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GaN nanorods grown on Si(111) substrates by plasma-assisted molecular beam epitaxy CHING-LIEN HSIAO, LI-WEI TU, TONG-WEI CHI, MIN CHEN, Department of Physics and Center for Nanoscience and Nanotechnology, National Sun Yat-Sen University, Kaohsuing 80424, Taiwan, Republic of China — Various GaN nanorod structures grown on Si(111) substrate are realized by plasma-assisted molecular-beam epitaxy. Evolution of the nanorod structure from isolated regular nanorods, to isolated non-regular nanorods, and to dense nanorods is well controlled by the GaN buffer structure. Adding the parameter of beam-equivalent pressure of N/Ga ratio to the nanorod growth, the density of the regular nanorod becomes also a controllable item. There are several combinations of rod density and diameter in the nanorod growth. High density-small diameter and low density-large diameter can be grown directly on the surface without buffer layer. Low density-small diameter, low density-large diameter, and high density-large diameter can be achieved by inserting a GaN buffer. Nanorod of single crystal wurtzite structure without dislocation was characterized by high-resolution transmission electron microscopy. Only Ga and N signals were detected by energy-dispersion x-ray spectroscopy analysis. Single freestanding nanorod was prepared to perform micro-Raman spectroscopy. Wurtzite-type Raman modes at different scattering configurations have small line width and indicate the high crystalline quality of the nanorod. Frölich interaction and the surface vibrational modes are observed at high laser power densities which will be discussed in detail.

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