Upconversion is a process, where under low-energy photoexcitation, the high-energy emission is observed. Owing to their special properties, upconverting nanomaterials can be applied in many different fields, from electronics to biomedicine[1]. However different applications require different luminescent properties of the nanomaterials, such as emission color, quantum yield (QY) or luminescence lifetimes etc. Therefore, it is of fundamental significance to design and modify up-converting nanoparticles (UCNPs) to obtain desirable or controllable luminescent properties. One of the possibilities to achieve this goal is the introduction of passive or active impurities to the upconverting systems[2–4]. Passive impurities, which affect activator distribution within the UCNP mainly have influence on upconversion intensity, but the active impurities, which play an active role in energy transfer processes, can change the emission intensity as well as emission color.

The research tasks proposed in the project represent an attempt to a new approach to modulating the luminescent properties of upconverting nanomaterials. The major scientific purpose of the project is to control and modulate the emission color and intensity by introducing the active codopant, which is the cerium ions (Ce^{3+}). Ce^{3+} ions, because of its small energy gap of about 3000 cm^{-1} , affects only energy transfers that involve similar energy gaps[5]. In is worth to mention that Ce^{3+} co-doping not only can change the emission color, but also enables to modulate and tune the luminescent properties by using different excitation pulses (intensity or time).

To achieve this, a series of core-shell materials with the optically active core, i.e. $NaYF_4$: Yb^{3+}, Ho^{3+}, $NaYF_4$: $Yb3^{+}$, Er^{3+}, $NaYF_4$: $Yb3^{+}$, Tm^{3+} and passive shell, will be synthesized. The shell will be used here as a protection from the influence of environment (solvents, ligands etc.) These systems are well defined in literature in respect to their luminescent properties. Next, respective counterparts will be synthesized and co-doped with the Ce^{3+}. By specific luminescent analysis, and comparison the results to those obtained for materials without Ce^{3+} ions, the influence of Ce^{3+} on the emission color, luminescence lifetimes, intensity and quantum yield will be investigated.

The obtained results will improve the knowledge about upconversion process and will open the new possibilities to increase the UC efficiency or even modulate the UC emission color in an predictable way, by either fixed co-doping or by modification of photoexcitation pulse width.

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