"Physico-chemical nanomaterials science"

Sequence of structural phase transitions in $Pr_{0.9}Sr_{0.1}AlO_{3-\delta}$ probed by high-resolution X-ray synchrotron powder diffraction

R.V. Stepchuk, L.O. Vasylechko, N.A. Ohon`

Lviv Polytechnic National University, 12Bandera Street, 79013 Lviv, Ukraine.
E-mail: stepchukroman@gmail.com

Microcrystalline powders of $Pr_{1-x}Sr_xAlO_{3-\delta}$ (x = 0.1, 0.2) were prepared from stoichiometric amounts of constituent oxides Pr_6O_{11}, Al_2O_3 and strontium carbonate $SrCO_3$ by solid-state reaction technique. The precursor powders were ball-milled in ethanol for 4 hours, dried, pressed in the pellets and sintered in air at 1673 K for 9 hours. After regrinding and powdering the obtained product was repeatedly fired in air at 1773 K for 9 hours. X-ray diffraction examinations revealed pure rhombohedral perovskite structure of $Pr_{0.9}Sr_{0.1}AlO_{3-\delta}$, whereas precipitation of the extra parasitic phases(s) has been detected in the sample with nominal composition $Pr_{0.8}Sr_{0.2}AlO_{3-\delta}$. From this observation, as well as from a comparison of the unit cell dimensions of the $Pr_{1-x}Sr_xAlO_{3-\delta}$ samples with the parent $PrAlO_3$ structure it may be concluded that solubility of strontium in praseodymium aluminate do not exceed 15–17 mole %.

In situ low- and high-temperature X-ray synchrotron powder diffraction examinations of $Pr_{0.9}Sr_{0.1}AlO_{3-\delta}$ performed in broad temperature range of 12–1173 K at *B*2 beamline of laboratory HASYLAB@DESY revealed a sequence of structural phase transformations $I4/mcm$–$Imma$–$R\bar{3}c$ at 130–150 K and 200–230 K, respectively (Fig.). In addition, the high-temperature phase transition from rhombohedral to the cubic perovskite structure is predicted to occur in $Pr_{0.9}Sr_{0.1}AlO_{3-\delta}$ at 1940 K from the extrapolation of the unit cell parameters of rhombohedral phase.

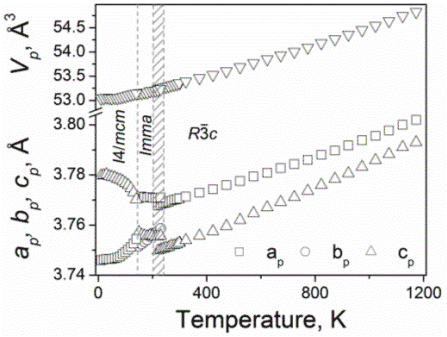

Fig. Temperature evolution of unit cell dimensions of $Pr_{0.9}Sr_{0.1}AlO_{3-\delta}$ illustrating structural changes occurred at the phase transitions. Lattice parameters of tetragonal, orthorhombic and rhombohedral phases are normalized to the cubic perovskite structure.