Field Emission Behavior of Self-Assembled and Patterned Gallium Nitride Nanowire Arrays

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Field emission nano-structures for high performance applications require: 1) Low turn-on threshold fields, 2) Chemical stability, 3) High current density capability, and 4) Modulation capability. Gallium Nitride (GaN) is well-known for its high current density, chemical and radiation stability[1], and high frequency operation through its work with high electron mobility transistors (HEMT)[2]. Epitaxial growth of GaN nanostructures can produce high quality, single crystal GaN nanowires (NW) without damage induced through dry etching processes. Molecular beam epitaxy (MBE) and metal-organic chemical vapor deposition (MOCVD) on sapphire (0001), Si(111)[3], and Si(100) substrates is demonstrated. The majority of nanowire epitaxy is through the self-assembly process, which randomizes the aerial density, diameter, and relative heights between nanowires in the array. We demonstrate the ability to grow nanowire arrays using patterning techniques to uniformly control all three parameters.

Field emission measurements of self-assembled and patterned GaN nanowire arrays will be presented, investigating field thresholds for emission current, NW emission behavior and examining the geometrical enhancement factor by comparing field emission behavior as a function of NW diameter.

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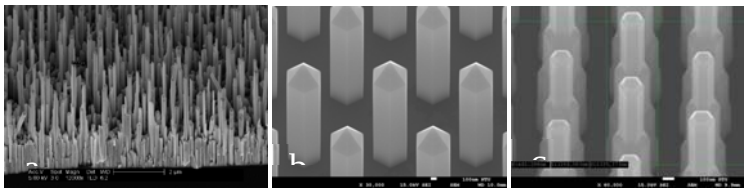

Figure 1. GaN NW arrays: (a) Self-assembled, (b) Tapered tip, (c) Tapered wire. NW diameters are ~ 100 nm.

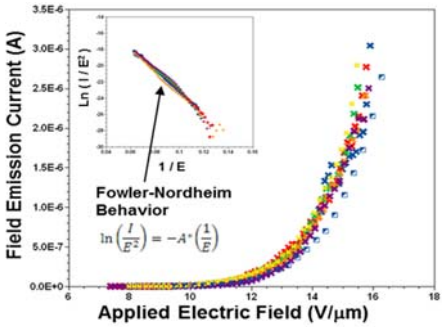

Figure 2. Field emission behavior of self-assembled GaN NW array in Figure 1 (a).