DESCRIPTION FOR THE GENERAL PUBLIC

Technological progress stimulates and inspires development of research on materials with luminescent properties, which are increasingly finding new applications from medical diagnosis by lighting techniques and solar convectors. Advanced applications increase requirements for luminescent materials, thus not only their chemical, mechanical or spectroscopic properties are important, but also their grain size or morphology. This is especially important in nanotechnology, as because of the very small size of the grains, nanomaterials possess physicochemical properties, which make them significantly different from their bulk counterparts or crystals. In nanocrystalites, quantum effects can play an important role and have effect on changes in the refractive index, electron-phonon interaction, multi-phonon relaxation, crystallographic positions and local symmetries of the active ion, or nonlinear processes. With regard to nanosized phosphors, it should be noted that together with desirable properties such as small particles, which reduce light scattering, some disadvantages occur as a large number of surface defects, which can lead to luminescence quenching. Thus, full understanding of the influence of grain size and morphology on the physicochemical properties of the material seems to be critical for the future design of materials with defined functionality. The main goal of the project is to correlate the influence of grain size and morphology of nano- and micro-scale orthophosphates $LnPO_4$ ($Ln=Lu^{3+}$, Gd^{3+}, Y^{3+}, La^{3+}, Bi^{3+}) doped by Nd^{3+}, Yb^{3+} and co-doped by Nd^{3+} and Yb^{3+} ions on their luminescent properties. The energy transfer between the optically active ions will be also investigated and analysed, and the effect of the presence of both dopants on deactivation processes of excited states will be determined. A particular attention will be paid to the effect of synthetic parameters on the synthesis of efficient phosphors emitting in the infrared region. The studied materials will be obtained by three methods - synthesis using ionic liquids as a reagent and stabilizer for rising nano-particles, hydrothermal and precipitation methods. The use of these methods should allow to obtain pure phase materials with different morphology and grain size. It is very important that phosphates, chosen for the study, are hardly soluble substances and practically insoluble in water, so they can be used, for example, in bio-imaging as a safer alternative to commonly-used fluoride-based materials. For imaging applications, it is very important that systems work in such spectral range, in which a deep tissue penetration is possible, mainly in the 700-900 nm (I-BW) and 1000-1400 nm (II-BW) spectral ranges. The ions selected for the study as optically active ions meet very well the requirements for bio-imaging materials or in optical thermometry. The obtained results will give the possibility to draw more general conclusions, to synthesize better, more efficient luminophores for modern applications in fields of medicine and technology, especially that the optically active ions selected for the study (Nd^{3+} and Yb^{3+}) can act as a structural probe to provide additional information on the lanthanide ion environment.

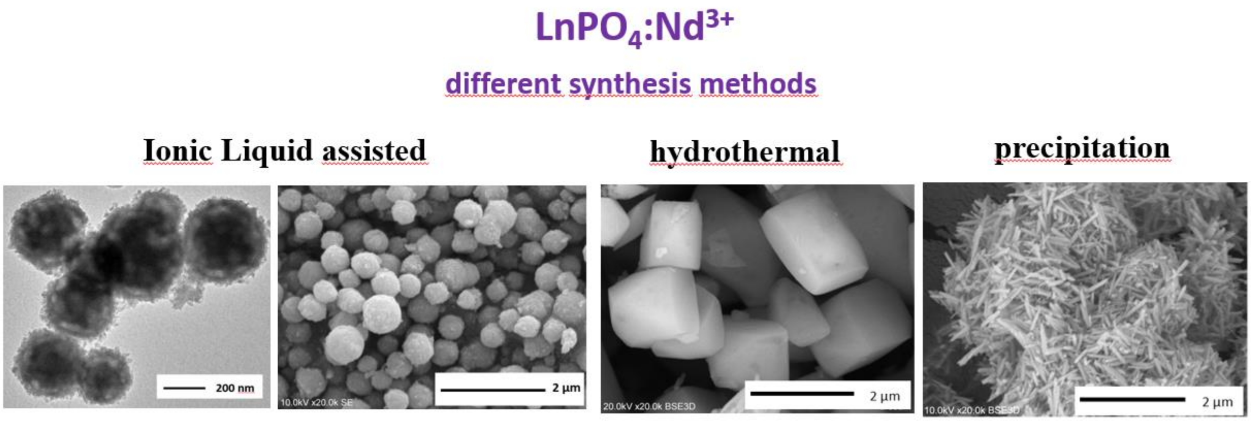

Fig. TEM and SEM micrographs of $LnPO_4:Nd^{3+}$ obtained by using different synthesis methods.