Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

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

Jin-Cheng Li[§], *Peng-Xiang Hou*[§], *Li-Li Zhang*, *Chang Liu*,* *Hui-Ming Cheng*

Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016, PR China

[§]These authors are equal major contributors

Corresponding Author: cliu@imr.ac.cn (C. Liu)

SI1.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[1]:

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

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

$$J_K = \frac{1}{nkFC_0}$$

where J is the measured current density, J_K and J_L are the kinetic- and diffusion-limiting current densities, ω is the angular velocity, F is the Faraday constant ($F = 96500$ C/mol), C_0 is the bulk concentration of O_2 ($C_0 = 1.2\times10^{-6}$ mol/cm^3), D_0 is the diffusion coefficient of O_2 in 0.1 M KOH solution ($D_0 = 1.9\times10^{-5}$ cm^2/s), ν is the kinematic viscosity of the electrolyte (ν=0.01 cm^2/s), and k is the electron-transfer rate constant.

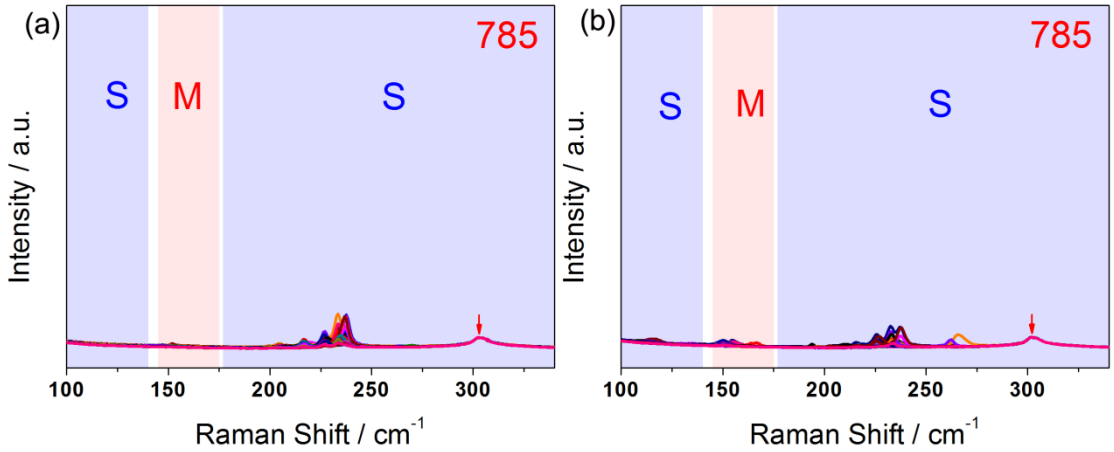

Figure S1.Raman spectra of the (a) N-doped and (b) un-doped SWCNTs excited with 785 nm lasers. The regions corresponding to semiconducting and the metallic transitions are labeled as S (cyan zone) and M (magenta zone). Each spectrum is normalized with respect to the 303 cm^{-1} peak (red arrow) from the Si/SiO_2 substrate.

