3.3.4.3 受益学生在校期间主要科技成果及获奖（代表性）

序号	学　生	专　业	主要科技成果及获奖（发表论文、授权专利、竞赛获奖、荣誉称号、学术活动等）
1	杨梦云 2016 级	纺织科学与工程	1、Large-Scale Production of Highly Stretchable CNT/Cotton/Spandex Composite Yarn for Wearable Applications 2、Conductive and durable CNT-cotton ring spun yarns 3、Conductive Cotton Fabrics for Motion Sensing and Heating Applications 4、“红绿蓝杯”第九届中国高校纺织品设计大赛三等奖 5、The 10th Textile Bioengineering and Informatics Symposium 6、中国纺织工业联合会“纺织之光”奖学金
2	何满堂 2016 级	纺织科学与工程	1、In situ reduction of TiO2 nanoparticles on cotton fabrics through polydopamine templates for photocatalysis and UV protection 2、Durable UV-protective cotton fabric by deposition of multilayer TiO_2 nanoparticles films on the surface 3、Growing ZnO nanoparticles on polydopamine templated cotton fabrics for durable antimicrobial activity and UV protection 4、Depositing a flexible substrate of triangular silver nanoplates onto cotton fabrics for sensitive SERS detection
3	吕　佩 2016 级	纺织科学与工程	1、Regulation of pore morphologies of PU films and thereof water vapor permeability by varying tetrahydrofuran concentration in binary solvent 2、Fabrication of Size-controllable Nanoparticles from Feaher Waste 3、“红绿蓝杯”第九届高校纺织品设计大机织服用织物组一等奖 4、“中国化学纤维工业协会·恒逸基金”优秀学术论文优秀奖 5、桑麻奖学金一等奖
4	王秋胜 2017 级	纺织科学与工程	1、Facile-produced natural silk nanofibers for electronic device applications 2、3D Printing of Silk Fibroin for Biomedical Applications 3、Facile preparation of bioactive silk fibroin/hyaluronic acid hydrogels 4、Facile fabrication of silk fibroin microspheres via electrostatic assembly 5、中国纺织工业联合会“纺织之光”奖学金
5	白　雪 2017 级	纺织科学与工程	1、Polydopamine-assisted immobilization of Ag@AuNPs on cotton fabrics for sensitive and responsive SERS detection 2、In situ hydrothermal growth of Cu NPs on knitted fabrics through polydopamine templates for heating and sensing 3、In situ hydrothermal growth of FeOOH on PDA- templated cotton fabrics for oil/water separation and visible-light-driven photocatalytic performance 4、第一届丽洋杯全国高等学校非织造材料与应用创新创意大赛三等奖 5、第二届“赛得利杯”全国高等学校非织造材料与应用创新创意论文大赛三等奖 6、2019 年度“中国化学纤维工业协会-恒逸基金”优秀学术论文三等奖；7、桑麻奖学金二等奖

6	周思婕 2018 级	纺织科学与工程	1、Purification of dye-contaminated ethanol-water mixture using magnetic cellulose powders derived from agricultural waste biomass 2、Blocking and Filtering Effect of Filter Tips of Natural Fibers against Mainstream Cigarettes Smoke 3、In situ synthesis of ternary hybrid nanocomposites on natural Juncus effusus fiber for adsorption and photodegradation of organic dyes 4、Titanium dioxide decorated natural cellulosic Juncus effusus fiber for highly efficient photodegradation towards dyes 5、Environment-friendly Juncus effusus-based adsorbent with a threedimensional network structure for highly efficient removal of dyes from wastewater 6、Juncus effusus fiber-based cellulose cigarette filter with 3D hierarchically porous structure for removal of PAHs from mainstream smoke 7、“红绿蓝杯”中国纺织品设计大赛机织组三等奖 8、长江学子；9、中国纺织工业联合会“纺织之光”奖学金
7	付　专 2018 级	纺织材料	1、Juncus effusus fiber-based cellulose cigarette filter with 3D hierarchically porous structure for removal of PAHs from mainstream smoke 2、In situ synthesis of ternary hybrid nanocomposites on natural Juncus effusus fiber for adsorption and photodegradation of organic dyes 3、Blocking and Filtering Effect of Filter Tips of Natural Fibers against Mainstream Cigarettes Smoke 4、2020 年湖北省大学生“挑战杯”创新创业竞赛金奖
8	张佳婧 2019 级	纺织科学与工程	1、Fabrication of PolyurethanePolyurethane Fiber Composite Film with Enhanced Mechanical Property 2、一种服装用仿真皮彩色功能纱线及其制备方法 3、一种制备持久抗菌皮革的方法 4、第七届“互联网+”大学生创新创业大赛湖北省现场赛银奖
9	刘金如 2019 级	纺织科学与工程	1、A novel flame-retardant composite material based on calcium alginate/poly (vinyl alcohol)/graphite hydrogel: Thermal kinetics, combustion behavior and thermal insulation 2、Green synthesis of silver nanoparticles with black rice (Oryza sativa L.) extract endowing carboxymethyl chitosan modified cotton with high anti-microbial and durable properties 3、Thermal insulating and fire-retarding behavior of treated cotton fabrics with a novel high water-retaining hydrogel used in thermal protective clothing 4、Flame-retardant PNIPAAm/sodium alginate/polyvinyl alcohol hydrogels used for fire-fighting application: Preparation and characteristic evaluations 5、Investigation of temperature-responsiveand thermo- physiological comfort of modified polyester fabric with Sericin/PNIP AAm/Ag NPs interpenetrating polymer network hydrogel 6、第三届全国大学生绿色染整科技创新竞赛三等奖；7、上海市纺织化学与染整工程研究生学术论坛二等奖 8、中国纺织工业联合会“纺织之光”奖学金
10	李俊锋 2019 级	纺织科学与工程	1、The rapid production of multiple transition metal carbides via microwave combustion under ambient conditions 2、第三届全国大学生绿色染整科技创新创新大赛二等奖 3、上海市首届纺织化学与染整工程研究生学术论坛特等奖

Cellulose
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ORIGINAL PAPER

Conductive and durable CNT-cotton ring spun yarns

Mengyun Yang · Chiyu Fu · Zhigang Xia · Deshan Cheng · Guangming Cai · Bin Tang · Xungai Wang

Received: 20 December 2017 / Accepted: 7 May 2018

Abstract A facile and original method was developed to fabricate flexible conductive yarns using cotton roving and carbon nanotubes (CNTs). The CNTs were assembled to cotton roving and then wrapped around by fibers through twisting during ring spinning. The obtained CNT treated cotton yarns (CNT-CYs) showed great electrical conductivity and durability properties. The CNT-CYs were analyzed using scanning electron microscopy and Raman scattering spectroscopy. The electrical conductivity, mechanical property and flexibility of CNT-CYs were investigated. The results show that electrical resistance of roving, twist and linear density of yarn affect the electrical conductivity of CNT-CYs. Combination with CNTs increased the breaking strength of cotton yarns. The electrical resistance of CNT-CYs was relatively stable during stretching and human motions. Moreover, no obvious changes in electrical resistance were found after CNT-CYs were bent 100 times. The CNT-CYs possessed good durability to repeated washing and abrasion.

Keywords Ring spinning · Carbon nanotube · Cotton · Composite yarn · Electrical conductivity · Durability

Introduction

Conductive textiles have attracted great attention recently due to their potential applications in flexible and stretchable electronics, wearable devices and electronic sensors (Wang et al. 2016a; Wang et al. 2017b; Weng et al. 2016; Yildiz et al. 2016; Zeng et al. 2014). Compared to traditional conductive materials including metals and semiconductors, textiles with electrical conductivity possess many special features, such as excellent flexibility, light weight, recoverable deformation and washability (Cai et al. 2017b; Pang et al. 2016; Pu et al. 2016; Xu et al. 2016; Zhang et al. 2016; Zhong et al. 2016). Cotton fibers are widely used in textiles because of their natural softness, good comfort, heat insulation, and high hygroscopicity (Cai et al. 2017a; Li et al. 2017b; Tang et al. 2012; Zahid et al. 2017). The abundant hydroxyl groups on the

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Article

Conductive Cotton Fabrics for Motion Sensing and Heating Applications

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Abstract: Conductive cotton fabric was prepared by coating single-wall carbon nanotubes (CNTs) on a knitted cotton fabric surface through a "dip-and-dry" method. The combination of CNTs and cotton fabric was analyzed using scanning electron microscopy (SEM) and Raman scattering spectroscopy. The CNTs coating improved the mechanical properties of the fabric and imparted conductivity to the fabric. The electromechanical performance of the CNT-cotton fabric (CCF) was evaluated. Strain sensors made from the CCF exhibited a large workable strain range (0–100%), fast response and great stability. Furthermore, CCF-based strain sensors was used to monitor the real-time human motions, such as standing, walking, running, squatting and bending of finger and elbow. The CCF also exhibited strong electric heating effect. The flexible strain sensors and electric heaters made from CCF have potential applications in wearable electronic devices and cold weather conditions.

Keywords: conductive fabric; electromechanical performance; strain sensing; electric heating fabric

1. Introduction

Flexible conductive materials have attracted considerable attention recently due to their potential applications in wearable displays, electronic sensors for human motion and electrically driven heaters [1–7]. The most common flexible sensors are generally fabricated using electrically conductive metal nanoparticles or nanowires, metal thin films, carbon nanotubes and graphene [8–15]. Although these sensors are electrically conductive and have high sensitivity, they have a small range of workable strain, which limits their practical applications. Some key factors need to be considered in designing strain sensors, such as a large strain range to monitor the human motion, rapid recoverable deformation, high sensitivity (high gauge factor (GF)) and fast response [16]. It is still a challenge to prepare strain sensors with a large workable strain range and high sensitivity.

Conductive textile materials (CTMs) have been widely used as flexible wearable devices because of their light weight, good flexibility, high stretchability and recoverable deformation [17–22]. Moreover, the CTMs possess high strength, good tear resistance, and excellent flexibility and comfort attributes. The response mechanism of CTMs-based strain sensors is that the resistance changes with stretching, which can be explained by changes in the fabric's geometric structure and associated contact points between fibers and yarns within the structure. A number of strategies have been developed to prepare CTMs with sensing performance [21,23–32]. For example, reduced graphene oxide was combined with cotton to fabricate flexible sensing fabrics [17,20]. Nevertheless, these sensors from ordinary cotton

杨梦云

获奖证书

“红绿蓝杯”第九届中国高校纺织品设计大赛

家纺装饰用织物组三等奖

作品名称：花样年华

设 计 者：杨梦云、陈新竹、唐文杨

指导教师：蔡光明

学　　校：武汉纺织大学

中国纺织服装教育学会

教育部高等学校纺织类专业教学指导委员会

二〇一七年七月

证书编号：HLL2017-345

杨梦云

获奖证书

“红绿蓝杯”第九届中国高校纺织品设计大赛

家纺装饰用织物组二等奖

作品名称：我的中国心

设 计 者：陈新竹、杨梦云、唐文杨

指导教师：唐彬

学　　校：武汉纺织大学

中国纺织服装教育学会

教育部高等学校纺织类专业教学指导委员会

二〇一七年七月

证书编号：HLL2017-325

碳纳米管棉复合导电纱的制备

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摘要：

本文采用碳纳米管与粗纱复合后纺制碳纳米管棉复合导电纱。研究不同浓度碳纳米管溶液和不同纺纱工艺参数对细纱导电性能的影响，并通过扫描电镜探究碳纳米管在纱线上分布。研究结果发现，复合纱线的电阻随碳纳米管溶液浓度增大而减小，随牵伸倍数增大而增大，随捻度的增大而减小，并且碳纳米管分布在纱线内部，有利于提高纱线的耐久性。

关键词：碳纳米管；复合纱；导电性能

导电纺织品在导电材料中存在潜在应用价值。由于碳纳米管具有高比表面积、低电阻、低质量密度和高稳定性等优点，适用于赋予柔性纺织品的导电性能。相关工作人员研究制备纯碳纳米管纱，长丝束吸附和织物表面浸渍碳纳米管[1]这些方法制备材料存在耐久性差，可服用性能低的问题，因此拟通过碳纳米管处理棉粗纱的方式制备碳纳米管棉复合导电纱。

本实验采用不同浓度碳纳米管和不同方式与棉粗纱复合，经过环定细纱机对粗纱进行牵伸和加捻而制备碳纳米管复合导电纱。探究碳纳米管溶液浓度、牵伸倍数、捻度对细纱电阻的影响。本实验通过对细纱结构形貌、粗纱和细纱电阻以及不同捻度对细纱电阻的影响进行分析。

下图 1 为碳纳米管棉复合纱的 SEM 图，图（a）为碳纳米管棉复合纱横截面图，可看出棉纤维之间紧密排列；图（b）中可以看到每根棉纤维之间有堆积的碳纳米管，图(c)中可以看到棉纤维表面有覆有一层膜状物质，为碳纳米管在棉纤维表面堆积的效果。从图中效果可以得出碳纳米管分布于整个纱线的内部和纤维表面，通过加捻使纤维之间产生压力，因此纱线内部的碳纳米管不易脱落，有利于提高纱线耐久性能。

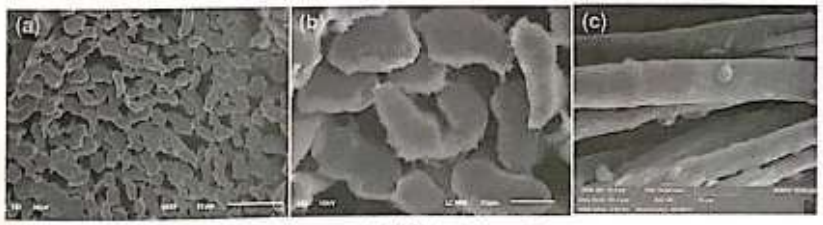

图 1 碳纳米管棉复合纱 SEM 图

杨梦云

Study on the Bending Fatigue Fracture Characteristic of High Performance Fibers

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Abstract

The damage of high performance fibers occurs easily in bending fatigue. In this paper, we discussed the effect of pre-tension and bending angle on the bending fatigue fracture characteristic of high performance fibers through a new fatigue testing method. The experimental results indicated that the fracture characteristic of fibers are different at different re-tension and bending angle. The morphologies characteristic obtained from the optical apparatus can be used to explain the bending failure mechanisms of high performance fibers.

