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Controlled In-Situ Microscopy Studies of the Effect of Heterogeneous Catalysis on the Growth, Structure and Composition of GaN Nanowires M. TAHERI, T. LAGRANGE, LLNL, B. SIMPKINS, NRL, N. BROWNING, LLNL — Controlled growth of GaN nanowires is vital to the efficient production of blue light emitting diodes and other nanoscale optoelectronic devices. The VLS (vapor-liquid-solid) method, which often uses foreign metal catalysts, is a mechanism by which nanowires grow using chemical vapor deposition. Defects, grain boundaries and impurity incorporation that arise during heterogeneous catalysis of nanowires can negatively impact a wire's electronic properties. These properties are directly related to the microstructure and composition of a wire. To understand the specific effects of these metal catalysts on a nanowire's electrical characteristics, a clear understanding of the structural evolution as a function of catalyst (Ni) must be obtained. This is achieved by using in-situ microscopy-based growth methods. In-situ TEM annealing is coupled with high resolution TEM/STEM and Energy Dispersive Spectroscopy (EDS) to study the structure and chemistry of the growing Ni-catalyzed GaN nanowires. Concurrently, laser controlled methods using a Dynamic Transmission Electron Microscope (DTEM) are used to monitor the various stages of the VLS method during microstructural evolution. Each step of wire nucleation and growth during VLS is triggered by a pulsed laser while being monitored in-situ in the TEM. Trends in impurity incorporation with morphology and defect concentration are compared for nanowires grown by both methods of in-situ TEM growth, and to those grown the conventional CVD-based VLS methods.

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