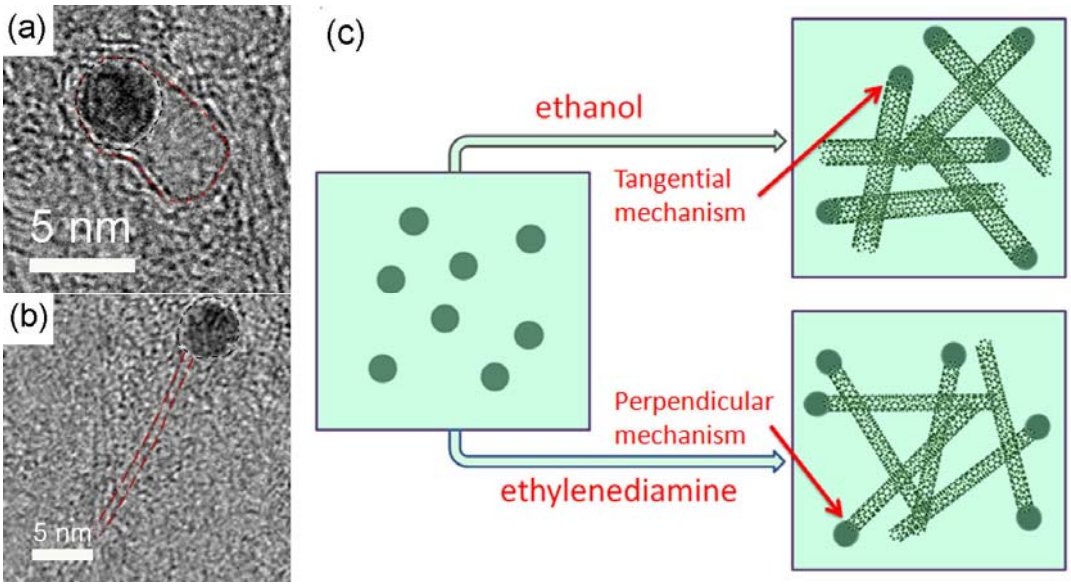

Figure S2. TEM images of (a) an un-doped and (b) a N-doped SWCNT. (c) Schematic showing the growth mechanism of the un-doped (upper) and N-doped (lower) SWCNTs from the SiO_x catalyst.

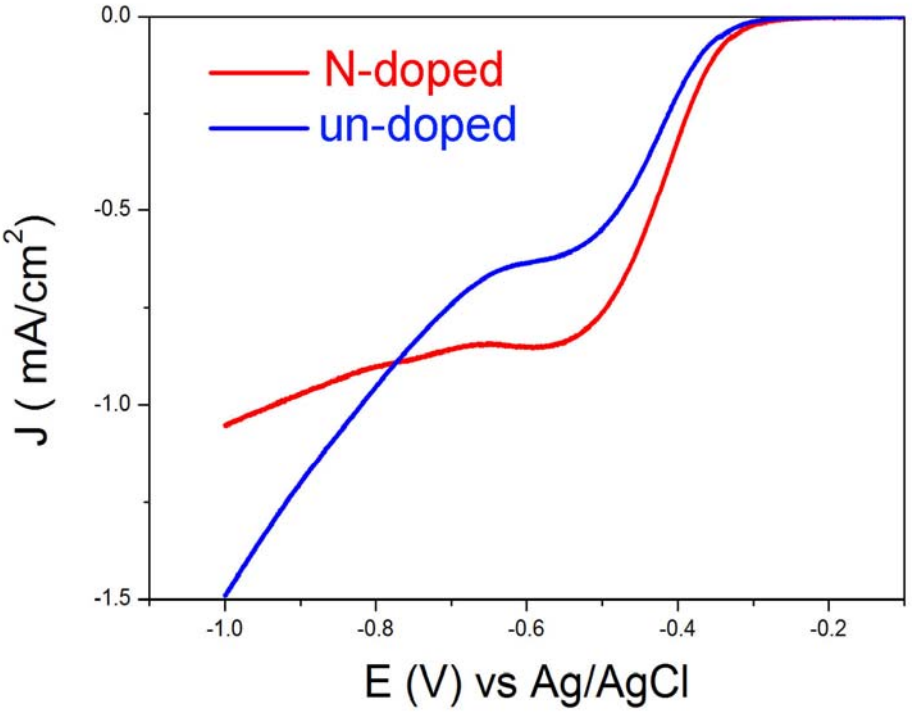

Figure S3. Comparison of the ORR polarization curves of the N-doped (red line) and un-doped (blue line) SWCNTs in O_2 saturated 0.1M KOH at 1600 rpm.

