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**THE USE OF NANOSIZED METAL OXIDES FOR
ANTIMICROBIAL FINISH OF COTTON FABRIC**

**ИСПОЛЬЗОВАНИЕ НАНОРАЗМЕРНЫХ ЧАСТИЦ ОКСИДОВ МЕТАЛЛОВ
ДЛЯ АНТИМИКРОБНОЙ ОТДЕЛКИ ХЛОПКОВОЙ ТКАНИ**

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The article focuses on the use of nano-sized particles of metal oxides, such as copper and iron oxides for imparting antimicrobial properties to cotton fabric. The results of the studies on the synthesis of nanoparticles of oxides of copper and iron, and verification of their antimicrobial activity are given in present article.

Статья посвящена вопросу использования наноразмерных частиц оксидов металлов, в частности, оксидов меди и железа, для придания антимикробных свойств хлопчатобумажным тканям. Представлены результаты исследований по синтезу наночастиц оксидов меди и железа и по проверке их антимикробной активности.

Keywords: metal oxides, nanoparticles, antimicrobial finish, cotton fabric, copper oxide, iron oxide, chemical reduction.

Ключевые слова: оксиды металлов, антимикробная отделка, хлопчатобумажная ткань, оксид меди, оксид железа, химическое восстановление.

In recent years nanotechnology has become one of the most important and exciting forefront fields in physics, chemistry, engineering and biology. It shows great promise for providing us in the near future with many breakthroughs that will change the direction of technological advances in wide range of applications. One of these applications is to prepare antimicrobial textiles based on heavy metal in their nanoscale. Inorganic materials such as metal and metal oxides have attracted lots of attention over the past decade due to their ability to withstand harsh process conditions. The use of nanoparticles of silver, gold, copper and zinc oxide has been seen as a viable solution to stop infectious diseases due to the antimicrobial properties of these nanoparticles [1], [2].

Copper has been recognized as hygienic material since the beginnings of civilization. Today, copper is used as a water purifier, algicide, fungicide and nematocide, and as antibacterial and antifouling agent. Copper nanoparticles have unique optical, catalytic and chemical properties specific to the nano level. Cuprous oxide nanoparticles-loaded cotton fabric could be used in medical and textile applications such as medical devices, healthcare, wound dressing, military, protective suits, personal care products, clothing and others. And cellulose can be used as a support for nanoparticles, reducing agent and stabilizer [3...6].

Metal oxide nanomaterials like ZnO and CuO have been used industrially for several purposes, including cosmetics, paints, plastics, and textiles. A common feature is that these nanoparticles exhibit their antimicrobial behavior against pathogenic bacteria. In research of Ameer Azam and his colleagues [7] was demonstrated antimicrobial activity of ZnO, CuO, and Fe₂O₃ nanoparticles against Gram-positive and Gram-negative bacteria. The order of antibacterial activity was demonstrated to be the following: ZnO > CuO > Fe₂O₃.

The aim of our research is to develop new ways for imparting antimicrobial properties to cellulosic textile materials using metal nanoparticles – copper and iron oxides, in particular. The synthesis of these nanoparticles on cotton fabric was carried out by wet chemical reduction method. The other task was to compare the antimicrobial activity of these NPs separately and in combination, as iron sulfate can be used as reductant.

The materials used for the present research were as follows:

- Plain weave 100 % cotton fabric;
- Copper sulphate (CuSO₄*5H₂O);
- Iron sulfate (FeSO₄*7H₂O);
- Sodium hydroxide.

In this paper we are giving information about structural, microstructural and microbiological characteristics.

The XRD pattern shows the presence of obtained in the result of chemical reduction with the addition of NaOH metal oxides – CuO and Fe₂O₃(Fig.1).

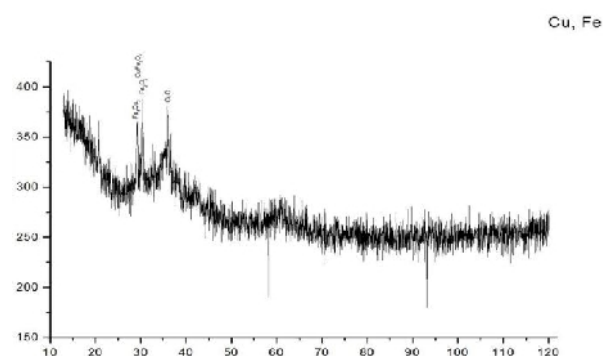


Fig. 1

The morphological structure of the treated cotton samples can be seen in Fig. 2 (SEM micrographs of cotton fabrics: a) untreated; b) treated with CuO NPs; c) treated with Fe₂O₃ NPs; d) treated with both with CuO and Fe₂O₃ NPs). The size of the Nps varies from 30...80 nm.

