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# PROCEEDINGS

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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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# Effects of Ammonia Flow Rate on the Synthesis of AlGaN Thin Films prepared via Spin Coating Approach

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**Keywords:** aluminum gallium nitride; sol-gel; spin coating; flow rate; wurtzite

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## ABSTRACT

We report on the growth of the aluminum gallium nitride (AlGaN) thin films on aluminum nitride (AlN) on silicon (111) template via sol-gel spin coating method followed by nitridation process. The nitridation process was carried out for 75 min under ammonia ($NH_3$) ambient. To investigate the effects of $NH_3$ flow rate on synthesis film, different $NH_3$ flow rates (i.e., 200 sccm, 300 sccm and 400 sccm) were used. The structural properties and surface morphologies of the deposited films were accessed using X-ray diffraction (XRD), field-emission scanning electron microscopy (FESEM) and atomic force microscopy (AFM). The XRD results reveal that all the deposited AlGaN thin films have wurtzite structure with the preferred growth orientation along the (002) crystallographic direction. As the $NH_3$ flow rate increases, the intensity of (002) peaks and crystalline quality were improved. The FESEM and AFM results show that the deposited AlGaN thin film have uniform and smooth surface. The optical properties of AlGaN thin films were investigated by using Fourier transform infrared (FTIR) spectroscopy under the reflectance mode. The infrared reflectance results show that the intensity of $E_1$(TO) peaks of the AlGaN increases with increasing $NH_3$ flow rate. All the results reveal that the $NH_3$ flow rate has significant effects on the structural, surface morphologies and optical properties of the deposited films. Finally, these results lead to conclude that the optimum $NH_3$ flow rate is 400 sccm.

## 1 Introduction

Aluminum gallium nitride (AlGaN) semiconductors have been widely applied in the fabrication of optoelectronics devices operating in blue and violet regions of the spectrum and semiconductors light emitting device [1–4]. This is owing to their direct and tune able band gap energy (ranging from 3.4 to 6.2 eV). Moreover, AlGaN semiconductor has superior physical properties such as excellent thermal conductivity [5], mechanical and chemical stability.

Synthesizing of AlGaN thin films by chemical solution deposition method using nitrogen gas ($N_2$) as a nitrogen (N) source has been reported by Sutanto et al. [6]. According to Sutanto et al. [6], $N_2$ was used due to its high reactivity through heating at high temperature. However, their EDX analysis results showed a low N concentration. It has been reported by Fong et al. [6–8] and Sardar et al. [10] that, the gallium nitride (GaN) thin films are successfully deposited using $NH_3$ via sol-gel spin coating method. However, the use of $NH_3$ for synthesizing of AlGaN thin films prepared by spin coating method has not yet been explored. Generally, the $NH_3$ gas is used as a source of N in epitaxy of nitride-based materials [11]. Also the flow rates of the $NH_3$ is one of the growth parameters that play an important role in the synthesis of nitride-based materials.

In the present work, the $Al_{0.2}Ga_{0.8}N$ thin films were prepared using a simple and cost effective spin coating method. The attention of this work is to investigate the effects of $NH_3$ flow rate on the structural, surface morphologies and