ATOMIC FORCE MICROSCOPY OF MODIFIED POLYMERS

Tojiyev Panji Jovliyevich[1]
[1]Termez State University Doctor of Technical Sciences, Associate Professor
E-mail: panjitojiyev74@gmail.com
Turaev Hayit Khudoynazarovich[2]
[2]Termez State University Doctor of Chemistry, Professor, Dean of the Faculty of Chemistry, TerSU
Nuraliev Gayrat Turaevich[3]
[3]3doctoral student Termez State University
Jalilov Abdulakhat Turopovich[4]
[4]Doctor of chemical sciences, prof., academician of the Academy of Sciences of the Republic of Uzbekistan Tashkent Chemical Technology Research Institute, Republic of Uzbekistan, Tashkent
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Introduction

The demand for polymer composite materials is growing annually in the world due to the high growth rates of population and industrial production. At the same time, high demands are placed on polymer composite materials in the automotive industry and construction. However, the low resistance to combustion inherent in polymers of composite materials based on polyethylene significantly limits their scope. [1,2].

Improving the fire resistance of polyethylene and materials based on it is a fundamentally difficult task, associated not only with the search for effective and at the same time environmentally friendly, affordable and inexpensive flame retardants and flame retardants, but also with the preservation of other valuable properties of the polymer. In accordance with this, the creation of nanocomposites based on ethylene polymers in order to enhance their thermal, mechanical, and fire-resistant characteristics is an urgent task. Comprehensive scientific research in this direction will make it possible to create materials with enhanced performance characteristics and increased resistance to combustion. [3, 4].

Objects and methods of research. Scientific substantiation of the following solutions for the production of automotive and household plastic parts based on new composite materials: selection of various reactive modifiers for micro- and nano-sized mineral modifiers added to polymers; modification of polymers with the help of dispersed particles; [5-7].

Modification of PP by introducing various additives makes it possible to significantly change the properties of the base polymer and regulate its technological and operational properties. In particular, to improve the physicochemical properties of PP, modification methods are currently widely used, which consist in the creation of new composite materials. The selection of a modifier, its content depending on the nature of the polymer is one of the most accessible and cheap methods for obtaining a polymer material with varying a wide range of characteristics and properties. [8, 9].

Results and its discussion. AFM is widely used to study the features of the topography and microstructure of the surface of various materials. This method is very sensitive to pixels and can form the surface of a sample obtained in the nanoscale, on a three-dimensional surface. The numbers show the changes in particle size, shape, surface, and mechanical properties of materials on the surface through the machining program. [10-12].

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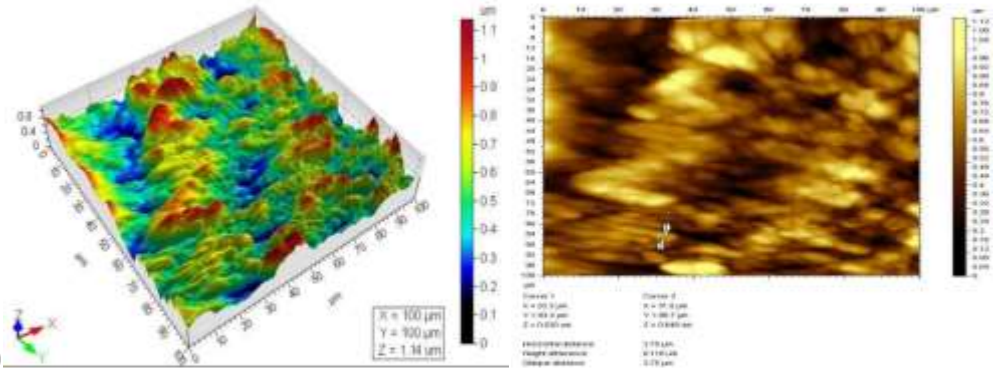
In this section, the effect of modification of metal compound particles on the polymer surface morphology is studied. The study and analysis of the surface of modified polypropylene shows the distribution of metal particles between polymer macromolecules and their interaction properties. The results were obtained for a polymer composite material obtained from the reaction mixture of polypropylene (JM350-Uzkorgaz) 3% ammophos with cadmium oxide and polyamide PA-6 with nickel and cobalt oxides. The analysis was carried out at the AFM (Research Institute of Chemistry and Physics of Polymers) using silicon cantilevers with a tip turning radius of 10 nm [13, 14].

The size of the scanned area was from 1 to 50 μm. Microscopy was carried out in air by a semi-contact method, registering changes in the amplitude of oscillations of the counting hand, which indicates the topography of the surface and oscillations of interfacial movement (phase detection), showing the adhesion of local surfaces to each other.

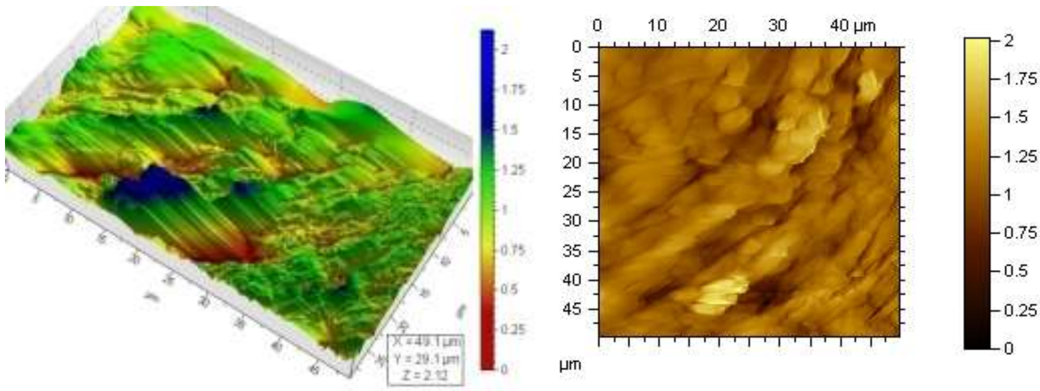
Figure 1 shows the surface of polypropylene modified with cadmium oxides.



a) б)

Rice. 1. Cadmium oxide / PP with ammophos: A) - three-dimensional image,B) - two-dimensional image.

The results show that the surface roughness of pure polypropylene is 100 nm, the surface roughness of polypropylene + 3% cadmium oxide is 210 nm.



a) б)

Rice. 2. Nickel and cobalt oxide / PA-6 with ammophos: A) - three-dimensional image, B) - two-dimensional image.

Figure 2 shows the surface of polyamide modified with ammophos based on nickel and cobalt oxide: A) - three-dimensional image, B) - two-dimensional image.

The results show that the surface roughness of pure polyamide-6 is 100 nm, the surface roughness of polypropylene + 3% cadmium oxide is 212 nm.

Conclusion: Thus, the phase structure of polypropylene modified on the basis of ammophos compounds with metal oxides can be explained by strong adhesion between the matrix and particles of metal compounds, which leads to the formation of new adsorption layers at the interface and at the junctions of amorphous components.

Modification of the polymer surface with metal particles leads to an increase in the degree of flammability on its surface.

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