Keywords: High Performance Fibers; Bending Fatigue; Fracture Characteristic

1. Introduction

High performance flexible fibers such as aramid, PBO, and UHMWPE fibers have high strength, high modulus, and high temperature resistant properties. They are widely used in various industries, such as the military, aeronautics, and aerospace. However, the bending strength, shearing strength and shearing modulus of high performance fibers are comparatively low [1], which could greatly limit applications in various fields [2]. Previous studies show that high performance fibers exhibit excellent tensile strengths and high modulus, however, the compressive and shearing strength and modulus are comparatively low [3-5]. An important method to illustrate the bending property of fiber is bending fatigue test [6], which test the major deformation caused by the bending force. In this paper, a new equipment developed by authors [7], which can perform the bending fatigue test under given bending angle, pre-tension and frequency. The bending fatigue fracture characteristic of single high performance fiber is measured and observed by a microscope. The purpose of this study was to investigate the effects of pre-tension and bending angle on the bending fatigue fracture characteristic of high performance fibers using this new apparatus.

2. Experimental

2.1 Testing Apparatus

A photo of a new bending fatigue test apparatus used in this study is shown in Fig.1. Fig.1 displays the details of the bending system, which includes the following parts: the 1) upper jaw, 2) positioning pin, 3) lower jaw, 4) running plane, 5) microscope, 6) CCD camera, 7) temperature sensor, 8) heater and 9) force sensor. The jaws are used to clamp fiber samples. The positioning pin is used to hold the fiber and fix the bending point under bending

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ORIGINAL PAPER

In situ reduction of TiO_2 nanoparticles on cotton fabrics through polydopamine templates for photocatalysis and UV protection

Deshan Cheng · Mantang He · Jianhua Ran · Guangming Cai · Jihong Wu · Xin Wang

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Abstract In this work, titanium dioxide (TiO_2) nanoparticles were immobilized on the surface of cotton fabrics by in situ reduction on polydopamine (PDA) templates. Evidenced by the results of scanning electron microscopy/energy-dispersive X-ray analysis (SEM–EDX), Fourier transform infrared and X-ray photoelectron spectroscopy (XPS), PDA films were successfully formed on the surface of cotton fabrics as the templates for the in situ reduction. The morphology, chemical composition and crystal structure of the coated cotton fabrics after in situ reduction of TiO_2 nanoparticles were characterized by SEM–EDX, XPS and X-ray diffraction, respectively. These results confirmed that anatase TiO_2 nanoparticles were well-dispersed on the surface of cotton fabrics. The photocatalysis experiment results indicated that about 90% of methylene blue solution was degraded after UV illumination of the coated cotton fabrics. The thermogravimetric analysis results demonstrated that the TiO_2 nanoparticles had little effect on the thermal stability of cotton fabrics. The results of UV protection showed that the value of the ultraviolet protection factor (UPF) of the coated cotton fabrics was 127.2. The UPF value was maintained at 108.8 after five cycles of laundering, indicating excellent durability of the coating in terms of UV protection.

Keywords TiO_2 nanoparticles · Polydopamine · Cotton fabrics · Photocatalytic activity · UV protection

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Introduction

Cotton has been widely used in clothing for its high wettability, permeability and comfort. But its disadvantages, such as poor ultraviolet resistance and breeding bacteria, confine its application potential (Gao et al. 2017). Functionalization of cotton fabrics is thus necessary for developing protective clothing. Researcher have focused on this area, and especially TiO_2 has been used to functionalize cotton fabrics with antimicrobial properties and UV protection together with antistatic, oil repellency and self-cleaning properties (Li et al. 2015; Karimi et al. 2014; Mishra and

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Durable UV-protective cotton fabric by deposition of multilayer TiO_2 nanoparticles films on the surface

Deshan Cheng, Mantang He, Guangming Cai, Xin Wang, Jianhua Ran, Jihong Wu

Abstract Durable ultraviolet (UV)-protective cotton fabric has great application potential in outdoor cotton clothing. In this study, oppositely charged TiO_2 nanoparticles were deposited onto cotton fabric through the layer-by-layer self-assembly technique, resulting in multilayer films with UV-protective properties. The mechanism of the technology has been investigated through characterization of the structure and properties using different techniques including FTIR, UV–Vis spectroscopy, and a scanning electron microscope with an energy-dispersive X-ray spectrum. The results showed that TiO_2 nanoparticles distributed uniformly on the surface of cotton fibers. The TGA results indicated that the TiO_2 nanoparticles deposit on cotton fabrics had little effect on the thermal stability of cotton fabrics. The tensile strength and air permeability of the cotton samples were tested by a universal material testing machine and automatic ventilation instrument. The UV protection property of cotton fabric after assembled multilayer films was measured by an ultraviolet transmittance analyzer, and the laundering experiments were carried out to determine the durability of TiO_2 nanoparticles on cotton fabric. The results showed that the UV protection property of cotton fabrics after assembled TiO_2 nanoparticles was still maintained at a high level after five launderings.

Keywords TiO_2 nanoparticles, Cotton fabric, LbL self-assembly, Multilayer nanocomposite films, UV protection property

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Introduction

UV irradiation causes severe damage to cotton fabric in terms of color, mechanical strength, and human physiological comfort.[1] To make the case worse, the rays at the wavelength of UVA (315–400 nm) and UVB (280–315 nm) have harmful effects on human skin, resulting in sunburn, allergies, and even skin cancer.[2,3] However, the ultraviolet protection factor (UPF) of cotton is too low to protect wearers against UV irradiation.[4] Consequently, improving the UV protection properties of cotton fabric is a major challenge in the application of cotton when the products are subject to severe UV irradiation. Metal oxide nanoparticles have brought UV protection properties to cotton fabric, and increased research attention has been put in this area. Among the metal oxide nanoparticles, titanium dioxide (TiO_2) is the most popular candidate used in UV-protective textiles due to its excellent physicochemical properties, chemical stability, nontoxicity, and low cost.[5–10] Immobilization of TiO_2 nanoparticles on the surface of cotton fabric is the usual method to serve this purpose, and several techniques have been explored to apply the coatings on fabric substrates. These techniques include dip coating,[11,12] atomic layer deposition,[13] mini-emulsion polymerization,[14] hydrothermal method,[15] in situ sonosynthesis,[16] and layer-by-layer self-assembly.[17] The LbL self-assembly technique is environmentally benign, relatively fast, and simple, and no expensive equipment or organic solvents are involved.

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何满堂

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Article

Growing ZnO Nanoparticles on Polydopamine-Templated Cotton Fabrics for Durable Antimicrobial Activity and UV Protection

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Abstract: This work aims to develop durable functional cotton fabrics by growing zinc oxide (ZnO) nanoparticles on polydopamine (PDA) templates. ZnO nanoparticles were grown on the PDA-templated cotton fabrics by the hydrothermal method at room temperature. The surface morphology, chemical composition, and crystalline structure of the ZnO-coated cotton fabrics were characterized by scanning electron microscope (SEM) with energy dispersive X-ray analysis (EDX), X-ray diffraction (XRD), and X-ray photoelectron spectroscopy (XPS). The ZnO nanoparticles were found to disperse evenly on the surface of cotton fabrics. The ultraviolet (UV) protection factor (UPF) value of the ZnO-coated cotton fabrics was maintained at 122.5, and 99% reduction in bacterial load was observed against *Gluconobacter cerinus* even after five cycles of laundering. The PDA was found to be effective in fixing the ZnO seeds tightly on the surface of cotton fabrics, resulting in excellent durability of the coating of ZnO nanoparticles.

Keywords: ZnO nanoparticles; polydopamine; cotton fabrics; antimicrobial; UV protection

1. Introduction

Functionalization of cotton fabrics is necessary in developing protective clothing and performance textiles [1]. There are many methods by which to functionalize the surface of cotton fabrics, such as coating [2], plasma treatment [3], surface modification [4], grafting [5], and growing of nanoparticles [6]. The most common method is impregnating nanoparticles on the surface of cotton fabrics to endow special properties. Zinc oxide (ZnO) is one of the most applied metallic oxides with high stability, nontoxicity, wide-band-gap semiconductor properties, and low-cost synthesis. It has been applied to endow new functions on textiles, such as antimicrobial activity [7], UV protection [8], self-cleaning [9], and superhydrophobicity [10]. Several methods have been developed to immobilize nanoparticles on the surface of cotton fabrics, including sol–gel [11], pulsed laser deposition [12], ultrasound irradiation [13], self-assembly [14], electroless deposition [15], and hydrothermal methods [16–18]. Among these methods, the hydrothermal method is widely used because it is simple and no special equipment is required, and the good dispersion of nanoparticles can be expected. The resulting nanoparticles from this method have good growth orientation with the morphology controllable by varying the hydrothermal conditions. However, seeding of ZnO on cotton fabrics requires the pad-dry-cure method, in which high temperature is usually applied [19]. The original properties of cotton fabrics will be deteriorated after high temperature treatment and the treatment itself is not

吕 佩

何满堂

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Regulation of pore morphologies of PU films and thereof water vapor permeability by varying tetrahydrofuran concentration in binary solvent

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ABSTRACT

The concentration of tetrahydrofuran (THF) was used to regulate the pore morphologies of PU films using a THF/*N,N*-dimethylformamide (DMF) binary solvent. Macro-void, micro-pore, and potential inter-connected pores are classified according to the cross-sectional FESEM images. Corresponding pore forming mechanisms are proposed. The water vapor permeability (WVP) was linked with total pore areas of different kinds of pores. Mechanical properties as a function of THF concentration was also investigated. Optimized PU coating could be achieved at a 40 wt% THF bearing the tensile stress, strain, toughness, and WVP of 9.2 ± 0.6 MPa, 1063.7 ± 57.1%, 43.6 ± 3.8 MJ m^{-3}, and 1894.3 ± 41.3 g m^{-2}·day^{-1}, respectively. This provides an alternative avenue for the production of PU coating with balanced mechanical property and WVP.

1. Introduction

PVC plastisols, polyacrylates, and polyurethanes (PU) are used to coat textile and synthetic leather on a large scale to alter their physical and haptic properties. Among which, PU is the only choice that fulfills particular requirement for permanent resistance to creasing at low temperatures [1,2]. Presently used coating for textile industry is the PU solutions in *N, N*-dimethylformamide (DMF) *via* phase inversion method [1], such as solvent evaporation, thermal precipitation, and non-solvent induced phase separation. Of all these techniques, non-solvent induced phase separation (NIPS) is a simple and one of the most popular film formation methods for preparing various film morphologies [3]. As described by several authors [4,5], the polymer solution could separate into a polymer rich phase and a polymer lean phase when the solution was immersed into nonsolvent during NIPS. As more solvent leaves the polymer solution and nonsolvent enters the polymer solution, a porous film was formed. It is known that the morphology of PU films influenced by several parameters including the type of solvents [6,7], the composition of non-solvents [5], and the film formation conditions [5]. In the NIPS process, the inevitable macro-voids formed inside PU coating due to fast solvent exchange deteriorate the mechanical property of the coating and thusly are highly desired to be avoided [8]. Besides the sufficient mechanical property, the wearing comfort is another main objective for PU-coated textile and synthetic leather which is tightly associated with their water vapor permeability [9]. Yang et al. [4] described the fabrication of polyurethane porous films with controlled morphology and excellent permeability using water micro-droplet as coagulant. Cross-sectional morphologies of PU film demonstrated that the reduced exchange rate between the solvent and nonsolvent resulted in an uniform porous structure. Boon et al. [10] fabricated hollow fiber by adding polyvinylpyrrolidone (PVP) into polyethersulfone/N-methyl-2-pyrrolidone solution. The resulting sponge morphologies confirmed that the macro-molecular additives could suppress macro-void formation by delaying demixing. Kuo et al. [11] fabricated polyvinylidene fluoride microporous membrane using alcohol as coagulant, which resulted in a delayed demixing with reduced amount of macro-voids. Thusly, the precipitant diffusion rate into casting solution determines the final morphologies and mechanical properties of PU films.

In this work, NIPS method is adopted to regulate the pore morphologies of PU coating by varying the weight percentage of the phase separation retarder, THF, which also acts as a co-solvent with DMF. Increased THF weight percentage is effective to reduce the macro-voids. Corresponding mechanical property of final PU film is significantly improved by the improved breaking strength and toughness up to 11.6 ± 0.7 MPa and 62.4 ± 4.4 MJ m^{-3}, respectively.