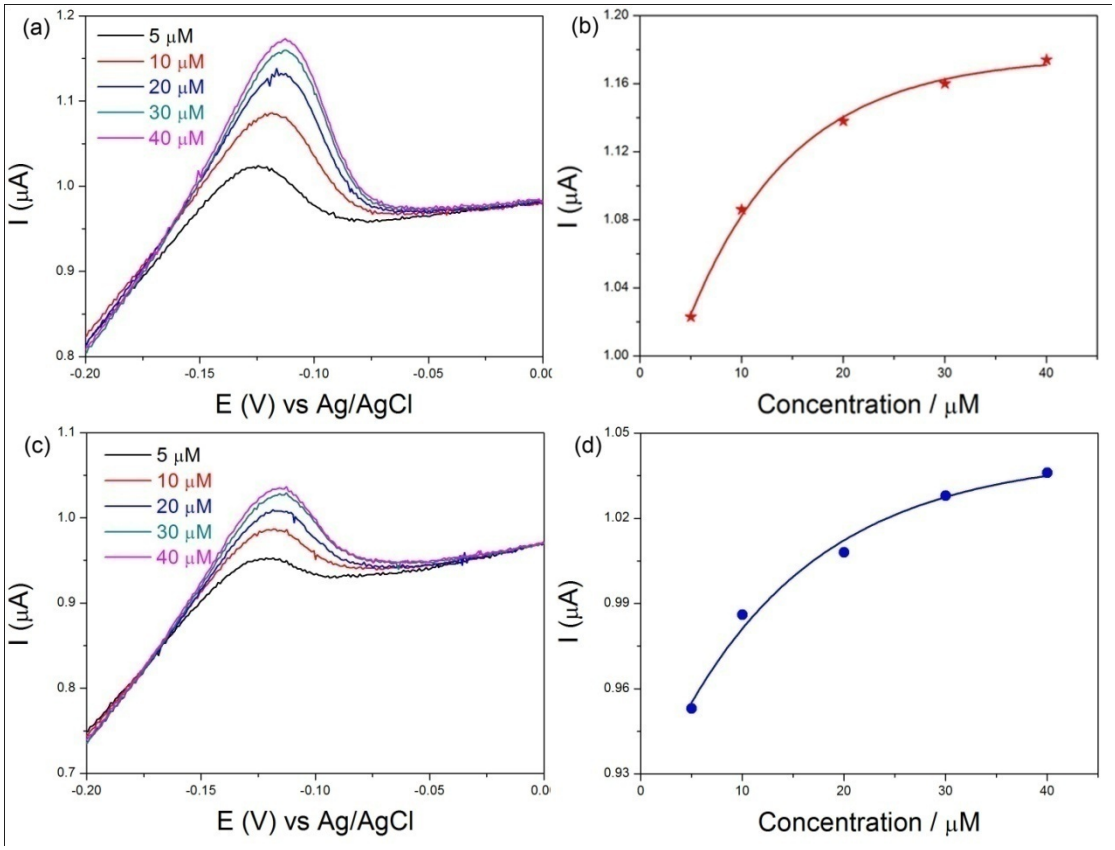

Figure S4. (a, c) CV curves and (b, d) current response curves of the (a, b) N-doped and (c, d) un-doped SWCNTs in PBS solutions containing different concentrations of AA.

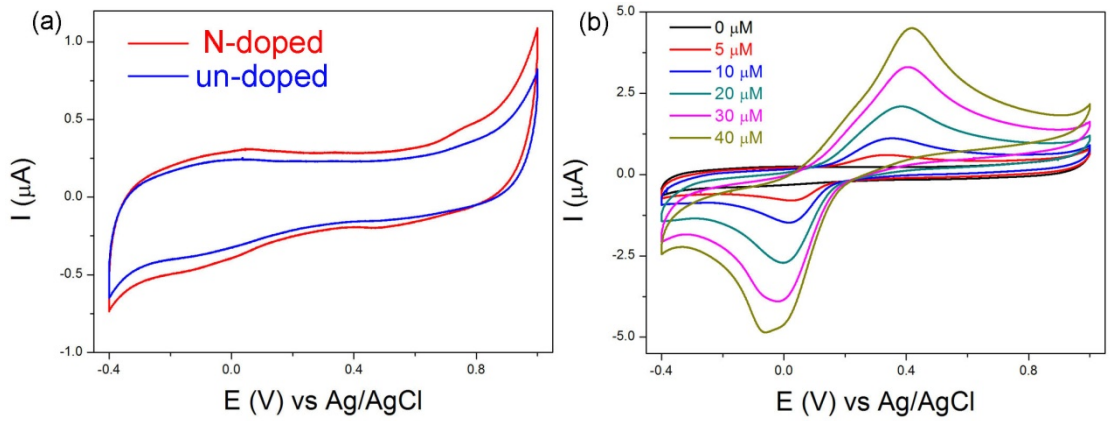

Figure S5. CV curves of (a) the N-doped and un-doped SWCNTs in a 0.025 M PBS (PH 6.9) solution saturated with Ar and (b) un-doped SWCNTs in PBS containing different concentrations of DA at a rate of 50 mV/s.

Reference:

1. Zheng, Y.; Jiao, Y.; Chen, J.; Liu, J.; Liang, J.; Du, A.; Zhang, W.; Zhu, Z.; Smith, S. C.; Jaroniec, M.; Lu, G. Q.; Qiao, S. Z., Nanoporous Graphitic-C3N4@Carbon Metal-Free Electrocatalysts for Highly Efficient Oxygen Reduction. *Journal of the American Chemical Society* **2011,** *133* (50), 20116-20119.