Nanocomposites and nanomaterials

An innovative method of nanocomposites' formation under the action of a constant electric field

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Copper nanoparticles have interesting optical properties, high catalytic, antibacterial and antifungal activity, which leads to an interest in obtaining a controlled metal-composite structure and the size of the nanoparticles.

Innovative and promising method of nanocomposites' formation is a reduction of metal ions (Me^{n+}) in triple polyelectrolyte-metal complexes (TPMC). This allows to specify the size of nanocomposites nanoparticles and their uniform distribution in the polymer matrix.

Investigations by method of wide angle X-ray diffraction have shown that as a result of a constant electric field (CEF) affect on the TPMC formation Bragg average distance between macromolecular chains of oppositely charged polyelectrolytes coordinated cations Cu^{2+}, decreases from 7,9 to 7,7 Å. It was defined that the Cu^{2+} cations chemical reduction in the volume of the TPMC under the influence of a CEF occurs to formation of the nanocomposite based on the polyelectrolyte complex (PEC) and nanoparticles exclusively of metallic phase Cu, whereas in the initial state (without action of the field) PEC–Cu/Cu_2O nanocomposite is formed.

It is found that the PEC formed by the action CEF is characterized micro-heterogeneous structure unlike its analog, that is structurally homogeneous. It is found that for all the investigated polymer systems under the influence of a CEF generated much larger heterogeneity microregions.

By the methods of thermomechanical analysis it is shown that the PEC and PEC–Cu nanocomposites samples, formed under the action of CEF, are characterized with increasing of T_g value, whereas TPMC is characterized with T_g reduction.

By the methods of dielectric spectroscopy it is defined that PEC and TPMC exhibit dielectric properties, PEC–Cu/Cu_2O nanocomposite's properties are between the insulator and semiconductor, and PEC–Cu system demonstrates semiconducting properties.