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Defect reduction of GaN nano rods on hetero-substrates: Behaviors of basal stacking faults

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Pulsed-mode growth in metal-organic chemical vapor deposition (MOCVD) has provided us attractive means to obtain homogeneous and elongated nano rod array in GaN epitaxy on heterosubstrates. Nowadays, ultra-elongation behaviors of pulsed-mode growth give rise to potential of growing single crystalline GaN on extremely challenging substrates such as Si(001) and amorphous substrates. Our finding in such harsh epitaxy has indicated that high quality of GaN nanorods can be achieved above the critical height (~500 nm) from the bottom of nanorods, while many structural defects are observed at the interface between the GaN nanorod and the heterolayers. Obviously, the dislocation density of epilayer is highly dependent on the lattice mismatch of the grown layers. In this presentation, we compare these structural imperfections of several hetero-substrates, e.g., sapphire, Si and amorphous quartz. Especially, we focus on the basal stacking faults (BSFs) of GaN nano rods, which were tremendously suppressed, compared to conventional epi-layers. The reduction and corresponding type of BSFs were identified by observing X-ray diffraction, thereby quantitatively proving the suppression of the crystal imperfection with selective-area growth. Moreover, to take into account the behaviors of BSFs in GaN nano rods, high-resolution transmission electron microscopy and low-temperature photoluminescence measurement were carried out. The suppression of BSFs in GaN nano rods were clearly observed by identifying defect-related luminescence peaks in the optical characterization. Therefore, the localized stain of nano architectures can provide better platform of crystal growth to overcome typical defects generated in the conventional epitaxy and finally enhance the efficiency of optoelectronic devices.

Biography

Si-Young Bae has completed his PhD from Gwangju Institute of Science and Technology (GIST) in South Korea and his Post-doctoral studies from Nagoya University, Institute of Materials and Systems for Sustainability (IMaSS) in Japan. He is currently working as a Researcher of IMaSS in Nagoya University. His research interests have been focused on crystal growth and characterization of III–N wide bandgap compound semiconductors for optoelectronic device applications. He has published more than 25 papers in reputed journals.

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