Nanocomposites and nanomaterials

Structural organization and properties of nanocomposites formed from triple polyelectrolyte-metal complexes pectin-Cu(II)-polyethyleneimine

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Topical studies on chemical reduction of metal ions (Me^{n+}) in triple polyelectrolyte-metal complexes (TPMK) obtained by the introduction of metal salts in the volume of polyelectrolyte complex (PEC) on the basis of two oppositely charged polyelectrolyte. This allows to obtain nanocomposites with controllable size of nanoparticles and their uniform distribution in the polymer matrix, which can be used in catalysis, optics, magnetism, electronics and more.

Formation of PEC was performed by mixing 5% aqueous solutions of pectin's and PEI, taken in molar ratio of 1:1 at T = 20±2 °C. TPMK films formed by immersing films PEC in aqueous salt $CuSO_4$, the concentration of which was 0.1 mol/l. Thus, colorless films PEC acquired dark blue. Chemical reduction of Cu^{2+} cations in the volume TPMK performed using $NaBH_4$ (molar ratio of $[BH_4^-]/[Cu^{2+}]$ = 0,5÷10) in an alkaline environment – in a solvent mixture of water–isopropanol (4:1 vol. %) for three hours at T = 20±2 °C (up to termination of the bubbles of gas). As a result, chemical reduction PEC films containing $CuSO_4$, changed color from blue to dark brown, which is characteristic of the formation of nanocomposites based on PEC and Cu_2O nanoparticles.

Investigation of the structure and properties of PEC (pectin–PEI) TPMK type PEC–Cu^{2+} and nanocomposites PEC–Cu_2O using methods wide and small x-ray scattering, transmission electron microscopy, thermomechanical analysis and dielectric spectroscopy.

It was established as a result of chemical reduction of Cu^{2+} cations TPMK is the formation of nanocomposites based on polyelectrolyte complex pectin–PEI and Cu/Cu_2O nanoparticles, and at molar ratio BH_4^-/Cu^{2+} = 6 is implemented structural manifestation of Cu metal phase. It is shown, that the transition from TPMK to nanocomposites decreases the glass transition temperature of the structural and increased electrical conductivity.