Electronic Supplementary Information (ESI)

Rechargeable Li-CO_2 batteries with carbon nanotubes as air cathodes

Xin Zhang, Qiang Zhang, Zhang Zhang, Yanan Chen, Zhaojun Xie, Jinping Wei, Zhen Zhou*

Tianjin Key Laboratory of Metal and Molecule Based Material Chemistry, Key Laboratory of Advanced Energy Materials Chemistry (Ministry of Education), Institute of New Energy Material Chemistry, Collaborative Innovation Center of Chemical Science and Engineering (Tianjin), School of Materials Science and Engineering, National Institute of Advanced Materials, Nankai University, Tianjin 300071, China

Experimental Section

Material Characterization: CNTs were purchased from J&K. Field emission SEM (FESEM) images were obtained on a JEOL-JSM 7500 microscope. HRTEM and EELS were conducted on a FEI Tecnai G2F20 field emission TEM. FTIR spectroscopy was collected with a Nicolet MAGNA-560 spectrometer. XRD was performed to characterize the discharge and charge products on a D/MAX III diffractometer with Cu Kα radiation

Cell Assembles and Electrochemical Tests: The cathodes were prepared as follows. A slurry containing 90 wt. % CNTs and 10 wt.% PVDF was mixed and then uniformly spread on the carbon paper. The electrochemical performances were evaluated in Swagelok-type cells. The cells were assembled in a glove box filled with high-purity argon (O_2 and H_2O < 1 ppm). The cells composed of lithium metal anodes,

ploytetrafluoroethylene (PTFE) separators, and CNTs cathodes. The electrolyte composed of 1 mol L^{-1} LiTFSI dissolved in TEGDEM. Electrochemical measurements were performed on the LAND-CT2001A tester at room temperature. EIS was also performed for the assembled Li-CO_2 cells at different discharge-charge stages under an electrochemical workstation (Zahner Elektrik IM6e) in a frequency window between 100 kHz and 10 mHz.

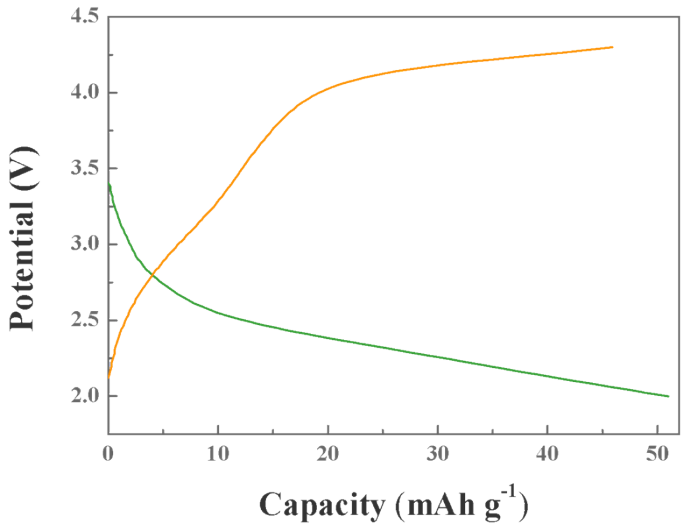

Fig. S1 Discharge-charge curves of Li-CO_2 batteries with Ar as the working gas.

