Supporting Information

Effect of Thermal Annealing in Ammonia on the Properties of InGaN Nanowires with Different Indium Concentration

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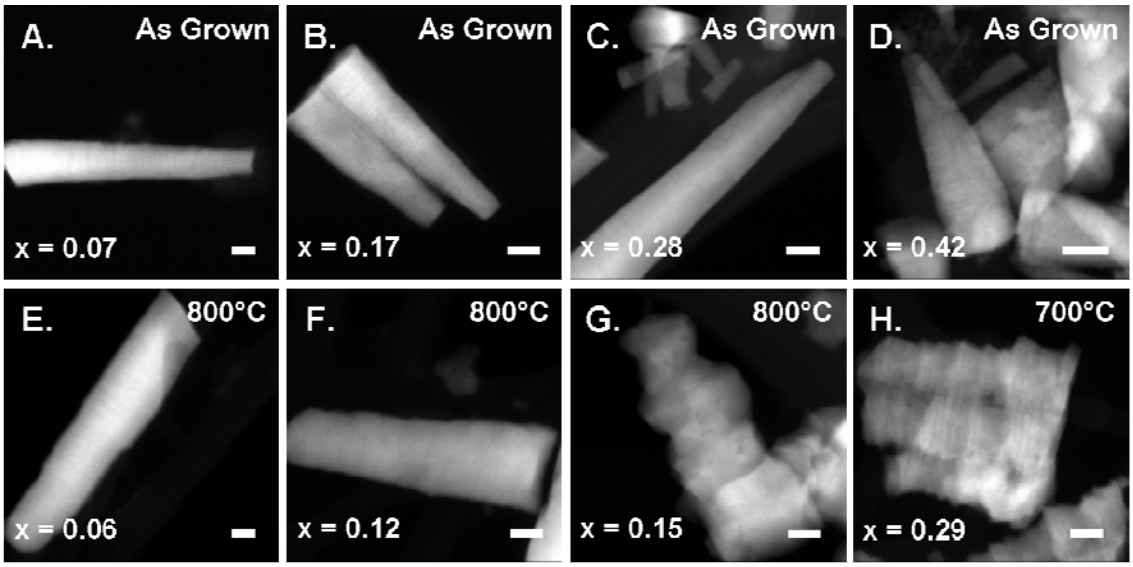

Figure SI1. HAADF STEM images of as grown and annealed $In_xGa_{1-x}N$ nanowires. HAADF STEM images of (A-D) as grown and (E-H) annealed nanowires show the instability of $In_xGa_{1-x}N$ nanowires with from increasing the indium composition. Significant surface etching was observed for samples (C,G) x = 0.28 and (D,H) x = 0.42 after annealing. Scale bar = 20 nm.

