SUPPORTING INFORMATION

Content

1.Supporting figures (Figure S1-S4 and Scheme S1)

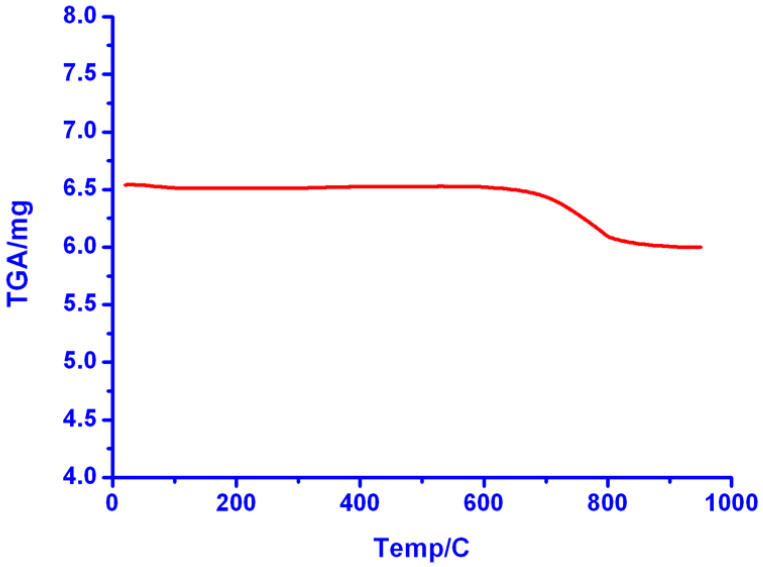


Figure S1. The TGA pattern of GD powders

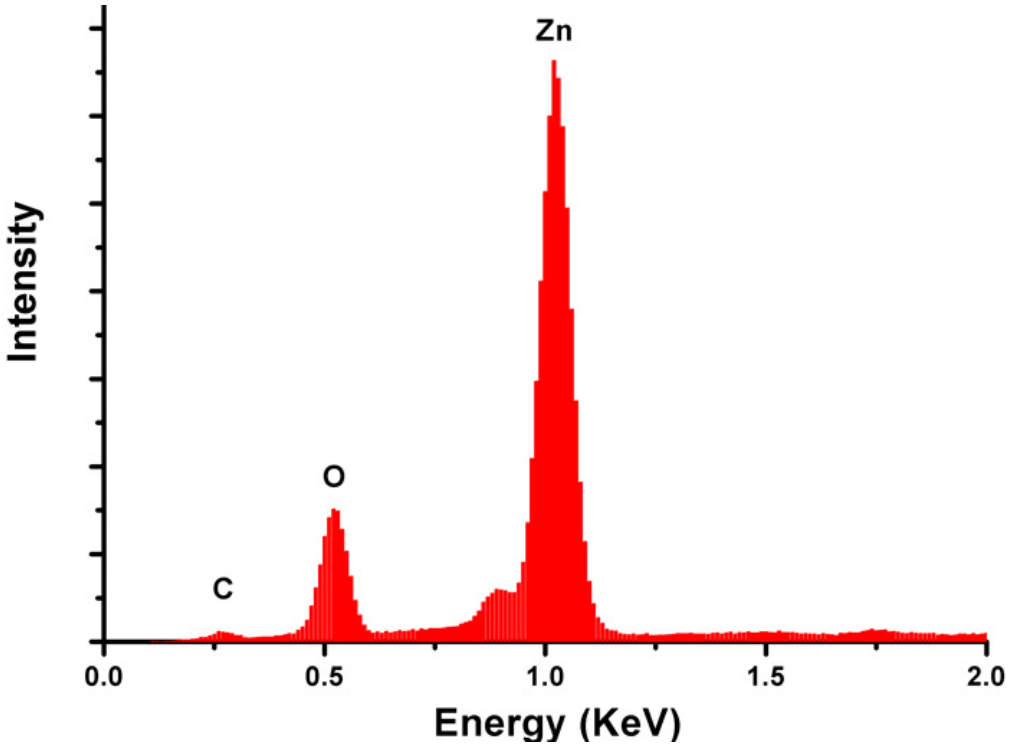


Figure S2. EDS pattern of GDNWs.

