

Supporting Information

Excellent Performance of Pt⁰ on High Nitrogen-Containing Carbon Nanotubes Using Aniline as Nitrogen/Carbon Source, Dispersant and Stabilizer

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Experimental Section

Synthesis of NC-CNT

The nanocomposites were synthesized by chemical oxidation polymerization of aniline on carbon nanotubes. A 10.0 mL solution of isopropyl alcohol (containing treated CNT 0.050 g) was first stirred before the synthesis, and then the aniline monomers (0.10 - 1.0 g) in 10 mL 0.5 M H₂SO₄ were added into the CNT suspension. The mixtures were subsequently stirred overnight at room temperature, and then the solution of 0.50 M H₂SO₄ containing the oxidant (NH₄)₂S₂O₈ (ammonium peroxodisulphate, APS) was added (the molar ratio of APS to aniline was 0.8:1). The polymerization was carried out at room temperature for 24 h. The resulting products were filtered and washed with deionized water, and then dried under vacuum at 70 °C overnight. The hybrid carbon materials were treated at 800 °C in an argon gas flow

oven (100 sccm) for 3 h to form a nitrogen dotted char layer surrounding carbon nanotubes.

Loading of Pt Colloids on Carbon Support

A solution containing 10 g of isopropyl alcohol and 8.0 g of deionized water had 0.030 g of NC-CNT and 0.0420 g of benzyl amine added (the molar ratio of benzyl amine to Pt was 10:1), and was stirred for 1 hour. 47.0 mL of Pt solution (0.082 M) in 200 mL of deionized water were added into the CNT suspension and stirred for 3 h at room temperature. Then 0.452 g of citrate was added to the mixture (the molar ratio of citrate to Pt was 40:1), after which the temperature was increased to 115 °C, the mixture stirred for 30 min, and then dried in vacuum at 70 °C overnight. Finally, the sample was heated at 400 °C in a quartz-tube furnace with flowing argon and hydrogen gas (1: 1) for 4 h.

Characterization

The morphological characterization was performed by scanning electron microscope (SEM) using a JEOL JEM6700 FESEM operating at 10 kV. X-ray photoelectron spectroscopy (XPS) measurements were carried out with a VG Scientific ESCALAB 210 electron spectrometer using MgK α radiation under a vacuum of 2×10^{-8} Pa. A CHI-608A potentiostat/galvanostat and a conventional

three-electrode test cell were used for electrochemical measurement. The CV test was performed on the working electrode by cycling the voltage between -0.25 and 0.95 V versus Ag/AgCl electrode in 0.1 M HClO₄ solution. The scan rate was 20 mV s⁻¹. Single fuel cell test was evaluated using a unit cell with an active area of 5 cm² fed with hydrogen and oxygen at the anode and cathode for a rate of 200 mL min⁻¹. The MEA for the single cell test were fabricated as follows. Catalyst ink was prepared by mixing Pt/C catalyst powder with water (2.0 mL for 1.0 g of electrocatalyst), and then adding iso-propanol (20 mL for 1.0 g of electrocatalyst) to avoid any ignition. 5% Nafion dispersion (Dupont) was added (0.8 g solid Nafion for 1 g of catalyst) to the catalyst slurry. Catalyst coating on gas diffusion layer (GDL, 50 wt% wet-proofing carbon paper, Toray) with 5 cm² active area was fabricated by brushing Pt/C catalyst ink.

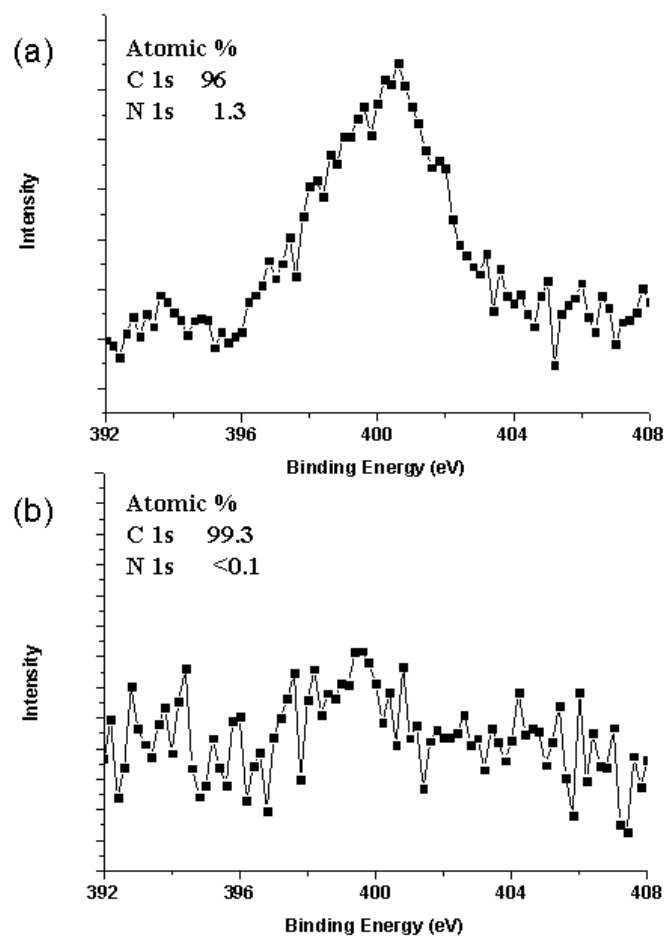


Fig. S1 The XPS spectra of the Pt/CNT catalyst: N 1s region before (a) and after (b) thermal treatment. The atomic % of nitrogen was showed in the inset.