

Supplementary Information

for

Direct Growth of Carbon Nanofibers to Generate a 3D Porous Platform on Metal Contact to Enable ORR

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S1

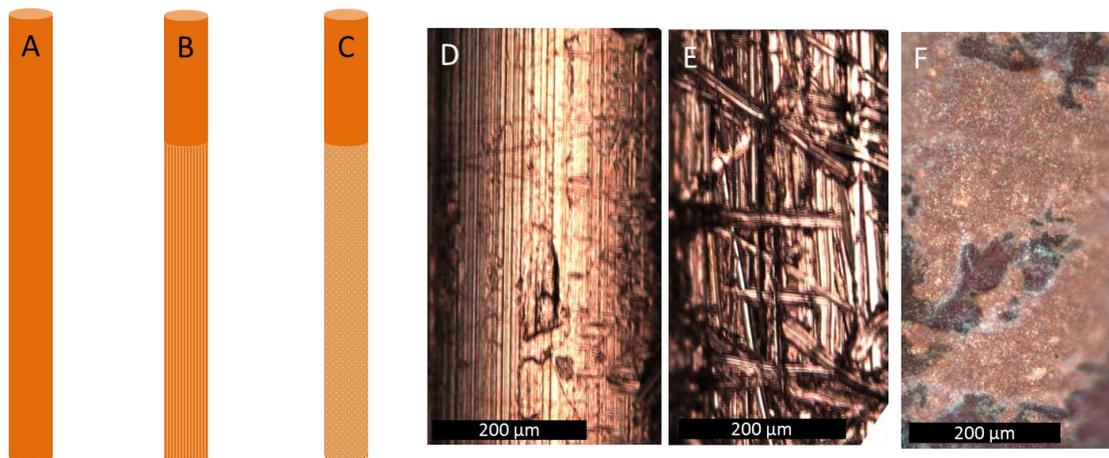


Figure S1. Diagram of a copper wire (a) that is then mechanically polished (b), and finally chemically etch (c). Micrographs of the unaltered copper wire (d), after mechanically polished (e) and then chemically etched (f).

S2

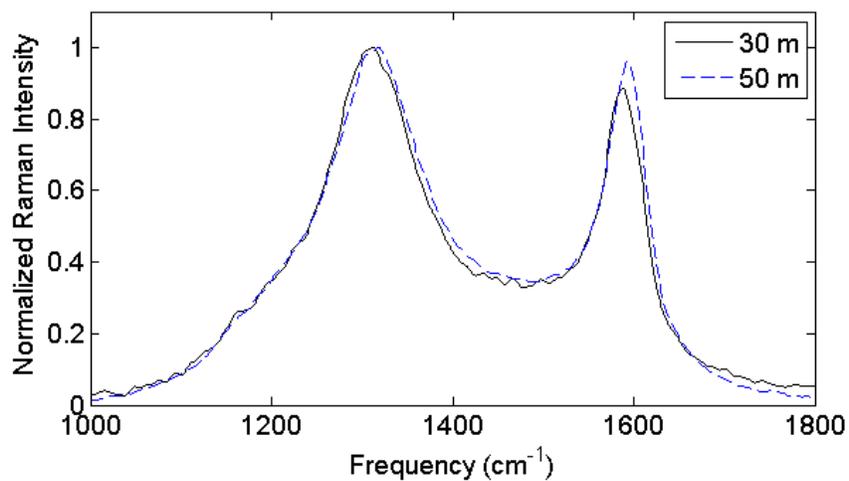


Figure S2. Raman spectra of as-grown CNFs with annealing times 30 min (black), and 50 min (dashed blue). $I_D:I_G$ ratios for the spectra are 1.13 and 1.16 respectively.

