The present thesis is focused on the development of a crystal structure of $A_2B_2O_7$ materials, where A is a rare-earth element and B is a transition metal. These materials crystalize generally in four crystallography structures. The thesis is focused on structural transitions from an ordered cubic structure, so-called pyrochlore structure, to a fully disordered cubic structure, so-called defect-fluorite structure, to semi-ordered rhombohedral structure. Compared to previous studies, which dealt with these structural changes in $A_2Zr_2O_7$ with the substitution of the rare-earth element, this thesis is focused on evolution of structure with a substitution on the B positions.

For this research of the crystal structure evolution two series of oxides, $Er_2(Ti,Zr)_2O_7$ and $Lu_2(Ti,Zr)_2O_7$, have been selected. Twenty-one samples of those series were prepared by the floating zone method and Czochralski method. Analysis of prepared crystals was performed by using the Laue diffraction method and the powder diffraction methods. For the study, X-ray and neutron diffraction were utilized. A quality of the prepared materials and their crystal structure were studied with the respect to a concentration of Ti-Zr. The development of the crystal structure has been discussed. The thesis will serve as a ground for following research of $A_2B_2O_7$ materials.