Revolutionary Ligand for Spatial Modification of Biologically Active Nanoparticles

Iakhontov, Timofei
Vatkovskiy, Gennady

The problem of stability of biologically active components in the environment of living organisms is one of the most important in the design of new drugs and diagnostic methods using them. We use coordinating ability and biological activity of sodium 2-aroyl-1,1,3,3-tetracyanopropenid (STCP) to obtain stable nanoparticles by colloidal mixing. We obtained 5 nm surface-modified nanoparticles based on CdS and BaS quantum dots, as well as 10 to 15 nm colloidal particles of synthetic analogs of isoniazid metabolite and podophyllotoxin being new medicines for tuberculosis and cancer, respectively. Modification was carried out by mixing the colloidal solution of quantum dots and STCP in ethyl acetate. The average diameter of the modified particles was found from the luminescence spectrum. Fluorescence spectrum of quantum dots modified by STCP ligand is shifted to the 390 nm being in transparency window of soft tissues. BaS quantum dots also absorb X-rays, allowing to detect their presence in malignant tissues by CT or X-ray inspection. Stability of the obtained nanoparticles in normal saline solution was studied experimentally by measuring time dependence of fluorescence intensity proportional to the number of particles. It was shown that 80% of quantum dots and 70% of organic nanoparticles remain stable up to three weeks in a solution. This stability can be explained using spatial models by high shielding ability of our ligand protecting active sulfide centers of quantum dots from the effects of water molecular dipoles and providing low toxicity of substances in tissues. The anticancer activity of obtained synthetic analog of podophyllotoxin was proven. Thus quantum dots modified by STCP ligand will possess both high cytostatic effect and dual visualization activity.