

Towards deliberate design of persistent phosphors: a study of La–Ga admixing in LuAG:Ce crystals to engineer elemental homogeneity and carrier trap depths

Autorzy

Karol Bartosiewicz
Verena Fritz
David van der Heggen
Damian Szymański
Justyna Zeler
Jan Pejchal
Akihiro Yamaji
Romana Kucerkova
Alena Beitlerova
Shunsuke Kurosawa
Akira Yoshikawa
Philippe F. Smet
Eugeniusz Zych
Martin Nikl

Rok wydania

2023

Czasopismo

Journal of Materials
Chemistry C

Numer woluminu

11

Strony

8850-8865

DOI

Streszczenie

This research investigated the crystal chemical principles related to the incorporation of incompatible atoms into a garnet host lattice. These considerations might be used to guide and drive the design of new garnet compounds with novel properties. The strongly incompatible La atoms at the Lu sites of the $\text{Lu}_3\text{Al}_2\text{Ga}_3\text{O}_{12}:\text{Ce}$ host lattice served as a research model. This study showed the possibility of designing material properties by exploiting atom mismatches in a crystal lattice. $\text{Lu}_3\text{Al}_2\text{Ga}_3\text{O}_{12}:\text{Ce}0.075\%$ crystals with increasing concentrations of La^{3+} ions were grown from the melt using the micro-pulling down method. The concentration of La^{3+} ions above 0.300 at% imposed physical and chemical boundary conditions on the crystallization process. The radial distributions of the chemical elements were studied as a function of the concentration of La^{3+} ions. It was revealed that La^{3+} codoping significantly reduced the cross-sectional fluctuation of the Ga and Al atoms. Persistent green-yellow luminescence due to the inter-configurational $5d \rightarrow 4f$ transition of Ce^{3+} was observed after the blue-light excitation. The $\text{LuAGG}:\text{Ce}0.075\%,\text{La}0.015\%$ phosphor showed long persistent luminescence for more than 14 h above 0.32 mcd m^{-2} , the detection limit of a human eye. The thermoluminescence glow curves revealed that the addition of La^{3+} ions increased the concentration of traps.

Adres publiczny

<http://dx.doi.org/10.1039/d3tc01304a>

Strona internetowa wydawcy

<https://www.rsc.org/>

10.1039/d3tc01304a

Kolekcja

Naukowa

Język

Angielski

Typ publikacji

Artykuł

Plik został wygenerowany dnia 2026-08-27 07:54:17

Adres w repozytorium <https://old.chem.uni.wroc.pl/pl/repozytorium/UpNY4Bf>.