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Editors:
Professor Dr. Zainuriah Hassan
Dr. Quah Hock Jin
Dr. Lim Way Foong
Dr. Ng Sha Shiong
Dr. Yam Fong Kwong

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Fax:04-653 5639

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Professor Dr. Zainuriah Hassan
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Effect of Films Thickness on the Surface and Structural Properties of InN Films

Grown on Flexible Substrate

Siti Aisyah Osman^{1,*}, Sha Shiong Ng¹, Fong Kwong Yam²

¹Institute of Nano Optoelectronics Research and Technology (INOR), Universiti Sains Malaysia, 11800 USM, Penang, Malaysia.

²School of Physics, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia.

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*sitiaisyahosman@gmail.com

ABSTRACT

In this study, indium nitride (InN) thin films were grown on flexible substrate by radio frequency reactive sputtering technique. An indium target with purity of 99.999% was used. Throughout this work, the RF power and the gas ratio of argon and nitrogen were maintained constant at 60 W and 40:60 (Ar : N₂), respectively. The depositions were carried out at temperature of 300 °C under various deposition thickness. As a result, InN films with various thickness, i.e., 300 nm, 500 nm and 700 nm were produced. Subsequently, the effects of the InN films thickness on the structural properties and surface morphology were investigated. X-ray diffraction results reveal that wurzite InN thin films were successfully deposited. It was found that InN film with thickness of 700 nm exhibits (101)-preferred orientation and strongest XRD diffraction peak compared to InN films with thickness of 300 nm and 500 nm. Field emission scanning electron microscopy and atomic force microscopy results show that all the InN thin films exhibit smooth and uniform surface morphology but the InN grain size increases with increasing film thickness. However, the root mean square surface roughness of the InN films shows little apparent variations as the film thickness increases. All the findings lead to conclude that the crystalline quality of InN thin films were effectively improved with increasing film thickness.

1 Introduction

Indium nitride (InN) is a III-nitride group semiconductor material to be involved in the development of light-emitting diode, laser diode, photodetector, high frequency transistor operating at high power and temperature, and high efficiency low cost solar cell [1]. InN has received little attention among researchers because of high-grade single crystal are expensive and not highly available in the market. In fact, InN is very difficult to grow and prepare in stoichiometric form [2]. Besides, the InN has low dissociation temperature, hence the condition for growth of InN are very stringent.

Various methods have been applied by the researchers as to obtain good quality InN thin films. The most advanced techniques included molecular beam epitaxy (MBE) and metal-organic chemical vapour deposition (MOCVD) [3,4]. Generally, these techniques are very expensive and the maintenance is very costly. Besides, the setup of these techniques also relatively complicated. Therefore, a rather simple and cheap technique, i.e., reactive radio frequency (RF) sputtering has been proposed.

To date, reactive RF sputtering technique has been widely used to grow the InN thin films on various substrates such as silicon, glass, quartz, and etc. Despite these experiments very little has been carried out on the growth of the InN thin films on the flexible substrate. Nowadays, the flexible substrate is the preferred substrate for microelectronic application due to the light weight, flexibility and low cost [5]. From these point of view, it is absolute needed to initial the study of the reactive sputtering growth of the InN thin films on the flexible substrate.

In the present work, kapton polyimide flexible substrate was used as the substrate for the RF sputtering growth of InN thin films. The structural properties and surface morphology of the deposited thin films are investigated through