Supporting Information for "Direct synthesis of platelet graphitic-nanofibres as a highly porous counter-electrode in dye-sensitized solar cells "

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1. DSSCs fabrication and photovoltaic performance measurements

The counter electrodes were prepared by GNFs forest and Pt film, respectively. In order to grow the GNFs on the FTO substrate (TEC-7, 2.2 mm, Hartford) directly, Ni film was deposited on FTO glass for GNFs growth; the area and thickness were 0.28 cm^2 and 10 nm, respectively. The Ni catalyst deposited FTO glass was subsequently placed on a quartz plate and loaded into furnace quartz tube to grow the homogenous and high-density GNFs via the low temperature LPCVD process. Low pressure chemical deposition (LPCVD) was then applied at 530°C and 20 Torr in a C_2H_2 mixing gas ($C_2H_2/H_2/Ar/O_2$ = 15/70/320/3 sccm), allowing 40 min of GNF growth. Samples were characterized by field emission gun scanning electron microscopy (FEG-SEM, JEOL-JSM-6330), transmission electron microscopy (TEM, JEOL-JEM-2100) and Raman spectroscopy (514 nm laser). Figure S1 shows a photography of our direct growth of GNFs on FTO glass.

The Pt film counter electrode was also prepared by e-gun evaporation as a reference electrode. To ensure high photoconversion efficiency in the Pt film, the Pt film electrode was deposited to a thickness of 50 nm [1].

The working electrode utilized the same FTO glass coated with nanocrystalline TiO_2 (the coating was performed using print-screen technology); the area and thickness of the TiO_2 film were about 0.28 cm^2 and 10 μm, respectively. After printing, the working electrodes were dried at 125°C, then sintered in air at 500°C for 30 min. Prior to the fabrication of the DSSCs, the sintered working electrodes were immersed in a N719 (Solaronix) solution (0.3 mM in a mixture of acetonitrile and tert-butylalcohol [volume ratio 1:1]) at room temperature for 24 hr. The dye-adsorbed electrode was then washed with acetonitrile and dried.

A 60 μm-thick hot melt spacer (SX1170-60, Solaronix) was sandwiched between the sensitized TiO_2 working electrode and various counter electrodes by heating at

100°C for a few seconds. The spacer between the electrodes was injected with a liquid, iodide-based electrolyte (AN-50, Solaronix). The photocurrent voltage characteristics of the DSSC devices were measured under simulated solar illumination (AM 1.5, 100 mW /cm^2, Oriel 91160), at 25°C. The solar light was calibrated using a reference Si cell (calibrated at NREL, PVM-81). Figure S2 shows a schematic diagram of the directly grown GNFs forest as a porous counter electrode in DSSC for the photovoltaic performance measurements.

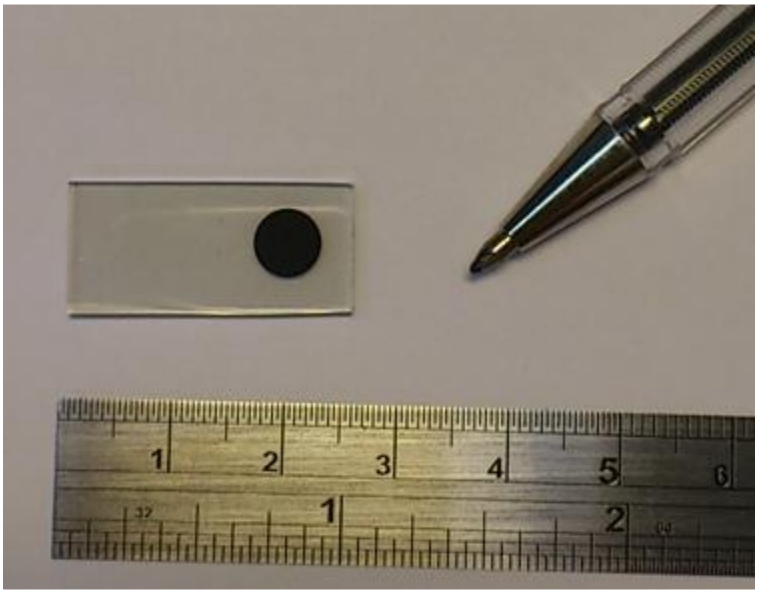

Figure S1. A photography of our direct growth of GNFs on FTO glass.

