

Physico-chemical nanomaterials science

Synthesis and properties of the $R_{1-x}Ca_xVO_4$, $R = La, Y, Eu, Nd$ ($0 \leq x \leq 0,5$) compounds

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Alkaline-earth metal orthovanadates have very important applications in various fields that involve chemical and biological applications, luminescent devices and optical fibers. The aim of this work is to study conditions of synthesis and properties of $RE_{1-x}Ca_xVO_4$, $RE = La, Y, Eu, Nd$ ($0 \leq x \leq 0,5$) compounds.

The samples were prepared by aqueous nitrate-citrate sol-gel synthesis route taking citric acid (CA) as a complexation agent. The NH_4VO_3 was dissolved in concentrated ammonia solution by stirring at 70-80 °C temperature. Then CA, dissolved in distilled water with a small amount of $NH_3 \cdot 4H_2O$, was added. Next, $La(NO_3)_3$, $Y(NO_3)_3$, $Eu(NO_3)_3$, $Nd(NO_3)_3$ and $Ca(NO_3)_2$ were added. To prevent precipitation, the pH reached the value of ~ 6-7 was controlled. Finally, the same amount of the aqueous solution of the complexation agent CA was repeatedly added to the reaction mixture to prevent crystallization of metal salts during the gelation process. The clear solution was concentrated by slow evaporation at 80-90 °C in an open beaker. A transparent gel formed after nearly 90 % of the water has been evaporated under continuous stirring. After drying in an oven at 100 °C, sol were obtained. The sol were calcined for 5 h at 150, 300, 450 °C and reground carefully in an agate mortar. After intermediate grinding, the obtained powders were repeatedly annealed for 5 h at 500, 600, 700, 800, 900, and 1000 °C.

The X-rays and structural features and morphological properties were studied and photoluminescence (PL) properties of the synthesized samples were investigated too. The PL spectra contain wide bands of matrix emission and narrow lines caused by f-f transitions in the RE^{3+} ions. Correlations between concentrations, morphology and luminescence characteristics were analyzed.