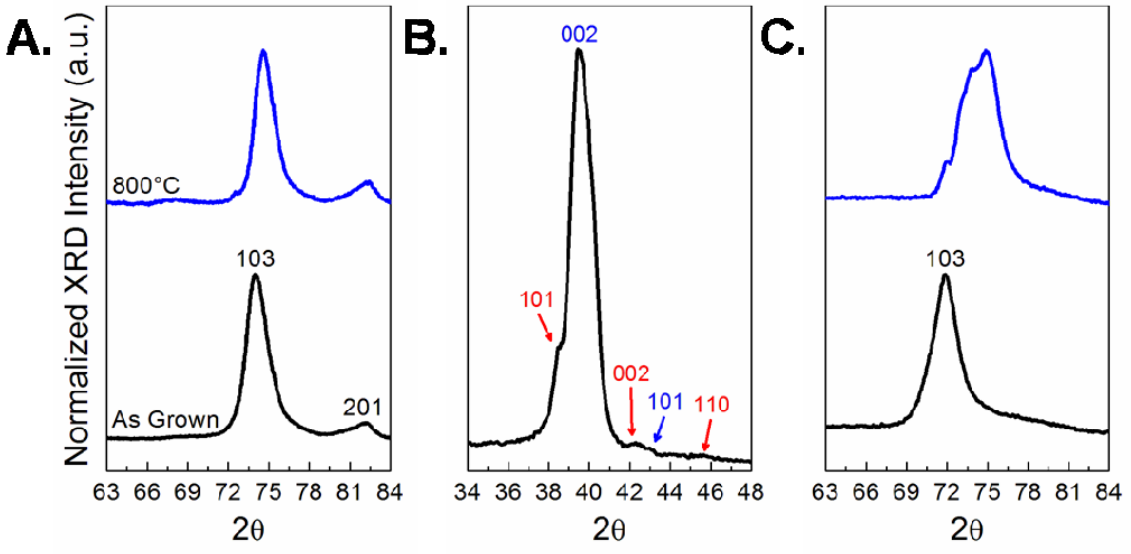

Figure SI2. XRD spectra of as grown and annealed $In_xGa_{1-x}N$ nanowires. (A) High angle wurtzite 103 and 201 diffraction peaks for sample x = 0.17 show no peak splitting after annealing, indicating that lower indium composition nanowires are phase stable. (B) The XRD spectrum for sample x = 0.42 reveals $In_xGa_{1-x}N$ wurtzite (blue) and In tetragonal (red) peaks, showing that nanowires decompose into In metal during the annealing process. (C) The high angle wurtzite 103 peak for sample x = 0.42 splits into multiple peaks after annealing at 800°C, indicating that higher indium composition $In_xGa_{1-x}N$ nanowires are metastable and phase separate at high temperatures.

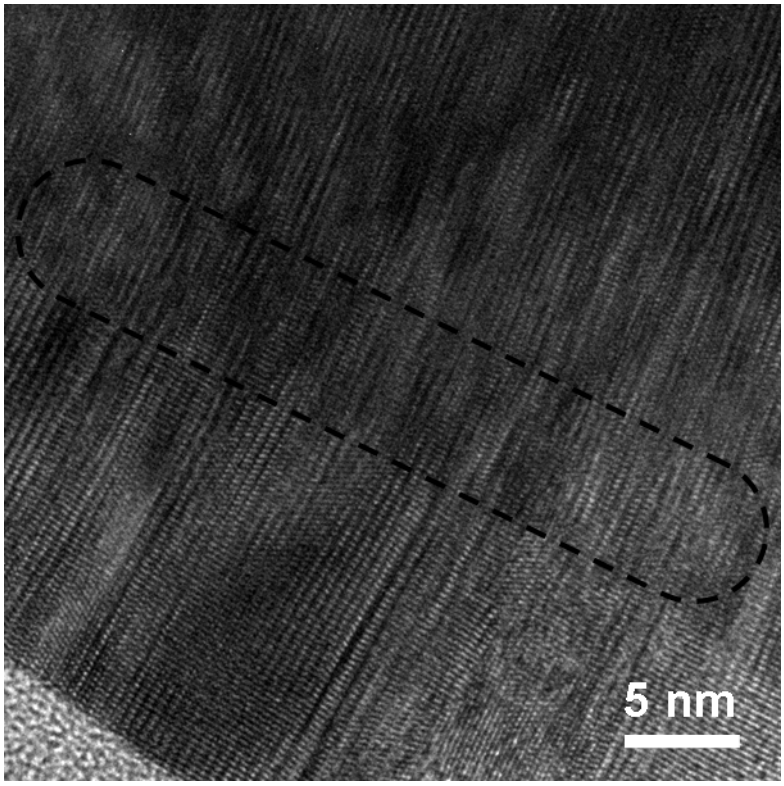

Figure SI3. HRTEM image of sintered InGaN nanowires. The HRTEM image shows a clear shift in lattice orientation from the bottom nanowire to the top nanowire, indicating that as grown InGaN nanowires are likely tilted/twisted in orientation from mosaic

growth. As a result, an increase in dislocation density can be seen at the interface of sintered InGaN nanowires (dashed area).

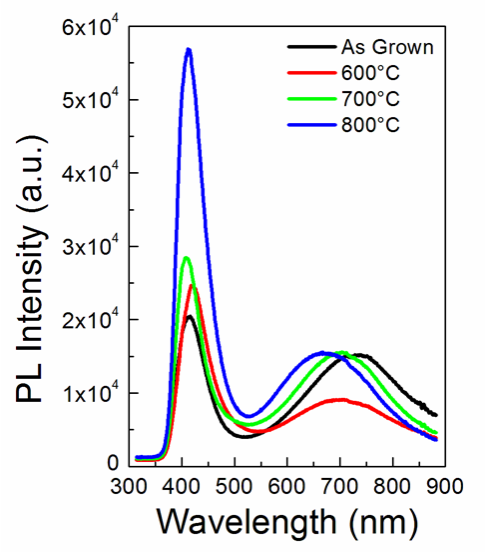

Figure SI4. PL spectra of as grown and annealed $In_xGa_{1-x}N$ nanowires. PL spectra for sample x = 0.07 show that the intensity of band-edge PL increases with annealing temperature.

