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Quantum confinement effect in Low Temperature grown Homo-epitaxial GaN Nanowall Network by Laser assisted Molecular Beam Epitaxy

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Abstract

Vertically well-aligned homo-epitaxial GaN nanowall network (NWN) was grown on metal organic chemical vapor deposited 3.5 µm thick GaN (0001) on c-sapphire by laser assisted molecular beam epitaxy (LMBE). The honeycomb GaN NWN with wall width of 8-12 nm and pore size of ~ 100-200 nm were obtained at a low growth temperature of 600 °C. The optical properties measured by photoluminescence (PL) spectroscopy showed a blue-shift of ~ 100 meV near band edge (NBE) emission for GaN NWN. In addition, temperature dependent (90-300 K) PL measurements of GaN NWN were investigated which follow the Varshni's temperature dependent energy gap relation. The structural and optical properties of pristine and wet-etched LMBE grown homo-epitaxial GaN thin film at 500 °C were also investigated and compared with the GaN NWN structures. X-ray photoelectron spectroscopy study confirms Ga rich nature of GaN nanowalls along with significant decrease in surface band bending in NWN compared to film. The KOH wet etched of GaN NWN showed that the wall width decreased to 6-10 nm and exhibited a blue-shift of 120 meV in the NBE in PL emission confirming the realization of quantum size effect in the GaN NWN structure. The low temperature grown GaN NWN