethylpyperidine-1-oxyl (TEMPO). During this oxidation process, we can obtain the oxidized regenerated cellulose with difference carboxyl contents which can improve the antibacterial and biodegradable of oxidized regenerated cellulose-based biomaterials. For degradation process of oxidized regenerated cellulose, it can dissolve and disappearing from the site of implantation by firstly hydrating and swelling into a gel-like material Importantly, the oxidized regenerated cellulose-based biomaterials can perform an appropriate host response in a specific application which mainly attribute to the characteristics of non-toxic and good biocompatibility. Due to the obviously

biocompatibility of the above-mentioned oxidized regenerated cellulose-based biomaterials and their versatility, oxidized regenerated cellulose-based biomaterials were combined with other materials and also popularized in scaffolds [16,17], drug release [18], bone repair [19], adhesion barriers [20-22]. Based on its unique mechanical flexibility, biocompatibility, biodegradability and other characteristics, researchers are exploring the degradation mechanism of oxidized regenerated cellulose-based biomaterials as a wound repair biomaterial for clinical application *in vitro* and *in vivo*.

References

1. Zdrojewicz Z, Waracki M, Bugaj B, Pypno D, Cabala K (2015) Medical applications of nanotechnology. Postepy Hig Med Dosw 69: 1196-1204.
2. Salernitano E, Migliaresi C (2003) Composite materials for biomedical applications: a review. J Appl Biomater Biomech 1(1): 3-18.
3. Williams DF (2019) Challenges with the development of biomaterials for sustainable tissue engineering. Front Bioeng Biotechnol 7: 127.
4. Das P, Rajesh K, Lalzawmliana V, Bavya Devi K, Basak P, Lahiri D, et al. (2019) Development and characterization of acellular caprine choncal cartilage matrix for tissue engineering applications. Cartilage 1947603519855769.
5. Tanjung FA, Arifin Y, Abdullah AH, Tahir I (2017) Bilayer-structured regenerated cellulose/chitosan films prepared with ionic liquid. Indonesian Journal of Chemistry 17(3): 351-359.
6. Kong K, Davies RJ, McDonald MA, Young RJ, Wilding MA, et al. (2007) Influence of domain orientation on the mechanical properties of regenerated cellulose fibers. Biomacromolecules 8(2): 624-630.
7. Nihsen ES, Johnson CE, Hiles MC (2008) Bioactivity of small intestinal submucosa and oxidized regenerated cellulose/collagen. Adv Skin Wound Care 21(10): 479-486.
8. Hart J, Silcock D, Gunnigle S, Cullen B, Light ND, et al. (2002) The role of oxidised regenerated cellulose/collagen in wound repair: effects *in vitro* on fibroblast biology and *in vivo* in a model of compromised healing. Int J Biochem Cell Biol 34(12): 1557-1570.
9. Coseri S, Nistor G, Fras L, Strnad S, Harabagiu V, et al. (2009) Mild and selective oxidation of cellulose fibers in the presence of N-hydroxyphthalimide. Biomacromolecules 10(8): 2294-2299.
10. Habibi Y, Chanzy H, Vignon MR, (2006) TEMPO-mediated surface oxidation of cellulose whiskers. Cellulose 13(6): 679-687.
11. Zhang B, Chakoli AN, He JM, Huang YD, Aleshin AN (2019) Hemostatic effect of aminated multiwalled carbon nanotubes/oxidized regenerated cellulose nanocomposites. J Nanosci Nanotechnol 19(11): 7410-7415.
12. Cheng F, He J, Yan T, Liu C, Wei X, et al. (2016) Antibacterial and hemostatic composite gauze of N, O-carboxymethyl chitosan/oxidized regenerated cellulose. RSC Advances 6(97): 94429-94436.
13. Li H, Cheng F, Chavez Madero C, Choi J, Wei X, et al. (2019) Manufacturing and physical characterization of absorbable oxidized regenerated cellulose braided surgical sutures. Int J Biol Macromol 134: 56-62.
14. Cheng F, Liu C, Wei X, Yan T, Li H, et al. (2017) Preparation and characterization of 2,2,6,6-tetramethylpiperidine-1-oxyl (tempo)-oxidized cellulose nanocrystal/alginate biodegradable composite dressing for hemostasis applications. ACS Sustainable Chemistry & Engineering 5(5): 3819-3828.
15. Wu S, Applewhite A J, Niezgoda J, Snyder R, Shah J, et al. (2017) Oxidized regenerated cellulose/collagen dressings: review of evidence and recommendations. Adv Skin Wound Care 30(11): S1-S18.
16. Cheng Y, Lu J, Liu S, Zhao P, Lu G, et al. (2014) The preparation, characterization and evaluation of regenerated cellulose/collagen composite hydrogel films. Carbohydr Polym 107: 57-64.
17. Song W, Zhao Y, Wu Y, Li Z, Lv H, et al. (2018) Fabrication, characterization and biocompatibility of collagen/oxidized regenerated cellulose-Ca composite scaffold for carrying schwann cells. Int J Biol Macromol 119: 1195-1203.
18. Kanko M, Liman T, Topcu S (2006) A low-cost and simple method to stop intraoperative leakage-type bleeding: use of the vancomycin-oxidized regenerated cellulose (ORC) sandwich. J Invest Surg 19(5): 323-327.
19. Turhan HN, Uysal OA, Haktanir A, Yildiz L (2005) Radiologic and histologic assessment of diced cartilage grafts for cranial bone defects of rabbits: an experimental study. Aesthetic Plast Surg 29(3): 195-201.
20. Aktekin A, Sahin I, Aydemir SU, Gulmez M, Ozkara S, et al. (2016) Carboxymethyl cellulose/oxidized regenerated cellulose hydrogels as adhesion barriers: comparative study with different molecular weights and substitution degrees. Cellulose 23(5): 3145-3156.
21. Cheng F, Wu Y, Li H, Yan T, Wei X, et al. (2019) Biodegradable N, O-carboxymethyl chitosan/oxidized regenerated cellulose composite gauze as a barrier for preventing postoperative adhesion. Carbohydr Polym 207: 180-190.
22. Zhang Y, Liu Q, Yang N, Zhang X (2016) Hyaluronic acid and oxidized regenerated cellulose prevent adhesion reformation after adhesiolysis in rat models. Drug Des Devel Ther 10: 3501-3507.