THE 67TH INTERNATIONAL

OPEN READINGS

CONFERENCE FOR STUDENTS OF PHYSICS AND NATURAL SCIENCES

BOOK OF ABSTRACTS | 2024

Vilnius University

VILNIUS UNIVERSITY PRESS

Editors:

Martynas Keršys
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Cover and Interior Design:

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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)

THE GROWTH OF GaN(0001) ON Sc_2O_3(111)/Si(111) TEMPLATE VIA MOVPE METHOD

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Group III nitride semiconductors are widely used in optoelectronics, high-power and high-frequency electronic devices and have now become critically important in the modern world. To expand their applicability and integrity, researchers are developing various technologies for growing nitride semiconductors on Si, which is widely used in electronics.
This work aims to evaluate the impact of nitrogen and hydrogen atmospheres on the crystallographic and morphological properties of GaN layers grown on Sc_2O_3/Si substrates using the MOVPE method. To achieve this goal we performed several tasks: to grow GaN layers on $Sc_2O_3(111)/Si(111)$ substrates using the MOVPE method in nitrogen and hydrogen atmospheres; to investigate the crystallographic and morphological properties of the grown structures; and to compare the physical properties of GaN layers grown in different atmospheres.

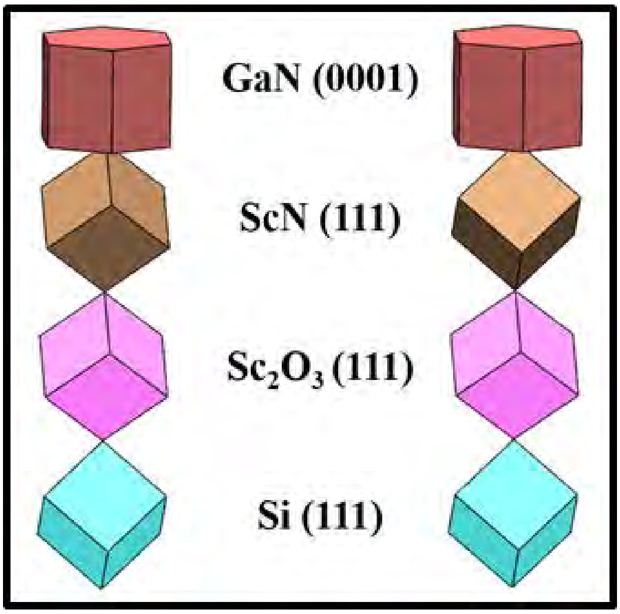

Fig. 1. *Schematic view of unit cells, demonstrating the azimuthal orientations of different layers in the sample, where ScN exists in two orientations.*

We have presented different layers of our samples and their unit cells azimuthal orientations, using XRD ω-2θ and ϕ scans. We found that the successful growth of continuous c-axis oriented monocrystalline GaN layer on a Sc_2O_3/Si substrate is possible, despite the formation of a ScN layer composed of twins during the nitridation process of Sc_2O_3. We observed that the strain values along a and c axes calculated from GaN(0002) ω-2θ scan do not depend on the atmosphere used during the growth. We compared them with strain values based solely on the differences in thermal expansion between GaN and Si. We found that the strain in the GaN layer is a result of a dual-component interaction: lattice mismatch between Si and GaN as well as their different thermal expansion rates. We also showed that controlling the growth atmosphere between N_2 and H_2 during various stages of the GaN growth on Sc_2O_3/Si templates allows to reduce the dislocation densities and enhance the surface morphology of GaN layers.