

УДК
 677.027.
 625

TATYANA ASAULYUK, YULIYA SARIBYEKOVA,
 IRINA KULISH, IHOR HOROKHOV
 Kherson National Technical University, Ukraine

APPLICATION OF MODIFIED ZnO NANOPARTICLES FOR IMPARTING DURABLE ANTIMICROBIAL PROPERTIES TO TEXTILE MATERIALS

The aim. *To substantiate the effectiveness of surface modification of ZnO nanoparticles with a bifunctional organosilane for their subsequent application in polymer-colloidal finishing compositions for final antimicrobial treatment of textiles*

Keywords: *ZnO nanoparticles, modification, 3-glycidoxypropyltrimethoxysilane, antimicrobial finishing compositions.*

Problem statement. A promising approach for functionalizing textile materials with antimicrobial properties involves the use of ZnO-based nanopreparations, which are characterized as multifunctional, economically viable, and environmentally safe materials.

The key challenge in antimicrobial textile finishing technologies lies in ensuring the stability of functional properties of modified materials. This problem is attributed to insufficient adhesion of biocidal agents to textile fibres and their migration from the material surface during product use.

Achieving stable immobilization of antimicrobial agents on the surface of textile materials can be realized through the formation of composite polymer coatings, which will preserve the performance characteristics acquired by the material as a result of modification with biocidal preparations.

A fundamental requirement for creating functional finishing compositions using nanoparticles is the uniform distribution of the filler within the polymer matrix. This can be facilitated by both reducing particle size and modifying their surface with specific substances that alter the surface charge.

Methods. Evaluation of the modified ZnO samples was conducted by studying the morphological structure of the nanoparticles using scanning electron microscopy (SEM).

Results. ZnO nanoparticles were preliminarily synthesized using an improved resource-saving direct precipitation method from an aqueous solution [1]. 3-glycidoxypropyltrimethoxysilane (GPTMS) was selected as

the modifying agent, which contains an epoxy functional group in addition to methoxy groups. The amount of GPTMS used for modification was 1.5 mmol per 1 g of synthesized ZnO nanoparticles. The modification reaction was carried out at a temperature of 70°C for 3 hours, followed by precipitation, washing, and drying of the nanoparticles.

The surface morphology of the studied modified ZnO nanoparticles was compared with the unmodified synthesized sample (Fig. 1).

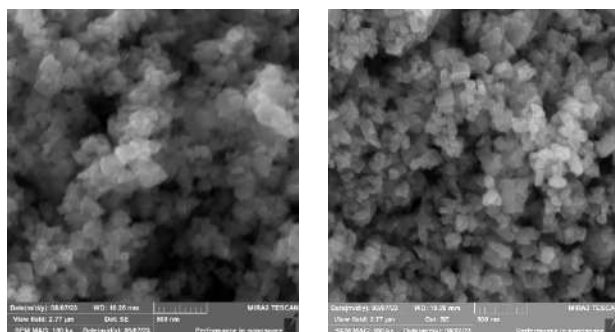


Fig. 1. SEM images of ZnO nanoparticle samples:
a) unmodified; b) modified.

The obtained micrographs indicate that both samples of the investigated crystalline materials consist of size-homogeneous nanoparticles predominantly in the form of short rods, which represents the typical morphology of ZnO particles synthesized in the hexagonal wurtzite structure. After modification (Fig. 1, b), a reduction in the degree of nanoparticle agglomeration is observed compared to the initial ZnO sample (Fig. 1, a), indicating a change in the surface energy of the modified particles.

Conclusion. Based on the SEM analysis results, it was established that modification with the selected organosilane promotes a reduction in the agglomeration degree of ZnO nanoparticles, which is expected to enhance the dispersibility of the nanofiller in polymer-colloidal finishing systems.

Reference

1. Asauliyuk T.S., Saribeykova Yu.G., Semeshko O.Ya., Kulish I.M. Synthesis and structural characterization of ZnO nanoparticles. *Herald of Khmelnytskyi National University. Technical sciences*, 2022, 4(311), 35-41. doi: <https://doi.org/10.31891/2307-5732-2022-311-4-35-41>