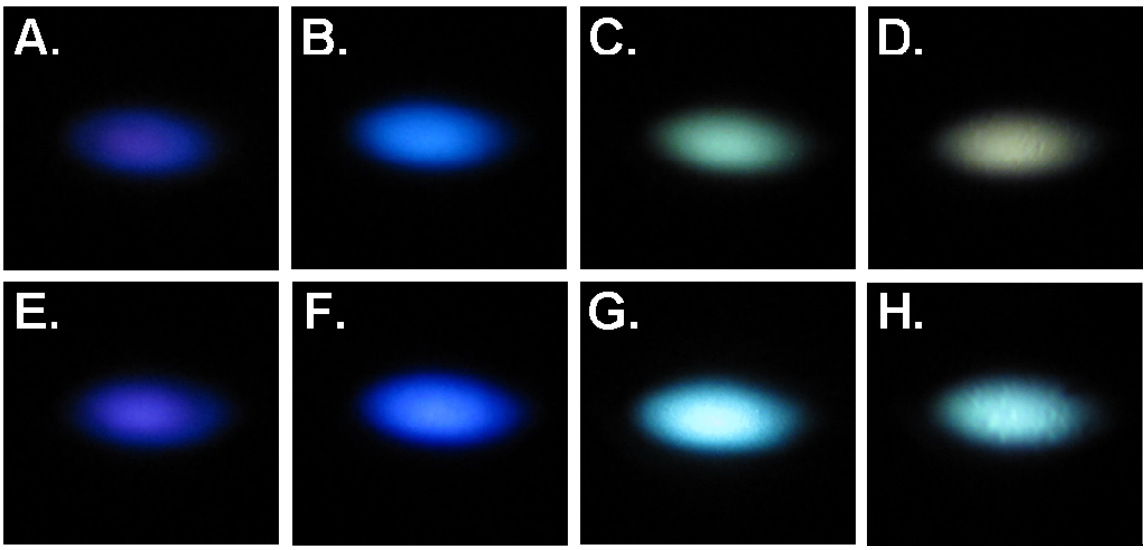

Figure SI5. Color PL images of as grown and annealed $In_xGa_{1-x}N$ nanowires. Color PL images of as grown samples (A) x = 0.07, (B) x = 0.17, (C) x = 0.28, and (D) x = 0.42 demonstrate the ability to tune the emission wavelength with indium composition. (E-H) The corresponding annealed nanowire arrays increase in intensity from an improvement in QE. (G,H) The PL of higher indium composition arrays changes in color from indium etching.

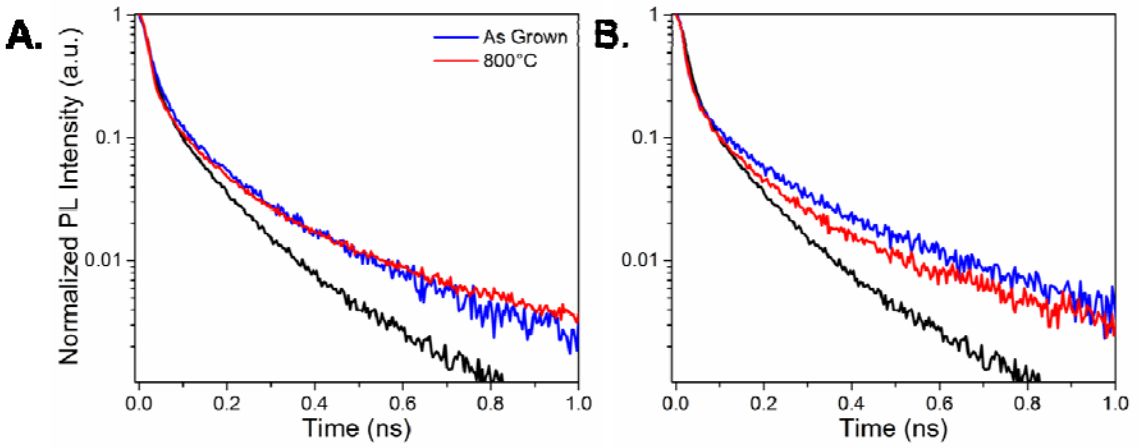

Figure SI6. Time-resolved PL spectra of as grown and annealed $In_xGa_{1-x}N$ nanowires. Time-resolved PL spectra of as grown and annealed samples (A) x = 0.28 and (B) x = 0.42 show fast initial decay of the PL intensity. The majority of the signal is limited by the instrument response function (shown in black).