Important Role of Reactive Pulse-Gas on Sputtered Zn_3N_2 Thin Film Formation

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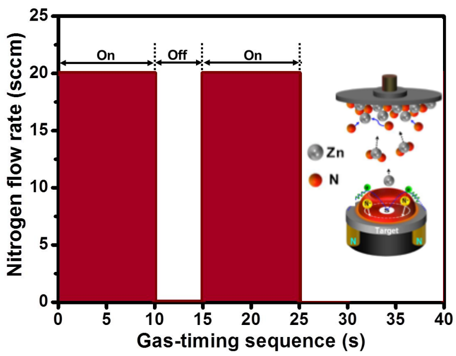
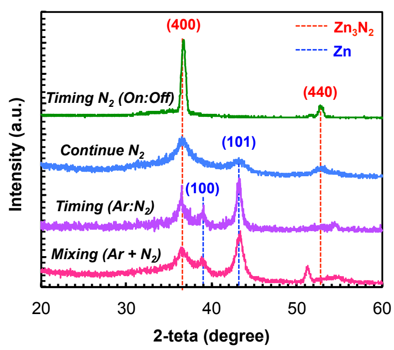
Zn_3N_2 thin film is a very attractive group II-V compounds with a high potentiality for photonic and electronic devices due to its high mobility couple with the direct band gap [1]. Likewise, the interesting property of Zn_3N_2 is the possibility of transforming Zn_3N_2 into p-type ZnO by thermal annealing [2], which would have major implications for semiconductor industry. However, the difficulties in preparation of high quality Zn_3N_2 thin film are still challenging issues because the stoichiometric nitride is provision of nitrogen having high chemical reactivity [2]. Such stoichiometric chemical composition for Zn_3N_2 formation requires a high substrate temperature (> 300 °C) [1]. Although several research groups have demonstrated the low temperature method (i.e. substrate temperature ~ 150 °C) to fabricate Zn_3N_2 thin film by using reactive rf magnetron sputtering which, is available to fabricate the Zn_3N_2 thin films via the provision of active nitrogen species from plasma [3], such added substrate heater sources enhanced forming energy of Zn_3N_2 thin films make a high cost and cannot be available to fabricate sputtered Zn_3N_2 on the flexible substrate. Here we demonstrate the utilizing of reactive gas-timing (RGT) rf magnetron sputtering to fabricate Zn_3N_2 thin films at room temperature [4]. By comparing with N_2-Ar mixing gas, Ar-N_2 reactive gas-timing (Ar-N_2-RGT) and continued N_2 gas flow, the single phase of Zn_3N_2 thin film can be obtained only when the reactive pulse-gas of N_2 is utilized. We found that the RGT technique not only enables us to enrich the forming energy of thin film formation but also provides the ability to adjust the number of sputtered atoms from the target through a small atomic mass of sputtered reactive gas selection. In addition, the chemical composition, electrical and optical of Zn_3N_2 films is investigated. Thus our results highlight that the RGT technique is a promising method to fabricate high quality sputtered compound thin films at room temperature (RT) and without any applying additional sources, which can be applicable for flexible electronic devices.





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