Nanocomposites and nanomaterials

Dynamic nanocomposite engineering methods for obtaining nanostructured smart materials based on aniline derivatives

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Aniline derivatives may be considered as a promising basis for functional nanocomposites and nanostructured smart materials owing to a valuable combination of switchable conductivity and electrochromic properties. A number of PDPA/Ag NP nanocomposites have been obtained within dynamically controlled single-step approach using diphenylamine monomers and $AgNO_3$ as oxidative agent at different concentrations. Obtained nanocomposites have been deposited on carbon substrate plates with compact structure as well as on a fiber-structured flexible carbon support. Conductive polymeric matrices in the case of poly(aniline), PANI, poly(diphenylamine), PDPA, and poly(triphenylamine), PTPA, and their mixtures provide an additional capabilities for controlling the NPs formation process due to two-route NP formation mechanism.

In the first case, Ag+ ions may be directly reduced by diphenylamine monomers consequently triggering their oxidative polymerization. In the second case, reduction of Ag+ ions may occur on the surface of the growing nanoparticles while the electrons for the reduction reaction may be provided via conducting polymeric matrices. The polymer ability to participate in such redox reaction strongly depends on its conductivity and oxidation state. Thus, the amount of electrons provided via second route that affects the NP formation process may be controlled using adaptive external polarization cycles [1].

In addition, based on electrochromism phenomenon, a wide range optically back-coupled material engineering methods may be implemented for controlling both the monomers polymerization and nanoparticle formation processes. Establishing regularities of the NP formation processes within conducting polymer matrices being combined with advanced programmable reaction cells will enable software-defined nanotechnology for obtaining materials with predefined physico-chemical and functional properties.

1. *Vyshnevska Yu.P, Brazhnyk I.V* The Electrochromic Feedback Methods for Obtaining Nanoparticles, Nanoalloys and Core-Shell Objects in Quasi-reversible Redox Systems // Springer Book Nanophysics, Nanomaterials, Interface Studies, and Applications.-2017.-P. 397–403 (in press).