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HYBRID POLYMER-TEXTILE COMPOSITES FOR ADVANCED AND SUSTAINABLE APPLICATIONS

Purpose. *To develop a concept and propose prospects for the use of magnetic functionalized textiles based on nanostructured polyaniline as a hybrid polymer-textile composite, which expands the capabilities of textile materials in technological and humanitarian fields*

Keywords: *composites, textile materials, applications, properties.*

Objectives. Modern development of materials science is aimed at creating multifunctional textiles. The combination of organic polymer with magnetic nanoparticles provides the formation of a composite with unique properties: adjustable electrical conductivity, electromagnetic shielding, antibacterial activity. Such functionalization opens up broad prospects for application in industries where lightness, flexibility and the ability to respond to the external environment are important - in particular, in military equipment, medical implants, vital signs monitoring systems and "smart" clothing [1].

Methodology. Polyaniline was synthesized by oxidative polymerization of aniline in an acidic medium using surfactants (surfactants), which provided the reaction system with a stable charge and ensured the deposition of polyaniline nanoparticles on the textile surface by the heterocoagulation mechanism. For hybridization, pre-synthesized Fe_3O_4 nanoparticles were used, which were introduced into the reaction mixture at the polymerization stage.

Research results. The work developed an approach to create hybrid knitted materials based on polyaniline with integrated Fe_3O_4 nanostructures, which form an organic-inorganic dual-functionality system.

A method of controlled saturation of knitted structures with a hybrid composite with the formation of a gradient distribution of nanoparticles in the fiber thickness is proposed. This allows to achieve selective sensitivity of the material to mechanical stretching, magnetic field or temperature. A new type of interface interaction between the polyaniline matrix and synthesized Fe_3O_4 nanoparticles is revealed, which provides increased stability of the conductive layer and preservation of functional properties after repeated deformations. It is assumed that the combination of organic and inorganic phases will contribute to the creation of a 3D-network

nanostructure, which will improve adhesion to the fibers of the knitted base and ensure the preservation of the electromagnetic response after washing and abrasion. The possibility of directional regulation of the properties of the composite by changing the ratio of organic polymer : Fe_3O_4 is shown.

The created composites are promising for protective clothing that combines the functions of electromagnetic shielding, antistatic and magnetosensitive protection. In medicine, it is possible to use such materials as "smart" bandages and compression products. Due to the compatibility of the hybrid system with fibers of natural origin, the material is suitable for environmentally friendly technologies of nanoprocessing of textiles, as well as re-recovery of coatings by controlled doping of polyaniline.



Fig. 1. **Potential applications of hybrid polymer-textile composites**

Conclusion. The combination of organic polymers and inorganic nanostructures forms a new class of hybrid composites that can be used in the fields of medicine, defense, ecological design and sustainable production.

The development of such materials is in line with the principles of circular economy and sustainable development, contributing to waste minimization and increased resource efficiency.

References

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