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Depositing a flexible substrate of triangular silver nanoplates onto cotton fabrics for sensitive SERS detection

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ABSTRACT

A flexible and effective substrate for surface-enhanced Raman spectroscopy (SERS) detection has been developed by dip coating of triangular silver nanoplates (TSNPs) onto cotton fabrics. The morphology, chemical composition and crystalline structure of the coated cotton fabrics were characterized by scanning electron microscope (SEM), ultraviolet-visible spectroscopy (UV-vis), X-ray photoelectron spectroscopic (XPS) and X-ray diffraction (XRD), respectively. These results confirmed the presence and well dispersion of the TSNPs on the surface of cotton fabrics. *p*-aminothiophenol (PATP) has been used as the probe molecule to evaluate the performance of the coated cotton fabrics as a flexible SERS substrate, and the PATP in diluted solutions can be detected with the concentration as low as 10^{-8} M. The results indicate that the TSNPs-coated fabrics exhibit sensitive SERS signals with excellent reproducibility and stability. The flexible SERS substrate has been demonstrated to rapidly detect carbaryl pesticides on fruits.

1. Introduction

As a powerful analytical technique for detecting molecular species on surfaces, SERS is sensitive, accurate, trustable and repeatable, with application in materials science, surface science, biological and medical testing and diagnosing [1–5]. The determining factor for SERS is the active surface that decides the intensity and repeatability of SERS signals. Metal nanoparticles exhibit strong enhanced Raman scattering effect, and the preparation of nanostructural surface from them has been an important challenge for SERS [6–8]. TSNPs have been extensively studied as the substrate for SERS due to their strong SERS performance [9–12].

Currently, TSNPs for SERS substrates are mainly in the form of self-assembled nanoparticles. In order to enhance the SERS performance with stability, nanoparticles are usually piled up to form a membrane on the substrate [13]. A SERS active surface was usually formed from metal nanoparticles on a solid substrate, such as silicon [14], copper [15], quartz [16] or glass [17]. The flexible SERS substrates are more favorable in application as they have good mechanical properties with well-covering effect and large surface areas. TSNPs have been applied as flexible SERS substrates with flexible matrices, such as filter papers [18], egg shell [19], graphene oxide [20] and textile fabrics [21].

Textiles are promising flexible SERS substrates for adsorption and diffusion of probe molecules with strong Raman signals due to their mechanical flexibility, porous structure, large specific surfaces and permeability. Liu et al. prepared SERS substrates through in-situ synthesis of gold nanoparticles on silk fabrics, and the SERS performance was discussed [22]. Qu et al. fabricated SERS cotton swabs by assembly of Ag-NPs with a detection limit of Rhodamine 6G (R6G) at 8.1×10^{-13} M [23]. Zaffino et al. presented a silver colloid on wool fibers to obtain Fourier-transform surface-enhanced Raman spectra (FT-SERS) of natural historical dyes [24]. However, there are no reports on the application of TSNPs as a flexible SERS substrate.

In this study, a flexible SERS substrate was prepared by self-assembly of TSNPs on cotton fabrics. The morphology and structure together with thermal stability of the TSNPs-coated cotton fabrics were characterized by SEM, UV-vis, XPS, XRD and TG. PATP was used as the probe molecule to evaluate the sensitivity, reproducibility and stability

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Fabrication of Size-controllable Nanoparticles from Feather Waste

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Abstract

Feather is a waste product generated in large quantities from industrial poultry processing, which has distinctive properties such as high protein content, biodegradability and biocompatibility [1-5]. In this study, the feasibility of producing nanoparticles from feather waste by conversion of alkaline and acid was investigated. The effect of NaOH concentration on the size of particles was evaluated to optimize the best condition. The results show that the smallest size of particles around 50 nm were obtained in the presence of 8% wt sodium hydroxide. SEM indicated the fiber fibrillation and degradation as it was progressively converted into particles form. FTIR showed no remarkable changes in the chemical composition of prepared samples.

Keywords: Size; Feather; Nanopaticles; Alkali; Acid

1. Introduction

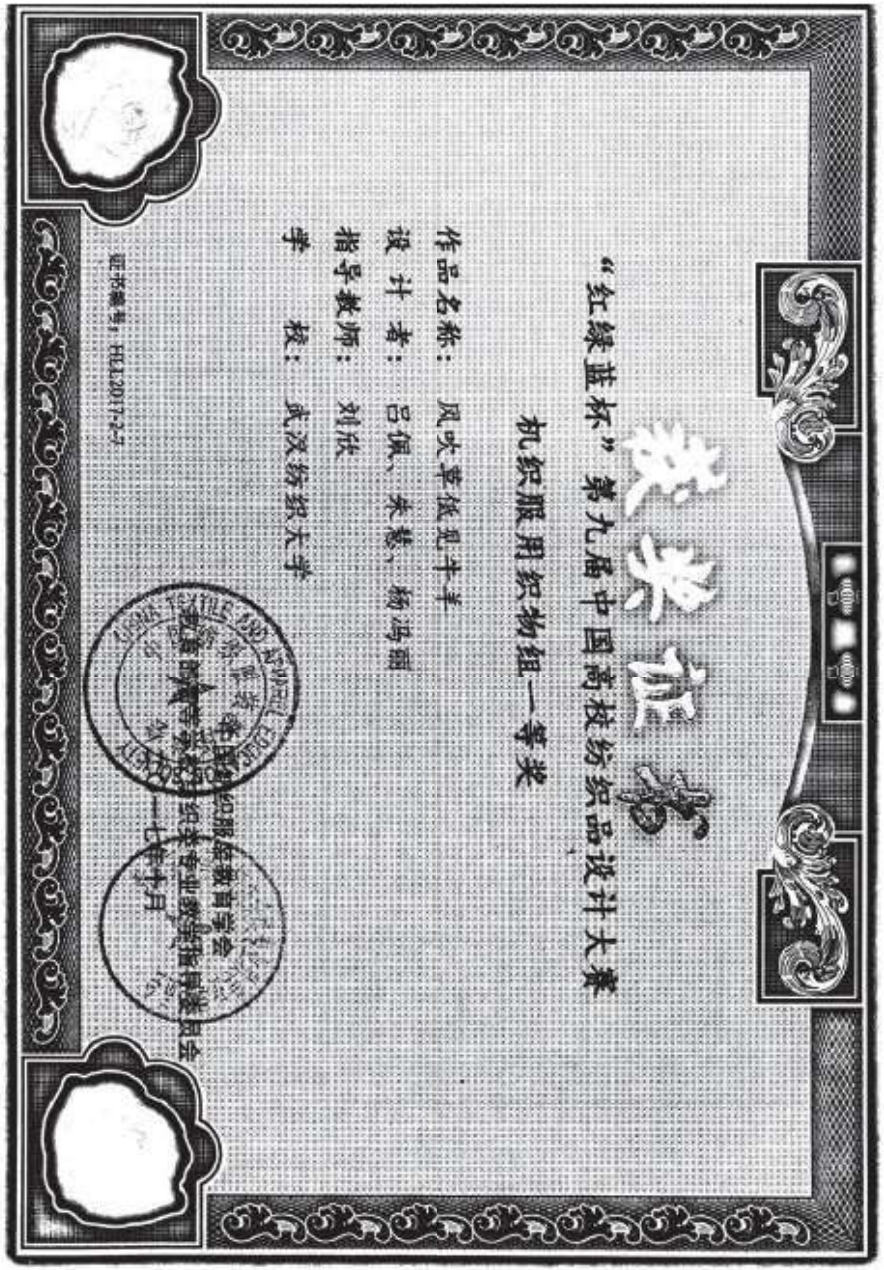
Environmental concerns continue to prompt research into the replacement of synthetic materials with an increasing variety of natural materials [6-8]. Poultry feathers are a significant waste material produced by the meat processing industry [9-11]. Fibers from feathers have several distinctive features such as: surface toughness, flexibility, high length to diameter ratio, hydrophobicity, and a highly organized morphology characterized by its complex hierarchical structure [12, 13]. However, in most cases, the feathers are disposed of by burial, whereas an improved, more effective, and hopefully profitable utilization of feather waste is desirable [14, 15]. Therefore, recycling of this renewable source of biopolymers has been the objective of many researches. Since the protein particles could keep the original properties of the material without destroying the microstructure, it has been widely applied in modern industries. In the investigation of Barone et al. [16], while polyethylene-based composites were prepared using keratin feather fiber obtained from chicken feathers, the best composite properties were found at processing temperature of 205℃, which seems to be relatively high. Bullions et al. concluded that polypropylene matrix composites could be fabricated using feather fiber, recycled kraft pulp fiber, recycled news pulp fiber, retted kenaf bast fiber [17].

However, it seems difficult to obtain different sizes of particles required for specific fields. In this paper, size-controllable nanoparticles were obtained from feather fibers by the treatment with sodium hydroxide. The effect of alkaline on the particles morphology were characterized. Results showed that most spherical particles were around 50 nm treated by 3 wt% sodium hydroxide. The influence of alkaline concentration on the size of feather nanoparticles were also studied, which is believed to be one of the most promising approachs due to the milder process conditions leaving no harmful byproducts.

2. Experimental

2.1 Materials

Feather fibers were kindly supplied by Zhejiang Natural Group. Sodium hydroxide (AR) and sulfuric acid (CP) were pruchased from Sinopharm Chemical Reagent Co.,Ltd (China). Distilled water was employed in all



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论 文 题 目：酸碱转换法制备尺寸可控多肽粒子

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王秋胜

materials

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Review

3D Printing of Silk Fibroin for Biomedical Applications

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Abstract: Three-dimensional (3D) printing is regarded as a critical technological-evolution in material engineering, especially for customized biomedicine. However, a big challenge that hinders the 3D printing technique applied in biomedical field is applicable bioink. Silk fibroin (SF) is used as a biomaterial for decades due to its remarkable high machinability and good biocompatibility and biodegradability, which provides a possible alternate of bioink for 3D printing. In this review, we summarize the requirements, characteristics and processabilities of SF bioink, in particular, focusing on the printing possibilities and capabilities of bioink. Further, the current achievements of cell-loading SF based bioinks were comprehensively viewed from their physical properties, chemical components, and bioactivities as well. Finally, the emerging issues and prospects of SF based bioink for 3D printing are given. This review provides a reference for the programmable and multiple processes and the further improvement of silk-based biomaterials fabrication by 3D printing.

Keywords: silk fibroin; 3D printing; bioink; properties; biomedical applications

1. Introduction

In recent years, three-dimensional (3D) printing is a promising strategy to the biomedical field and it is regarded as a future alternative to current clinical treatments. Not only that it can alleviate the artificial organ or tissue shortage crisis, but it can also design and produce complex and precise microstructures according to reconstruction of tissue engineering requirements [1–3]. More importantly, a series of advanced 3D printing techniques have been approved to achieve structural and functional consistency with model design, which means that competitive manufacturing technology is ready for tissue repair and transplantation [4–6]. Bioink as a core of the 3D printing is the key to success for 3D printing products. Specifically, bioinks loading cells, growth factors, and cues for bio-applications are still in the early stage in 3D printing. Therefore, it is an urgent need to seek an appropriate material as bioink for 3D printing.

Bioinks are cell-encapsulating biomaterials that are used in 3D printing process and they must be friendly to both printing process and 3D cell culture [7]. However, most of biomaterials are insufficient in meeting requirements of ideal bioink, so that choosing a suitable biomaterials as bioink plays an significant role in rebuilding the similar function of native tissue following the principle of tissue engineering [8]. In the field of tissue engineering, the three strategies that were used to replace or repair native tissue: using cells, cytokines, or cell substitutes only; using biocompatible biomaterials only to induce tissue regeneration; combination of using cells, cytokines, and biomaterials [9]. Thus, including non-toxic, cytocompatibility, bioactivity, free-standing, and applicable mechanical properties, and cell-loading and encapsulation ability in the physiological conditions, are the pre-requirements and properties of the biomaterial as a bioink. Additionally,

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Facile preparation of bioactive silk fibroin/hyaluronic acid hydrogels

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ABSTRACT

Proteins and polysaccharides are primary components in mammal soft tissue. In this study, we established a rapid hydrogel to imitate the nature extracellular matrix via silk fibroin (SF) and hyaluronic acid (HA) blend hydrogel. SF/HA hydrogel was prepared effectively, and its formation time was shorted. With the increase of HA content, the water absorption, porosity and breaking strengths of the hydrogel increased, while hydrophilic of the hydrogel was enhanced extremely determined by contact angle decreasing. Especially, the SF/HA hydrogel with a ratio of 5:5 presented the highest water absorption and mechanical properties. The molecule conformation of the composite hydrogel was mainly amorphous structure and contained the small number of β-sheets which gradually decreases with the increase of HA content. In drug release test, accumulative release ratio of the composite gel was about 80% at day 40. And the mass loss of the hydrogel reached approximately 78% in vitro degradation. In vivo, the SF/HA hydrogels presented good histocompatibility and promoted vascular-like tissue regeneration when were implanted subcutaneously of Sprague Dawley rats. This study provides a new approach to fabricate silk-based biomaterials for soft tissue regeneration.