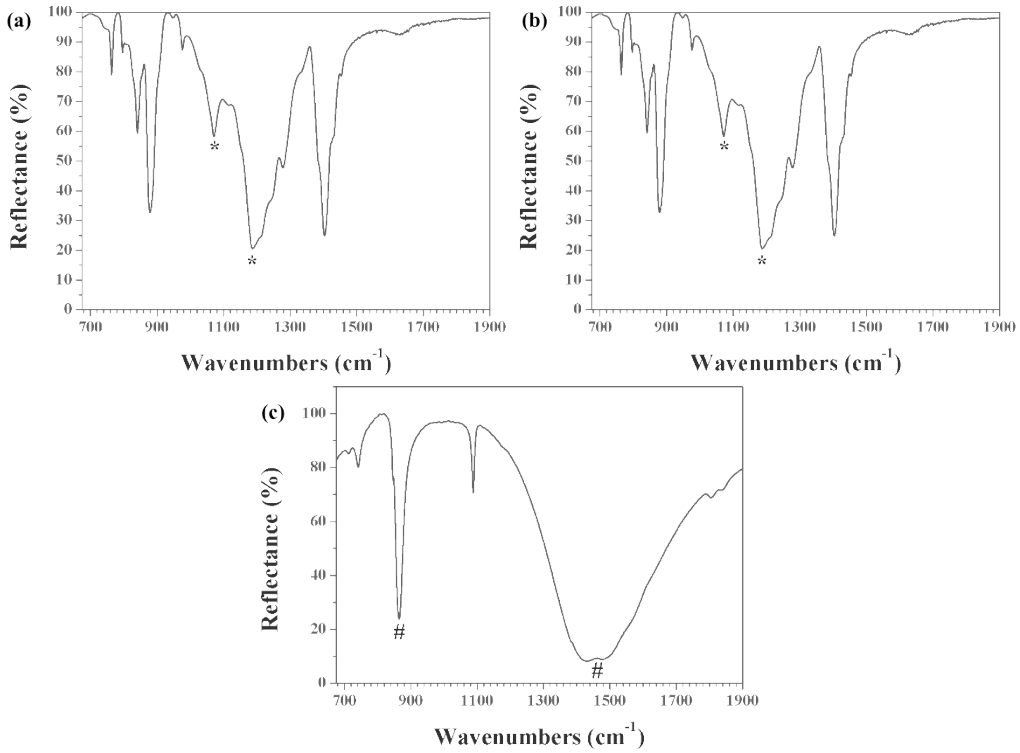

Fig. S2 FTIR spectra of (a) PVDF, (b) LiTFSI/TEGDME and (c) Li_2CO_3.

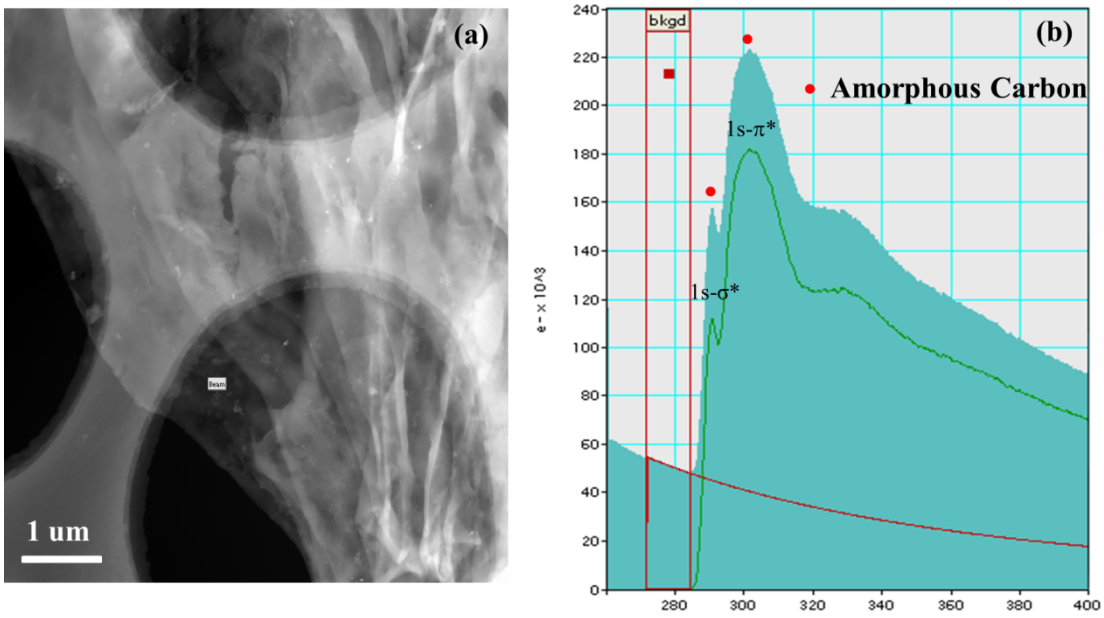

Fig. S3 (a) TEM and (b) EELS of discharge product of Li/CO_2 batteries with platinum net cathodes in the first discharge state.

Table S1 Summary of electrochemical performance of Li-CO_2 batteries with different cathodes at room temperature.

Cathode	Maximum capacity	Cyclability	Ref
Super P	~0 mAh g^{-1}	/	[16]
High surface area carbon	~750 mAh g^{-1}	/	[16]
KB	1032 mAh g^{-1}	7 cycles at 30 mA g^{-1}	[17]
Graphene	14772 mAh g^{-1}	20 cycles at 50 mA g^{-1}	[22]
Carbon nanotubes	8379 mAh g^{-1}	29 cycles at 50 mA g^{-1}	This work