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Investigation of the Nd_2O_3–Lu_2O_3–Sc_2O_3 phase diagram for the preparation of perovskite-type mixed crystals $NdLu_{1-x}Sc_xO_3$

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Abstract

Based on differential thermal analysis (DTA) and X-ray powder diffraction (XRD), a description of the Nd_2O_3–Lu_2O_3–Sc_2O_3 system was obtained by thermodynamic assessment. Four fields of primary crystallization could be identified; from melt compositions close to the Lu_2O_3–Sc_2O_3 edge, the rare-earth oxide C-phase crystallizes first which is stable down to room temperature. From Nd_2O_3 rich melts, the X-phase forms which is stable only at high temperatures. An additional field, where the alternative high-temperature phase H solidifies as primary product touches the Nd_2O_3–Lu_2O_3 edge of the concentration triangle. From melts close to the composition $NdScO_3$, the P-phase (perovskite) can be crystallized and mixed crystals with second endmember $NdLuO_3$ have been grown from the melt. Crystals of this mixed perovskite were grown by the micro-pulling-down and Czochralski methods.

Keywords: A1. Phase diagrams, A1. Solid solutions, A2. Czochralski method, B1. Oxides, B1. Perovskites, B1. Rare-earth compounds

1. Introduction

Rare-earth scandates with orthorhombically distorted perovskite structure (P-$REScO_3$, RE = rare-earth element; in this case Pr–Dy) have come into the focus of interest as substrates for the epitaxial deposition of many functional oxides, and especially for strain engineering of perovskitic layers [1, 2]. Their

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