1. Introduction

The use of biocompatible hydrogel to assist soft tissue repair has great potential for in biomedical field [1,2]. A composite gel with proteins and glycosaminoglycans is attracted more attention which could mimic mainly compound and structure of the human nature soft tissue. However, the hydrogel clinic use is greatly limited by its long gelation time and unstable insolubility [3,4]. This challenge motivates the researches to implore more novel hydrogels to meet clinical requirements.

Bombyx mori silk is protein-based natural biopolymer consisting of fibrous proteins fibroin as the core and glue-like proteins called sericin that surround the fibroin fibers. To date, silk fibroin (SF) has been widely used for biomaterials due to its outstanding biocompatible and tunable degradation [3–5]. Recently, SF based hydrogel has received extensive attention toward the application in tissue engineering and drug delivery therapies [6–12]. Hyaluronic acid (HA, also referred to as hyaluronan), one composition of the extracellular matrix, plays a vital role in tissue regeneration and angiogenesis. HA exhibited good biocompatible and promotion of soft tissue regeneration via its water retention and bioactivity sites [9,13], which allows small molecules in the hydrogel could be a good penetration and diffusion. SF and HA blend hydrogels mimicking nature extracellular matrix are ought to good bioactivity of soft tissue rebuilding. Also, SF/HA hydrogel was easily crosslinked by chemical agents and enzymes [14] and injected into the spinal cord injury area could inhibit the formation of glial scar [15–17].

SF based hydrogels are easily fabricated by inducing structural transition into β-sheets to form physical cross-linking in aqueous SF solution [18]. Yet, this process is usually time-consuming, and the mechanical properties of the hydrogel are disappointing. For SF solution based on aqueous system with concentrations from 0.6% to 15%, its gelation time over several days to weeks was required [18]. Hence, physical methods such as vortexing, sonication were explored for enhancement sol-gel transition [2,19–24]. Reducing pH near to the isoelectric point of SF and adding surfactant also could reduce the gelation time from a few hours to 15 min [24,25]. However, these hydrogels tolerated poorly mechanical properties and wild processing with chemical agents, which is detrimental to their use in regenerative medicine. Therefore, a facile and practical approach to build rapid SF based hydrogel with good mechanical performance was an urgency need in silk-based biomaterials.

In this study, we developed a rapid hydrogel with silk fibroin and hyaluronic acid by crosslinked with carbodiimide. The gelation time of

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Materials Research Express

王秋胜

PAPER

Facile fabrication of silk fibroin microspheres via electrostatic assembly

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Abstract

Silk-based microsphere received remarkable attentions due to its impressive biocompatibility and biodegradation in drug delivery system. However, its application was still limited by complex process and unfriendly chemical agents using. In this study, we developed a novel approach to prepare silk fibroin nano or microspheres rapidly via electrostatic assembly. We demonstrated experimentally that the silk fibroin microsphere (SFM) with diameters ranging from 0.5 μm to 3 μm could be easily fabricated by combining pH value adjustment and low voltage electrostatic field. The production was optimized to be a simple and highly repeatable process that did not require sophisticated equipment and chemical agents. SFM represented α-helix structure enriching and homogeneous morphology, as well as improved dispersion and controllable size by regulating the silk fibroin concentration. The SFM demonstrated concentration-dependent drug release behavior with about 75% accumulative release ratio at day5. Thus, this SFM with high production efficiency and promise features provided a new drug carrier and substitute in control release field.

1. Introduction

Microspheres provide a predictable opportunity for regenerative medicine and life science, such as drug delivery systems, cell culture carriers, and enzyme carriers [1–3]. Especially, microspheres are gaining increasing attentions as drug delivery system due to its efficiency and controllability [4, 5]. Up to now, many kinds of drug delivery system have been developed, including polymeric micelles, liposomes, microspheres, water-in-oil emulsification method, and nanoparticles [6–10]. As a drug delivery vehicle, microspheres should exhibit some excellent performances, such as sufficient stability for function, excellent incorporation for drugs and green process etc [11]. Considering requirements of microsphere and its fabrication, the protein material continued to be useful to prepare the nano or microspheres as promise applications in biomedicine field.

In recent years, silk fibroin as a natural polymer with a broad range of potential applications in textile, advanced materials, biomedical devices and drug delivery [12–15], which dependents on its impressive mechanical properties, good biocompatibility, biodegradability, and low-inflammatory response. Silk fibroin microspheres (SFM) showed a high promise to be effective vehicles of drug carrier [16]. This prospect motivated many researches develop various methods to prepare SFM, such as phase separation, emulsion-solvent evaporation method, electrostatic spraying, spray drying and self-assembly [17–21]. However, the barriers that the microsphere prepared with complex process and chemical or toxicant agents hinder its application in the medical field of drug release. To overcome the drawbacks, electrostatic field was employed to assemble the SFM without chemical agents [22]. Under electric fields, the silk fibroin molecules were drafted and assembled into nano or microspheres. Although this approach meets a friendly mild need of the SFM preparation, the challenges of time-consuming, the low productivity and non-uniform size of SFM still remained.


武汉纺大两研究生获评“长江学子”，他是执行力超强的科研小伙，也是踏足多领域的创业女侠

长江学子 青春风采

王秋胜

王秋胜

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ORIGINAL RESEARCH

Polydopamine-assisted immobilization of Ag@AuNPs on cotton fabrics for sensitive and responsive SERS detection

Deshan Cheng · Xue Bai · Mantang He · Jihong Wu · Hongjun Yang · Jianhua Ran · Guangming Cai · Xin Wang

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Abstract Depositing anisotropic noble metal nanoparticles with high uniformity and yield on flexible substrates is the determining factor for surface enhanced Raman spectroscopy (SERS) detection. In this work, flexible, durable and sensitive SERS substrates were fabricated by in situ reduction of Ag nanoparticles on polydopamine templated cotton fabrics (CF) as catalytic hotspots to enhance the following deposition of Au nanoparticles. The coated CF were characterized by scanning electron microscopy (SEM), X-ray photoelectron spectroscopy and X-ray diffraction to understand the surface morphology, chemical composition and crystalline structure, respectively. The SEM images indicate that the nanoparticles are dispersed evenly on the CF. 4-Mercaptobenzoic acid (4-MBA) has been used as the probe molecule to evaluate the sensitive and reproducible SERS properties of the as-fabricated SERS substrate. The as-prepared SERS substrates were demonstrated to detect carbaryl pesticides on a cucumber, and carbaryl with the concentration of as low as 10^{-6} M (0.20 ppm) could be detected to ensure food safety.

Keywords Polydopamine · Cotton fabrics · AgNPs · AuNPs · SERS

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Introduction

Organophosphorus compounds are widely used as pesticides due to their excellent insecticidal performance (Worek et al. 2016; Hiscock et al. 2015), which has aroused a big concern of food safety. Conventional detection methods of these pesticides are commonly performed with complex instrumentation such as chromatography (Kiljanek et al. 2016), fluorescence spectrometry (Chen et al. 2015) and mass spectrometry (Bamba 2015), and require complicated sample pretreatment process and long detection time with high costs (Lan et al. 2017; Xu and Lu 2015). Simple, real time, rapid and efficient methods of pesticides are highly demanded. Surface enhanced Raman spectroscopy (SERS) is one of the most prominent spectral

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In situ hydrothermal growth of Cu NPs on knitted fabrics through polydopamine templates for heating and sensing

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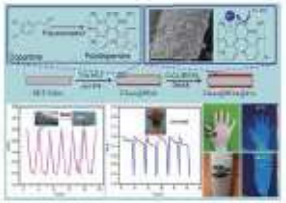
HIGHLIGHTS

- Implementing in situ hydrothermal growth of Cu NPs on textiles.
- Introducing polydopamine as a template to facilitate growing nanoparticles.
- Fibrous structure has been preserved with nanoparticles deposited on fibers.
- Durable and highly-flexible textile based wearable sensor was developed.

GRAPHICAL ABSTRACT



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Polydopamine
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Electrical conductivity
Wearable sensor
Heater

ABSTRACT

Incorporating conductive components into fibrous structure for wearable applications has attracted research attention recently. However, utilizing the flexibility and wearability of textiles to maintain a stable and durable wearable performance is a big challenge, as the intrinsic properties of textiles and the conductivity of the incorporated components have to work synergically in the fibrous system without compromising. In this work, polydopamine-templated PET fabrics were prepared to grow copper nanoparticles (Cu NPs) on the surface of the knitted PET fabrics. The surface morphology, chemical composition and crystalline structure of the Cu NP-coated PET fabrics were investigated by scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), X-ray photoelectron spectroscopy (XPS) and X-ray diffraction (XRD). The results showed that Cu NP layer was successfully deposited onto the polydopamine-templated PET fabrics. The fabrics showed excellent electrical conductivity due to the loading of Cu NPs. The unique knitted structure together with the durable deposition of Cu NPs resulted in negative change in electrical resistance of the fabrics under strains, granting the fabrics the potential in wearable applications. The Cu NP-coated PET fabrics were demonstrated to be applicable as wearable strain sensors and electrical heaters.

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Cellulose
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ORIGINAL RESEARCH

Mussel-inspired fabrication of superhydrophobic cotton fabric for oil/water separation and visible light photocatalytic

Deshan Cheng · Yali Zhang · Xue Bai · Yuhang Liu · Zhongmin Deng · Jihong Wu · Shuguang Bi · Jianhua Ran · Guangming Cai · Xin Wang

Received: 21 January 2020 / Accepted: 4 April 2020

Abstract Flexible multiple functional textiles for oil/water separation and photodegradation are highly demanded in highly effective and environmentally friendly wastewater purification. In this work, β-FeOOH nanorods were in situ hydrothermally grown on polydopamine (PDA)-templated cotton fabric (CF) followed by decoration of 1-Dodecanethiol (DDT) on the surface for highly efficient oil/water separation and visible-light-driven photodegradation of dyes. The morphology, structure and wettability of the as-prepared fabrics were characterized and the oil/water separation together with photocatalysis of MB were investigated. The results showed that β-FeOOH nanorods were successfully grown on the PDA-templated cotton fabrics with durable hydrophobicity and lipophilicity. The as-prepared fabrics were demonstrated in oil/water separation of different oil with high separation rates, and the mechanism was proposed. The fabrics also showed excellent visible-light-driven photocatalytic performance in degrading methylene blue (MB) solution with stability and reliability, and the photocatalysis mechanism was contributed. This work provides insights on developing multiple functional textiles by combining photocatalysis with special wettability.

Keywords Oil/water separation · Photocatalysis · β-FeOOH · Polydopamine · Cotton fabric

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白 雪

“中国化学纤维工业协会·恒逸基金”
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为了鼓励化纤科技工作者开展学术研究、勇于创新，推动行业技术进步，表彰在全国化纤行业基础研究、管理创新、成果推广中做出突出成就的个人，特发此证，以资鼓励。

论文题目：基于 PDA 棉织物沉积 Ag@Au 纳米粒子的 SERS 检测

奖励等级：三等奖

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二〇一九年六月

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二〇一九年六月

黄成豪

白 雪、黄成豪

Cellulose
https://doi.org/10.1007/s10570-019-02558-y

ORIGINAL RESEARCH

Composite nanofiber membranes of bacterial cellulose/halloysite nanotubes as lithium ion battery separators

Chenghao Huang · Hui Ji · Bin Guo · Lei Luo · Weilin Xu · Jinping Li · Jie Xu

Received: 18 April 2019 / Accepted: 3 June 2019

Abstract Composite nanofiber membranes comprising bacterial cellulose (BC) and halloysite nanotubes (HNTs) were prepared by vacuum filtration. The tensile strength and ionic conductivity of the nanofiber membranes were improved by the blending of HNTs. The BC/HNTs nanofiber membrane with m(BC): m(HNTs) = 150: 1 (denoted as BC/HNTs-150) exhibited superior tensile strength (84.4 MPa), high porosity (83.0%), outstanding thermal stability as well as good electrolyte retention (369% electrolyte uptake). In addition, the BC/HNTs-150 membrane delivered a higher ionic conductivity (5.13 mS cm^{-1}) than that of the BC (2.88 mS cm^{-1}) and commercial PP–PE–PP (2.05 mS cm^{-1}) separators. The battery containing the BC/HNTs-150 separator also showed better capacity (162 mAh g^{-1}) and cycling property (95% after 100 cycles) than the battery using the BC separator, demonstrating the BC/HNTs composite membranes to be hopeful candidates used in high-performance lithium-ion batteries.

