THE 67TH INTERNATIONAL

OPEN READINGS

CONFERENCE FOR STUDENTS OF PHYSICS AND NATURAL SCIENCES

BOOK OF ABSTRACTS | 2024

Vilnius University

VILNIUS UNIVERSITY PRESS

Editors:

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Cover and Interior Design:

Goda Grybauskaitė

Vilnius University Press
9 Saulėtekio Av., III Building, LT-10222 Vilnius
info@leidykla.vu.lt, www.leidykla.vu.lt/en/
www.knygynas.vu.lt, www.journals.vu.lt

Bibliographic information is available
on the Lithuanian Integral Library Information System (LIBIS) portal www.ibiblioteka.lt
ISBN 978-609-07-1051-7 (PDF)

SYNTHESIS AND LUMINESCENT CHARACTERIZATION OF DOPED $Na_{1-x}AlGe_{1-0.5x}O_4$:X PHOSPHORS

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The demand for energy-efficient lighting has spurred research into luminescent materials, crucial for the development of next-generation technologies. As white light-emitting diodes (LEDs) gain prominence for their efficiency, long life, and minimal energy consumption, thereś a growing need to explore novel luminescent materials. Recently, increasing attention has been paid to germanate compounds, which are suitable for the development of phosphors due to their low synthesis temperature and excellent physicochemical properties.

Sodium aluminum germanate $NaAlGeO_4$ has a monoclinic structure with the symmetry space group $P2_1/n$. The lattice parameters of $NaAlGeO_4$ are $a = 8.783$ Å, $b = 15.432$ Å, $c = 8.252$ Å, and the lattice angles $\alpha = 90.00°$, $\beta = 90.00°$, $\gamma = 90.09°$. $NaAlGeO_4$ is characterized by unique optical and electronic properties, including high thermal stability, strong photoluminescence, and high transparency in the visible and near-infrared range. Furthermore, its composition and crystal structure render it well-suited for diverse applications, including serving as a host material for rare earth ions in solid-state lighting and functioning as a dielectric material for capacitors.

During this study, a sequence of $Na_{1-x}AlGe_{1-0.5x}O_4$:X samples doped with varying concentrations of Bi^{3+}, Ce^{3+}, Dy^{3+}, Eu^{3+}, Pr^{3+}, Sm^{3+} and Tb^{3+} ions were synthesized using the solid-state synthesis method. The obtained samples underwent characterization through the powder X-ray diffraction (XRD) technique and photoluminescence (PL) measurements, including excitation and emission spectra, luminescence decay times, and quantum efficiencies. The XRD analysis demonstrated that all samples exclusively consisted of the pure $NaAlGeO_4$ phase. Insights from the PL measurements revealed specific emission characteristics for each ion: red emission in Eu^{3+}-doped samples, yellow emission in Dy^{3+}-doped samples, blue emission in Bi^{3+} and Ce^{3+}-doped samples, orange-red emission from Pr^{3+}, orange emission from Sm^{3+}, and green emission from Tb^{3+}.

Acknowledgment: This research has been funded by Lithuanian Science Council (LMT)ś Studentsŕesearch practice project No. S-ST-23-193