Morphology control of InGaN layer on GaN substrate by metalorganic vapor phase epitaxy

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Nowadays, nitride-based semiconductor allows people to obtain light emission from the ultraviolet to the infrared and get good optical property. However, the EQE is still low for high-In-content InGaN optoelectronic devices because of poor quality in InGaN layer [1]. One of the major issues is low growth temperature for high In-content InGaN deposition as well as large lattice mismatch between GaN and InN. Though the morphology of InGaN layer grown by MOVPE has been studied by some research groups [2], the relationship between the morphology of InGaN layers on GaN substrate and growth conditions has not yet been systematically investigated. In this work, we demonstrated InGaN layer growth on GaN substrate. The dependence of InGaN layer morphology on growth parameters, including growth rate and metalorganic source flow rate are investigated.

InGaN layers were grown on 1 μm-thick undoped GaN on n-type c-plane free-standing GaN substrate. During the growth, trimethylgallium (TMG) or triethylgallium (TEG), trimethylindium (TMI) and ammonia (NH_3) were used as gallium, indium and nitrogen sources respectively. InGaN layer was grown on GaN layer with different growth rate varying from 0.017nm/s to 0.135nm/s at 670℃. TMG(TEG)/TMI flow ratio and the thickness of the InGaN layers were kept around 1.25 and 4.5 nm, respectively.

Atomic force microscopy (AFM) image of InGaN layers grown with different growth rate were shown in Fig.1. The step can be seen but not clear for sample grown at rate of 0.017 nm/s. Island structure was observed in the sample grown at rate of 0.060 nm/s. The size of these islands is similar to the terrace width of underlying GaN layer. In the sample with growth rate of 0.135 nm/s, small dot-like structure was observed. The size of dots is about 50 nm and the height is about 3.5 nm. The density is 1.5×10^{9} cm^{-2}. Other growth parameters and underlying GaN morphology effect will be discussed in the conference.

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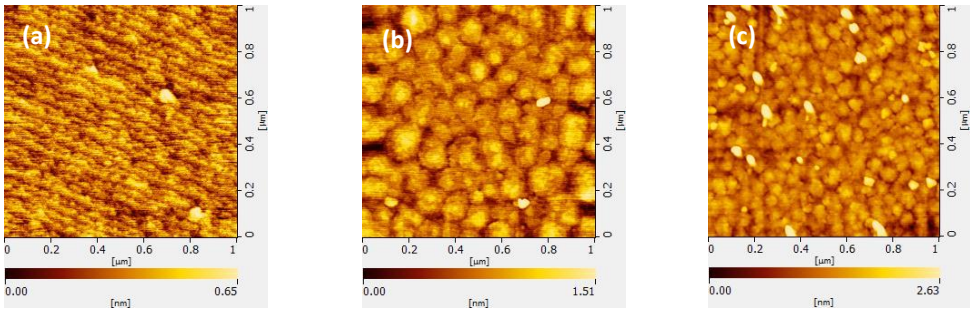

Figure 1 AFM image of InGaN layers grown with growth rate (a) 0.017, (b) 0.060 and (c) 0.135 nm/s