INTERACTION OF COMPONENTS IN $PrAlO_3$- AND $LaAlO_3$-BASED SYSTEMS

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In order to study crystal structures, thermal expansion and phase transitions in the $PrAlO_3$–$RAlO_3$ and $LaAlO_3$–$RAlO_3$ (R = Nd–Lu, Y) pseudo-binary systems, series of samples have been synthesized by a combination of solid state reactions in air and arc-melting in Ar atmosphere. The ICP-OES method was used for the determination of cationic composition of selected specimens. It was established, that at room temperature continuous solid solutions with rhombohedral $LaAlO_3$-type of structure are present in the systems $PrAlO_3$–$RAlO_3$ and $LaAlO_3$–$RAlO_3$ (R = La, Pr, Nd). However, in the other systems two or three kinds of solid solutions with rhombohedral and orthorhombic (*Pbnm* and *Imma*) structures with immiscibility gaps between the different perovskite-type phases are formed. Lattice parameters and cell volumes of $Pr_{1-x}R_xAlO_3$ and $La_{1-x}R_xAlO_3$ solid solutions decrease monotonically with decreasing R content.

Study of structural and thermal behaviour of the the solid solutions performed by means of *in situ* high-resolution powder diffraction technique applying synchrotron radiation (beamline B2, HASYLAB at DESY) and thermal analysis revealed several kinds of phase transformations. The $La_{1-x}Nd_xAlO_3$ solid solutions undergo only phase transition from a rhombohedral to the cubic structure. Continuous phase transition $R\bar{3}c \leftrightarrow Pm\bar{3}m$ and a first-order transformation $Pbmn \leftrightarrow R\bar{3}c$ are observed in the systems $LaAlO_3$–$RAlO_3$ (R = Sm–Lu, Y). Both transitions are induced by a structural deformation and its temperatures increase with decreasing R-cation radius and tolerance factor. Besides above-mentioned high-temperature phase transitions, a number of low-temperature phase transformations $R\bar{3}c \leftrightarrow Imma$, $Imma \leftrightarrow I2/m$, $I2/m \leftrightarrow I4/mcm$, $R\bar{3}c \leftrightarrow I2/m$ and $R\bar{3}c \leftrightarrow I\bar{1}$ has been detected in the $PrAlO_3$–$RAlO_3$ pseudo-binary systems. The low-temperature transitions in $PrAlO_3$-based systems are caused by electronic effects and for the most part its temperatures decrease with decreasing Pr content. Substitution of RE cations allow to tune the desired structural properties of $LaAlO_3$ and $PrAlO_3$-based perovskites in a vide temperature range in order to use theirs as substrate materials for diverse epitaxial applications.

Based on the results of *in situ* synchrotron powder diffraction examinations and DTA/DSC measurements, as well as available literature data, the structural phase diagram of the pseudo-binary systems $PrAlO_3$–$RAlO_3$ and $LaAlO_3$–$RAlO_3$ have been constructed.