

GROWTH AND CHARACTERIZATION OF AlGaN THIN FILMS VIA SOL-GEL SPIN COATING METHOD

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ABSTRACT

In this study, the growth and characterization of aluminum gallium nitride (AlGaN) thin film grown on AlN/Si (111) template via sol-gel spin coating method were reported. The structural, morphological and optical properties of AlGaN thin film were compared with GaN thin film which prepared using the same method. The structural and morphological properties of the deposited films were characterized using X-ray diffraction (XRD), field-emission scanning electron microscope (FESEM) and atomic force microscopy (AFM). XRD results revealed that all the deposited GaN and AlGaN thin films have wurtzite structure and with preferred growth orientation of (002). The FESEM and AFM revealed that the deposited GaN and AlGaN thin films have uniform and smooth surface. However, the AlGaN thin film exhibits more packed grain as compared to GaN. The optical characteristics of the GaN and AlGaN thin films were accessed by using Fourier transform infrared (FTIR) spectrometer. It was observed from the FTIR results that the $E_1(\text{TO})$ peak was shifted to higher wavenumber for the AlGaN sample.

Keywords : Aluminum gallium nitride, sol-gel, spin coating, structural properties, optical properties

1. INTRODUCTION

Group-III nitride ternary alloys, in particular aluminum gallium nitride (AlGaN) semiconductors have been recognized to have the potential applications in semiconductor light emitting devices and solar-blind ultra-violet detectors [1] as well as sensor devices, particularly for operating under harsh environment conditions. These are strongly driven by their superior physical properties such as excellent thermal, mechanical, and chemical stability, and unique optical properties such as direct and tune able band gap energy (ranging from 3.4 to 6.2 eV). Traditionally, metal organic chemical vapor deposition, molecular beam epitaxy and hydride vapor phase epitaxy methods were employed as the preferred manufacturing technology for growing the epitaxial AlGaN thin films. However, these methods involved complicated set up and high in production cost. Apart from that, some of these method also involved with toxic chemical . Therefore, technique such as sol-gel method which is simple and cost effective is highly desirable [2-4]. In this work, we reported for the first time the growth of the AlGaN thin film using the sol-gel spin coating method. The structural, morphological and optical properties of the deposited thin films were characterized with various characterization tools. Finally, the obtained results were compared with those obtained from the GaN thin film which prepared using the same method.

2. METHOD

In this work, the GaN and AlGaN thin films were grown on good quality commercial AlN/Si (111) template by using the sol-gel spin coating method. The spin coating was done by dropping the prepared precursor onto the AlN/Si (111) substrate and spun in ambient condition. Three zones tube furnace was used to synthesized the GaN and AlGaN thin films. The synthesize process was carried out at 950 °C with ammonia flow rate of 450 sccm for 75 min. Various characterization techniques were used to access the structural, morphological and optical properties of the deposited of thin films.

3. RESULTS AND DISCUSSION

Figure 1 shows the XRD diffraction pattern of GaN and AlGaN thin films. For both sample, a strong diffraction peak corresponds to the (002) and (002) diffraction plane is observed. However, the intensity of the (002) diffraction peak for the GaN is about 4 times higher than that of the AlGaN sample. Figure 2