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Optical and Field Emission Properties of Thin Single-Crystalline GaN Nanowires

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Thin high-quality gallium nitride (GaN) nanowires were prepared by a catalytic chemical vapor deposition method. The synthesized GaN nanowires have the thin diameters of 10–50 nm and lengths of tens of micrometers. The synthesized GaN nanowires are hexagonal single crystalline with uniform morphologies and clean surface. Intense UV bands at 3.481eV and 3.285eV are revealed in low temperature PL measurements due to the recombination of donor bound excitons and donor-acceptor pairs, respectively. The observed UV band blue shifts in photoluminescence measurements imply a quantum confinement effect. For field emission properties of GaN nanowires, the turn-on field of GaN nanowires was 8.5 V/m and the current density was about 0.2 mA/cm² at 17.5 V/m. We also investigated the stability of field emission properties through the lifetime measurements for GaN nanowires. The GaN nanowires indicate very stable emission current densities for 10 hours. We consider that the stable emission properties were caused by good crystallinity and high oxidation durability of the GaN nanowires. Therefore, we suggest that GaN nanowires can be used to stable field emitters for field emission displays and vacuum microelectronic devices.