TEM of GaN, ELOG GaN, and InGaN/GaN Multi Quantum Wells grown by Metalorganic Chemical Vapor Deposition

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Crystal defects of GaN on sapphire grown by metalorganic chemical vapor deposition(MOCVD) were characterized by transmission electron microscopy(TEM) analysis and surface etching experiments by molten potassium hydroxide(KOH). The Burgers vector analysis with visibility criteria determined three types of treading dislocations(TDs) of pure edge, mixed, and pure screw in GaN epilayer. From the configuration and distribution of each types of TDs and nanopipes, the origin of these defects and spiral growth mechanism were suggested. The pure edge TDs generated by coalescing the slightly misaligned islands in early growth stage are dominant defects in our specimen. Nanopipes and mixed or screw dislocations act as spiral growth centers by making constant atomic steps on growth surface. These surface steps, which are proper sites for chemical attack, form etch pits by chemical etching. The density of threading dislocations can be dramatically reduced by Epitaxial lateral over growth(ELOG) thchnique. The results of microanalysis on ELOG GaN using TEM were presented, InGaN/GaN multy quantum well structures and TEM and double crystal X-ray diffraction. Highly strained InGaN layers with a high In mole fraction were found to contain V-shaped surface pits with (10-11) facet planes on pure or mixed screw treading dislocations. Phase separation was also found on thick InGaN/GaN superlattices and bulk InGaN layers. The mechanism of the surface pit formation was discussed in terms of strain energy and surface mobility of InGaN.