FUNCTIONAL LUMINESCENT AND MAGNETIC NANOPARTICLES AS BIOANALYTI-CAL REAGENTS AND DRUG CARRIERS

Description

Biocompatible colored, luminescent and magnetic nanoparticles with controlled particle size distribution, reactivity and functionality as well as the techniques of their synthesis were developed in collaboration with the Institute of Cell Biology of NASU, Ukraine, Lviv. We obtained a series of colloidal systems containing monodisperse nanoparticles with tailored particle morphology. Composite nanoparticles comprise of polystyrene, polyacrylate (including fluorine containing acrylates) or siliceous, Fe3O4, Ni, Ag core and functional reactive polymer shell. The polymeric nanoparticles were sized 30, 100 and 300 nm. The size of hybrid polymer-mineral nanoparticles was 10–20 nm. Functional hybrid nanoparticles are surely protected from oxidation and contain functional shell providing targeted compatibility and dispersancy in various media. Functional nanoparticles of Ag, Fe3O4, and Ni, colored and luminescent polymeric nanoparticles that can bind specific proteins and interact with cell membrane, particularly with the apoptotic cells were developed. We successfully examined them as magnetic and luminescent markers, drug carriers and bioanalytical reagents. Stable reactive hydrosols of functional silver nanoparticles were tested for obtaining the hydrophobic coatings possessing antibacterial activity.

We also developed micellar and colloidal polymeric drug nanocarriers and water based preparations with antimicrobial and fungicidal activities using physiologically active functional oligoperoxide surfactants. They can be used as additives to the paints and varnishes providing the antimicrobial and fungicidal coating formation, for the sterilization of the working space, surgical instruments and materials. Some of these products were examined as remedies for plant protection from Mildew of cucumbers, Phytoftoros of tomatoes, and Grey rot of beans. Comparing with conventional materials the developed products are characterized by both the ability to chemical binding with various surfaces and prolongation of their action.

The principal feature of the developed functional nanoparticles is an availability of radical forming sites in their polymeric shell providing them an ability to initiate radical grafting and to introduce desired functional groups at definite distance from the particle core.

Innovative Aspect and Main Advantages

The development of polymeric and polymer-mineral nanoparticles and their stable colloidal systems is based on using novel surface-active coordinating metal complexes with functional oligoperoxide ligands as templates for the particle homogeneous nucleation, as initiators and stabilizers simultaneously. They determine nanoparticle size distribution and provide the formation of functional reactive polymeric shell irreversibly attached to the particle surface. The opportunity to control conformational state of sorbed oligoperoxide molecules provides purposeful particle compatibility, the formation of stable colloidal systems in the media of various polarities and their desired rheological characteristics. The availability of peroxide, anhydride, epoxy, isocyanate, carboxyl and other reactive functional groups in polymeric shell allows grafting functional polymeric chains by radical reactions on the particle surface and other polymer analogous transformations. Therefore, the developed functional nanoparticles are convenient universal products for the tailored introduction of various functional fragments on the definite distance from the surface providing targeted control of the particle specific properties and activity.

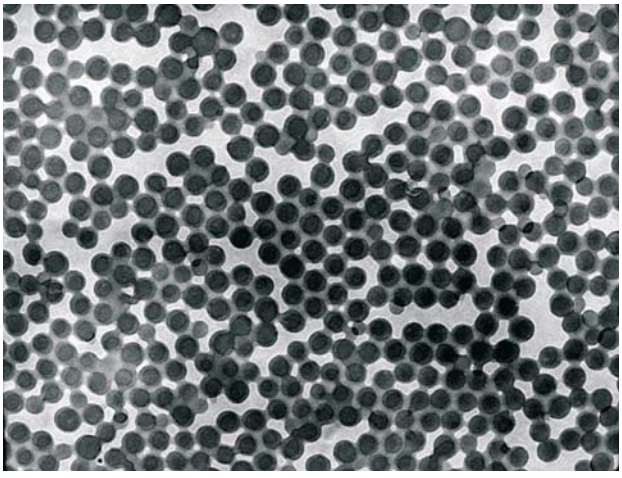

Fig.1. Transmission electron microscopy (x30,000): picture of colored functional polystyrene nanoparticles

Areas of Application

Novel magnetic and colored polymeric functional nanocomposites can be used for the measuring the phagocytic activity of granulocytes of human blood, as carriers of immobilized enzymes and drugs.

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Stage of Development

- The stage of the patenting.
- Prototype available for testing

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