THE INFLUENCE OF ELECTROTHERMOPOLARIZATION ON THE MICROSTRUCTURES AND COMPOSITION STRENGTH PROPERTIES ON THE BASIS OF POLYPROPYLENE AND MnO_2

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The investigation results of polarization influence on the microstructure and composition strength properties on the base of polypropylene and low-molecular addition MnO_2 are described in the given work. It is established, that the change of strength properties of composition samples PP+MnO_2 after electrothermopolarization is connected with change of charge state and formation of order physical composition structures.

It is known, that the composition dielectrics have electret properties [1-2] after electrothermopolarization. It is also known, that charge carriers in polarization process are accumulated on the phase interface and in heterogeneities [3-4].

The composition electrothermopolarization changes its charge state. The accumulation of charge carriers on the phase interface changes the interphase interactions, and this can lead to the change of composition strength properties [5].

In the given work the investigation results of polarization influence on the microstructures and composition strength properties on the base of polypropylene and low-molecular addition MnO_2 are described. The compositions PP+MnO_2 are obtained from the PP solution by the way of mixture of PP solution and MnO_2 with the further solubility moving away. The concentration MnO_2 varies from 0 up to 5%. The obtaining of sample composite is carried out by the method of hot pressing at polymer melting point and pressure 15 MPa during 10 minutes with further cooling under the pressure up to room temperature.

The microstructures of PP+MnO_2 compositions are investigated on the scanning atomic force microscope (AFM).

The strength characteristics of sample compositions are defined at temperature 293K.

It is established, that the mechanical and electric strengths of the investigated samples increase with the increase of electric field intensity of (E_p) polarization, achieves the maximum at $E_p=7\cdot10^6$ V/m, and later the decrease of the values of electric and mechanical strengths take place.

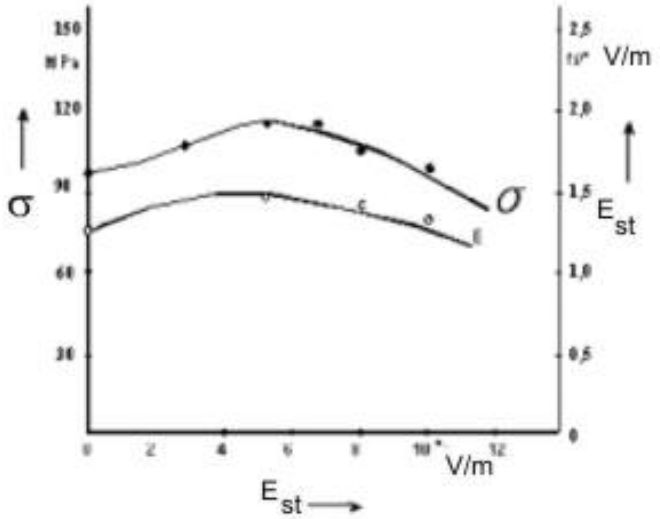

Fig.1. The dependence of electric and mechanical strengths of PP+MnO_2 composition, polarized at the temperature T_p=373K on the polarization field intensity.

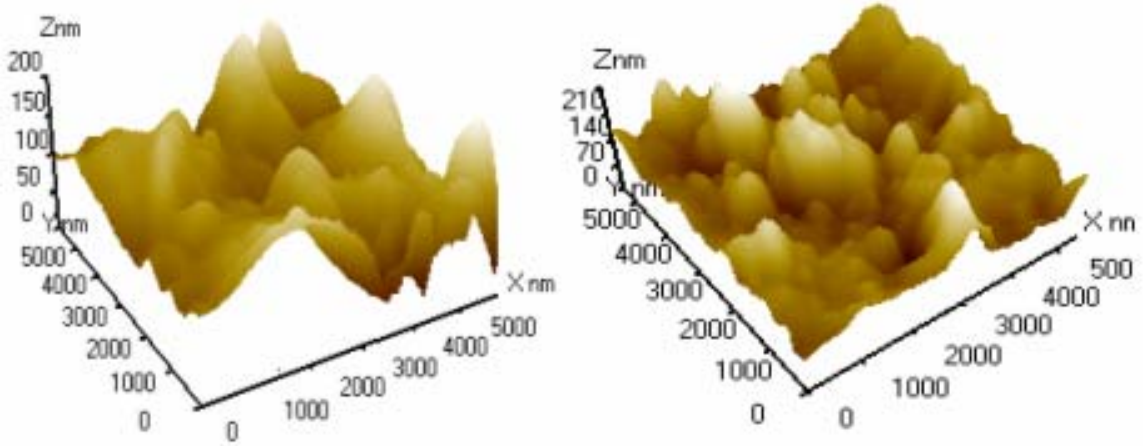

Fig.2. AFM image of ПП+MnO_2 composition before and after electrothermopolarization: a) unpolarized sample; b) polarized sample $E_p=7\cdot10^6$ V/m, T_p=373K, t_p=1 h.

The charges, accumulated on the phase interface of composite components increase with the increase of electric field intensity of polarization. First of all, the charge accumulation changes the interphase interaction between composite components. The increase of interphase interactions leads to the increase of composition strength properties. The decrease of the values of electric and mechanical strengths higher E_p=7·10^6 V/m, probably, is connected with the charge dispersion in the composition volume, which leads to the decrease of composition strength properties. These results are well agreed with work results [3].

