Electronic Supplementary Information (ESI)

Electrochemical properties of graphene flake as an air cathode material for Li–O_2 batteries in an ether-based electrolyte

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Supporting Information

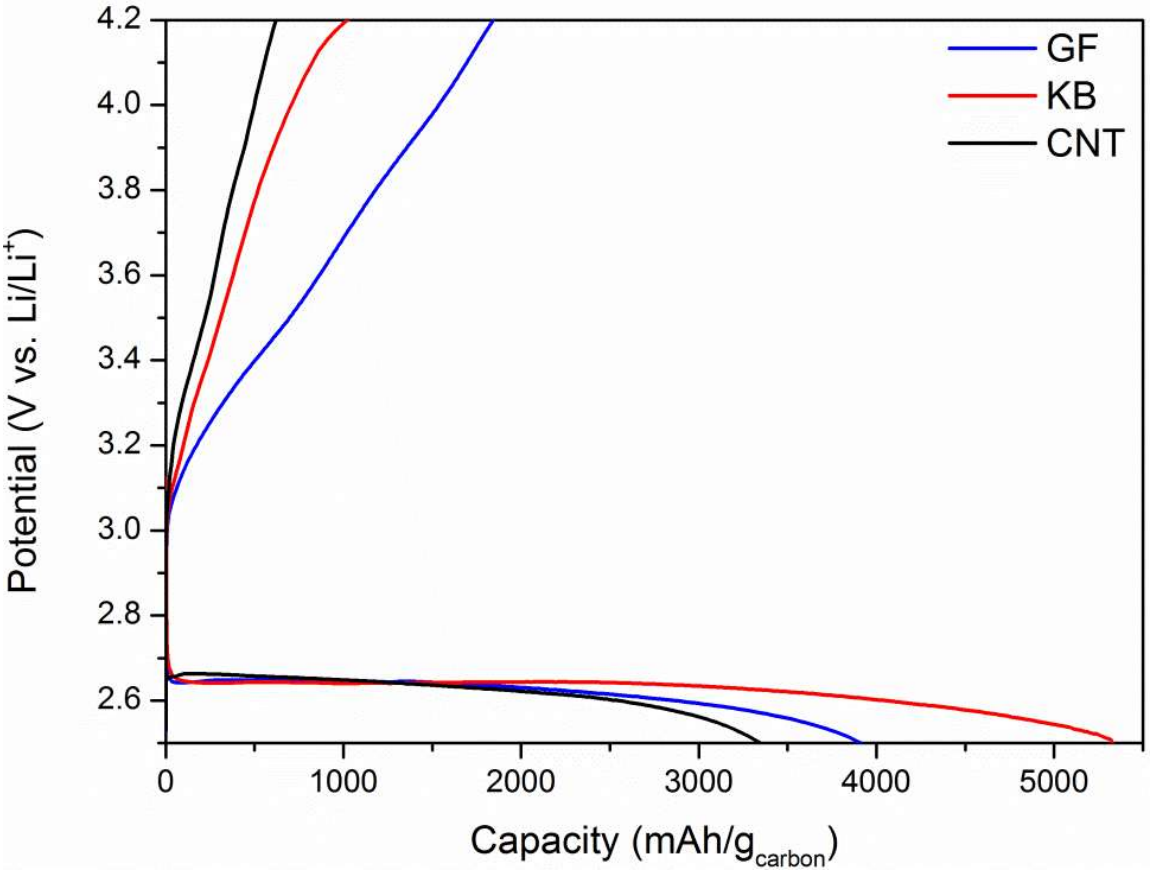

Fig. S1 Potential profiles of (a) GF, (b) KB, and (c) CNT–air cathodes for the first deep discharge/charge at 0.4 mA/cm^2

Fig. S1 shows the first discharge/charge profiles of the three carbon–air electrodes examined. The GF–air cathode showed a discharge onset potential of 2.7 V for ORR and a charge onset potential of 3.0 V for OER. The first discharge/charge capacities are 3914 mAh/g_{carbon} and 1855 mAh/g_{carbon}, respectively, with a Coulombic efficiency of 47%. The KB–air cathode showed discharge and charge capacities of 5330 mAh/g_{carbon} and 1152 mAh/g_{carbon}, respectively, with a Coulombic efficiency of 21.7%. The CNT–air cathode showed discharge and charge capacities of 3346 mAh/g_{carbon} and 682 mAh/g_{carbon}, respectively, with a Coulombic efficiency of 20.7%. Among the three carbon materials tested as an air-cathode material, KB showed the highest discharge capacity. This might be attributed to the larger BET surface area compared to that of GF or CNT. However, GF showed the highest Coulombic efficiency.

