Preparation of bimetallic nanoparticles with controllable core-shell ratio in irradiated interpolyelectrolyte complexes

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The bimetallic nanostructures (BNs) are of considerable interest for various prospective applications. Radiation-chemical methods have been proved to be extremely useful for preparation of nanoparticles and detailed studies are concentrated on the mechanisms of their formation [1]. The poly(acrylic acid)–polyethyleneimine (PA–PEI) interpolyelectrolyte complexes (IPEC) were shown to be particularly suitable precursors for preparation of metal-polymer nanocomposites via reduction of metal ions using chemical and radiation-chemical methods [2].

Cu\textsubscript{shell}/Ag\textsubscript{core} and Cu\textsubscript{shell}/Au\textsubscript{core} nanoparticles were synthesized in situ in films of interpolyelectrolyte complexes containing both Ag (or Au) and Cu ions by irradiation with x-ray and e-beams accelerator. HRTEM data show the core-shell structure of nanoparticles. XRD data exhibits that irradiation led to formation of the nanoparticles cores (Ag or Au) at early stage of irradiation while increase of the irradiation dose resulted in the growth of copper shell. On the BNs sizes and core-shell ratio affect the irradiation doze and initial concentration of metal ions in IPEC.

In summary, we have demonstrated that the radiation-induced reduction of metal ions in the IPEC matrices can be used for the single-stage preparation of nanocomposite films containing the bimetallic nanoparticles with controllable core-shell ratio [3].

Figure 1. a) TEM images of Cu\textsubscript{shell}/Ag\textsubscript{core} and Cu\textsubscript{shell}/Au\textsubscript{core} nanoparticles with initial content of copper ions 10 wt% and silver ions 1 wt%, irradiation dose 250 kGy; b) XRD patterns of patterns of irradiated films of interpolymer complexes containing 10 wt% of copper ions and 1 wt% of silver, irradiation dose 125, 250, 500 kGy.

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References