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2019 年桑麻奖学金评审结果公示

根据《武汉纺织大学桑麻奖学金评选管理办法》的相关规定，经个人申请，学院推荐，学校评审小组专家评审，拟推荐以下 3 人为我校 2019 年桑麻奖学金研究生候选人。

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	学号	姓名	学院	等级
1	1715043026	黄成豪	材料学院	一
2	1715073020	白雪	纺织学院	二
3	1715313067	赵红艳	服装学院	三

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联系人：熊老师，联系电话：027-59367500。

武汉纺织大学研究生处

2019 年 7 月 4 日

黄成豪

ARTICLE IN PRESS

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TEMPO-oxidized bacterial cellulose nanofiber membranes as high-performance separators for lithium-ion batteries

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ARTICLE INFO

Keywords:
Bacterial cellulose
TEMPO oxidation
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Separator
Lithium-ion battery

ABSTRACT

In this paper, 2, 2, 6, 6-tetramethylpiperidine-1-oxyl (TEMPO)-oxidized bacterial cellulose (TOBC) nanofiber membranes as separators of lithium-ion batteries were successfully prepared from a water dispersion of TOBC nanofibers via a vacuum filtration approach. The TOBC membranes had adequate porosity and desirable affinity with the liquid electrolyte and lithium electrode, giving rise to superior electrolyte uptake and small interfacial resistance. Among the TOBC nanofiber samples, the TOBC1.0 membrane exhibited the best properties, including high electrolyte uptake (339 %), superior electrochemical stability window (> 6.0 V), outstanding ionic conductivity (13.45 mS cm^{-1}) and small interfacial resistance (96 Ω). The half cells obtained using the TOBC1.0 membrane achieved a discharge capacity of 166 mA h g^{-1} (0.2 C), corresponding to 97.6 % of the theoretical value of $LiFePO_4$ (170 mA h g^{-1}), excellent cycle stability (with capacity retention of 94 % after 100 cycles) at 0.2 C and good C-rate performance. Thus, the TOBC nanofiber membranes could be considered as a promising high-performance separator used in lithium-ion batteries.

1. Introduction

Lithium-ion batteries (LIBs) have become a key component for energy storage systems owing to their superior energy density, fast charging, good service lifespan, low self-discharge rate, high operation voltage and negligible memory effect (Huang, 2011; Jabbour, Bongiovanni, Chaussy, Gerbaldi, & Beneventi, 2013; Li, Wang, Chen, & Huang, 2009; Qiu et al., 2019; Zhao et al., 2019). They have been widely used in consumer electronics, aerospace technology, electric vehicles and other fields. In recent years, the safety of LIBs has attracted extensive concerns (Lee, Yanilmaz, Toprakci, Fu, & Zhang, 2014). As one of the indispensable parts of LIBs, the separator not only provides a smooth path for the transport of lithium ions (Li^+) between the anode and cathode, but also acts as an electrically insulating unit to avoid internal short circuiting caused by accidental contact between the electrodes (Deimede & Elmasides, 2015). Therefore, the separator plays an important role in influencing the performance and safety of LIBs.

Microporous polyolefin membranes (polyethylene (PE), polypropylene (PP) and their composites) have been widely used in contemporary LIBs on account of their low cost, good tensile strength, excellent chemical and electrochemical inertness as well as shutdown behavior (Huang, 2011). However, their inferior electrolyte wettability and poor porosity limit the electrolyte storage capacity, consequently leading to low ionic conductivity and undesirable LIB performance (Fang, Yang, Zhao, Du, & Xiong, 2016; Lee, Jeong, & Cho, 2013). Furthermore, thermal stability of the polyolefin membranes is quite poor, which might result in sharp thermal shrinkage and severe safety problems during battery operation. The limitation of the thermal features have impeded their further applications especially in high-power LIBs and also aroused wide safety concerns (Feng et al., 2018; Fu, Luan, Argue, Bureau, & Davidson, 2012; Li et al., 2015; Liao, Hong, Zhang, & Li, 2016; Zhang et al., 2019). As a result, the developments of novel separators with superior electrolyte wettability and heat resistance for LIBs have become imperative.

Cellulose, one of the most available biomacromolecules in nature, has been extensively attempted as separator materials in LIBs on

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Purification of dye-contaminated ethanol-water mixture using magnetic cellulose powders derived from agricultural waste biomass

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ARTICLE INFO

Keywords:
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Magnetic cellulose powder
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Dye adsorption
Ethanol-water mixture

ABSTRACT

Eco-friendly ethanol (EtOH)-water (H_2O) mixture has demonstrated huge potential in the textile industry. However, the uncontrolled discharge of dye-contaminated EtOH-H_2O mixture to the ecosystem has numerous adverse effects. Herein, a sustainable approach utilizing the agricultural waste biomass-*Juncus effusus* (JE) to synthesize magnetic cellulose JE powders (M-JEPs) has been proposed for purification of dye-contaminated EtOH-H_2O mixture. Batch experiments and physical-chemical analyses were performed to explore the adsorption performance and mechanism. The as-prepared cellulose M-JEPs exhibited ultrafast adsorption performance, which can reach the adsorption equilibrium within 10 min. The adsorption isotherms and kinetics demonstrated that the adsorption fitted well with the Langmuir isotherm and pseudo-second-order kinetic models, exhibiting the maximum adsorption capacity towards C.I. Reactive Red 195 and C.I. Reactive Blue 222 of 58.21 mg/g and 86.06 mg/g at the temperature of 303K. These findings indicate the feasibility of using cellulose M-JEPs for rapid purification of the dye-contaminated EtOH-H_2O mixture.

1. Introduction

Conventional textile dyeing industry is a water-intensive industry, which generates large volumes of effluents containing high concentrations of chemicals and organic dyes, which require complex treatment and purification procedures. The emergence of ecolabels has indicated a shift towards the exploration of substitutes for reducing water consumption. Recently, as a promising alternative to the conventional dyeing method, organic solvent-assisted dyeing technologies, including silicone nano micelle dyeing (Gao et al., 2018), liquid paraffin (Xu, Chen, Wang, & Yang, 2016), D5 media (Li, Liu, Li, & Li, 2011), and alcohol-assisted dyeing (Ferrero & Periolatto, 2012) have been investigated extensively. Among these solvents, the environmental-friendly recycle, biodegradation, and low molecular performance have been taken into account. The EtOH-H_2O mixture has been widely used in the printing and dyeing industry. First, in the ethanol-assisted dyeing, Ferrero, Periolatto, Rovero, and Giansetti (2011)) investigated the dyeing process with the aim of substituting some auxiliary agents with EtOH. Ferrero and Periolatto (2012) reported the advantages of EtOH in the dyeing process compared to other solvents to reduce environmental pollution. According to the investigation of Xia et al. (2018) and Xia, Wang et al. (2020), the EtOH-H_2O system has also shown reduction in salt and water requirements for cotton dyeing, thereby reducing the effluent load. Second, the EtOH-H_2O mixture has demonstrated high extraction efficiency for the extraction of natural dyes from rosella and blue pea flowers, which were reported by Wongcharee, Meeyoo, and Chavadej (2007) and Guinot, Gargadennec, Valette, Fruchier, and Andary (2008), demonstrating the high extraction efficiency of EtOH-H_2O mixture for extracting the flavonoids from the patulitrin and patuletin. Sofyan, Ridhova, Yuwono, Udhiarto, and Fergus (2019) studied the potential of natural dyes extracted with EtOH-H_2O mixture, which enhanced the photoactivity of dye-sensitized solar cells. Third, for the reusing of adsorbent, Alatalo et al. (2016) and Abdi, Vossoughi, Mahmoodi, and Alemzadeh (2017) indicated that the regenerated

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Blocking and Filtering Effect of Filter Tips of Natural Fibers against Mainstream Cigarettes Smoke

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ABSTRACT

Conventional cellulose diacetate filter tips of cigarette (CDFTC) are poor filtration performance of toxic compounds. However, environmentally benign filter tips can be made by replacing cellulose diacetate fibers with various types of natural fibers. In the present work, the blocking and filtering effect of natural fibers such as cotton and wool was examined with regards to the polycyclic aromatic hydrocarbons (PAHs) present cigarette smoke. Using various techniques, including scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) and Fluorescence detection, the blocking and filtering mechanisms were investigated in detail. The results showed that compared with CDFTC, the filter tips made from natural fibers (cotton or wool) were investigated superior at filtering out toxic particles, which is mainly due to the natural twist or crimp along with their longitudinal directions. The efficiency of PHAs removal by the cotton and wool fibers reached 71.0% (with absorption of up to 71.0 μg cig^{-1}) and 60.5% (with absorption of up to 60.5 μg cig^{-1}), respectively. Compared with the Zhongnanhai filter tip used in this study (54.0%), the filtration efficiency of the cotton and wool fibers was increased by 17.0% and 6.5%, respectively.

摘要

传统的醋酸二醋酸纤维素滤嘴（CDFTC）对有毒化合物的过滤性能较差. 然而，用各种类型的天然纤维代替二醋酸纤维素纤维，可以制造出对环境无害的过滤头。研究了棉、毛等天然纤维对卷烟烟气中多环芳烃（PAHs）的阻隔过滤效果. 采用扫描电子显微镜（SEM）、傅立叶变换红外光谱（FTIR）和荧光检测等多种技术，详细研究了封孔过滤机理. 结果表明，与CDFTC相比，用天然纤维（棉或羊毛）制成的滤嘴在过滤有毒颗粒时性能优越，这主要是由于自然扭曲或卷曲及其纵向方向所致. 棉纤维和羊毛纤维对PHAs的去除率分别达到71.0%（吸收高达71.0μg cig-1）和60.5%（吸收高达60.5μg cig-1）. 与中南海滤嘴（54.0%）相比，棉纤维和羊毛纤维的过滤效率分别提高了17.0%和6.5%.

KEYWORDS
Cotton fiber; wool fiber; filter tip; filtration; adsorption; polycyclic aromatic hydrocarbons

关键词
棉纤维; 羊毛纤维; 滤嘴; 过滤; 吸附作用; 多环芳烃

Introduction

Pollution and health hazards caused by smoking have become an urgent global problem (Tian et al. 2009). Mainstream cigarette smoke with its vapor and particulate phase is a complex aerosol,

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In situ synthesis of ternary hybrid nanocomposites on natural *Juncus effusus* fiber for adsorption and photodegradation of organic dyes

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ARTICLE INFO

Keywords:
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Juncus effusus
Nanocomposites

ABSTRACT

Natural biomass-based *Juncus effusus* (JE) fiber offers a wide range of applications in wastewater treatment. Recently, the hybridization of various semiconductors has emerged as an efficient approach to enhance adsorption and photodegradation properties. Herein, we in situ synthesized the ternary hybrid NiO/ZnO/TiO_2 nanocomposites on the JE fiber using a sol-gel method with coprecipitation. The JE fiber with the ternary hybrid nanocomposites was applied for simultaneous adsorption and photodegradation of cationic and anionic dyes from wastewater. The results showed that the as-prepared NiO/ZnO/TiO_2-JE (nano PS-JE) fiber exhibited excellent adsorption and photodegradation properties towards organic dyes. Approximately 98.0% of removal efficiency was achieved towards six kinds of organic dyes under the simulated UV irradiation. Therefore, the as-prepared nano PS-JE fiber may offer a new possibility for wastewater treatment as a promising candidate adsorbent for removing organic dyes.

1. Introduction

The tremendous pressure from water shortage causing irreversible environmental impacts has created significant economic and social challenges. Meanwhile, the organic dyes generated from the textile industry also pose serious threats to the water resources [1–3]. Owing to the stability and long half-life of organic dyes, the efficient removal and degradation of organic dyes from wastewater has been widely investigated [4–6]. Recently, many advanced technologies have been developed to treat the wastewater, such as physical, chemical, and biological methods [7–11]. Additionally, developing a green and sustainable dyeing method with high dye utilization is also another effective way to reduce the pollution generated by organic dyes [12,13]. The energy source of photocatalytic degradation is sunlight, which is both abundant and nonpolluting. Consequently, removing dyes using a photodegradation way is expected to become one of the most promising methods [14–16]. Photodegradation operates within milder conditions, available light sources, which is a stable and highly efficient alternative to traditional decoloration techniques for a variety of organic pollutants in wastewater.

Heterogeneous photocatalysis is emerging as a superior technique to alleviate environmental pollution [17,18]. Among the various photocatalysts, titanium dioxide (TiO_2) and zinc dioxide (ZnO) have been widely used for environmental remediation, which is mainly due to their high oxidizing abilities, stable properties, availability, and low cost [19,20]. However, the single component photocatalysts may limit the UV-light response and extensive applications [21]. Hybrid nanocomposites, based on the combination of various metal oxide semiconductors, have been applied extensively in photodegradation of organic pollutants. Since the production of charge carrier pairs and the separation efficiency of charge carriers can be significantly promoted using the hybrid nanocomposites, the photocatalysis properties can be potentially enhanced correspondingly [22,23]. Compared to the single metal oxide semiconductors, the hybridization of TiO_2 and ZnO exhibits significant photocatalytic activities and results in a synergistic effect. For TiO_2 and ZnO, it is easy to combine with other metals or metallic oxides [24,25]. Due to the closer bandgap energies and similar photocatalytic mechanisms, ZnO is suitable for coupling with TiO_2, exhibiting

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Titanium dioxide decorated natural cellulosic *Juncus effusus* fiber for highly efficient photodegradation towards dyes

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ARTICLE INFO

Keywords:
Juncus effusus
Cellulosic fiber
3D network
TiO_2
Potocatalytic degradation

ABSTRACT

The removal of dyes via photocatalytic degradation has been identified as an eco-friendly method for producing clean and purified water. Natural cellulosic fibers are significant renewable resource and important in a wide range of applications. Herein, we report a natural cellulosic *Juncus effusus* (JE) fiber with 3D network structure as a framework to provide controllable space for the growth of TiO_2 particles. The TiO_2-JE showed remarkable activity in the removal of C.I. Reactive Red 120 (RR120), C.I. Direct Yellow 12 (DY12), and methylene blue (MB) with a photodegradation efficiency of 99.9 % under simulated sunlight irradiation. Additionally, an orientate fabric was fabricated using the prepared TiO_2-JE fibers for the photocatalytic degradation of dye-contaminated water in the sun, further confirming its practical application. The TiO_2 decorated natural cellulosic JE fiber can be a promising material for photocatalysis and sustainable chemistry.

