OLIGOPEROXIDE BASED FUNCTIONAL LUMINESCENT NANOCOMPOSITES

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The intensive development of contemporary biotechnology, biochemistry and medicine is based on the purposeful synthesis and application of mineral, polymeric and hybrid nanoparticles with predetermined size and controlled functional properties.

Molecular design and controlled synthesis of novel oligoperoxide based surface-active block, comb-like functional oligoelectrolytes and nanogels of controlled size distribution, porosity, functionality, and biocompatibility were proposed and studied. These substances are capable to form poly dentate coordinating complexes of lanthanide (Ln) (Eu, Pr, Ce, Tb) possessing luminescent ability in wide wavelength range. Other developed route of the obtaining water based nanosized luminescent functional composites consists in encapsulation of low molecular weight organic complexes, for instance, Eu(TTA)3TFFO, Yb(TTA)3, Tb(AA)3, where TTA - thenoyltrifluoroacetone, TFFO - triphenyl phosphineoxide, AA - acetyl acetone, using various techniques, namely:

1) formation of intermolecular complexes of oligoelectrolyte surfactant and low molecular lanthanide - containing substances;
2) solubilization of water insoluble lanthanide - containing complexes in hydrophobic zones of micelle-like structures or porous formed by surface-active oligoelectrolytes or nanogels in water;
3) nanoencapsulation of water insoluble lanthanide - containing complexes in polymeric nanoparticles via multi-stage water dispersion polymerization initiated with oligoperoxide metal complexes.

We have developed also the promising techniques of the synthesis of luminescent (fluorescent), magneto-responsible, X-ray detectable functional nanoscale vehicles for enzymes, proteins, drugs and markers of biological objects including pathological and tumor cells. There are monodisperse polymeric, ferric oxide, gold and silver particles with predetermined size, charge, functionality. Novel functional nanocomposites consist of polymeric including fluorine-containing or siliceous, Fe_3O_4, Fe_2O_3, Pd, silver, gold core and functional oligoelectrolyte based shell. The shell and/or core of luminescent or X-ray detectable markers contain phosphor of organic or mineral nature including complexes of rare earth elements. The size of polymer nanoparticles is in the range of 30÷300nm. The size of hybrid polymer-mineral nanoparticles is 5÷30nm. Functional hybrid nanoparticles contain functional shell, which provides biological compatibility and ability to dispersion in physiological solution as well as to interaction with cell membranes of pathological including tumor cells. These carriers have been successfully tested as magnetic and luminescent markers for detection, separation and killing pathological cells as well as for the study of phagocytosis by granulocytes of human blood.

As a result stable water systems consisting of the functional carrier including luminescent substances in the core, porous or micelle hydrophobic zones of polymer nanoparticles (70-300 nm), nanogels (100-700 nm) or micelle-like structures (50-200 nm), respectively are formed (Fig.). Besides -COOH, -S03H, -SH, -N(CH3)2 groups, the developed nanocomposites contain desired amount of ditertiary peroxide fragments capable to initiate grafting functional reactive spacers of desired length for covalent attachment of cell recognizing vectors of natural origin (lectins, antibodies etc.). The polymeric nanogels were filled with antimicrobial or anticancer drugs including water insoluble ones also.

Functional nanocomposites including nanogels that can bind specific proteins and interact with cell membrane, particularly with rte apoptotic cells, bacteria and fungi were successfully examined as luminescent markers and drug carriers.

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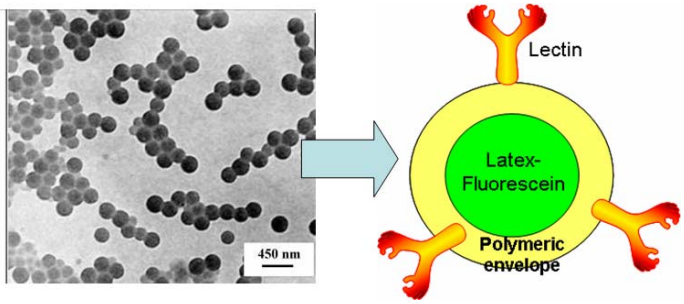

Figure 1

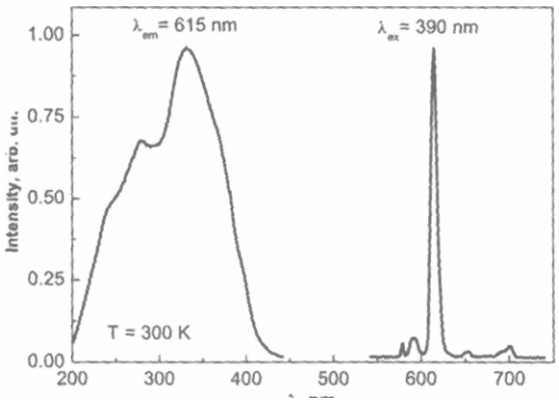

Figure 2

Figure 1
TEM-image of functional polystyrene particles containing fluorescein in the core and the scheme of obtaining lectin-particle conjugate.

Figure 2

Emission (excited at 390 nm) and luminescence excitation (for 615 nm emission) spectra ofEu (TTA)i in the micelle hydrophobic zones of polymer nanoparticles