Abstract

Some of lanthanum – titanate ceramics exhibit interesting microwave dielectric properties making them useful for the development of modern advanced telecommunication technologies. In order to obtain ceramics, which would have had improved microwave dielectric properties, many investigations focus on the complex ternary lanthanum – titanate ceramics by integrating third metal ion. The characteristics of these materials are affected by their crystal structure to a great extent. Ceramic materials are usually unsuitable for single crystal X-ray structural analysis. For structure determination of such materials, powder methods are applicable, in this case the X-ray powder diffraction.

Advanced ternary systems of $CaO–La_2O_3–TiO_2$, $La_2O_3–TiO_2–Mn_2O_3$ and $La_2O_3–TiO_2–GeO_2$ were examined. In the system $CaO–La_2O_3–TiO_2$ a subsolidus phase equilibria was determined as well as crystal structures of selected phases were solved. By X-ray powder diffraction the structure of perovskite solid solutions between $CaTiO_3$ and La_2O_3, which extends from $CaTiO_3$ up to $Ca_3La_4Ti_3O_{15}$, solid solution between La_2TiO_5 and $Ca_3La_4Ti_3O_{15}$ and between $La_4Ti_3O_{12}$ and $CaLa_4Ti_4O_{15}$ were examined. The phase relations in the system $La_2O_3–TiO_2–Mn_2O_3$ was known, however the structure of ternary compounds formed in this system was not determined. By a wet technique, I have synthesized a compound $La_{1.78}Ti_{13.62}Mn_{6.6}O_{38}$ of high crystallinity and determined its structure by X-ray powder diffraction. The compound is isostructural with $Ca_2Zn_4Ti_{16}O_{38}$ and other davidites from the group of crichtonite minerals. In this structure the La^{3+}, Ti^{4+}, Mn^{2+} in Mn^{3+} ions are distributed over six crystallographic sites, which are, as well as all oxygen sites, fully occupied. For the phase relations determination in the system $La_2O_3–TiO_2–GeO_2$ I prepared several tens of samples by using a wet precipitation techniques. Based on the obtained experimental results I constructed the phase diagram. In addition, I structurally characterized two solid solutions in this system – first on the compositional line $La_2Ge_3O_9–La_2O_3{\cdot}3TiO_2$ and the other with general formulae $La_{9.33}Ti_xGe_{6-x}O_{26}$ ($x \leq 2.2$) having apatite-like structure.

Keywords: X-ray powder diffraction; crystal structure; Rietveld refinement; phase relations; lanthanum-titanate ceramics.