1. Introduction

Water is one of the most vital requirements of living organisms on earth (Vorosmarty et al., 2010). A common observation is that water is abundant on earth but only a small amount is easily accessible, and in the fresh water cases, this is especially true for human (Oki, 2006). However, industrial processes produce toxic wastewater containing aromatic compounds from dyes, which have harmful effects on human immune system and ecosystems. (Dhanya & Aparna, 2016; Meseck, Kontic, Patzke, & Seeger, 2012; Zhang, Li, Li, Li, & Yang, 2018). Conventional adsorption technologies, such as biological degradation (Oh et al., 2014), chemical oxidation (Li, Zhang, Liang, & Yediler, 2013; Sohrabi, Ross, Martin, & Barker, 2013), activated carbon absorption and carbon nanotube nanocomposite absorption (Gao, Zhao, Cheng, Wang, & Zheng, 2013; Hashemian, Salari, Salehifar, & Atashi Yazdi, 2013), ultrafiltration by chemical agents or physical filtration, reverse osmosis, coagulation, and ion exchange (Karimifard & Alavi Moghaddam, 2018; Konstantinou & Albanis, 2004; Natarajan, Thomas, Natarajan, Bajaj, & Tayade, 2011; Tang & An, 1995), because of quantity production and harsh experimental conditions, generation of by-products, and regeneration and reasonable disposal of adsorbents restrict their broader, acceptable application.

As one of the most widely used photodegradable materials, TiO_2 has attracted much attention for the treatment of organic and contaminated components (Hoşgün & Aydın, 2019), due to its biological activity and chemical stability, high oxidizing power toward organic materials, low price, and non-toxicity (Fernández-Ibáñez et al., 2015; Wang et al., 2017; Yang et al., 2017). However, as a single constituent, TiO_2 has some disadvantages, most of which are associated with its limited photocatalytic efficiency in the visible light range on account of its wide band gap and rapid recombination of hole–electron pairs (Da Vià, Recchi, Gonzalez-Yañez, Davies, & Lopez-Sanchez, 2017), low absorption capacity, and low surface area (Cheng, Wang, Zhao, & Han, 2014), thereby reducing its photocatalytic activity. Moreover, in the practical applications, residual TiO_2 nanoparticles in the photocatalytic reaction solution need to be recycled. To address these problems, a large number of synthetic materials, such as polymer films and porous inorganic membranes (Leong et al., 2014; Liu, Chen, Lv, Feng, & Meng, 2015), porous composites (Lefatshe, Muiva, & Kebaabetswe, 2017), composite sponges (Hickman, Walker, & Chowdhury, 2018), clays and clay minerals, zeolites, silica gels, and metal-organic frameworks, as well as complicated methods synthesis have been used to immobilize nano-

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Environment-friendly *Juncus effusus*-based adsorbent with a three-dimensional network structure for highly efficient removal of dyes from wastewater

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ABSTRACT

The increasing contamination of water from textile dyes is one of the major environmental problems facing humanity, which has stimulated extensive investigation of fabricating adsorbents with high removal efficiency and excellent adsorption capacity towards textile dyes. Nature has engineered some intriguing high-performance materials that may be excellent sustainable materials for water purification use. Herein, we report a novel *Juncus effusus* (JE)-based adsorbent with a three-dimensional network structure and interconnected channels for dye removal from wastewater. To further enhance its adsorption capacity towards textile dyes, the biodegradable chitosan (CS) was employed for the chemical modification of the JE fiber. The results showed that the CS–JE fibers exhibited a high adsorption capacity towards three types of anionic dyes at the temperature of 296 K: 526.3 mg g^{-1} for C.I. Acid Yellow 11 (AY11), 452.5 mg g^{-1} for C.I. Reactive Red 195 (RR195), and 255.1 mg g^{-1} for C.I. Direct Blue 15 (DB15), which outperforms most of the reported CS-modified adsorbents. The Langmuir model satisfactorily fitted the equilibrium adsorption curves of the CS–JE fibers. Throughout the kinetics studies, the adsorption fitted well with the pseudo-second-order model and exhibited a two-stage of intraparticle diffusion, indicating the adsorption of the investigated dyes onto the CS-JE fiber is rather complex that both the external surface adsorption and intraparticle diffusion occurred simultaneously. Finally, taking advantage of the specific 3D network structure and interconnect channels of the CS-JE fiber, a vertically oriented CS–JE cake was fabricated using CS–JE fibers for continuous filtration of dyes from wastewater. The cake exhibited high flow flux and rapid filtration performance under continuous flow without requiring additional pressure. The present work confirmed that the CS-JE composite can be a promising candidate for wastewater treatment.

1. Introduction

As one of the most important natural resources, water is the major constituent for human beings, animals, and plants. Despite its well-established importance, there are still many places lack of water due to water pollution. Moreover, although more than 70% of our planet is covered in water, the steady deterioration of the environment results in that less than 3% of them is fresh water (Oki and Kanae, 2006). Even worse, this number is decreased dramatically (Piao et al., 2010). The dyeing effluent discharged from the textile industry is regarded as one of the main causes leading to the continuous decrease of fresh water (Essandoh and Garcia, 2018). It is reported that nearly 25% of the industrial effluents are from textile dyeing (Leaper et al., 2019). Depending on the nature of dyes, there are approximately 100,000 types of dyes commercially available for textile dyeing (Tan et al., 2015). However, owing to the low affinity between fibers and dye molecules, 10–30% of these dyes find their way into industrial wastewaters after the dyeing process (Xia et al., 2018). The wastewaters are generally

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Juncus effusus fiber-based cellulose cigarette filter with 3D hierarchically porous structure for removal of PAHs from mainstream smoke

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Keywords:
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ABSTRACT

Polycyclic aromatic hydrocarbons (PAHs) from cigarettes are one of the main pollutants affecting public health. Herein, a cellulose cigarette filter with three-dimensional (3D) hierarchically porous structure was fabricated using a natural cellulose *Juncus effusus* (JE) fiber, whose pore size was well controlled by biocompatible polyvinylpyrrolidone (PVP) using a simple dip-dry method. The adsorption capacity and mechanism of the PVP–JE filter tips (PJF) against PAHs were investigated in detail. Compared with conventional cellulose acetate filter tips (CAF), the cellulose PJF were superior at filtering and adsorbing of PAHs from mainstream smoke with the removal efficiency of 61.79 %, which was 22.57 % higher than that of CAF (39.22 %). The ternary structures including polymer filter membrane, 3D network, and interconnected channels were demonstrated as the main roles for highly effective removal of PAHs. The JE-based cellulose cigarette filter can be a promising candidature to broaden the application range of polysaccharide in pollutant elimination.

1. Introduction

The urgent global problem of smoking-related hazards has received widespread attention (Tian, Chen, Chen, & Bai, 2009). More than 4000 harmful chemical substances exist in cigarette mainstream smoke (MS), which is a complex aerosol composed of particulate matter, various gases, and organic vapors that generally affect the health of smokers (Senneca, Ciaravolo, & Nunziata, 2007). Some very severe health risks, including cancer, heart disease, and hypertension, can be assumed to result from tobacco smoking or chronic exposure to smoke toxicants with recognized risks to health (Richter, Pechacek, Swahn, & Wagman, 2008). During the sequence of cigarette MS generation, phenomena with various overlapping chemical, physical, and physiological characteristics occur within a complex, dynamic, and reactive system (Borgerding & Klus, 2005). A group of compounds called polycyclic aromatic hydrocarbons (PAHs) from smoking is produced through this extremely complex process, and these have mutagenic, carcinogenic, and endocrine-disrupting properties (Yu et al., 2019; Zhao et al., 2019).

The history of attempting to modify tobacco products to make them less hazardous is a long one, and the utilization of various absorption materials or different filter configurations for absorbing or filtering toxic chemicals from MS has been investigated extensively. Different cigarette filter construction can obviously change filtration properties by altering the physical properties of filter materials, burn rates, combustion, temperature, mainstream chemistry, smoke toxicity, and smoking behavior (McAdam et al., 2016). To reduce the production of harmful substances in MS of cigarettes, there have been attempts to develop a novel tobacco-substitute sheet and smoke dilution, and some alternative materials have also been blended into tobacco to reduce the overall amount of tobacco available for combustion (McAdam et al., 2011). Investigations of cigarette MS have generally concentrated on the particulate phase of the smoke because the constituents penetrating deep into the respiratory tract were particulate matter, which influenced the regional deposition, such as the diameter of the inhaled particulate matter (Bernstein, 2004). Low volatility substances, such as PAHs, tend to reside almost exclusively in the particulate phase, so adsorbing PAHs from cigarette MS is very important (Pankow, 2001). Research on adsorbing materials for removal of toxic chemicals from cigarette MS, which mainly takes advantage of the inherent high adsorption of nanomaterials, is ongoing. The methods of blending

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湖北省教育厅办公室

鄂教学办函〔2021〕2号

省教育厅办公室关于公布第七届“长江学子”大学生就业创业人物事迹征集宣传活动推选结果的通知

各普通高等学校：

根据《省教育厅办公室关于开展第七届“长江学子”大学生就业创业人物事迹征集宣传活动的通知》（鄂教学办函〔2021〕1号）要求，经个人申报、学校审核推荐、专家评议、社会公示，武汉大学郑迪威等100名大学生入选第七届“长江学子”大学生就业创业人物。

各高校要坚持以习近平新时代中国特色社会主义思想为指导，全面贯彻党的教育方针，落实立德树人根本任务，培养德智体美劳全面发展的社会主义建设者和接班人。要深入学习贯彻习近平总书记关于教育的重要论述，扎实推进党史学习教育，通过校园网站、宣传栏、“三微一端”等渠道和平台，做好“长江学子”典型事迹的宣传推介，大力引导高校毕业生树立远大理想、热爱伟大祖国、担当时代责任、勇于砥砺奋斗、练就过硬本领、锤炼品德修为，为经济社会发展贡献力量。要把毕业生就业创业作为立德树人的重要环节，作为“三全育人”重要内容，不断健全“就业思政”工作体系，加强就业指导服务，大力引导毕业生就业创业，为加快实现“建成支点、走在前列、谱写新篇”作出新的更大贡献。

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Juncus effusus fiber-based cellulose cigarette filter with 3D hierarchically porous structure for removal of PAHs from mainstream smoke

Zhuan Fu[a,1], Sijie Zhou[a,1], Liangjun Xia[a,b,*], Yunshan Mao[a], Liyun Zhu[a], Yunqi Cheng[a], Aming Wang[a], Chunhua Zhang[c], Weilin Xu[a,*]

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Keywords:
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ABSTRACT

Polycyclic aromatic hydrocarbons (PAHs) from cigarettes are one of the main pollutants affecting public health. Herein, a cellulose cigarette filter with three-dimensional (3D) hierarchically porous structure was fabricated using a natural cellulose *Juncus effusus* (JE) fiber, whose pore size was well controlled by biocompatible polyvinylpyrrolidone (PVP) using a simple dip-dry method. The adsorption capacity and mechanism of the PVP–JE filter tips (PJF) against PAHs were investigated in detail. Compared with conventional cellulose acetate filter tips (CAF), the cellulose PJF were superior at filtering and adsorbing of PAHs from mainstream smoke with the removal efficiency of 61.79 %, which was 22.57 % higher than that of CAF (39.22 %). The ternary structures including polymer filter membrane, 3D network, and interconnected channels were demonstrated as the main roles for highly effective removal of PAHs. The JE-based cellulose cigarette filter can be a promising candidature to broaden the application range of polysaccharide in pollutant elimination.

1. Introduction

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The history of attempting to modify tobacco products to make them less hazardous is a long one, and the utilization of various absorption materials or different filter configurations for absorbing or filtering toxic chemicals from MS has been investigated extensively. Different cigarette filter construction can obviously change filtration properties by altering the physical properties of filter materials, burn rates, combustion, temperature, mainstream chemistry, smoke toxicity, and smoking behavior (McAdam et al., 2016). To reduce the production of harmful substances in MS of cigarettes, there have been attempts to develop a novel tobacco-substitute sheet and smoke dilution, and some alternative materials have also been blended into tobacco to reduce the overall amount of tobacco available for combustion (McAdam et al., 2011). Investigations of cigarette MS have generally concentrated on the particulate phase of the smoke because the constituents penetrating deep into the respiratory tract were particulate matter, which influenced the regional deposition, such as the diameter of the inhaled particulate matter (Bernstein, 2004). Low volatility substances, such as PAHs, tend to reside almost exclusively in the particulate phase, so adsorbing PAHs from cigarette MS is very important (Pankow, 2001). Research on adsorbing materials for removal of toxic chemicals from cigarette MS, which mainly takes advantage of the inherent high adsorption of nanomaterials, is ongoing. The methods of blending

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In situ synthesis of ternary hybrid nanocomposites on natural *Juncus effusus* fiber for adsorption and photodegradation of organic dyes

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ABSTRACT

Natural biomass-based *Juncus effusus* (JE) fiber offers a wide range of applications in wastewater treatment. Recently, the hybridization of various semiconductors has emerged as an efficient approach to enhance adsorption and photodegradation properties. Herein, we in situ synthesized the ternary hybrid NiO/ZnO/TiO_2 nanocomposites on the JE fiber using a sol-gel method with coprecipitation. The JE fiber with the ternary hybrid nanocomposites was applied for simultaneous adsorption and photodegradation of cationic and anionic dyes from wastewater. The results showed that the as-prepared NiO/ZnO/TiO_2-JE (nano PS-JE) fiber exhibited excellent adsorption and photodegradation properties towards organic dyes. Approximately 98.0% of removal efficiency was achieved towards six kinds of organic dyes under the simulated UV irradiation. Therefore, the as-prepared nano PS-JE fiber may offer a new possibility for wastewater treatment as a promising candidate adsorbent for removing organic dyes.

