Supporting Information

Synthesis and Photocatalytic Properties of Single Crystalline $(Ga_{1-x}Zn_x)(N_{1-x}O_x)$ Nanotubes

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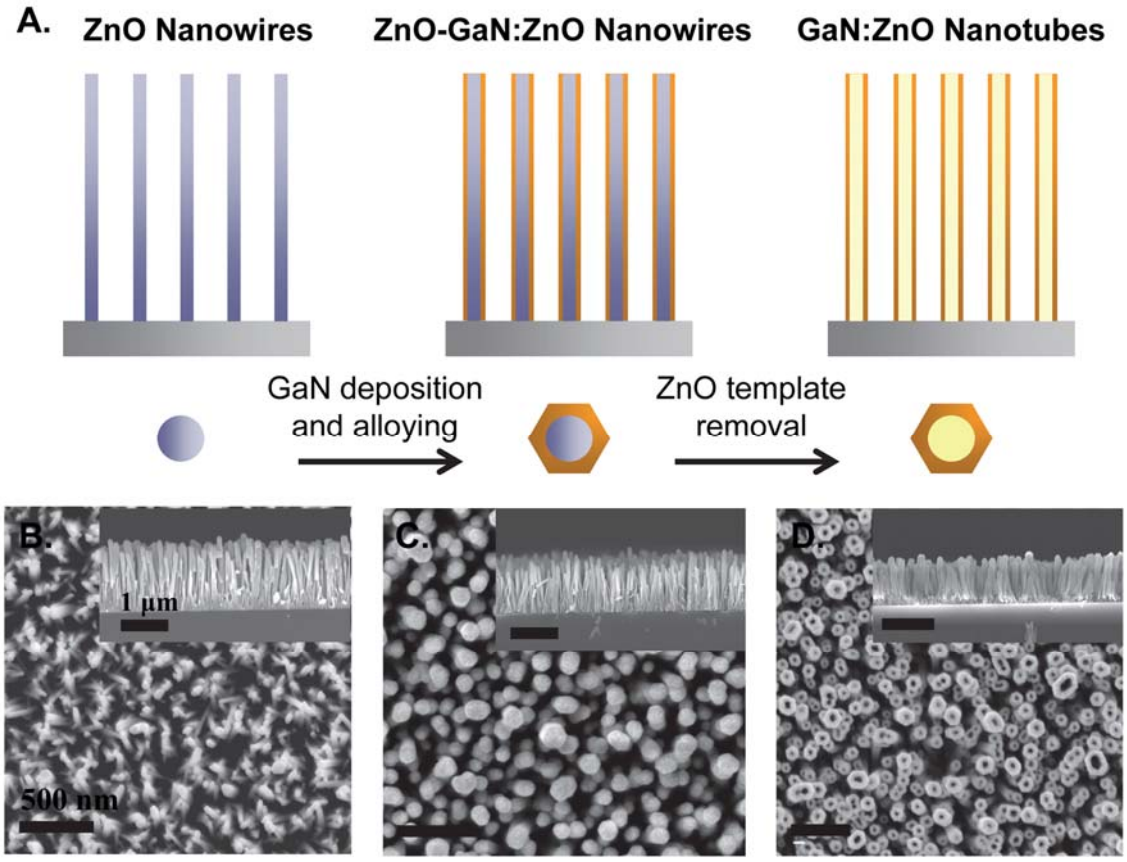

Figure S1. A) Schematic showing the epitaxial casting procedure used to generate vertical GaN:ZnO nanotube arrays. B-D) SEM images of arrays consisting of b) ZnO nanowires, C) ZnO-GaN:ZnO core-shell nanowires, and D) GaN:ZnO nanotubes. The tips of the nanotubes D) have clearly opened after etching out the ZnO core. The insets show cross-section images of the arrays at each step of the epitaxial casting procedure.

