The goal of this research project is preparation **luminescent nanocolloids**, which shows up-conversion phenomenon (anti-Stokes emission, UC). In the described system, the dispersed phase will be inorganic nanoparticles, based on fluoride matrices and Sr^{2+} as well as Rare Earth Elements ions (SrF_2, Sr_2ScF_7, Sr_2NdF_7, Sr_2LuF_7, doped with lanthanide ions Ln^{3+}, where Ln= Yb, Er, Tm, Nd), while water or saline (PBS) will be continuous phase. These compounds are interesting due to their efficient emission in the visible spectrum under the near-infrared excitation (NIR, 800- 1000nm).

During the realization of the project, above-mentioned matrices will be obtained in solvothermal and thermal decomposition method. Applied method of luminescence enhancement (addition of metal ions Mg^{2+}, Sc^{3+}, Zn^{2+} or surfactants, synthesis of core-shell structure), as well as surface modifications (ligands sorption), allow obtaining stable aqua/PBS colloids, characterized by intense emission of light in the visible range. Mentioned colloids will be prepared by using ultrasonic dispersion method, which enables to obtain small monodisperse particles, without aggregates, preceded by freezing of nanopowders/suspensions with liquid nitrogen. In order to separate the large particles from formed clusters, which have not been eliminated during synthesis, the dispersing systems will be purified with membrane filters of appropriate pore size.

The analysis to determine the physicochemical and spectroscopic properties of the obtained nanomaterials and colloids e.g. X-ray diffraction **(XRD),** transmission electron microscopy **(TEM)**, inductively coupled plasma mass spectrometry (**ICP-MS)**, Fourier transform infrared spectroscopy **(FT-IR),** dynamic light scattering **(DLS)** and zeta potential, **viscometer and rotational rheometer** measurements, **sedimentation tests, excitation and emission spectra**, luminescence decays, up - conversion luminescence power dependencies and luminescence quantum yields and others will be made. Also, the c**ytotoxicity** of the obtained nanocolloids on animal cell lines will be studied. The impact of choosing matrices and dopants, synthesis methods, used surfactants and surface modification, the concentration of dispersed phase as well as irradiation of the excitation **on stability, physicochemical and spectroscopic properties** of water/ PBS colloids will be investigated.

The research about water luminescent nanocolloids is important not only for cognitive reasons but also because of the increasing number of possible applications in biology, medicine and criminology or documents security. Using for this purpose inorganic luminophores, characterized by up-conversion phenomenon has a lot of advantages. These compounds have **low phonon energy**, **high chemical stability, they are good electrons acceptor and are characterized by high quantum yield** [1], in a result, they have very large application possibilities, including mentioned biomedical applications (biological markers, drug release, photochemical reaction activators). Additionally, with excitation from near-infrared light, it is possible to **penetration of tissue localized deep** below the skin as a result of the existence of "**optical transparency window**" (750-1000 nm), without autofluorescence of tissue.[2] To make this possible, it is necessary to develop methods for obtaining stable aqueous colloids, which allow on the introduction of luminophores into organisms. Unfortunately, due to hydrophobic character of nanoparticles or their low affinity to water molecules, the surface modification must be carried out.

Although interest in the subject of up-conversion phosphors is increasing from year to year and colloids based on $NaREF_4$ matrices (RE = Y, Gd, Lu), where continuous phase are organic solvents are known [3,4], there are not many reports of water/ in saline nanocolloids based on strontium- fluoride matrices, especially about changes in morphological and spectroscopic properties in aqueous systems during their long-time storage. The proposed subject can significantly expand current state of knowledge about luminescent colloids and allow to **understand the mechanism occurred** in mentioned dispersion system, particularly up - conversion phenomenon.

Literature:

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