



Mini Review

Multifunctional Textile Fabric and Their Application

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Abstract

In both fundamental research and industrial applications, multifunctional textile fabrics with unique wettability have piqued interest. The latest developments of various methodologies and strategies for constructing superhydrophobic coatings on textile materials are described in detail in this review.

Keywords: Textile, Cotton, Superhydrophobic, Nanotechnology, Review

Introduction

Multifunctional superhydrophobic textile materials have attracted extensive worldwide attention in recent decades. Superhydrophobic materials have applications in fundamental research and potential applications in the fields of self-cleaning [1], anticorrosion [2], oil-water separation [3], water collection [4], anti-icing [5], drag reduction [6], energy conversion [7] antibacterial [8] and fire protective [9]. The common multifunctional superhydrophobic materials such as metallic mesh [10], filter paper [11], foam polyurethane [12], fabric [13], carbon-based materials [14], and ceramic membranes [15] have been extensively studied in current research. Among textile fabrics, cotton fabric is the most popular material used by various consumers and professional apparel due to its comfort, elastic-plastic nature, non-hazards, and a moisture absorbing good strength in both wet and in a dry condition, perfect dimension stability, and excellent wearing properties. The cellulosic hydroxyl group in cotton fiber makes it a tremendous water-loving adsorbent. This excessive water absorbability allows cotton textiles to be easily stained and dirtied. Sometimes cotton textiles are also wetted and contaminated by blood, oil, and even bacteria, which are undesirable in their use as cloths particularly in hospital settings. Thus, the development of non-wettable cotton textiles with high water contact angle values and dirt-resistant cotton textiles has long been an interesting subject to research. To achieve this goal surface modification of cotton fabric is necessary. Nowadays such smart textile surfaces are prepared by tailoring the surface morphology using techniques such as dip coating [16], hydrothermal [17], layer-by-layer (LBL) coating techniques [18], UV-Irradiation [19], chemical vapor deposition (CVD) techniques [20], admicellar polymerization [21], etc. have been employed to improve its water-loving character.

Recent Progress in Multifunctional Finishing Textiles

Recently, Tudu et al. [22] prepared superhydrophobic cotton

fabric using TiO₂ nanoparticles and PFDTs via a simple dip-coating approach, which showed excellent chemical durability, laundering durability, antibacterial, and oil-water separation. Mondal et al [23] fabricated fluoropolymer adhered bio-inspired hydrophobic, chemically durable cotton fabric for dense liquid removal and self-cleaning application. Superhydrophobic and antibacterial active cotton textiles were successfully fabricated via a simple in situ coating method using silver nanoparticles followed by hydrophobization with Hexadecyltrimethoxysilane (HDTMS) [24]. The superhydrophobic nature of modified cotton textile fabric was investigated by contact angle measurement having a water contact angle of 157° and show water droplets roll easily on the cotton fabric surface. Microwave irradiation technique was applied for the fabrication of nanoparticles coated superhydrophobic antibacterial cotton fabric via a thiol modification followed by nanoparticle deposition. Series of nanoparticles such as FeNPs, MnNPs, CoNPs, and CuNPs were used for cotton surface modification [25]. A simple and facile fabrication approach was applied for the synthesis of ZnO nanoparticles coated textile substrate to improve some novel properties such as biosensor for pesticide detection, Photocatalytic degradation of organic dyes, and antibacterial activity [26]. Cotton fabric was modified via the sol-gel method by the nanocrystalline TiO₂ and cross-linking agent 1, 2, 3, 4-butane tetracarboxylic acid (BTCA) as a spacer [27]. The bonding mechanism, chemical bonding, and the physical adsorption of the TiO₂ nanoparticles to the fabric surface were confirmed by SEM and FT-IR results. Laundering durability silver nanoparticles functionalized antibacterial active cotton fabric fabrics were prepared by radiation-induced co-incident reduction and graft polymerization approach [28]. Karimi and co-workers [29] examined a simple inventive approach to the development of the multifunctional application of cotton fabric based on graphene oxide/titanium dioxide coating. Modified samples were assessed for various applications such as electrical resistance, self-cleaning, UV blocking, and antimicrobial properties. Khajavi et al. [30] reported modifying the superhydrophobic and antibacterial active cotton fabric by doping copper nanoparticles with silica-based sols. Enhancement of hydrophilicity and antibacterial activity the GTAC/3-MPTMS/AgNPs modification was applied successfully on cotton fibers surface [31]. The QA/AgNPs treated cotton fabric showed higher moisture regain and antibacterial properties than raw cotton fabric. Surface modification of cotton fabric was performed by laser exposure of cotton followed by silver nanoparticles coating [32]. The presence of carboxylic acid groups on the laser-treated cotton fabric was examined spectrophotometrically by dye absorption capability of Methylene blue dye. A facile hydrothermal deposition method [33] was presented for the synthesis of Ag/TiO₂ coated cotton fabrics. The coated cotton fabric displayed sustainable antibacterial reduction and durable UV-protection activity (UPF) before and after laundering.

Conclusion

The latest developments in multifunctional superhydrophobic fabric, as well as their various fabrication methods, are discussed. Incorporation of foreign materials enhances the anti-wetting activity of the fabricated textiles fabrics along with numerous physical properties of textiles in the areas such as water repellent, photocatalyst, self-cleaning fabrics, UV-protection, antistatic, flame

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retardant, stain resistant, wrinkle resistance, and drug delivery properties of textile materials. Applications are summarised for each type of fabrication technology, providing state-of-the-art progress and understanding in producing superhydrophobic surfaces.

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