Yttrium, gadolinium and lutetium orthovanadates, activated with Eu\(^{3+}\), Nd\(^{3+}\), Yb\(^{3+}\) and Tm\(^{3+}\), are good known luminophors and materials for laser elements since the middle of XX century. V\(^{5+}\) cations are optical inactive, and rare-earth oxides REVO\(_4\) (were RE is trivalent rare-earth elements) are transparent in optical band. Therefore, these matrices can be considered as promising hosts for scintillation materials activated with rare-earth elements.

It’s known, that solid state synthesis of rare-earth vanadates from starting oxides is carried out rather easy – 80% of orthovanadates formed at 600°C for 6h, and full reaction between the oxides takes place in the temperature range 700 – 900°C for 5 min [1]. However, difficulties of obtaining transparent rare-earth orthovanadates crystals with of good optical quality are connected with uncontrolled evaporation of V\(_2\)O\(_5\) from the melt in inert atmosphere, and unstable valence of vanadium leading to formation of oxygen vacancies in crystals. Evaporation of V\(_2\)O\(_5\) is more intensive for LuVO\(_4\):RE than for GdVO\(_4\):RE and YVO\(_4\):RE[2].

Oxygen vacancies formed during growth of crystals can be compensated with long-term annealing in air or in pure oxygen atmosphere.

In present work we have investigated optimal conditions of synthesis, crystal growth and annealing of orthovanadate (LuVO\(_4\), GdVO\(_4\) and YVO\(_4\)) crystals activated with different rare-earth cations. Optical-luminescent properties of obtained crystals in different regimes of growth and annealing are studied and discussed as well.

References