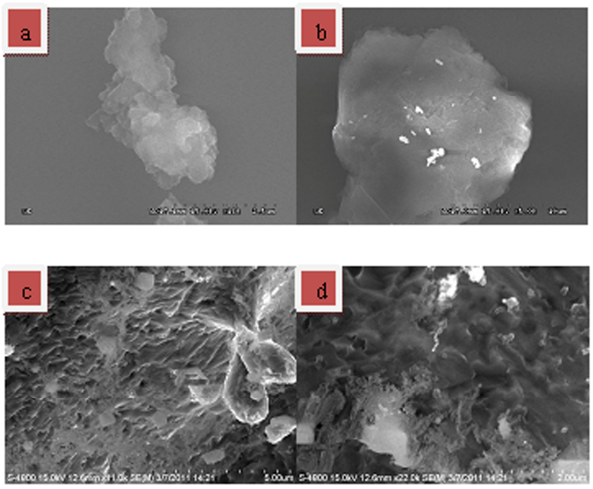


Figure S3 (a) and (b) GD growth on silicon; (c) and (d) GD growth on Cu foil

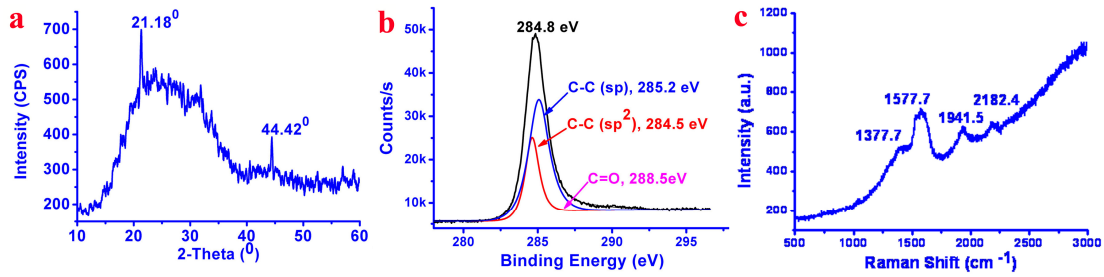
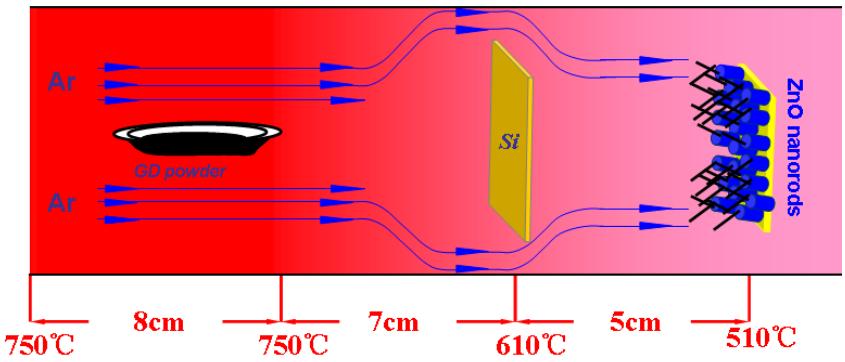


Figure S4. (a) XRD pattern of GDNWs. (b) XPS pattern of GDNWs. (c) Raman spectra of GDNWs



Scheme S1. The scheme of synthesis of GDNWs

2. Experimental details

The details of the synthesis of GD film on copper foil are described in Ref 10. Then, the GD film was scaled off the copper foil using ultrasonic and wash by acetone and DMF in turn. After vacuum drying, the GD powder was gotten. The GDNWs were synthesized using GD powder as vapor source and ZnO nanorod arrays on silicon slice as substrate which was produced through a multi-step hydrothermal process [34].The scheme S1 shows the synthesis process of GDNWs. 100 sccm argon gas was introduced for 60 min in room temperature to remove the air and then the flux was turned to 60 sccm as carrier gas. A quartz boat with 60 mg of graphdiyne powder was kept in the center of furnace, when the furnace temperature is at 750 ºC. Then the graphdiyne powder was evaporated from the boat and deposited on the surface of ZnO nanorod arrays films at the low-temperature region downstream. The distance between quartz boat and the substrate was kept 12 cm and a silicon slice was stood up the front of the substrate with ZnO nanorod arrays films away of 5 cm for decreasing the shock of graphdiyne vapor to the ZnO nanorod arrays films. The deposition process lasted for 30 min and quickly cooled to room temperature under argon gas. The gray products were obtained from the surface of ZnO nanorod arrays films on the silicon substrate. The residues in the quartz boat is about 54.6 mg. The GDNWs were characterized by scanning electron microscopy (SEM, Hitachi S-4300, operated at 15 KV) equipped with an X-ray energy dispersive spectrometer (EDS) and the X-ray photoelectron spectroscopy (XPS, ESCA Lab2201-XL). The TGA data of GD powder was measured by DTG-60 smultaneous DTA-TG apparatus (SHIMADZU). The nitrogen gas flow was 20 sccm and the heat rate was 10□/min. The GD powder sample was put into ceramic crucible and heated to 950°C. For the characterization of X-ray diffractometer (XRD), the substrate with GDNWs was washed by 0.05 mL HCl (0.1M) for 5 seconds. Then, a droplet was transferred onto the glass slide and the glass slide was washed several times by distilled water. After drying at 100 ºC for 1h in vacuum, the sample was characterized by XRD (Rigaku Dmax200, Cu Kα). The scanning rate was 0.05 °/s, and the 2θ range was from 10° to 60°. For transmission electron microscopy (TEM), the GDNWs were scratched from the ZnO nanorods by copper screen. Then, the copper screen was washed by 0.1M HCl, distilled water and ethanol, respectively. After infrared drying, the sample was characterized by TEM, high resolution transmission electron microscopy (HRTEM) and selective area electron diffraction pattern (SAED) on Hitachi-2010 equipped with an X-ray energy dispersive spectrometer (EDS) and operated at 200 KV.The electric properties measurement of GDNWs.Two MM3A-nanoprobes (Kleindiek) installed in a FEI QUANTA 600F SEM were used to hold W tips for nanomanipulation and electric properties measurement of GDNWs. Electrical properties measurement was carried out by using Keithley 4200 semiconductor analyzer. W tips were made by chemical etching in 5 M NaOH solution. At first, an electrically induced melting process was used to clean W tips for good electrical contact. Under the observation of SEM, a clean W tip was manipulated to approach the substrate and contact with individual GDNWs on the substrate. The contact was then strengthened by amorphous carbon deposited through electron beam induced deposition (EBID). The W tip was then moved up to pick up the GDNW from the substrate. Another W tip was manipulated to contact the other end of the GDNW and the contact was strengthened by amorphous carbon through EBID. A sweep voltage (from -5V to +5 V) was then applied between two W tips at low current-limiting at the beginning to improve the electrical contact. A series of *I-V* data was measured by Keithley 4200. We then increased the value of current-limiting step by step until the GDNW was burned out.