Abstract Submitted for the MAR13 Meeting of The American Physical Society

Characterization of free-standing GaN with thermal treatment¹ CHEN-CHI YANG, IKAI LO, CHENG-HUNG SHIH, CHIA-HSUAN HU, YING-CHIEH WANG, YU-CHIAO LIN, CHENG-DA TASI, SHUO-TING YOU, Department of physics, National Sun Yat-Sen University, Kaohsiung 80424, Taiwan, R. O. C., WEI-I LEE, CHUO-HAN LEE, Electrophysics, National Chiao Tung University, 1001 University Road, Hsinchu 30010, Taiwan, R. O.C. — We have grown free-standing GaN by hydride vapor phase epitaxy. The free-standing GaN samples were annealed by rapid thermal annealing for 3 minutes at 600, 650, 700, 750, and 800°C in vacuum. The crystal structure and quality of GaN samples were characterized by X-ray diffraction. We found that the full width half maximum of the (0002) and (10-12) of GaN samples are decreased significantly after thermal annealing. The (0002) rocking curve of GaN sample was 218.8 arc-sec without thermal annealing, and it became 49.5 arc-sec after annealing at 800°C. The FWHM of the (10-12) rocking curve was 113.5 arc-sec without thermal annealing, and it reduced to 58.3 arc-sec after annealing at 800°C. According to the observation of atomic force microscopy, we found that the dislocation density of annealed GaN samples $(7.04 \times 10^6 / \text{cm}^2)$ is smaller than that of pre-annealed GaN samples $(1.02 \times 10^7 / \text{cm}^2)$. The optical properties of the samples by photoluminescence measurement which showed that the sample annealed at 650°C had the best quality due to its narrowest FWHM at 3.4eV. According to these analytic results, we found that thermal annealing treatment could improve the quality of free-standing GaN.

¹This project is supported by National science council of Taiwan(NSC 101-2112-M-110-006-MY3)

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Date submitted: 26 Nov 2012

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