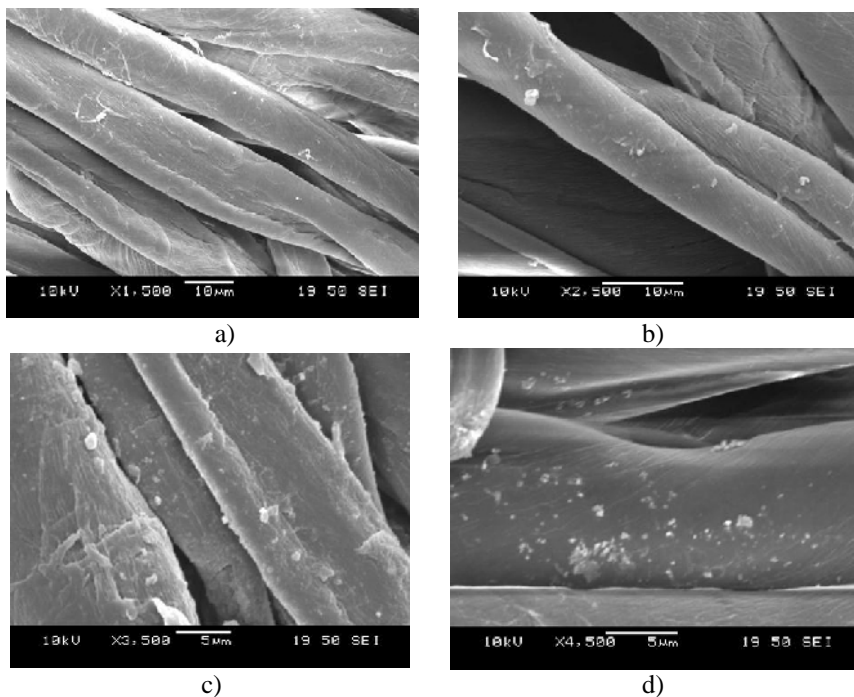


Fig. 2

The effectiveness of these samples for microbiological stability was tested in the laboratory of the Institute of Microbiology and Virology of the Republic of Kazakhstan.

The study of samples of textiles on the bacterial contamination was carried out as follows: to verify the contamination of cotton fabric washouts from their surface were made [8], [9]. The capture of washouts was made by means of the sterile moistened cotton tampon. Before sowing the washouts into the test tube 5 ml of isotonic sodium chloride solution were added. The tampon was carefully washed off, and then 0.1 ml of lavage fluid was placed in a Petri dish with beef-extract agar medium. The plates were placed in an incubator at 30°C. Preliminary calculations of colonies were made after 48 hours, final – after 72 hours.

The studies revealed that the samples treated with new dressing agents based on cop-

per and iron nanoparticles using Sodium hydroxide showed complete absence of growth of bacteria and fungi (Fig.3 – no growth of bacteria and fungi according to the results of seeding from fabrics treated with the CuO and Fe₂O₃ NPs), in contrast to the untreated sample (Fig. 4).

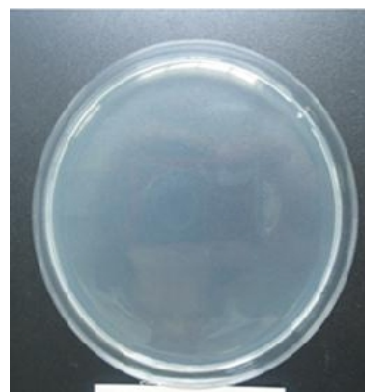


Fig. 3



Fig. 4

Number of constituted units of fungi -20...30 cells, bacteria - hundred (110) cells.

Microbiological testing proved the effectiveness of all the treated cotton fabric samples.

CONCLUSIONS

The relevance of the chosen direction of scientific research is evident. Nanosized copper and iron oxides were synthesized by simple method of chemical reduction. Treated with these NPs cotton fabric has got antimicrobial and fungicidal properties.

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