

## Supporting Information

# N-Dopant-Mediated Growth of Metal Oxide Nanoparticles on Carbon Nanotubes

Jin Ah Lee <sup>1,2,3</sup>, Won Jun Lee <sup>1,2,3,4</sup>, Joonwon Lim <sup>1,2,3,5,\*</sup> and Sang Ouk Kim <sup>1,2,3</sup>

<sup>1</sup> National Creative Research Initiative Center for Multi-Dimensional Directed Nanoscale Assembly, KAIST, Daejeon 34141, Korea; lja0508@naver.com (J.A.L.); wjlee@dankook.ac.kr (W.J.L.); sangouk.kim@kaist.ac.kr (S.O.K.)

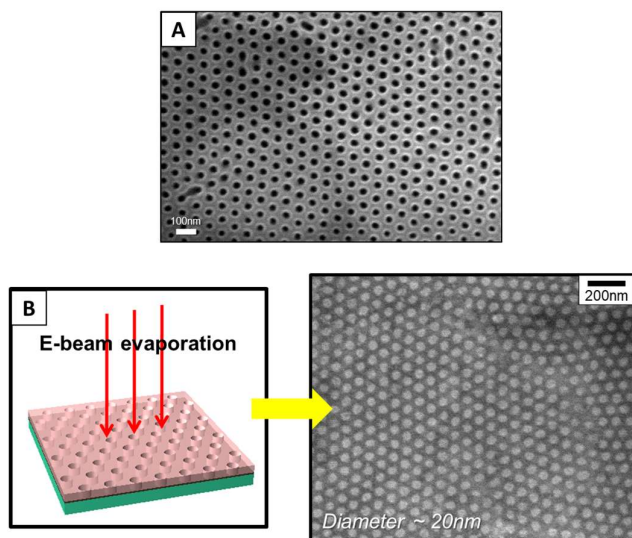
<sup>2</sup> Department of Materials Science and Engineering, KAIST, Daejeon 34141, Korea

<sup>3</sup> KAIST Institute for Nanocentury, KAIST, Daejeon 34141, Korea

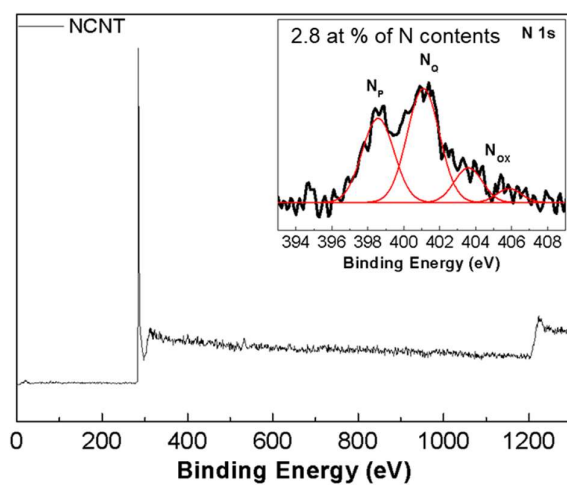
<sup>4</sup> Department of Fiber System Engineering, Dankook University, Yongin-si 16890, Korea

<sup>5</sup> Department of Information Display, Kyung Hee University, Seoul 02447, Korea

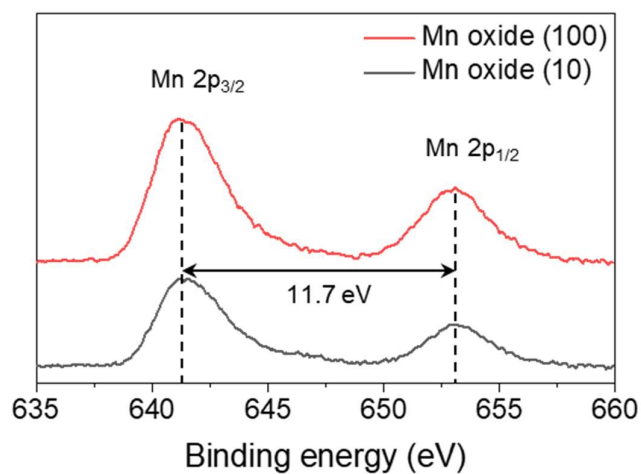
\* Correspondence: joonwon.lim@khu.ac.kr



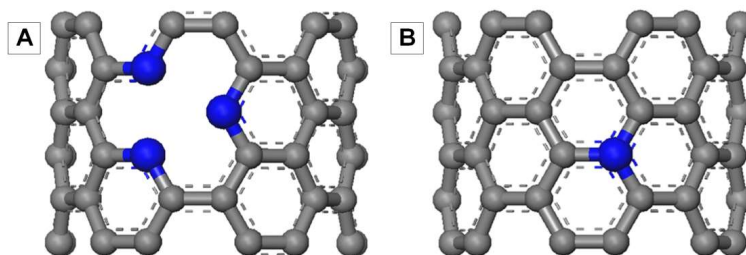
**Figure S1.** Preparation of Fe catalysts using PS-*b*-PMMA nanotemplates (A) PS-*b*-PMMA cylinder type block copolymer template after the removal of PMMA core. (B) Hexagonally packed Fe catalyst arrays prepared by E-beam evaporation with PS-*b*-PMMA nanotemplate in (A).



