359c Direct Synthesis of Gan Nanowires with Control on Growth Directions

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Direct synthesis approaches for GaN nanowires with two distinct growth directions (<0001> and <10-10>) without using single crystal templates have been demonstrated. First approach utilized spontaneous nucleation followed by basal growth from nitrogen saturated Ga melts in the presence of hydrogen/ammonia for GaN nanowires with <0001> growth direction. Experiments using vapor transport of Ga in the presence of dissociated ammonia resulted in GaN nanowires with <10-10> growth direction. In both cases, the GaN nanowires with diameters as small as 20 nm and lengths exceeding hundred microns were obtained. The nanowires with <0001> growth direction exhibited stacking faults at regular intervals compared to nanowires with <10-10> growth direction which are free of stacking faults. Photoluminescence measurements showed a blue shift of about 50meV for <10-10> nanowires compared with <0001> nanowires. Homo-epi experiments onto these pre-synthesized GaN nanowires with two distinct growth directions (<0001> and <10-10>) were performed using vapor transport of Ga and dissociated ammonia illustrated distinct morphological growth features, e.g. micro hexagonal prisms for <0001> nanowires and micro belts for nanowires with <10-10> growth direction. The results with homo-epitaxial growth onto pre-synthesized sub 30 nm size nanowires exhibited an interesting phenomenon, i.e., the surface transport of adatoms on the nanowires seems to be enhanced on nanowires specifically those with growth direction in <0001>. This homo-epitaxial growth procedure also lends itself as a simple technique for determining the growth directions of sub-30 nm size wires which otherwise appear as rounded.