Improved photoluminescence properties of selectively grown III-nitride core－shell nanorod array on quartz substrates

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The epitaxy on amorphous substrate is quite challenging due to no lattice match between substrate and above layer. Such harsh condition for growth usually results in poor structural and luminescence properties of growth structure. To overcome the issue, selective area growth (SAG) can be used to improve the epitaxial quality. Especially, it forms three-dimensional (3D) building blocks with geometrically controlled manner via local epitaxy irrespective of the kinds of substrates. To accomplish the arrangement of the grown structures, we have used a buffer layer deposited by molecular beam epitaxy (MBE), providing a new means to control the preferential orientation of GaN on amorphous substrates. Then, pulsed-mode metal–organic chemical vapor deposition (MOCVD) can be employed to grow nanorod structures on the buffer layer. The axial nanorod structures composed *m*-plane nonpolar planes gives several merits to optoelectronic applications: suppression of the quantum-confined Stark effect, enhanced indium incorporation, tuneable emission spectrum by adjusting the diameter and/or external bias and large emission area. Recently, we have fabricated near-vertically elongated GaN nanorods on quartz substrates. Experimentally, plasma-assisted MBE (PA-MBE) was utilized to grow flat surface of buffer layer on amorphous substrates. The grown buffer layer featured ordered coalescence of columnar GaN structures and preferred orientation along the surface normal direction. For the potential optoelectronic device applications, the microstructural and optical properties of InGaN/GaN core–shell nanorods were also investigated. Obviously, the defect density was dramatically reduced on the grown structures, thereby photoluminescence showed enhanced band-edge emission of GaN peak at low temperature of 10K.