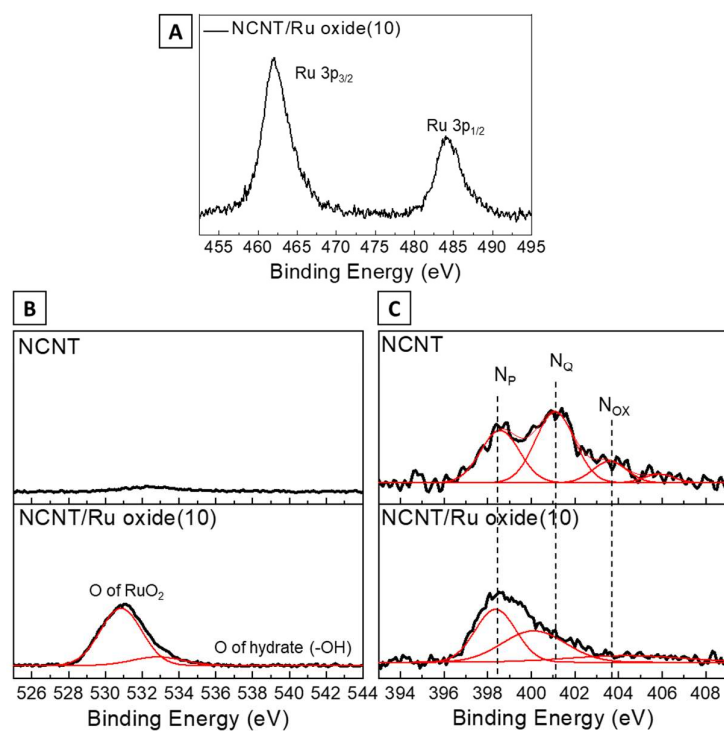
**Figure S2.** Survey scan and N 1s XPS spectra of NCNTs



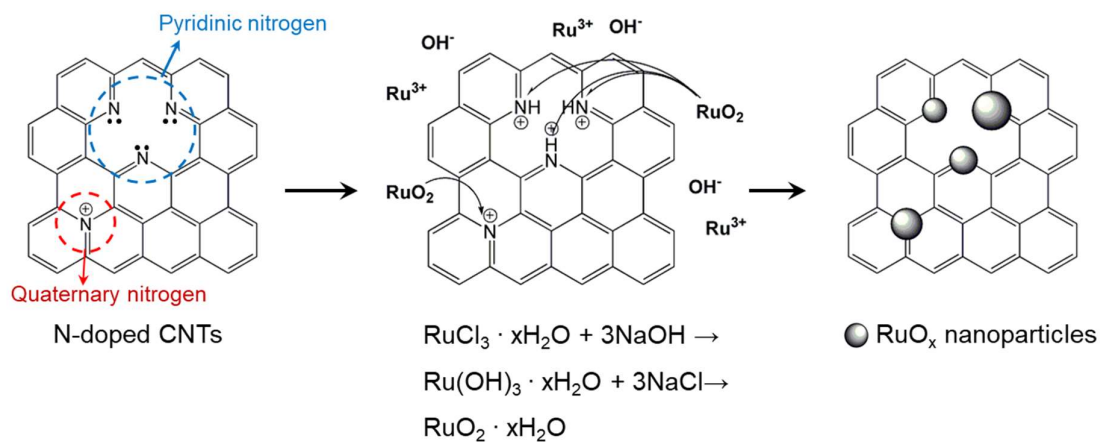
**Figure S3.** Mn 2p XPS Spectrum of Mn oxide (100)/NCNT and Mn oxide (10)/NCNT. The number in parentheses indicates the molar concentration of KMnO<sub>4</sub> in a Mn precursor solution used for hybridization process.



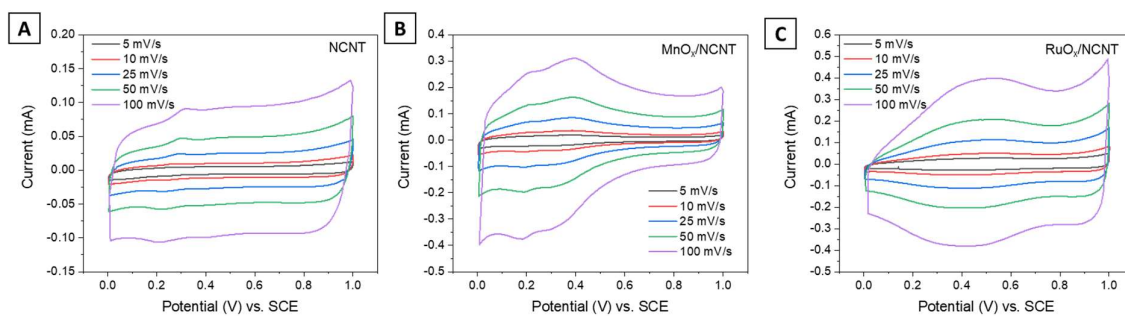
**Figure S4.** Chemical configuration of nitrogen dopants in NCNT. (A) Pyridinic nitrogen (N<sub>P</sub>), (B) Quaternary nitrogen (N<sub>Q</sub>)



**Figure S5.** XPS analysis of RuO<sub>x</sub>/NCNT hybrids.



**Figure S6.** Schematic diagram of the nucleation of RuO<sub>x</sub> nanoparticles at N<sub>Q</sub> or N<sub>P</sub> dopant sites in NCNT



**Figure S7.** Electrochemical characterization. (A–C) Cyclic voltammograms at various scan rates of NCNT, MnO<sub>x</sub>/NCNT and RuO<sub>x</sub>/NCNT. The cathodic peak at 0.2 V vs. SCE in (A) originates from the redox reaction of residual Fe elements used as a catalyst for NCNT growth.