

## (0001) 사파이어 기판위에 성장된 GaN 박막내 나노파이프의 에치핏 형성

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GaN is one of the most promising semiconductor materials for optical devices in the region of blue to ultraviolet light. Due to the poor matching of lattice parameters and thermal expansion coefficients between  $\text{Al}_2\text{O}_3$  and GaN, a typical dislocation density was found in the range of  $10^8 \sim 10^{10}\text{cm}^{-2}$ [1].

Recently, another type of defect referred to nanopipe has been reported on MOCVD grown GaN[2]. The nanopipes were observed to thread through the entire thickness of the GaN layers. Due to their small size, the observation of nanopipes in GaN have been carried out by TEM, normally. Cross-sectional view is difficult to observe nanopipes because of random sampling of limited thin specimen region and the specimen should be so thin as the diameter of nanopipe. Moreover, the image contrast from the nanopipe is similar to the dislocations. For these reasons, the observation of nanopipes in GaN, including defect density measurement have been done in plan-view observation. However, in case of nanopipes in GaN, the density is difficult to be measured accurately because of their small size. The reported density of nanopipes is  $10^5 \sim 10^7\text{cm}^{-2}$  which have large error as pointed out by Qian *et. al.*[2]. In this paper, we suggest a simple and accurate method to evaluate the density of nanopipes in GaN.

We used  $\text{H}_3\text{PO}_4$  solution for etch-pits development of nanopipes. After the etch-pit development, the GaN surfaces were investigated by SEM and TEM. Based upon above observation, we found that etch-pits were formed at nanopipes in GaN films.

#### References

- [1] X. H. Wu, L. M. Brown, D. Kapolnek, S. Keller, B. Keller, S. P. DenBaars, and J. S. Speck, *J. Appl. Phys.* 80 (1996) 3228
- [2] W. Qian, G. S. Rohrer, and M. Skowronski, K. Doverspike, L. B. Rowland, and D. K. Gaskill, *Appl. Phys. Lett.* 67 (1995) 2284

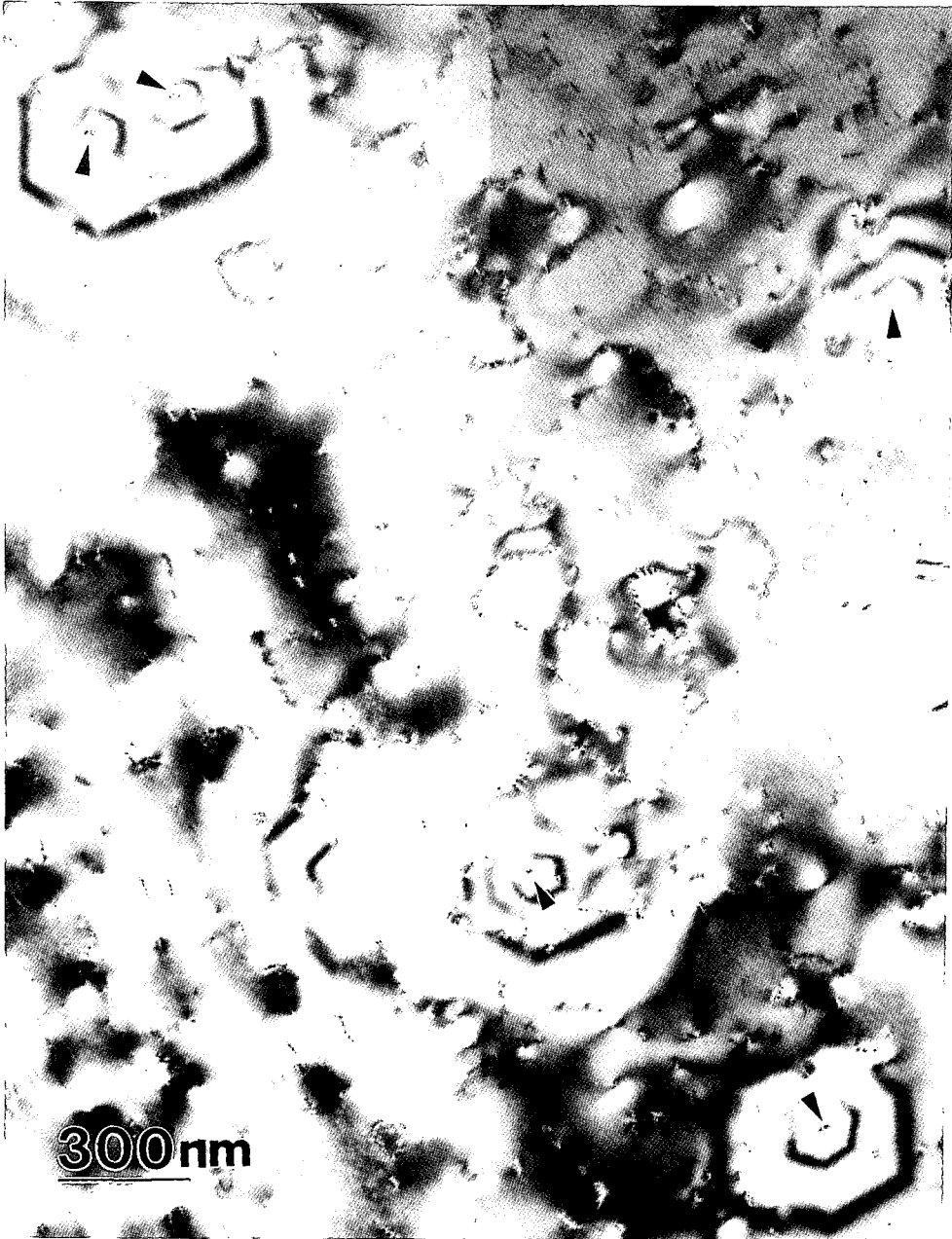


Figure 1. Plan-view TEM micrograph of etch-pit developed sample. We can observe the nanopipes and etch-pits around these nanopipes. Many threading dislocations are also observed.