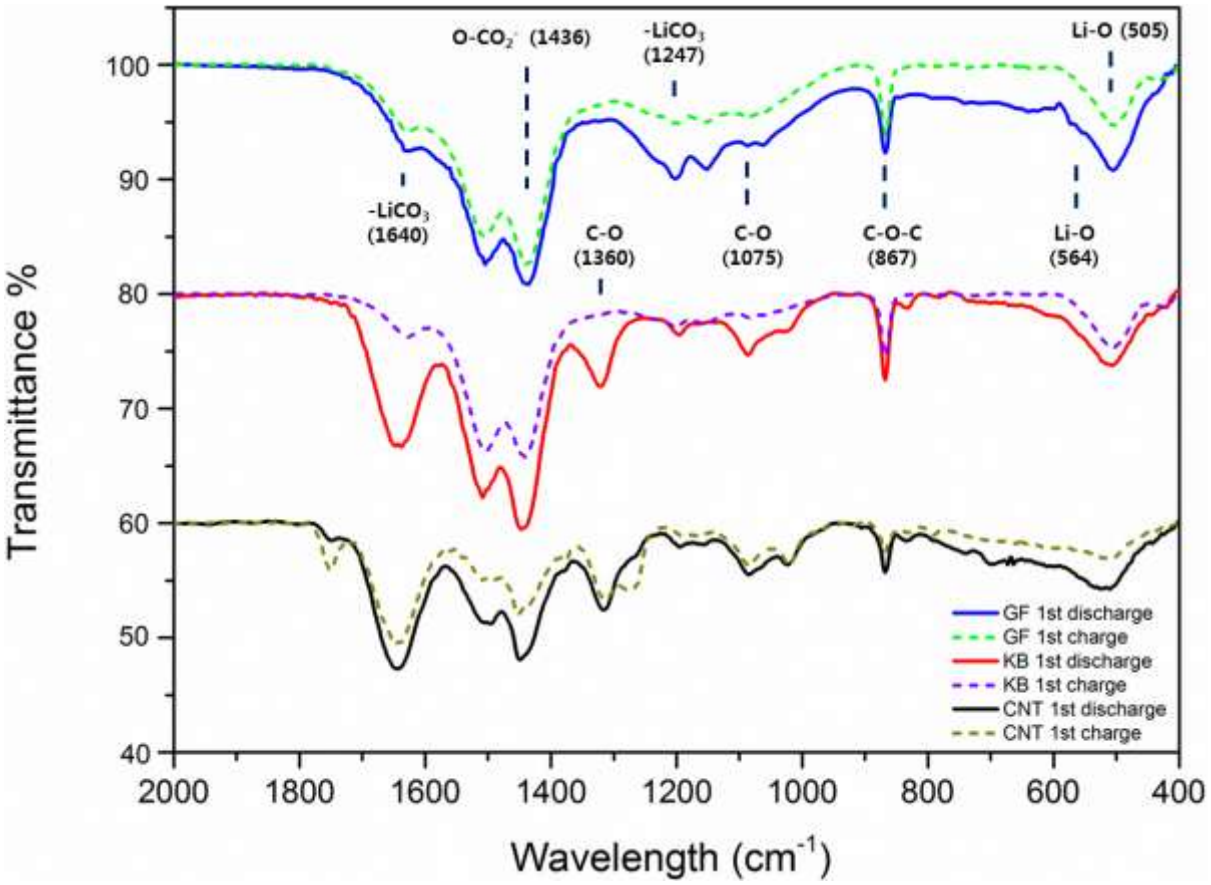

Fig. S2 FT-IR spectra of the carbon–air cathodes after first discharge and charge processes. The discharge capacity was controlled at 1280 mAh/g_{carbon} in the potential range of 2.5–4.2 V (*vs.* Li/Li^+) at 0.4 mA/cm^2.

Fig. S2 compares the FT-IR spectra of GF, KB, and CNT–air cathodes after the first discharge and subsequent first charge processes. After the first discharge for the GF–air cathode, a peak appeared around 505 cm^{-1} and 564 cm^{-1} (Li–O), corresponding to Li_2O_2 and Li_2O, respectively. The formation of Li_2CO_3 was confirmed by the presence of peaks at 1640 cm^{-1} (–$LiCO_3$), 1436 cm^{-1} (O–CO_2^-), 1315 cm^{-1} (C–O), and 867 cm^{-1} (C–O–C). Upon the subsequent charge, the intensities of the peaks from the discharge products decreased but did not completely disappear, indicating that discharge products could not be completely removed during the charge. The FT-IR spectra of KB and CNT–air cathodes indicate the formation of the same discharge products after the first discharge. As for KB and CNT, decrease in the peak intensities of LiO_2 and Li_2O_2 at around 505 cm^{-1} and 564 cm^{-1} (Li–O), respectively, after the first charge was clearly less than that for GF, which indicates that removal of the discharge products were more effective for GF.