Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Abruptness improvement of the interfaces of AlGaN/GaN superlattice by cancelling asymmetric diffusion

DUANJUN CAI, XIAOHONG CHEN, NA LIN, FUCHUN XU, HANGYANG CHEN, Department of Physics, Xiamen University, Xiamen, 361005, China, SHANSHAN CHEN, University of Texas at Austin

— Interface abruptness has been an important issue in the construction of quantum wells as active layer in optoelectronic devices, which is extremely crucial in achieving stronger quantum confinement and consequently higher emission efficiency. The interfacial sharpness is highly associated with the crystal structure as well as the elemental transition. However, few studies have been done focusing on the elemental diffusion effect at the interface. In this work, the accurate determination was approached to the elemental inter-diffusion depth across the GaN/$Al_{0.5}Ga_{0.5}N$ interfaces by using transmission electron microscopy, Auger electron microscopy, and X-ray diffraction. The GaN/$Al_{0.5}Ga_{0.5}N$ superlattice was grown by metalorganic chemical vapor deposition (MOCVD) at high growth temperature (1070 °C). The results showed that the Al diffusion at the upper and lower interfaces of $Al_{0.5}Ga_{0.5}N$ barrier appears an asymmetric behavior, which is 0.62 and 0.99 nm, respectively. Such will lead to the gradient interfacial region and asymmetric quantum well, affecting the carrier quantum confinement. To improve the abruptness of the interface and to modify the asymmetric diffusion, self-compensation pair technique was proposed and introduced to the growth of the lower $Al_{0.5}Ga_{0.5}N$/GaN interface, blocking the Al downward diffusion. Fist-principles simulations also showed that the structural relaxation at the strained heterointerface influences the electronic structure as well as elemental diffusion.

Shanshan Chen
University of Texas at Austin

Date submitted: 26 Nov 2011 Electronic form version 1.4