

## Supporting Information

# Growth of Gallium Nitride and Indium Nitride Nanowires on Conductive and Flexible Carbon Cloth Substrate

Yi Yang,<sup>§,a</sup> Yichuan Ling,<sup>§,a</sup> Gongming Wang,<sup>a</sup> Xihong Lu,<sup>a,b</sup> Yexiang Tong,<sup>b</sup> and Yat Li<sup>\*a</sup>

<sup>a</sup> Department of Chemistry and Biochemistry, University of California, Santa Cruz, California 95064, United States of America

<sup>b</sup> KLGHEI of Environment and Energy Chemistry, MOE of the Key Laboratory of Bioinorganic and Synthetic Chemistry, School of Chemistry and Chemical Engineering, Sun Yat-Sen University, Guangzhou 510275, People's Republic of China

§ These authors contributed equally to this work.

\*Corresponding Author. E-mail: [yli@chemistry.ucsc.edu](mailto:yli@chemistry.ucsc.edu)

## **Experimental Section**

### **Synthesis of GaN nanowires**

Carbon cloth (AvCarb 1071 HCB 40cm×40cm) was cleaned by ethanol and followed by deionized water. The substrate was soaked with zinc acetate (0.02 M) ethanol solution and then allowed it to air dry. This substrate was further heated on a hot plate at 550°C for 10 min to form a layer of ZnO seeds. The ZnO seeded carbon cloth substrate was then dipped into the Ni(NO<sub>3</sub>)<sub>2</sub> ethanol solution (0.2 M) and was heated to form a NiO catalyst layer. GaN nanowires were grown in a horizontal tube furnace at a fixed pressure of 100 torr and a temperature range between 800 and 1100 °C for 30 min, using gallium metal (99.999%, Alfa Aesar) and ammonia (15 sccm) as Ga and N precursors, respectively. The carbon cloth substrate was covered on the gallium metal (99.999%, Alfa Aesar) and holded by a mica plate. Ultrahigh purity hydrogen gas (30 sccm) was used as carrier gas. Si-doped GaN nanowires were synthesized with the similar method with the injection of silane as the Si dopant source with a flow rate of 5sccm into the CVD system.

### **Synthesis of InN nanowires**

The pre-cleaned carbon cloth substrate was dropped the gold colloidal solution and allows it to air dry. InN nanowires were grown in a tube furnace at 550 °C and 150 torr for 30 min, using indium metal (99.999%, Alfa Aesar) and ammonia (200 sccm) as In and N precursors, respectively. The indium metal was contained in a ceramic boat and the carbon cloth substrate was covered on the top of ceramic boat. N<sub>2</sub> was used as the carrier gas (100 sccm).

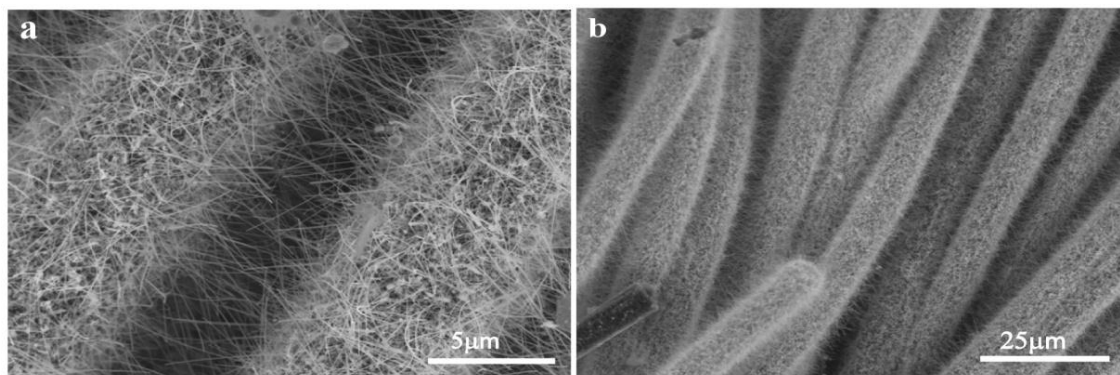
### **Photoelectrochemical measurements of nanowire photoanodes**

The Si-doped GaN nanowires grown on carbon cloth substrate were fashioned into electrodes by securing the carbon cloth substrate to a copper wire with conducting resin. Edges of the substrate were then sealed with insulating epoxy resin. The exposed effective area for the working electrode is around 0.30 cm<sup>2</sup>. All the photoelectrochemical measurements were performed by a CHI 660D electrochemical station, using Ag/AgCl (Sat.KCl) as reference electrode, Pt wire as counter electrode, and 0.5M Na<sub>2</sub>SO<sub>4</sub> aqueous solution (pH = 6.8) as an electrolyte, under a simulated sunlight (100 mW/cm<sup>2</sup>) generated with a 150W xenon lamp (Newport 6255) coupled with an AM 1.5 global filter (Newport 81094). The power density of the incident light was measured with a digital power-meter. The electrolyte was 0.5M Na<sub>2</sub>SO<sub>4</sub> solution with a pH value of 7.

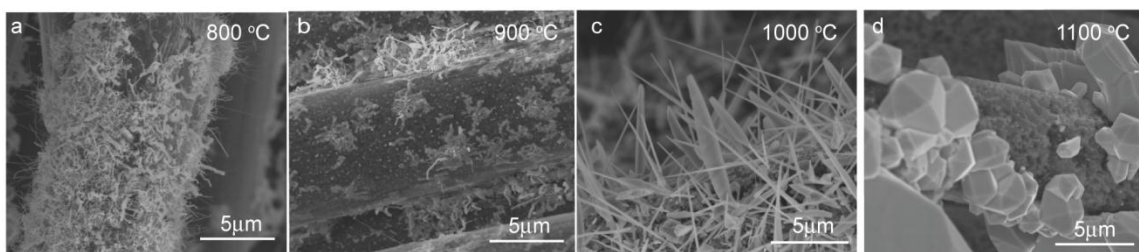
### **Material Characterization**

X-ray diffraction (XRD) spectra were measured at room temperature on a Rigaku Americas Miniflex Plus powder diffractometer from a 2θ angle of 20 to 70 degree with a step size of 0.04 degree at a rate of 1 degree/min. Scanning electron microscopy (SEM) images were collected by a field-emission SEM (Hitachi S-4800 II). High resolution transmission electron microscopy images were collected by a TEM (Tecnai F20 UT) operated at 200 kV.

### Supplementary Figure



**Figure S1.** SEM images collected for GaN-900 nanowires prepared on carbon cloth by ZnO seeded method.



**Figure S2.** SEM images collected for GaN nanowires prepared at different temperatures (a) 800 °C, (b) 900 °C, (c) 1000 °C, and (d) 1100 °C.