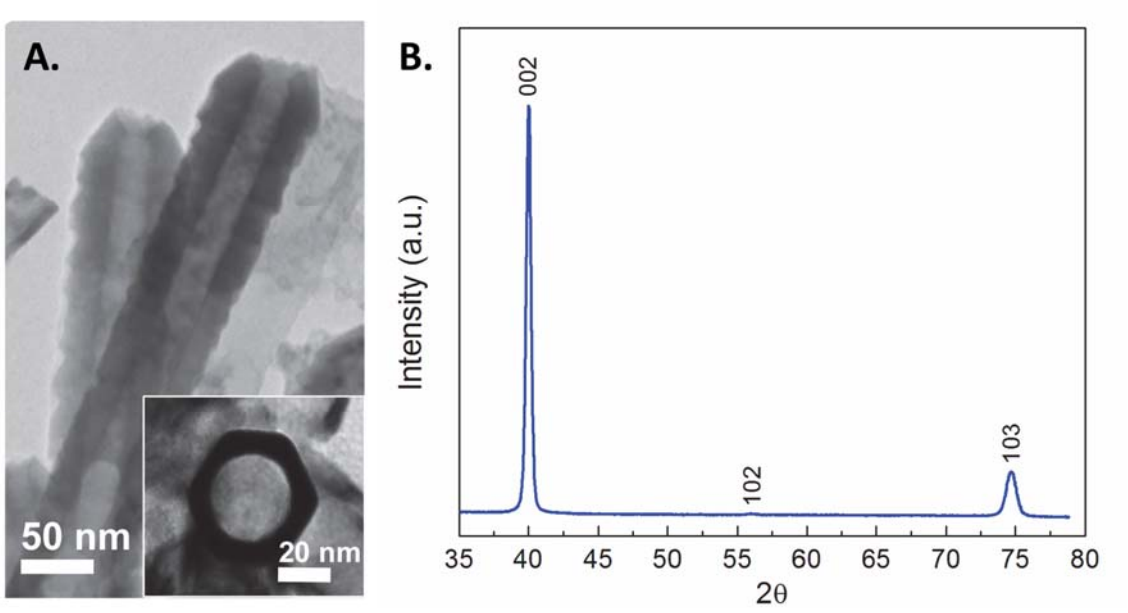

Figure S2. A) A low magnification TEM image confirms that the nanotubes have open tips and are hollow. A cross section view (inset) reveals that nanotubes have a hexagonally faceted outer wall. B) The XRD pattern shows that oriented GaN:ZnO nanotubes have a wurtzite crystal structure. An intense 002 diffraction peak can be seen because of the vertical orientation of the nanotubes.

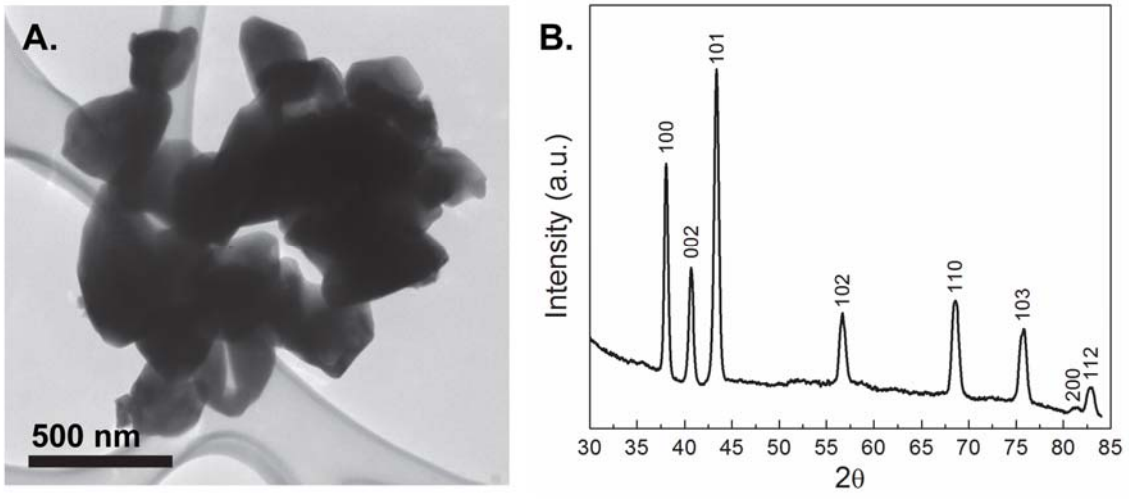

Figure S3. A) A TEM image of a GaN:ZnO powder agglomerate shows that grain sizes range from hundreds of nanometers to microns. Powders were found to have a composition range of x = 0.05-0.10 from EDS analysis. B) A XRD pattern shows that powders have a wurtzite crystal structure. No pure GaN or ZnO peaks are present indicating the formation of a solid solution.

