Electronic Supplementary Material (ESI) for RSC Advances


# Supporting Information

## All carbon nanotube and free standing air electrodes for rechargeable Li-air batteries

**Hui Wang,*[a] Kai Xie[a] , Linyan Wang and Yu Han[a]**

[a] *Department of Material Engineering and Applied Chemistry, National University of Defense Technology, Changsha, 410073, P.R. CHINA*

*E-mail: wanghuichn1234@gmail.com*

**NMP-based electrolytes:** 0.1 M electrolytes were prepared by mixing N-methyl-2-pyrrolidone (Sigma-Aldrich, battery grade, $H_2O$<10 ppm) with lithium perchlorate ($LiClO_4$, battery grade >99.9%, Sigma-Aldrich). The electrolytes were prepared and stored in a glove box, where the moisture and oxygen content was less than 1 ppm.

**Li-air cell assembling and characterization** Li-$O_2$ cells were constructed as reported in our previously published work. A lithium foil, two celgard 2500 separators, and an all MWCNTs electrode were placed in turn into a custom-designed cell (Fig S1), then about 50 μL electrolyte solution was added. Cells were cycled on a Land cycler (Wuhan Land Electronic Co. Ltd.) within a voltage range from 2.0 V to 4.0 V (vs. $Li^+$/Li) at a constant current density. All tests are carried under 1 atm pure $O_2$ pressure at 25 ℃. X-ray photoemission spectroscopy (XPS) measurements were performed on a K-Alpha 1063 (Thermo Fisher Scientific) spectrometer with monochromatic Al-Kα as the excitation source. $N_2$ adsorption-desorption data was collected using a QuadraSorb SI (Quantachrome) automated gas sorption system. The pore distribution was evaluated by the Density Functional Theory (DFT) methods. The cycled cells were disassembled in an Ar-filled glove box and the cathodes were rinsed twice with dimethoxyethane (DME) and then dried under an Ar atmosphere. The morphologies of pristine and cycled electrodes were observed by using a Hitachi S-4800 filed emission scanning electron microscope (SEM). The Raman spectra of the cathodes were collected on a Bruker SENTERRA Raman spectrometer. The 532 nm line from a Krypton laser with a power of 20 mW is used as the excitation source.

Fig. S1 Photo of custom-designed cell