Selective area growth of GaN nanowires

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Abstract

GaN nanowires with wide band gap have been attracted extensively in recent years due to the potential use of the materials toward fabrication of nano-scaled devices and system integration. Selective area growth of high-quality GaN nanowires over a large-area substrate is very important for the application of GaN nanowires. Meanwhile, GaN nanowires have been prepared by direct reaction between Ga metal and NH3, however, it yields inhomogeneous vapor pressure of reactants over substrate and is difficult to implement to achieve selective growth. Here we report the selective area growth of GaN nanowires on substrates using metalorganic chemical vapor deposition (MOCVD) process. Selective area growth of high -purity and high-quality GaN nanowires has been achieved via reaction of TMGa (trimethylgallium) and NH3, using two different substrates with a patterned catalyst or a patterned dielectric mask layer, respectively. The relationship between processing parameters and the selective growth behavior including substrate coverage, diameter and length of nanowires was investigated. The high-resolution transmission electron microscopy (HRTEM) analysis performed on the individual nanowire indicated that the nanowires were well-defined single crystal with wurtzite structure. The growth mechanism and novel nano-techonlogical applications of these GaN nanowires will be discussed.