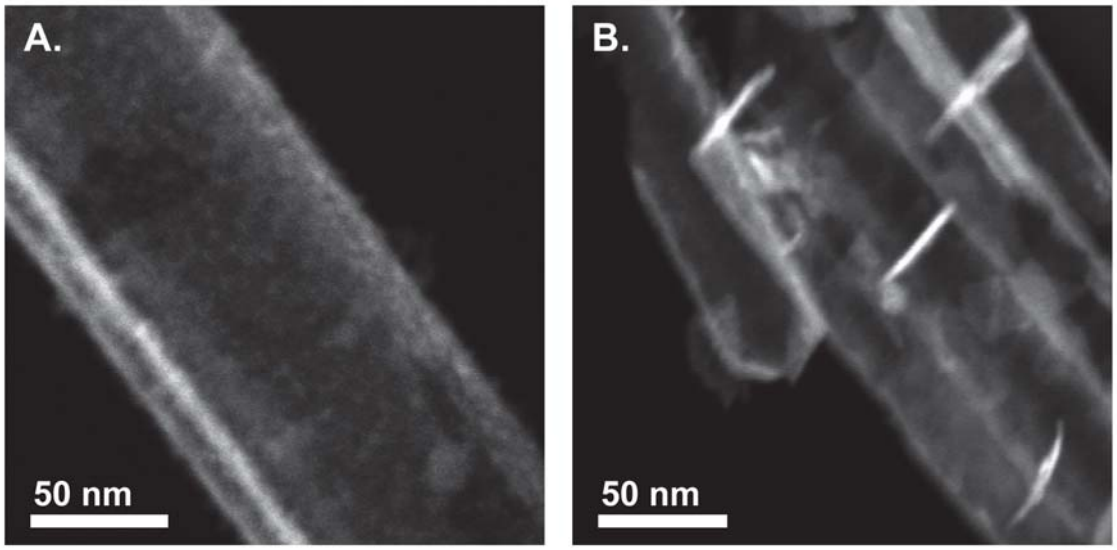

Figure S4. High-angle annular dark-field (HAADF) scanning TEM (STEM) image shows the uniform decoration of catalyst particles on nanotube surface. A) The brighter contrast areas show the uniform dispersion of Rh cores from Rh-Cr_2O_3 nanoparticles on the surface of GaN:ZnO nanotubes. b) IrO_x nanoparticles that were mixed with the nanotubes aggregated into the bright rod shaped features.