AFM 3D image of composition relief PP+MnO_2 before and after electrothermopolarization are given on the fig.2. AFM investigation of sample relief of PP+MnO_2 compositions shows that relief of sample compositions strongly changes after electrothermopolarization, i.e. sample relief becomes uneven. It is seen, that structural changes take place after electrothermopolarization on the surface of composition samples.

The histogram of the element values of image and mean-square roughness of composition surface PP+MnO_2 is shown on the fig.3. The histogram of surface heterogeneity shows, that composition relief becomes relatively uneven after polarization under the influence of electric field. It is also shown, that mean-square roughness of composition surface for the unpolarized samples is 90-130 nm, and for polarized ones is 110-160 nm. The distribution of Fourier-analysis shows, that relief heterogeneities are distributed on the surfaces uniformly.

From the fig.2 and fig.3 it is seen, than the blending of surface heterogeneities takes place after electrothermopolarization, i.e. physical structure of PP+MnO_2 composition changes. It is also seen, that microstructure change leads to the change of composition strength properties.

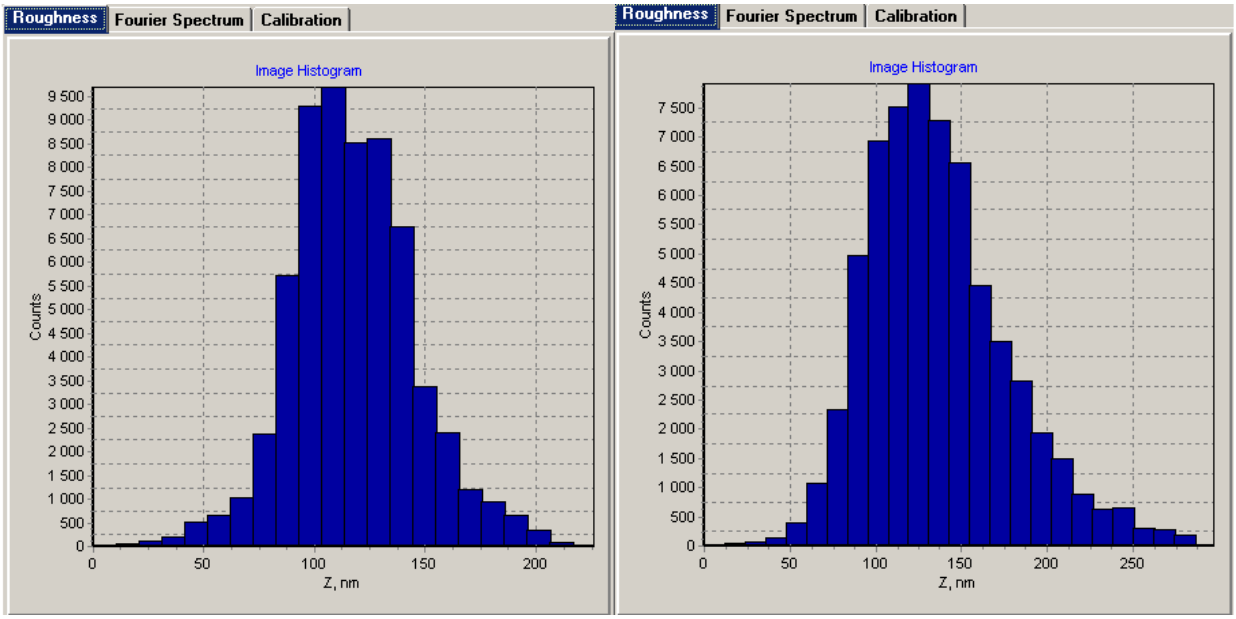

Fig.3. The analysis of surface properties of PP+MnO_2 compositions and histogram of values of image elements: a) unpolarized sample; b) polarized sample E_p=7·10^6 V/m, T_p=373K, t_p=1h.

Thus, the change of strength properties of sample compositions PP+MnO_2 after electrothermopolarization is connected with the change of charge state and formation of order physical composition structure.

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POLİPROPİLEN VƏ MnO_2 ƏSASINDA ALINMIŞ KOMPOZİSİYALARIN MİKROQURULUŞUNA VƏ MÖHKƏMLİK XASSƏLƏRİNƏ ELEKTROTERMOPOLYARLAŞMANIN TƏSİRİ

Bu məqalədə polipropilen və MnO_2 əsasında alınmış kompozisiyaların mikroquruluşuna və möhkəmlik xassələrinə elektrotermopolyarlaşmanın təsirinin tədqiqinin nəticələri verilmişdir. Göstərilmişdir ki, PP+MnO_2 əsasında alınmış kompozisiyaların möhkəmlik xassələrinin elektrotermopolyarlaşmadan sonra dəyişməsi yük halının və nizamlı fiziki quruluşun yaranması ilə əlaqədardır

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ВЛИЯНИЕ ЭЛЕКТРОТЕРМОПОЛЯРИЗАЦИИ НА МИКРОСТРУКТУРЫ И ПРОЧНОСТНЫЕ СВОЙСТВА КОМПОЗИЦИЙ НА ОСНОВЕ ПОЛИПРОПИЛЕНА И MnO_2

В данной работе излагаются результаты исследования влияния поляризации на микроструктуры и прочностные свойства композиций на основе полипропилена и низкомолекулярной добавки MnO_2. Показано, что изменение прочностных свойств образцов композиций ПП+ MnO_2 после электротермополяризации связано с изменением зарядового состояния и образованием упорядоченной физической структуры композиций.

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