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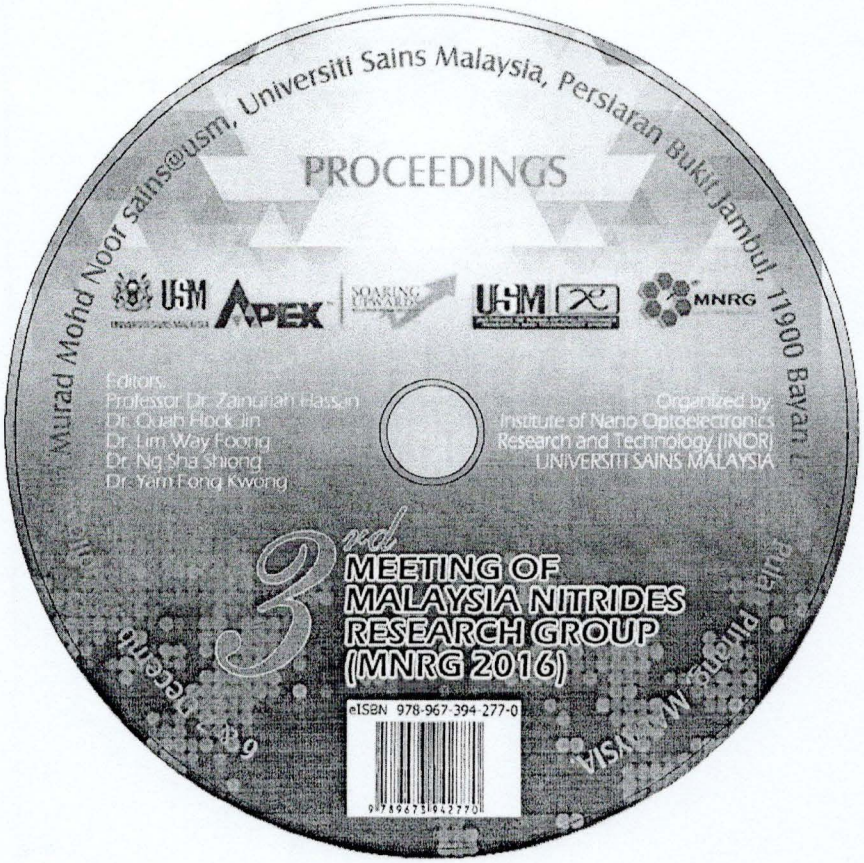
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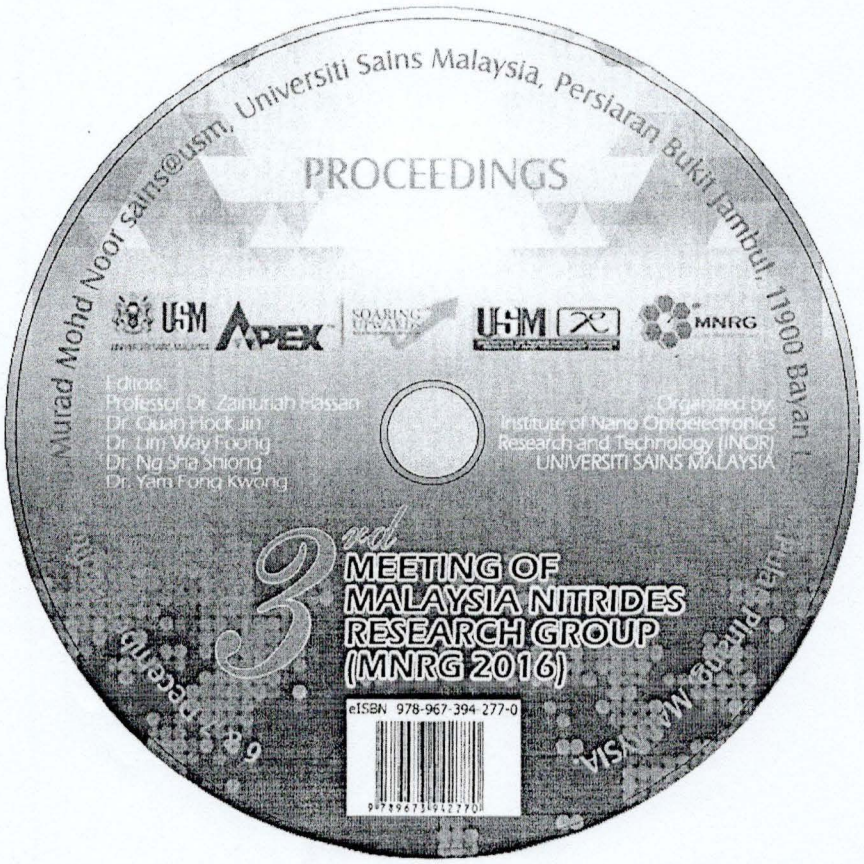
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Sol Concentration Effects on Sol-Gel Spin Coated Indium Nitride Thin Films

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ABSTRACT

Indium nitride (InN) is a potential semiconductor material in the development of optical and electronic devices due to its unique properties such as the narrow energy band gap of 0.7 – 1.0 eV, high electron mobility and low carrier concentration. The present work focusses on the synthesis of InN thin films using sol-gel spin coating method. It is relatively simple, fast processing and cost effective in producing thin films as compared to the conventional deposition methods such as molecular beam epitaxy, metal-organic chemical vapour deposition and reactive sputtering which involve the ultrahigh vacuum system, complicated and expensive setup. In this experiment, precursor with different sol concentrations of 0.05 and 0.10 M were prepared. The sol concentration effects on the structural properties and surface morphologies of the deposited thin films were investigated. In addition, the cross-sectional analysis was performed to determine the resulting film thickness. X-ray diffraction measurements show that the InN thin film with better crystalline quality can be obtained at sol concentration of 0.05 M. Field emission scanning electron microscopy images reveal that the InN thin film prepared using sol 0.05 M exhibits surface with closely packed InN grains; while that prepared using sol 0.10 M exhibits surface with tiny cracks. In this study, it can be concluded that the 0.05 M is the optimal sol concentration for the synthesis of InN.

1 Introduction

Group III-nitride compounds, specifically indium nitride (InN) has received much attention for the applications in light-emitting diodes, high efficiency solar cells and transistors [1, 2]. Despite, there remain fundamental issues in the growth mechanism of InN. The growth allows to take place under stringent conditions due to the tremendous challenges such as low dissociation temperature, volatility of nitrogen atoms and lack of lattice-matched substrates [3, 4].

Various sophisticated deposition methods such as molecular beam epitaxy (MBE), metal-organic chemical vapour deposition (MOCVD) and reactive sputtering have been used to obtain high quality InN thin films [5–7]. Although MOCVD is beneficial in large scale deposition, an essential requirement in this technique is the availability of precursor with sufficient volatility and stability. Several studies reported that the crystallinity of InN is strongly dependent on the V/III ratio, where the lack of either source will cause the tendency to form indium droplet [8]. On the other hand, the ultrahigh vacuum system is required for the MBE growth to overcome the problem of impurity atoms [9].

In this work, we propose an alternative method to grow the InN thin films, namely the sol-gel spin coating technique. This technique is easy in handling, low cost and effective technique as compared to the conventional methods as aforementioned [10]. The study investigates the effects of sol concentration on the film properties. The crystalline structure of the deposited films were examined using X-ray diffraction (XRD); while the surface morphologies were determined using field-emission scanning electron microscopy (FESEM). In addition, the resulting film thickness was revealed through cross-sectional analysis.

2 Experimental Details