a-plane GaN microchannel epitaxy on r-plane sapphire substrate using nano-patterned graphene mask

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a-plane GaN attracts much attentions because fabrication of high-performance optical devices is possible without suffering Stark effect. However, the growth of a-plane GaN is difficult and dislocation density of a-plane GaN grown by MOCVD is more than 10^8 cm^{-2}. Therefore, a drastic improvement of the crystal quality is necessary for the fabrication of excellent devices. Microchannel epitaxy (MCE) is a special technique for reduction of dislocations in highly-mismatched heteroepitaxy [1]. We have succeeded in a drastic reduction of dislocation density in a-plane GaN MCE on r-plane sapphire using chemical beam epitaxy [2]. On the contrary, mask material is also important factor to perform superior MCE and we studied usefulness of graphene mask to improve growth selectivity of MCE [3]. In this paper, nano-patterned graphene mask is tried to apply a-plane GaN MCE on r-plane sapphire.

Graphene was firstly gown on r-plane sapphire substrate using low-pressure CVD [4] to form graphene nano-patterned mask [5]. The growth was stopped just before the formation of uniform layer to remain small holes. Using a nano-patterned graphene mask, a-plane GaN MCE was performed by Rf-MBE.

Figure 1 shows an AFM image of nano-pattered graphene mask. Small holes, which are as small as several micrometers with submicron width, are observed, which act as a channel for GaN MCE. Fig. 2 shows the surface SEM image of MCE layer. The surface of the layer is flat and smooth because each growth islands, which initially nucleated at the beginning of the growth, combined each other to form a flat layer in the course of MCE. In the conference site, the characteristics of the MCE will be discussed with comparing to the results of a-plane GaN remote-epitaxy, where the graphene mask completely covers the sapphire surface.

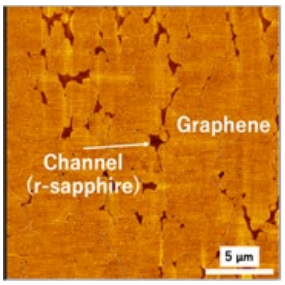

Fig.1 AFM image of nano-pattered graphene.

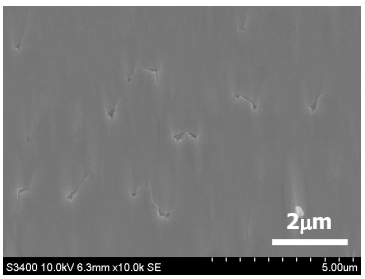

Fig.2 SEM image of a-plane GaN MCE.

References

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