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**Nanotechnologies - Evaluation of the antimicrobial
performance of textiles containing manufactured nanomaterials**

纳米技术 含人造纳米材料纺织品抗菌性能的评估

(English Translation)

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Foreword

This document is a standard or guiding technical document.

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents". Drafting.

This document is equivalent to ISO /T S23650.2021 "Nanotechnology - Evaluation of antimicrobial properties of textiles containing synthetic nanomaterials".

The type has been changed from ISO technical specifications to my country's national standardization guidance technical documents.

The following minimal editorial changes have been made to this document.

---Delete the following from paragraph 3 of section 5.2."For example, chemical reagents used for different purposes (e.g., dyeing, printing) may react with nanomaterials." Since the materials have similar elemental and chemical compositions, a careful selection of an appropriate set of measurements is necessary to identify the latter from the former.

Technically, because for this situation, there is usually no single technology that can solve this problem. In this regard, ASTM E3025-16.This paper discusses the measurement methods for some physicochemical properties and the challenges faced in the detection of textiles containing silver nanomaterials.

---Delete "Note 2" in 7.3.

---The items in Chapter 8 have been adjusted accordingly based on Table 2.

---Reordering of references.

Introduction

Nanotechnology can be used in the textile industry to endow conventional textiles with antibacterial, stain-resistant, wrinkle-resistant, UV-resistant, flame-retardant, and enhanced mechanical strength properties.

New functions are being developed without significantly compromising or altering the original properties of textiles. Data from the Nanodatabase website indicates that... There are over 400 textiles containing artificial nanomaterials (TCMNM), ranking second in the nanoproduct market [21]. [Continued rapid development]

The existence of TCMNM has increased the demand for international standards and testing process guidelines for man-made nanomaterials (MNM) in textiles.

This demand comes not only from industry but also from consumers.

Based on how nanomaterials are integrated into textiles, TCMMNM can be divided into three categories. nano-processed textiles, nano-composite textiles, and nano-composite textiles. and nanofiber textiles[22].

a) Nano-processed textiles. After textile manufacturing is completed, the textile fibers are given a nanostructure through post-treatment or coating methods.

Nanotextiles are textiles that possess nanoscale properties on their surface. Most nanotextiles on the consumer market belong to this category.

b) Nanocomposite textiles. textiles composed of fibers containing one or more components with nanostructures or nanoscale dimensions.

These nanoscale properties are integrated into the fiber components through preprocessing.

c) Nanofiber textiles. Textiles made of nanofibers that have a cross-sectional area at the nanoscale, but whose length is not necessarily nanometers. scale.

Natural and synthetic textile fibers can be treated with various nanomaterials and chemicals to enhance their antibacterial properties. TCMNM Its antibacterial activity includes activity against bacteria, fungi, viruses, and other microorganisms. Furthermore, due to its ability to reduce microbial activity, its antibacterial activity helps... This gives it odor-resistant properties. Typically, various metals (mainly silver and copper), as well as metal oxides [such as copper oxide (CuO), titanium dioxide] are used.

TiO₂ and zinc oxide (ZnO) were used in the antibacterial TCMNM.

Several properties of MNM have a significant impact on its antibacterial properties, including size, shape, specific surface area, chemical composition, surface chemistry, and surface properties.

Surface charge. The size and shape of MNMs have a significant impact on their antibacterial properties because they are related to specific surface area. Generally speaking, nano... The antibacterial properties of rice grains are size-dependent; smaller grains have a higher specific surface area, allowing them to come into contact with more bacterial or fungal cells.

And to improve the efficacy of antibacterial and/or antifungal agents, or to improve the effectiveness of both simultaneously [23]. Therefore, compared with large particles at the micron and macroscopic scales In contrast, small nanoparticles integrated into textiles still exhibit significant antibacterial activity even at very low concentrations [24-26].

The shape of MNMs significantly affects their interaction with microbial cells and their uptake rate; for example, spherical gold nanoparticles exhibit better interaction with microbial cells than rod-shaped ones.

Gold nanoparticles exhibit higher cellular uptake [27]. The surface charge of MNM is another important property (which can be measured by the Zeta potential method).

The antibacterial effect of MNM is triggered by the electrostatic interaction between positively charged MNM and the negatively charged microbial cell membrane, ultimately... It causes cell damage while simultaneously inhibiting cell growth and reproduction. The surface chemistry of MNM also significantly affects its antibacterial activity; the surface of nanomaterials... The presence of functional groups, protective agents, or biomolecules can potentially influence their antibacterial activity. Surface-functionalized antibacterial nanoparticles, such as those with biomolecules... Silver nanoparticles containing bioactive molecules exhibited stronger antibacterial activity compared to bare silver particles [28]. The above-mentioned interactions highlight The physicochemical properties of TCMNM have a significant impact on its antibacterial properties.

Currently, there are various TCMNM products on the market with antibacterial properties, such as underwear, shirts, socks, bed sheets, and duvet covers. Nanomaterials The antibacterial mechanism of action can generally be described by the following three modes. oxidative stress induction, metal ion release, or non-oxidative mechanisms. These three reactions... It may also occur simultaneously [22]. The antibacterial activity of TCMNM decreases significantly after repeated washing and soaking in sweat, which is due to the above process.

Embedded nanomaterials may be released, and sweat and detergent solutions may also chemically interact with them. Currently, there are no specific treatments for TC- International standard documents for MNM products. Therefore, it is necessary to develop an international standard document to evaluate the antibacterial properties of TCMMNM after washing or soaking in sweat.

This will promote trade and market growth for the product. It is worth noting that there are already international standards for assessing the antibacterial properties of conventional textiles.

There are also relevant standard documents for the detection and characterization of silver nanomaterials in textiles [19]. However, these documents do not address the issue of nanomaterials.

There is a potential problem that materials or nanostructures may be released from TCMNN after washing or soaking in sweat, and this process may affect the antibacterial activity of textiles. Sexuality has an impact.

This document does not address the impacts of nanomaterials released from TCMMNM