Supporting Information

Growth of metal-catalyst-free nitrogen-doped metallic single-wall carbon nanotubes

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Estimation of the number of electrons transferred in the oxygen reduction reaction.

For a precise estimate of the number of electrons transferred (n), we analyzed the kinetic parameters on the basis of the Koutecky–Levich equations:

\[
\frac{1}{J} = \frac{1}{J_L} + \frac{1}{J_K} = \frac{1}{B\omega^{1/2}} + \frac{1}{J_K}
\]

\[
B = 0.62nFC_0(D_0)^{2/3} \nu^{-1/6}
\]

\[
J_K = \frac{1}{nkFC_0}
\]

where \(J\) is the measured current density, \(J_K\) and \(J_L\) are the kinetic- and diffusion-limiting current densities, \(\omega\) is the angular velocity, \(F\) is the Faraday constant (\(F = 96500 \text{ C/mol}\)), \(C_0\) is the bulk concentration of O\(_2\) (\(C_0 = 1.2 \times 10^{-6} \text{ mol/cm}^3\)), \(D_0\) is the diffusion coefficient of O\(_2\) in 0.1 M KOH solution (\(D_0 = 1.9 \times 10^{-5} \text{ cm}^2/\text{s}\)), \(\nu\) is the kinematic viscosity of the electrolyte (\(\nu = 0.01 \text{ cm}^2/\text{s}\)), and \(k\) is the electron-transfer rate constant.
Figure S1. Raman spectra of the (a) N-doped and (b) un-doped SWCNTs excited with 785 nm lasers. The regions corresponding to semiconducting and the metallic transitions are labeled as S (cyan zone) and M (magenta zone). Each spectrum is normalized with respect to the 303 cm⁻¹ peak (red arrow) from the Si/SiO₂ substrate.

Figure S2. TEM images of (a) an un-doped and (b) a N-doped SWCNT. (c) Schematic showing the growth mechanism of the un-doped (upper) and N-doped (lower) SWCNTs from the SiOₓ catalyst.
Figure S3. Comparison of the ORR polarization curves of the N-doped (red line) and un-doped (blue line) SWCNTs in O₂ saturated 0.1M KOH at 1600 rpm.
Figure S4. (a, c) CV curves and (b, d) current response curves of the (a, b) N-doped and (c, d) un-doped SWCNTs in PBS solutions containing different concentrations of AA.

Figure S5. CV curves of (a) the N-doped and un-doped SWCNTs in a 0.025 M PBS (PH 6.9) solution saturated with Ar and (b) un-doped SWCNTs in PBS containing different concentrations of DA at a rate of 50 mV/s.
Reference: