Supplementary Material (ESI) for *Nanoscale*

Supplementary Information

Effective Post-Treatment for Preparing Highly Conductive Carbon Nanotube/Reduced Graphite-Oxide Hybrid Films

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Experimental Methods

Chemicals: The P3 SWNTs (from Carbon Solutions Inc.) synthesized by arc-discharge were used as received. RNA (double strand, salmon sperm, 2000 base pairs) was obtained from Sigma Chemicals. Graphite flake (bought from alfa-aesar Co., ltd) was exfoliated into GO by modified Hummers' method. 1.0 g of graphite flakes, 1.0 g of $NaNO_3$ and 46 mL of concentrated H_2SO_4 were mixed together in an ice bath for 4 h. Then 6.0 g of $KMnO_4$ was added slowly into the solution. Afterwards, the ice bath was removed and the suspension was stirred for another 4 h. After adding 92 mL of distilled water dropwise, the suspension was heated in oil bath at 98 ^oC for 30 min. Then the suspension was further treated with 200 mL of warm water and 20 mL of H_2O_2 (30%). The mixture was centrifuged at 4000 rpm and washed with HCl and water. Then the

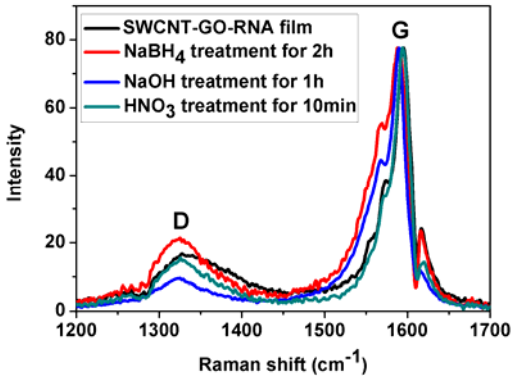
sample was dried at 50 ^{o}C for 48 h to obtain GO.

Preparation of SWCNT/GO hybrid films: RNA was dissolved in 0.03 M NaAc aqueous solution. SWCNTs and GO were added and bath sonicated in RNA solution for 2 h. The weight ratio between SWCNTs and GO was 10:1 and that between SWCNTs and RNA was 1:1. The obtained dark solution was centrifuged at 8000 rpm for 30 min. The supernatant was carefully collected and diluted with water by 20 folds. Then 10-60 mL solutions were filtrated through a 220 nm Millipore ester membranes to prepare films. After filtration, the filter membranes were then transferred onto PET substrates, dried in air at 90 °C for 1 h and then dipped in acetone for 30 min to dissolve the filtration membrane leaving SWCNTs/GO thin films on the PET substrates. The obtained films were finally dried at 90 °C for 2 h.

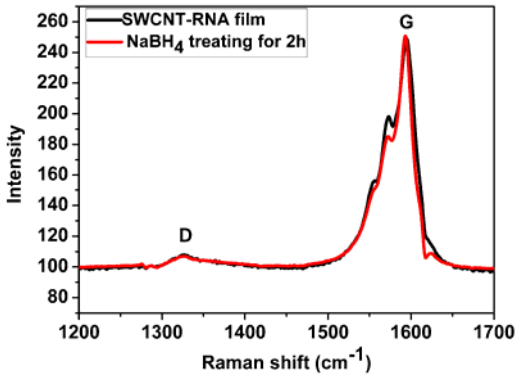
Post treatment: First, films were immersed in 150 mM sodium borohydride solution for 2 h and then rinsed with deionized water followed by drying at 60 ^{o}C. Then, they were immersed in 5 wt% sodium hydroxide solution for 1 h followed by rinsing with deionized water and drying. At last, they were treated by 14 M nitric acid for 10 min and rinsing with abundant water.

Characterization: The dispersion states of SWCNTs/GO solution were characterized by TEM (JEM-2100F, JEOL, Tokyo, Japan). SEM images of SWCNT/GO films were taken on a field emission scanning electron microscope (FESEM, JEOL, JSM-6700F). The transmittance at 550 nm of the films was measured via a UV-vis spectrometer (Lambda 950, Perkin-Elmer, Shelton, USA). A four-point probe resistivity meter (Loresta EP MCP-T360, Mitsubishi Chemical, Japan) was used to measure the sheet resistance of the films. X-ray photoelectron spectra (XPS) analysis was conducted using the Mg Kα (1253.6 eV) monochromatic X-ray source

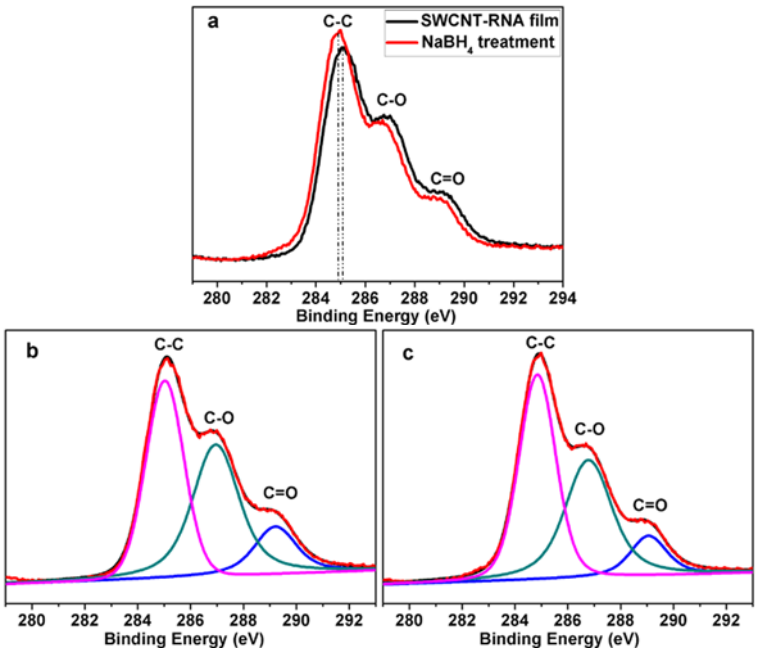
(Axis Ultra DLD, Kratos). Raman spectra were recorded using a Thermofisher spectrometer (DXR) with an excitation length of 633 nm.



S1 Raman spectra of SWCNT/GO hybrid films before and after post-treatment



S2 Raman spectra of SWCNT films before and after treatment with $NaBH_4$



S3 XPS analysis of SWCNT films before and after treatment with $NaBH_4$: (a) SWCNT films before and after $NaBH_4$ treatment; SWCNT film before (b) and after treatment (c) with its deconvolution into Gaussian curves.

Table 1 Atomic concentration (at. %) analysis of SWCNT/GO hybrid films before and after treatment

Semi-quantitative analysis	C	N	O	P
SWCNT-GO film	62.1	4.1	28.2	0.05
$NaBH_4$ treatment for 2 h	67.3	2.1	24.4	0.0
NaOH treatment for 1 h	71.6	0.8	22.8	0.0
HNO_3 treatment for 10 min	68.4	3.7	22.4	0.0

Table 2 C1s peak position of SWCNT/GO hybrid film before and after treatment

Samples	Peak position of C1s
SWCNT-GO film	285.01
$NaBH_4$ treatment for 2 h	285.02
NaOH treatment for 1 h	284.8
HNO_3 treatment for 10 min	284.68