1. Introduction

The tremendous pressure from water shortage causing irreversible environmental impacts has created significant economic and social challenges. Meanwhile, the organic dyes generated from the textile industry also pose serious threats to the water resources [1–3]. Owing to the stability and long half-life of organic dyes, the efficient removal and degradation of organic dyes from wastewater has been widely investigated [4–6]. Recently, many advanced technologies have been developed to treat the wastewater, such as physical, chemical, and biological methods [7–11]. Additionally, developing a green and sustainable dyeing method with high dye utilization is also another effective way to reduce the pollution generated by organic dyes [12,13]. The energy source of photocatalytic degradation is sunlight, which is both abundant and nonpolluting. Consequently, removing dyes using a photodegradation way is expected to become one of the most promising methods [14–16]. Photodegradation operates within milder conditions, available light sources, which is a stable and highly efficient alternative to traditional decoloration techniques for a variety of organic pollutants in wastewater.

Heterogeneous photocatalysis is emerging as a superior technique to alleviate environmental pollution [17,18]. Among the various photocatalysts, titanium dioxide (TiO_2) and zinc dioxide (ZnO) have been widely used for environmental remediation, which is mainly due to their high oxidizing abilities, stable properties, availability, and low cost [19,20]. However, the single component photocatalysts may limit the UV-light response and extensive applications [21]. Hybrid nanocomposites, based on the combination of various metal oxide semiconductors, have been applied extensively in photodegradation of organic pollutants. Since the production of charge carrier pairs and the separation efficiency of charge carriers can be significantly promoted using the hybrid nanocomposites, the photocatalysis properties can be potentially enhanced correspondingly [22,23]. Compared to the single metal oxide semiconductors, the hybridization of TiO_2 and ZnO exhibits significant photocatalytic activities and results in a synergistic effect. For TiO_2 and ZnO, it is easy to combine with other metals or metallic oxides [24,25]. Due to the closer bandgap energies and similar photocatalytic mechanisms, ZnO is suitable for coupling with TiO_2, exhibiting

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Blocking and Filtering Effect of Filter Tips of Natural Fibers against Mainstream Cigarettes Smoke

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ABSTRACT

Conventional cellulose diacetate filter tips of cigarette (CDFTC) are poor filtration performance of toxic compounds. However, environmentally benign filter tips can be made by replacing cellulose diacetate fibers with various types of natural fibers. In the present work, the blocking and filtering effect of natural fibers such as cotton and wool was examined with regards to the polycyclic aromatic hydrocarbons (PAHs) present cigarette smoke. Using various techniques, including scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) and Fluorescence detection, the blocking and filtering mechanisms were investigated in detail. The results showed that compared with CDFTC, the filter tips made from natural fibers (cotton or wool) were investigated superior at filtering out toxic particles, which is mainly due to the natural twist or crimp along with their longitudinal directions. The efficiency of PHAs removal by the cotton and wool fibers reached 71.0% (with absorption of up to 71.0 μg cig^{-1}) and 60.5% (with absorption of up to 60.5 μg cig^{-1}), respectively. Compared with the Zhongnanhai filter tip used in this study (54.0%), the filtration efficiency of the cotton and wool fibers was increased by 17.0% and 6.5%, respectively.

摘要

传统的醋酸二醋酸纤维素滤嘴（CDFTC）对有毒化合物的过滤性能较差. 然而，用各种类型的天然纤维代替二醋酸纤维素纤维，可以制造出对环境无害的过滤头。研究了棉、毛等天然纤维对卷烟烟气中多环芳烃（PAHs）的阻隔过滤效果. 采用扫描电子显微镜（SEM）、傅立叶变换红外光谱（FTIR）和荧光检测等多种技术，详细研究了封孔过滤机理. 结果表明，与CDFTC相比，用天然纤维（棉或羊毛）制成的滤嘴在过滤有毒颗粒时性能优越，这主要是由于自然扭曲或卷曲及其纵向方向所致. 棉纤维和羊毛纤维对PHAs的去除率分别达到71.0%（吸收高达71.0μg cig-1）和60.5%（吸收高达60.5μg cig-1）. 与中南海滤嘴（54.0%）相比，棉纤维和羊毛纤维的过滤效率分别提高了17.0%和6.5%.

KEYWORDS
Cotton fiber; wool fiber; filter tip; filtration; adsorption; polycyclic aromatic hydrocarbons

关键词
棉纤维; 羊毛纤维; 滤嘴; 过滤; 吸附作用; 多环芳烃

Introduction

Pollution and health hazards caused by smoking have become an urgent global problem (Tian et al. 2009). Mainstream cigarette smoke with its vapor and particulate phase is a complex aerosol,

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High-resilience cotton base yarn for anti-wrinkle and durable heat-insulation fabric

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Heat insulation

ABSTRACT

The hollow structural yarn of cellulose fibers can be easily flattened to remove their heat insulation ability and folded to incur unfavorable wrinkles. In contrast, natural hollow bamboos are flexible and shape-preserving with regard to external forces, and hollow cocoons are heat insulating to protect silkworms. Inspired by hollow bamboos and cocoons, a high resilience cotton base (i.e., silicon tube/cotton composite hollow, denoted as SCH) yarn was constructed by embedding a continuous hollow silicon tube into the cotton wrapping sheath, aiming to mitigate hollow cellulose yarn collapse and wrinkle problems. Comparatively, three other structural cotton base yarns were also designed: cotton core (CC), vinylon-core/cotton-sheath (VC) and vinylon-dissolved cotton hollow (VCH) yarns. ABAQUS CAE was applied to conduct a comparative theoretical finite element analysis of the heat transfer performance of the four different yarns. The theoretical analysis results indicated that the SCH yarn showed the minimum heat transfer performance to obtain maximum heat insulation. Then, the CC, SCH, VC and VCH yarns were fabricated into woven fabrics. The corresponding yarn structure, properties and fabric performance were comparatively analyzed. The analyzed results indicated that the SCH yarn was stronger and more elastic than other yarns, resulting in a maximum anti-wrinkle performance. The compression rebound ratio of the SCH yarn fabric (85.07%) was much higher than that of the VCH yarn fabric (18.78%) and other fabrics, indicating the excellent recovery ability of the SCH yarn. Different from other yarns, SCH yarn stored static air in the silicone tube, allowing a minimum permeability of air. Accordingly, the SCH yarn fabric had a more durable heat insulation rate than the other yarn fabrics.

1. Introduction

In daily life, maintaining body temperature is very important for humans [1,2], especially for those who are often exposed to excessive cold stress in winter, such as polar scientists, railway maintenance workers and sanitation workers. A lack of protection in cold environments often reduces the effective working time and productivity, even increasing the risk of cold-related diseases [3–6]. In extremely cold environments, the solution to the above problems is a protective garment that mitigates the excessive decrease in human skin temperature [7]. With the development of the economy and the progress of society, an individual's requirements for diversified personal thermoregulation have promoted the recovery of personal thermal management (PTM) technology [8]. Although the existing thermal management insulation materials exhibit excellent performance, they are complex and expensive for textile production and application [9]. Up to the present time, cotton-touch garments have played an important role in the textile industry due to their excellent softness, low allergy prevalence, wearing comfort and other properties [10–12]. The application of cotton fibers in personal heat management is a possible method for industrial production.

The heat insulation of static air is much better than that of textile materials [13]. Therefore, various textiles, including fibers, yarns and fabrics, are formed with hollow structures for heat insulation garments.

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付 专

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2020年9月

张佳婧

Fabrication of Polyurethane/Polyurethane Fiber Composite Film with Enhanced Mechanical Property

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Abstract

To obtain synthetic leather with enhanced mechanical properties, we proposed a simple composite fabrication method based on nonsolvent induced phase separation for preparing polyurethane yarn (PUY) reinforced polyurethane (PU) composite films. The morphology of PUY/PU matrix interface and the mechanical properties of the as-prepared composite films were investigated in detail. The results showed that the addition of PUY did not change the microstructure of the PU. The stress and strain of PU/PUY-3 were 61.98% and 32.60% higher than that of PU film. It was proposed that the good interfacial interaction between PUY and PU mainly contributed to the simultaneously improvement in stress and strain. Furthermore, the as-prepared PU/PUY composite films were elastic within the applied tensile strain of 10%. The present work suggests an efficient way to reinforce PU matrix and can be used for design and optimization of leather products.

Keywords: Polyurethane; Fiber; Interface; Mechanical Property

1. Introduction

The leather industry is one of the oldest industries and have modernized fast during decades in China. To meet global demands of high-quality leather products, leather needs to be tanned and finished. The leather processing enterprises produce 1.4 million tons of solid waste such as scraps annually, 75% of which contain chrome, [1]. This may lead to the environment pollution and risks to human health. With the exploration of new materials and new technologies, synthetic leather has developed rapidly in recent years, due to its low cost and low toxic. Synthetic leather usually includes a base of textile and a polymer. Among the polymer, polyurethane (PU) synthetic leather accounts for the largest proportion in the fabrication of synthetic leather [2].

To add synthetic leather all the attributes of natural leather, many researches focused on improving the mechanical properties and moisture permeability of synthetic leather. Wang et al proposed a method of grafting collagen-chrome tannins in the super-fiber synthetic leather base for improve the moisture and transfer abilities [3]; Xu et al used superfine wool power physical blending with PU resin to prepared blend film with permeability [4]; Duo et al mixed polyhydroxybutyrate hydrophilic nanofibers in microfiber synthetic leather base to improve moisture absorbent and transfer abilities [5]; Bai et al used electrospinning to fabricate a blend fibrous membrane with silk fibroin power with high hydrophilicity [6]; Shi et al developed controllable water vapor permeability film by synthesized waterborne PU, elastomeric PU and thermosensitive PU [7]; Zhao et al prepared thermoplastic polyurethane (TPU)/sulfonated polysulfone (SPSf) electrospun nanofibers synthetic leather with high tear strength [8]; Dev Gurera et al used multi-layered nanocomposite coating structure to develop high mechanical durability synthetic leather [9]. However, the enhance moisture permeability of PU were achieved by sacrificing mechanical property.

The PU synthetic leather is usually prepared by nonsolvent induced phase separation (NIPS) and solvent evaporation method (SE). Compared with the PU synthetic leather obtained using SE, the PU synthetic leather obtained using NIPS has good moisture permeability due to its porous structure. However, the mechanical properties of PU synthetic leather fabricated using NIPS needs to be further improved.

In this paper, PU yarns with high orientation are used to prepared PU composites to improve the mechanical

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ORIGINAL RESEARCH

A novel flame-retardant composite material based on calcium alginate/poly (vinyl alcohol)/graphite hydrogel: thermal kinetics, combustion behavior and thermal insulation performance

Jinru Liu · Zhicai Yu · Hualing He · Yushu Wang · Yuhang Zhao

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Abstract Design and development of fire-resistant composite materials with improved flame retardancy are critically needed for firefighters in fire protection fields. Herein, a novel fire-resistant composite hydrogel (FRCH) was fabricated based on calcium alginate (CA), poly (vinyl alcohol) (PVA) and expandable graphite (EG). The obtained FRCH material displayed prominent flame retardancy due to a large amount of heat was removed as contained water evaporation. Meanwhile, the EG in hydrogel occurred expansion to prevent heat transfer when exposed to fire. Results indicated that peak heat release rate and total release rate of FRCH decreased from 264.9 to 67.2 W/g and 15.4 to 12.1 KJ/g, respectively. The thermal kinetic behavior of FRCH was investigated by using Flynn-Wall-Ozawa (FWO) and Kissinger-Akahira-Sunose (KAS) models. TPP test further confirmed that introduction of EG in hydrogel prolonged the second-degree skin burn time for 2.73 s compared to without EG component. Besides, benefiting from the expansion behavior of EG when being burned, EG formed a conductive pathway and resulting in LED light up. This work provided an effective way to prepare flame retardant composite material with an early fire warning detection function, which may meet the requirements in firefighting fields.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10570-021-04047-7.

