TEMPLATE SYNTHESIS AND CHARACTERIZATION OF OLIGOPEROXIDE BASED POLYMER-MINERAL NANOSCALE PHOSPHORS AND SCINTILLATORS

O. Shapoval[1], L. Myagkota[2], N. Mitina[1], V. Glazunova[3], Yu. Kulyk[2], V. Vistovskiy[2], A.Voloshinovskii[2], A. Gektin[4], and A. Zaichenko[1]

[1]Lviv Polytechnic National University, 12 S. Bandera Str., Lviv, 79013, Ukraine; [2]Ivan Franko National University of Lviv, 8 Kyryla i Mefodiya str, Lviv, 79005, Ukraine; [3]O.O.Galkin Donetsk Institute of Physics and Engineering of NASU, Donetsk, 83114, Ukraine; [4]Institute for Scintillation Materials of NASU, Kharkiv, 61001, Ukraine e-mail: zaichenk@polynet.lviv.ua

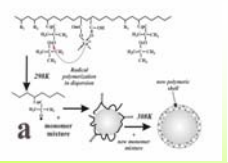
Biocompatible luminescent (fluorescent) nanoparticles with controlled size distribution, reactivity and functionality as well as the techniques of their synthesis were developed. We obtained colloidal systems containing monodisperse nanoparticles with tailored particle morphology. The development of 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.

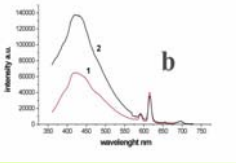
Composite nanoparticles comprise of polystyrene, polyacrylate core containing in some cases fluorescent dyes or LaPO4, Au, core and functional reactive polymeric shell. The polymeric nanoparticles were sized 60, 100 and 300 nm. The size of hybrid polymer-mineral nanoparticles was 15–30nm.

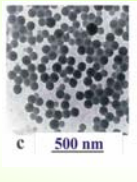
The principal feature of the developed functional nanoparticles is an availability of radical forming sites in their polymeric shell providing them an ability to initiate radical grafting and to introduce desired functional groups at definite distance from the particle core and as a result to attach cell recognizable proteins – lectins targeting to the pathological (apoptotic or tumor) cell specifically.

We successfully examined them as luminescent markers, drug carriers and bioanalytical reagents. Novel colored polymeric functional nanocomposites can be used for the measuring the phagocytosis activity of granulocytes of human blood, as labeled carriers of immobilized enzymes and drugs

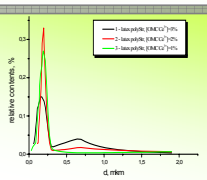
Polymer Nanoparticles with Luminescent Shell



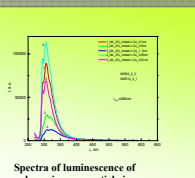




The scheme of the synthesis and functionalization of luminescent polymer NCs (a); luminescence spectrum (b) of Eu+3 coordinated OMC (1) and polymer NCs (2) synthesized in the presence of this OMC; TEM images of luminescent NCs (c).

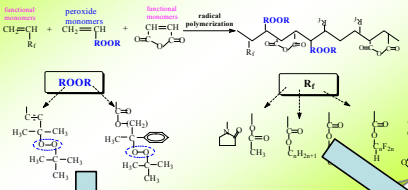


Size distribution of luminescent polymeric nanoparticles: 1- poly St latex with 3%; 2- poly St latex with 2%; 3- poly St latex with 1% of metal complex of Ce^{+3}([Ce^{3+}]per=1.25%)

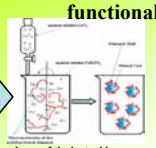


Spectra of luminescence of polymeric nanoparticle in water based on Ce+3 coordinating oligoperoxide VA-VEP-BA-MA complexes

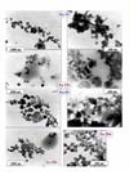
Functional oligoperoxide surfactants



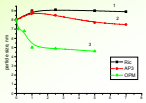
Nanoparticles of lanthanide salts with functional polymer shell



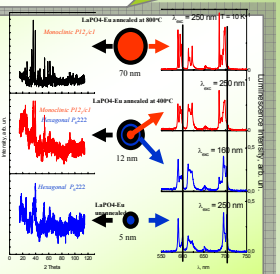
scheme of the lantanide nanoparticle template synthesis



TEM - images of the LaPO4 - Eu particles obtained at different concentrations of oligoperoxide surfactant, before(19, 20) and after (19v,20v) annealing: 19) 1% OPM, 20) 2,5% OPM



Dependence of particle size on the oligomer concentration

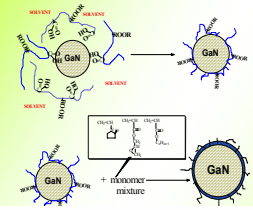


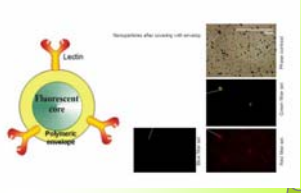
X-Ray of nanoparticles $LaPO_4$-Eu

The luminescence spectra of nanoparticles $LaPO_4$-Eu; T=10 K

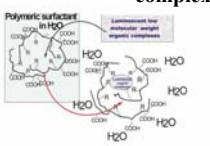
The dependence of the crystal structure of LaPO4 nanoparticles on the annealing temperature

Oligoperoxide functionalization of luminescent mineral nanoparticles

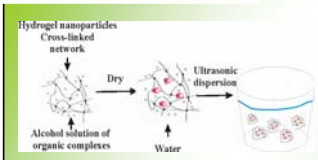




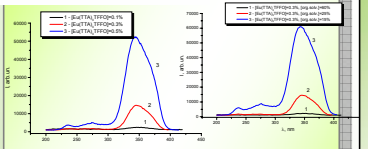
Encapsulation of water-insoluble organic complexes



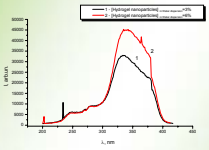
The scheme of the preparing water systems via solubilization of water insoluble organic complexes in the solution of oligoperoxide surfactants



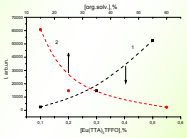
The scheme of obtaining dispersions of nanogel particles with adsorbed organic luminescent complexes



The excitation spectra (excited at 390 nm) complexes Eu (TTA) 3TFFO solubilized in water in the presence of oligoperoxide

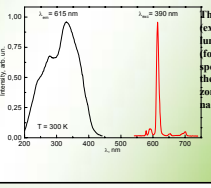


The excitation spectrum (excited at 390 nm) of water suspensions of nanogel particles with the adsorbed complex Eu (TTA) 3TFFO



The dependences of the excitation intensity on the concentration of luminescent complex in aqueous suspension (1) and the concentration of organic solvent used for solubilization (2)

Eu(TTA)3TFFO, where TTA - thenoyltrifluoroacetone, TFFO - tripheny iphosphineoxide



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