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Journal of Crystal Growth 264 (2004) 184–191
JOURNAL OF CRYSTAL GROWTH
www.elsevier.com/locate/jcrysgro

Comparison of ion-beam-assisted molecular beam epitaxy with conventional molecular beam epitaxy of thin hexagonal gallium nitride films

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Received 15 September 2003; accepted 15 January 2004
Communicated by S. Hiyamizu

Abstract

Structural and electronic properties of hexagonal gallium nitride thin films on 6H–SiC, prepared by both low-energy ion-beam-assisted growth as well as molecular beam epitaxy (MBE), have been compared. According to X-ray diffraction and transmission electron microscopy, films deposited by ion-beam-assisted growth contain a significantly lower defect density than MBE films. Moreover, infrared reflectance spectroscopy and photoluminescence measurements substantiate the improvement of the electrical and optical parameters, respectively, if an ion assists the growth of the film. The advanced structural, optical and electrical properties are discussed in the context of enhanced surface mobility during growth, provoked by ion-beam irradiation, resulting in a reduced lattice defect formation probability.

PACS: 81.15.Hi; 81.15.Jj; 68.37.Lp; 78.55.Cr; 78.30.Fs

Keywords: A1. Ion beam; A3. Ion-beam-assisted deposition; A3. Molecular beam epitaxy; B1. Gallium nitride

1. Introduction

Due to its large bandgap of 3.4 eV at room temperature, hexagonal gallium nitride (w-GaN) is a semiconducting material with a broad field of applications. The most important ones are blue and white light emitting diodes, blue laser diodes, field effect transistors and ultra-violet light sensors. In order to deposit gallium nitride thin films there exist many methods. Mostly, metal-organic vapour phase epitaxy is used to fabricate semiconductor components of gallium nitride. But molecular beam epitaxy (MBE) has become an important alternative for deposition of GaN,

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doi:10.1016/j.jcrysgro.2004.01.027