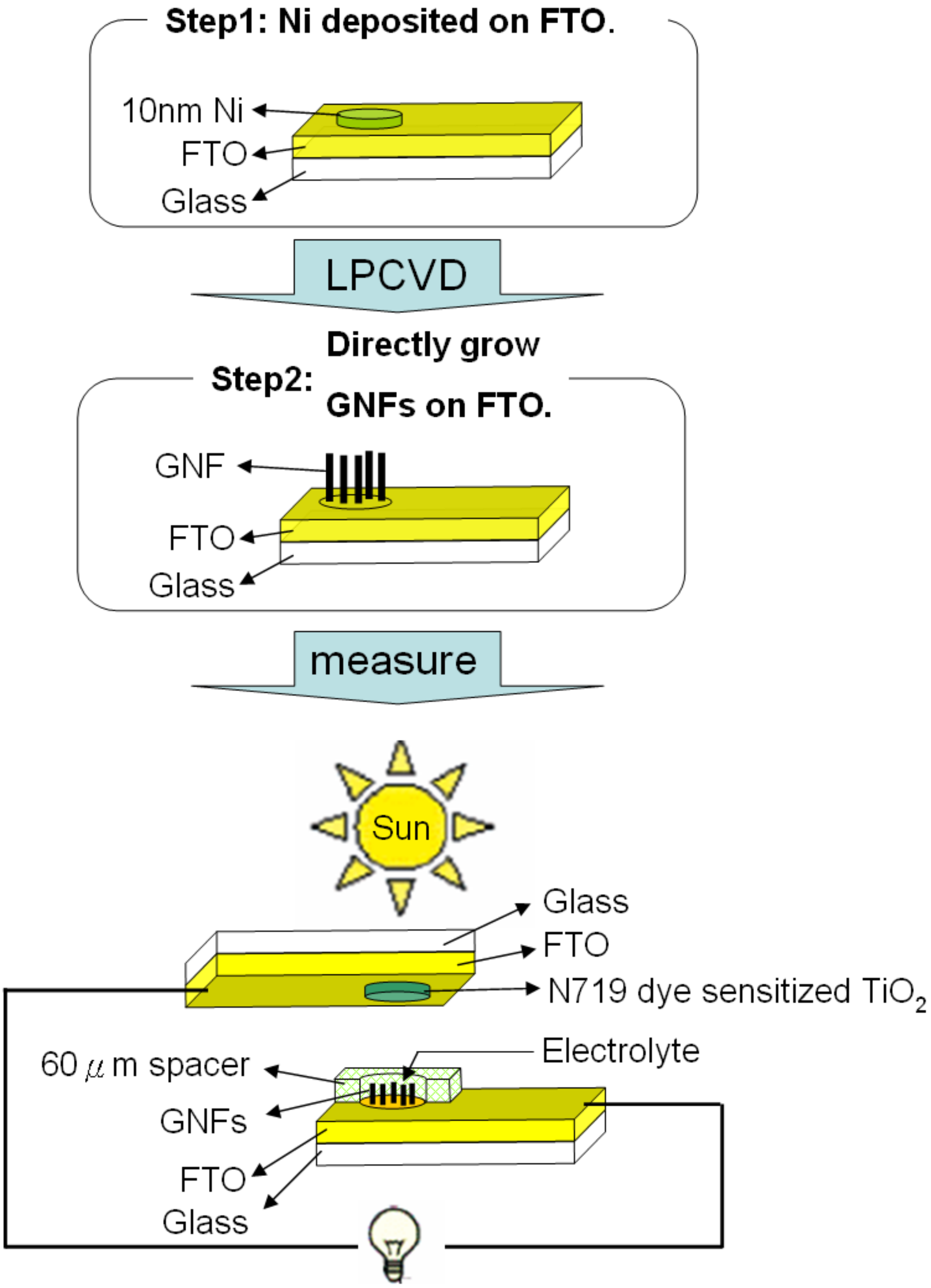

Figure S2. Schematic diagram of the directly grown of GNFs forest as a counter electrode in DSSC for photovoltaic performance measurement.

