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High Quality GaN Template Using Nanometer-Size SiO_2 mask structure fabricated by UV-NIL

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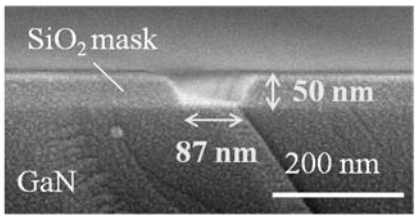
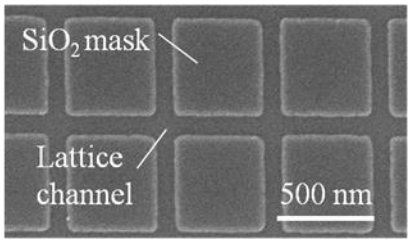
In this study, high quality 2-inch GaN template with low dislocation density was demonstrated by nanometer-size channel facet-initiated epitaxial lateral overgrowth (nano-channel FIELO) [1, 2] using 500-nm-square SiO_2 masks. Square-lattice SiO_2 masks were designed to reduce a dependence of stripe pattern orientation on the crystal quality. The SiO_2 masks were fabricated by UV nanoimprint lithography (UV-NIL) and inductively coupled plasma (ICP) etching. The cross-sectional scanning electron microscope (SEM) observations reveal that uniform SiO_2 mask was successfully fabricated (Fig. 1). As shown in Fig.2, GaN clearly grew to the facet structures along the lattice channel and eventually the surface became flat within the growth thickness of 1 μm. The etch pit density measurements reveal that the dislocation density successfully decreased to 3.2 x 10^7 /cm^2 and X-ray rocking curve (XRC) measurements show that the fabricated GaN had isotropic characteristics. Therefore, nano-size lattice SiO_2 mask is highly effective in realizing isotropic nature of crystal quality as well as reducing dislocation density.

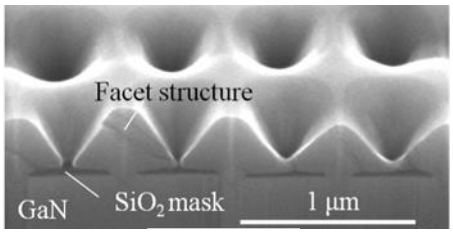


(a)

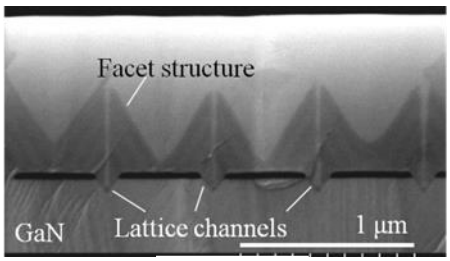


(b)

Figure1 (a) Cross-sectional and (b) top-view SEM image of SiO_2 mask structure.



(a)



(b)

Figure2 SEM images of (a) the facet structure developed on a lattice channels and (b) GaN layer with the flat surface.

Reference:

[1] A. Usui, T. Matsueda, H. Goto, H. Sunakawa, Y. Fujiyama, Y. Ishihara, A. Okada, S. Shoji, A. A. Yamaguchi, H. Nishihara, H. Shinohara, H. Goto, J. Mizuno, *Jpn. J. Appl. Phys.*, **52**, 08JB02 (2013).

[2] A. Okada, S. Shoji, H. Shinohara, H. Nishihara, H. Goto, H. Sunakawa, T. Matsueda, A. Usui, A. A. Yamaguchi, J. Mizuno, *J. Photopolym. Sci. Technol.*, **26**, 69-72 (2013).