The Influence of Conductive Polymer Filler on Microhardness of Composites with Dielectric Polymer Matrices

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Advances in modern science and technology make the need for new polymer composite materials, which would have complex of functional properties - electrical conductivity, mechanical strength, flexibility, etc. Special attention causes so-called "smart-materials" that have the ability to change their properties depending on changes in external conditions (the electric field, radiation, adsorption of gases). These materials include the conjugated polymers and their composites with polymer matrices. An important task when creating polymer-polymer composites is to determine their mechanical properties, in particular, microhardness, and connection the nature of polymer matrix and mechanical characteristics of composites.

We studied the effect of acid-doped polyaniline (PAN) as a conductive filler on the microhardness of its composites with polymer matrices of different structure – polyvinyl alcohol (PVA), polymethylmethacrylate (PMMA), polybutylmethacrylate (PBMA), epoxy resin ED-20 (ES). Composite samples for research were obtained by pressing fine powders of conducting polymers, dispersed in the matrix of PVA, PMMA, PBMA, under the pressure of 150 kg/cm^2 at softening point and flow temperature. The mechanical properties of the composites were studied by measuring microhardness and limit fluidity point on the Heppler consistometer.

It is established that the nature of the interaction between the polymer matrix and conductive polymer filler depends on its content and structure of the matrix, which manifested itself in an increase of microhardness (composites PBMA – PAN and ES–PAN and its decrease for PVS–PAN and PMMA–PAN composites. Microhardness value for polymer PBMA and epoxy resin ED –20 is smaller than filled composites and are $4.51\cdot10^{-9}$ N/m^2 and $9.05\cdot10^{-9}$ N/m^2. With introduction of filler increases microhardness to $7.5\cdot10^{-9}$ N/m^2 and $10.1\cdot10^{-9}$ N/m^2 at 15% content of conductive polymer, respectively. With increasing PAN content up to 20% is observed a noticeable drop in the values of the conical point of fluidity. Perhaps in this case a separate micro phase PAN is formed, causing loosening effect.

The values of the specific density of the obtained composites are well correlated with changes in microhardness, which proves the interaction between the polymer matrix and conductive polymer filler.

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