2. N_{Diff} at various applied biases.

The I_3^- ion concretion in the electrolyte is directly correlated with the Nerest diffusion impedance (N_{Diff}) between the electrodes. Figure S3 (a-d) show the Nyquist plots of Pt film and GNFs forest, with various applied bias. Figure S3 (a) shows the Nyquist plots of Pt film, the N_{Diff} of Pt film are extremely large at high bias regime (0.6 to 0.8 V). Figure S3 (b) shows the Nyquist plots of GNFs forest, compared with Pt film, GNFs forest electrode provided much smaller N_{Diff} at high applied bias regime (0.6 to 0.8 V). Figure S3 (c) and figure S3 (d) show the enlarged of figure S3 (a) and figure S3 (b), respectively. As we can see, the N_{Diff} of Pt film and GNFs forest are almost comparable at the low bias regime (0 to 0.4 V). The N_{Diff} of bias dependent EIS measurement provided the evidence to descript the porous structure promoted the kinetics of charge-transfer reaction, tally with De Levie's theory [2].

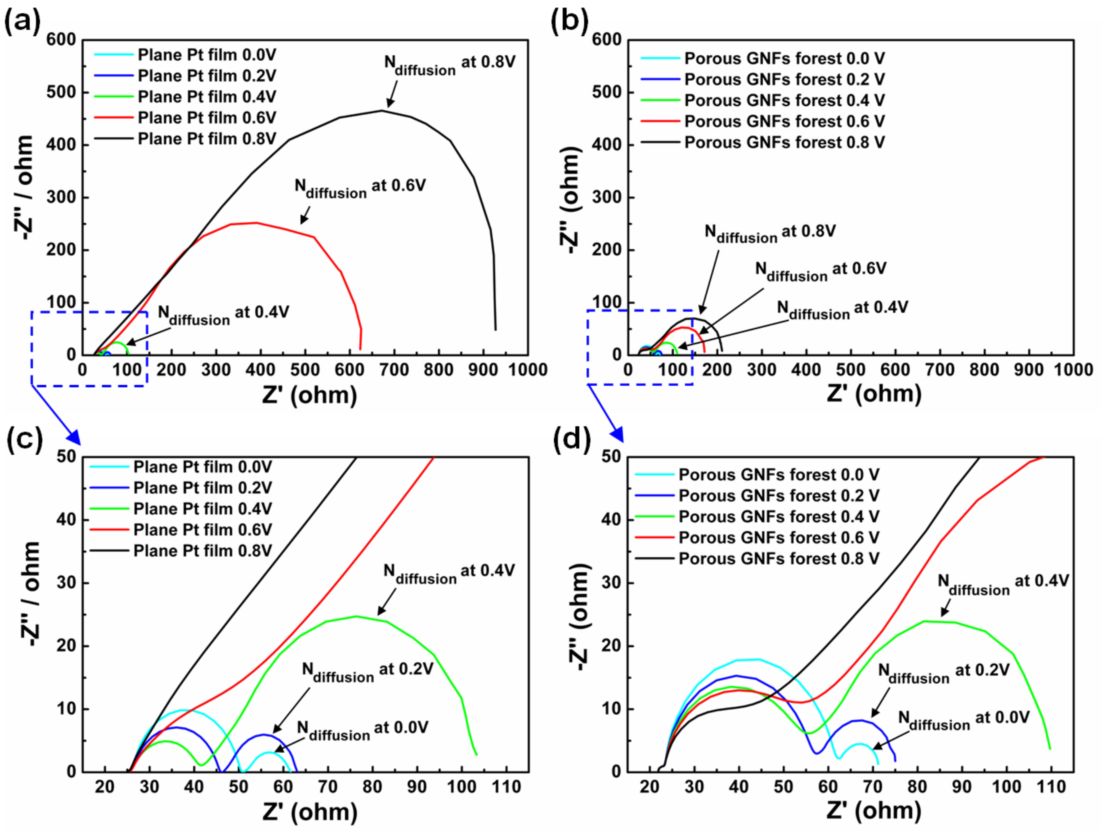

Figure S3. Nyquist plots from a symmetrical cell with various applied voltage of Pt film and GNFs forest electrodes.

Reference

1. Fang, X. M., Ma, T. L., Guan, G. Q., Akiyama, M., Kida, T. and Abe, E., *J. Electroanal. Chem.*, **2004**, 570, 257.
2. De Levie, R., *Interscience Publishers, New York*, **1967**, 6, 329.