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ORIGINAL RESEARCH

Green synthesis of silver nanoparticles with black rice (*Oryza sativa* L.) extract endowing carboxymethyl chitosan modified cotton with high anti-microbial and durable properties

Zhicai Yu · Jinru Liu · Hualing He · Yushu Wang · Yuhang Zhao · Qi Lu · Yi Qin · Yushi Ke · Ying Peng

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Abstract Deep exploitation and utilization of renewable industrial crops as the source of eco-friendly and cost-effective natural reductant has becoming an efficient approach to green synthesis of silver nanoparticles (Ag NPs). In this study, an eco-friendly approach for producing durable antibacterial textile based on in situ green synthesis and deposition of Ag NPs on carboxymethyl chitosan (CMCTS) modified cotton fabric was developed. During the operation, $AgNO_3$ and black rice (*Oryza sativa* L.) extract of anthocyanins were employed as precursor solution and natural reductant, respectively. Finally, the Ag NPs were synthesized and linked to cotton fibers through coordination bonds with amine and hydroxyl groups in CMCTS. This novel method imparted cotton fabric with excellent antibacterial ability against *Escherichia coli* and *Staphylococcus aureus.* The effects of $AgNO_3$ concentration in synthesis bath on the apparent colour, surface morphology, silver content, UV protection, laundering durability, and antibacterial activity were investigated. Results indicated that the synthesised Ag NPs were evenly deposited on cotton fibres with great washing resistance and robust hydrophobic properties. This study provides an innovative method towards the clean and scale-up preparation of Ag NPs using black rice extract as green reductant to endow cotton fabrics with durable antibacterial activity, UV protective, and hydrophobic performance, which was possessed of universal applicability for many kinds of industrial crops containing anthocyanins.

Z. Yu · J. Liu · H. He (✉) · Y. Wang · Y. Zhao · Q. Lu · Y. Qin · Y. Ke · Y. Peng
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Cellulose
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ORIGINAL RESEARCH

Thermal insulating and fire-retarding behavior of treated cotton fabrics with a novel high water-retaining hydrogel used in thermal protective clothing

Zhicai Yu · Jinru Liu · Abhijeet Suryawanshi · Hualing He · Yushu Wang · Yuhang Zhao

Received: 10 October 2020 / Accepted: 11 January 2021

Abstract Hydrogel-born fire resistance materials have attracted great attention due to their flame retardance and environmental friendliness. In this work, a facile strategy is presented to prepare a novel hydrogel–cotton fabric laminate with excellent thermal insulation and fire-retarding performance. The hydrogel–fabric laminates exhibited outstanding flame retardant behavior. The flame-retardant mechanism of this system was mainly due to the absorption of a large amount of energy as the water is heated and evaporated in the hydrogel layer. To increase the water retention capacity of the fire-resistant hydrogel, highly hydratable salt ($CaCl_2$) was incorporated into the fire-resistant composite hydrogel composed of poly(*N*-isopropylacrylamide) (PNIPAAm)/sodium alginate (SA) to prolong water retention time. Here in this work, we aimed to investigate the effect of $CaCl_2$ concentration on water retention capacity, fire-resistant and thermal insulating properties of hydrogel–cotton fabric laminates. Results indicated that the presence of hydratable salt successfully prolonged the water retention time and provided superior fire retardance property over traditional hydrogel. In additional, infrared imaging and vertical flammability test results confirmed that hydrogel–fabric laminates were capable of sustaining 1200 °C for 30 min without the cotton fabric layer burning, whereas natural cotton fabric was completely burned after 12 s. Finally, the hydrogel–cotton fabric laminates exhibited remarkable antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* due to incorporated silver nanoparticles in hydrogels, and the bacteriostatic rates both exceeded 96%. The preparation of this hydrogel-born fire resistance materials is facile and can extended the period of protective time as fire resistant clothing for the firefighters.

Z. Yu · J. Liu · A. Suryawanshi · H. He (✉) · Y. Wang · Y. Zhao
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Flame-retardant PNIPAAm/sodium alginate/polyvinyl alcohol hydrogels used for fire-fighting application: Preparation and characteristic evaluations

Zhicai Yu [a], Jinru Liu [a], Hualing He [a,b,c,*], Shengnan Ma [a], Jinyin Yao [a]

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ABSTRACT

A novel fire-preventing triple-network (TN) hydrogel was prepared and laminated on cotton fabric to improve fire-resistant performance of cellulose fabric. The TN hydrogel composed of Poly (N-isopropylacrylamide) (PNIPAAm)/sodium alginate (SA)/ Poly (vinyl alcohol) (PVA) exhibited excellent swelling ratio, swelling-deswelling behavior and antibacterial property. Results indicated that introduction of SA could improve water retention capabilities of TN hydrogels. Thermogravimetric experiments showed that the thermal stability of hydrogels was best at a SA: PVA ratio of 2:1. Furthermore, the obtained hydrogel-cotton fabric laminates displayed efficient flame retardancy. Compared to original fabric, hydrogel-fabric laminates were nearly undamaged when exposed to fire for 12 s. This result is attributed to energy absorption as water is heated and evaporates in the hydrogel. The present work provides a new concept to prepare fire-resistant polymer fabric, which may be used in fire-protective clothing to protect the skin from burn injuries.

1. Introduction

Cotton fabric is one of the most popular natural fibers currently available and has been widely functionalized to achieve fire-retardant (Farooq, Sipponen, Seppälä, & Österberg, 2018), UV-protective (Abd El-Hady, Sharaf, & Farouk, 2020) and antibacterial properties (Lin et al., 2018). Compared with other chemical fibers, cotton fabric does not produce molten drops that injure the skin during combustion. Moreover, as a fire-resistant textile, cotton fabric has excellent moisture absorption capacity, wearing comfortability, and breathability (Liu, Huang, Zhang, & Zhang, 2019). These characteristics indicate that cotton fabric may be used in life-saving application, such as fire-resistant blankets or apparel. Unfortunately, flammability, which is one of the major drawbacks to use traditional cotton fabrics, limits the application in fire-resistant materials (Wang et al., 2019). This has motivated researchers to modify cotton fabrics and improve its fire-resistance performance.

Over the past decades, traditional flame-retardant agents are commonly used to finish and obtain fire-resistant fabrics. However, halogen-containing flame retardants could release toxic gases that are hazardous to humans (Wang et al., 2018(a)). Therefore, halogen-free flame retardants such as phosphorus-containing flame-retardant agents have received much attention due to better safety (Satdive, Mestry, Borse, & Mhaske, 2020). Nevertheless, the signal phosphorus-containing flame retardants treated on cotton fabrics exhibit poor fire retardancy and low durability. Later, a number of new fire-resistant approaches, such as sol-gel treatment (Jiang, Xu, Ma, Liu, & Zhu, 2019), layer-by-layer assembly (Wang et al., 2020), and plasma-induced graft-polymerization, have been proposed to improve the fire resistant of cotton fabric (Li, Tong, & Yi, 2019). Zhang et al. (2017) prepared a novel multifunctional fire-resistant cotton fabric with excellent flame-retardant and hydrophobic properties using the sol-gel and self-assembly techniques. Rosace, Castellano, Trovato, and Iacono (2018)) developed a flame-retardant fabric by immobilizing a carboxyl-functionalized organophosphorus oligomer onto cotton fabrics, which subsequently exhibited self-extinguishing properties. Li et al. (2018) demonstrated a strategy to produce durable

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Investigation of temperature-responsive and thermo-physiological comfort of modified polyester fabric with Sericin/PNIPAAm/Ag NPs interpenetrating polymer network hydrogel

Jinru Liu[1], Hualing He[1,2,3], Zhicai Yu[1], Abhijeet Suryawanshi[1], Yongquan Li[1], Xuebo Lin[1] and Zenghui Sun[1]

Abstract

Stimuli-responsive polymers applied to traditional textiles have received widespread attention. In this work, a new type of polymer-modified polyester fabric was prepared with interpenetrating polymer network (IPN) hydrogel. The IPN hydrogel comprised of poly (N-isopropylacrylamide) (PNIPAAm), silk sericin (SS), and silver nanoparticles (Ag NPs). The presence of the IPN hydrogel on the surface of fibers can change the wettability of polyester fabric, in response to temperature. The thermal behavior of IPN hydrogel was characterized by differential scanning calorimetry (DSC) and thermogravimetric analysis (TG). DSC results indicated that the IPN hydrogel exhibits temperature-responsive behavior and the lower critical solution temperature (LCST) was around 32.9°C. The decomposition temperature of modified polyester fabric (400.5°C) was better than the original polyester fabric (335°C). TG results indicated that the polymer-modified fabric possessed higher thermal stability than the original polyester fabrics. The thermo-physiological comfort of modified polyester fabric was characterized by water contact angle and vertical wicking test. Above the LCST, the wettability of the polymer-modified polyester fabric would decrease because of the volume phase transition of IPN hydrogel. Moreover, the antibacterial activity of the modified temperature-sensitive fabric against *Staphylococcus aureus* and *Escherichia coli* was also investigated, and the antibacterial activity for both microorganisms exceeded 95%. This study provided a feasible route to fabricate the temperature-responsive textile with great antibacterial performance.

Keywords

hydrogel, temperature-responsive textile, thermo-physiological comfort, antibacterial activity

In recent years, polyester fabric has been widely used in the textile industry due to its high strength, good durability, and dimensional stability.[1,2] However, poor moisture absorption, low antibacterial activity and texture of polyester fabric cannot satisfy consumers who seek for comfort in protective clothing and active sportswear.[3] Therefore, improving the wear comfort properties of polyester fabric has become increasingly significant because of these problems.[4] Comfort is a complex concept that includes thermal comfort, tactile

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你们的《基于智能自膨胀凝胶的阻燃隔热复合材料研究及应用》获2020年上海市纺织化学与染整工程研究生学术论坛优秀论文评选

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Nanoscale

PAPER

Rapid Production of Multiple Transition Metal Carbides via Microwave Combustion under Ambient Conditions†

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Transition metal carbides (TMCs) have attached great interest owing to their potential application for energy storage and electrocatalysis. But the synthesis of high quality TMCs usually need high-energy consumptions, long reaction durations or dangerous chemical reagents which limit their practical application. Here, a microwave combustion method is developed to rapidly (~2 mins) produce transition metal carbides under ambient condition. The as-synthesized TMCs (W_2C, VC, Fe_3C, NbC, TaC, Mo_2C) and rGO composites exhibit outstanding catalytic performance for hydrogen evolution reaction (HER) over a broad range of pH value. This work highlights a novel strategy for the design and synthesis of transition metal carbides.

1. Introduction

Transition metal carbide has been extensively applied for electrocatalysts, battery electrode materials, gas sensor, cutting tools and protective coatings owing to its features of electronic and thermal conductivity, chemical stability and extreme hardness.[1-5] Generally, TMCs are made by powder metallurgical method through carbon thermal reduction, which mixing metal oxide, hydrate, or metal powder with carbon powder as precursor, and then carbonizing at high temperature to fabricate metal carbide phase.[6, 7] However, the excess carbon powder and sintering at high temperature will cause a thick layer of carbon on the surface of carbides. In order to synthesize high-quality TMCs, some effective routes including chemical vapor deposition (CVD), temperature programmed reaction (TPR) and ultrasound irradiation of metal carbonyl compounds have been successfully realized.[3, 8-10] For instance, Xu *et al.* carbonized metal foil in the CH_4 atmosphere under high temperature (> 1000°C) to grow high-quality 2D ultrathin Mo_2C, WC and TaC.[3] Fan *et al.* deposited a layer of metal on the tips of graphene nanoribbons, and then annealing this hybrid composite under high temperature to synthesize the nanocrystalline M_3C (M: Fe, Co, Ni).[11] Gong *et al.* prepared ultrasmall phase-pure W_2C nanoparticles supported on MWNTs via carburizing the composite of WO_x/MWNTs at high temperature.[12] Moreover, researchers also developed other approaches to synthesize TMCs with controllable nanostructures, including solvothermal and electrochemical methods, etc.[13-17] All these methods are effective way to fabricated various TMCs, but high-energy consumptions, long reaction durations, inert gas protection and dangerous chemical reagents are often encountered in these processes, which would limit their further application. Therefore, developing a new way to produce transition metal carbides with features of speediness, no temperature programmed reaction and safety is of great significance.

Recently, microwave has been progressively applied to fabricate or modify nano materials by using its feature of rapid heating process.[18-20] Considering carbon materials own highly reduction property under high temperature,[21] microwave heating the mixture of metal oxides and carbon materials might realize rapidly synthesis of TMCs. Herein, we developed a fast and facile way to produce various TMCs (W_2C, VC, Fe_3C, NbC, TaC and Mo_2C) through microwave treating the mixture of metal oxides and graphene oxide (MO/GO) under ambient condition. The TMCs synthesized from the corresponding oxides by using this microwave combustion method just need a few seconds. Furthermore, the as-synthesized TMCs/rGO composites show good catalytic performance for hydrogen evolution reaction (HER) under acidic and basic solution (0.5 M H_2SO_4 and 0.1 M KOH). VC/rGO shows a low onset overpotential (21 and 19 mV vs RHE) and a small Tafel slope (56 and 58 mV dec^{-1}) in H_2SO_4 and KOH, respectively. This work provides wholly new insight to the design and synthesis of metal carbides.

2. Experimental

2.1 Materials

All chemicals were purchased from Sinopharm Chemical Reagent Co. Ltd in China. The grade and purity of all chemicals are as follows: ethanol (99.5%, ACS reagent), hydrogen peroxide (30%), hydrochloric acid (36%, AR), hydrogen nitrate (69%, AR)

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†Electronic Supplementary Information (ESI) available: [details of any supplementary information available should be included here]. See DOI: 10.1039/x0xx00000x
‡Authors with equal contribution.

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证 书

武汉纺织大学姜会钰、李俊锋、万骏：

你们的《Various transition metal carbides were rapidly produced by microwave combustion under environmental conditions》获2020年上海市纺织化学与染整工程研究生学术论坛优秀论文评选

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