PHASE RELATIONSHIPS IN THE QUASI-TERNARY SYSTEM OF ORTHOPHOSPHATES OF La, Gd, AND Y AT *T* = 230 °C AND *P* ≈ 10 atm

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Rare earth element (REE) orthophosphates ($REEPO_4$, where *REE* La → Lu, Y, and Sc) are a broad class of inorganic compounds that crystallize in various structural types: rhabdophane, churchite, monazite, xenotime, and anhydrite. Particular attention to REE orthophosphates and materials based on them is due to their unique physicochemical properties, such as high melting points (≈1800-2300 °C), low thermal conductivity, resistance to aggressive and aqueous environments, resistance to radiation damage, and the ability to widely substitute REEs for other REEs, actinides, and other elements.

Of considerable interest are multicomponent systems of rare-earth element orthophosphates, which can exist as either continuous solid solutions or phases with limited solubility of the components in the solid state. Such multicomponent systems hold promise for the production of structural and thermal insulation materials, as matrices for the immobilization of radioactive and toxic waste, luminescent materials, and so on. However, multicomponent systems remain a poorly understood area of rare-earth element orthophosphate chemistry, due to the diversity of chemical compositions and structural types they form depending on their composition and synthesis conditions. The least studied areas include the formation of rare-earth element orthophosphate nanoparticles, including those of variable composition, under “soft chemistry” conditions, structural evolution, and phase stability boundaries.

To date, studies of phase equilibria in complex systems based on REE orthophosphates have been conducted only for stable phases with monazite and xenotime structures at $T \geq 1000$ °C (at temperatures above the melting point of non-autonomous phases [1]), since below this temperature, the mass transfer rate of the components is low enough to approach the equilibrium state and avoid metastable or kinetically "inhibited" labile states.

In connection with the above, the aim of the study is to determine the phase state of particles in a $LaPO_4$-$GdPO_4$-YPO_4 system obtained under hydrothermal conditions at $T = 230$ °C and $P \approx 10$ atm, as well as to study the mechanism of structural transformations under conditions of limited mass transfer.

1. Almjasheva O.V. The role of non-autonomous phases in the formation and transformation of solid-phase oxide systems // Nanosyst. Phys. Chem. Math. 2024. 15(6). P. 755-76.

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