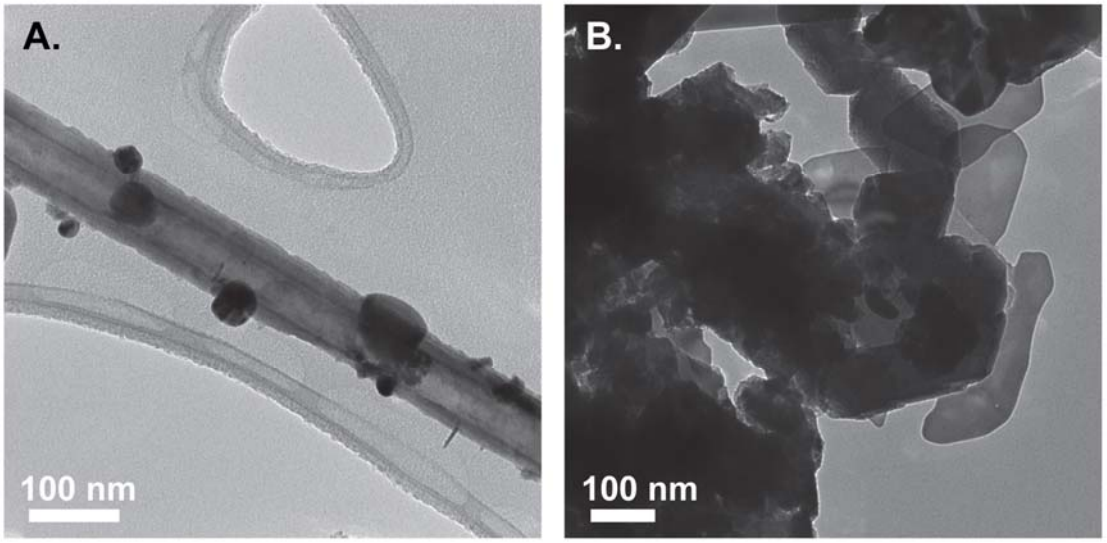

Figure S5. TEM images of samples illuminated for 18 hrs show that Ag particles nucleate from the reduction of Ag(I) ions on nanotube A) and powder B) surfaces. Nanotubes had a higher amount of Ag deposited on the surface (34.1% wt, measured by EDS) compared to powders (5.5%).

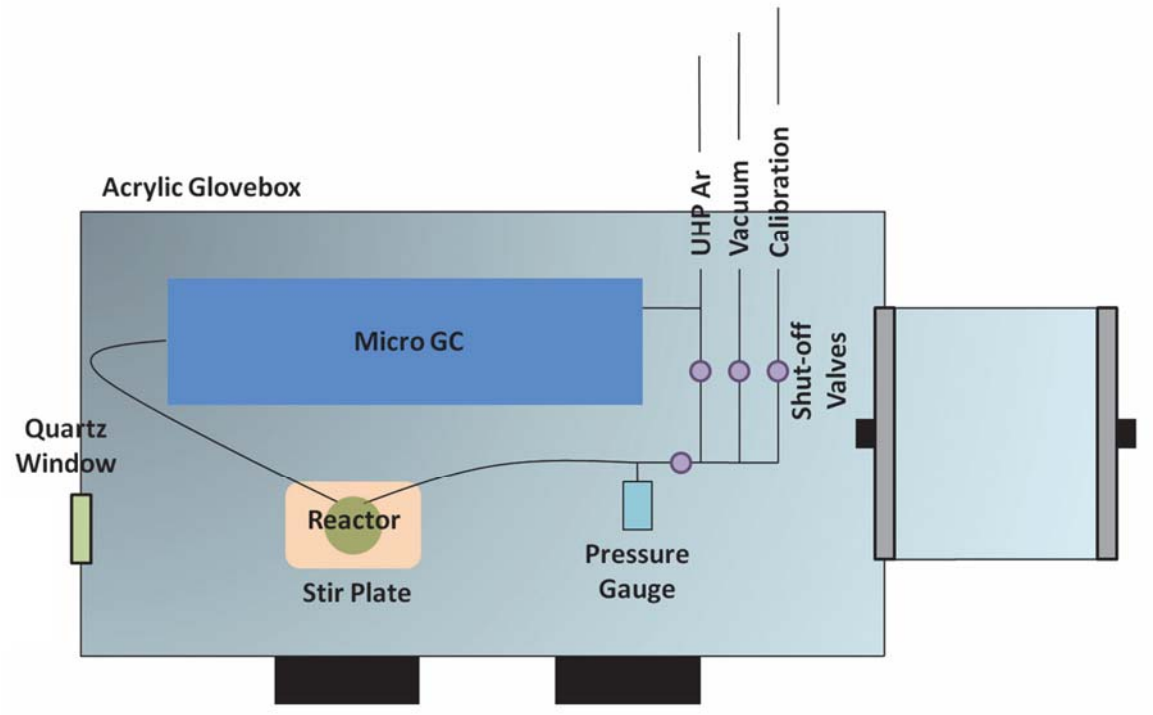

Figure S6. The micro GC and batch reactor were placed within an acrylic glovebox to control the ambient. The reactor was illuminated horizontally through a quartz window.