S3a

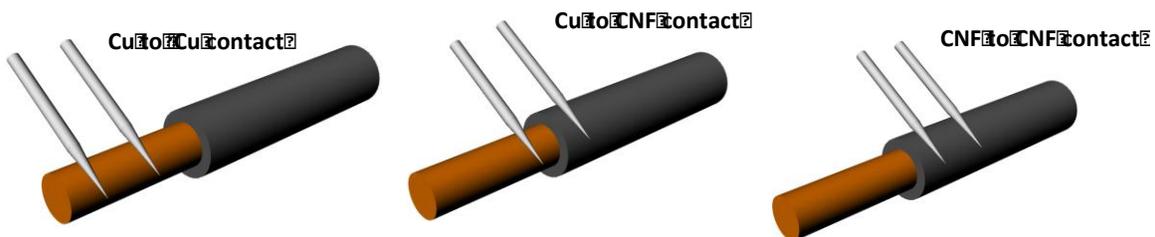


Figure S3a. Contact resistance test measurement set-up

S3b

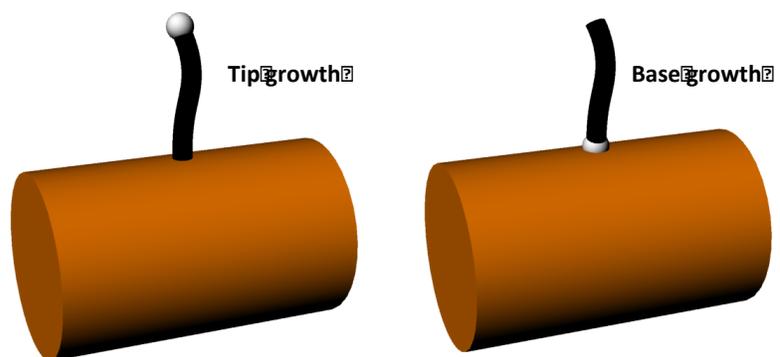
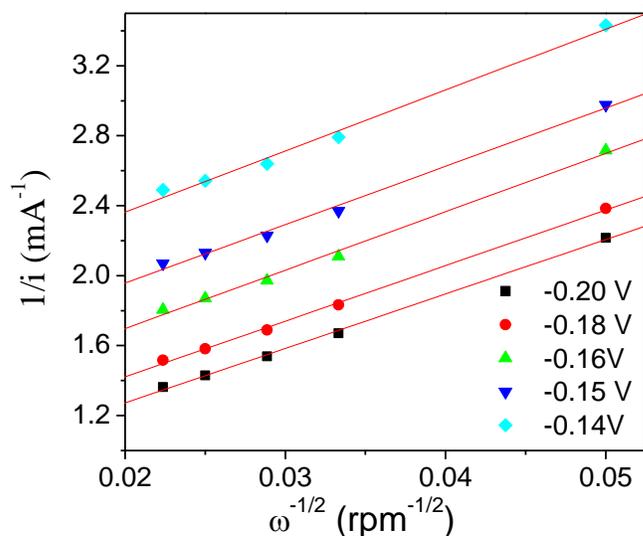


Figure S3b. Proposed tip-growth to form open end CNTs with Cu wires.

S4a

Kinetic current of ORR: Koutecky-Levich plot



	-0.20	-0.18	-0.16	-0.15	-0.14	-0.12
intercept	0.64971	0.78734	1.02927	1.29043	1.66679	3.49931
slope	31.13525	31.75007	33.40272	33.36677	34.86019	39.90901
R	0.99913	0.99911	0.99747	0.9971	0.99582	0.98776
i_k / mA	1.53915	1.2701	0.97156	0.77494	0.59996	0.28577
j_m / mA mg⁻¹	30.8	25.4	19.4	15.5	12.0	5.7

Figure S4a. Koutecky-Levich plot of FePc-functionalized CNFs. The functionalized CNFs, 50 mg by weight, were scraped from Cu wires and mixed with a 0.05% Nafion binder before depositing onto a rotating graphite disk electrode (0.070 cm²). The RDE experiment was run with a Pt counter electrode and Ag/AgCl reference electrode. The amount of peroxide was detected electrochemically using a gold ring electrode with Ag/AgCl as the reference electrode.

S4b**H₂O₂ yield:**

$$n = \frac{4i_d}{i_d + (i_r / N_o)} \quad (3)$$

$$\% \text{H}_2\text{O}_2 = 50(4 - n) \quad (4)$$

Collection efficiency (N_o) of RRDE: 0.37

At -0.4 V, $i_d = 0.895$ mA; $i_r = 4.0$ μ A

$n = 3.95$; % H₂O₂ = 2.5%

Figure S4b. Calculations for electron transport during oxygen reduction.

S5

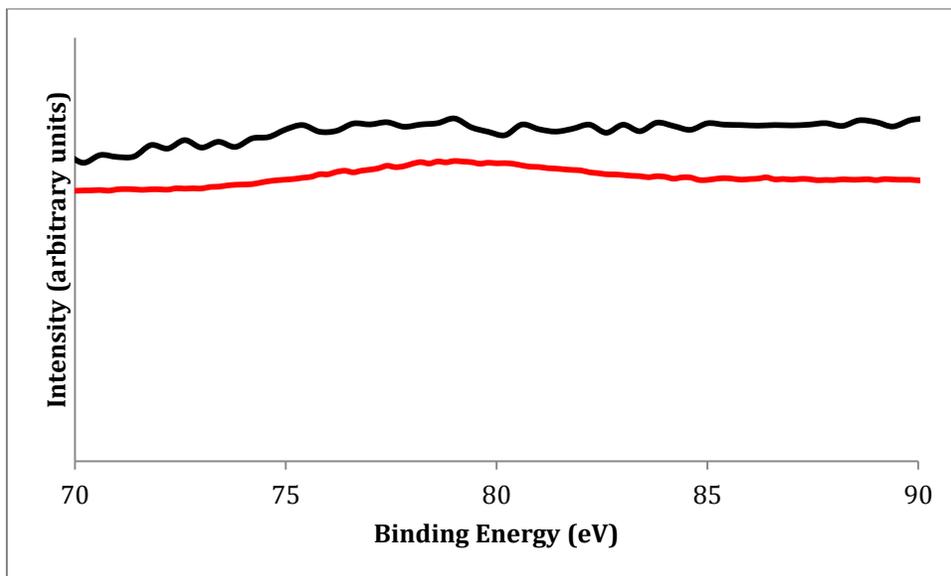


Figure S5. XPS analysis in Figure S5 shows no trace of platinum. FePc functionalized CNFs were removed from the Cu wires and transferred to glass slides for analysis. Two different spots on the sample was examined and shown as separate curves in the figure.