Electronic Supplementary Material (ESI) for Energy & Environmental Science.

On Rechargeability and Reaction Kinetics of Sodium-Air Batteries

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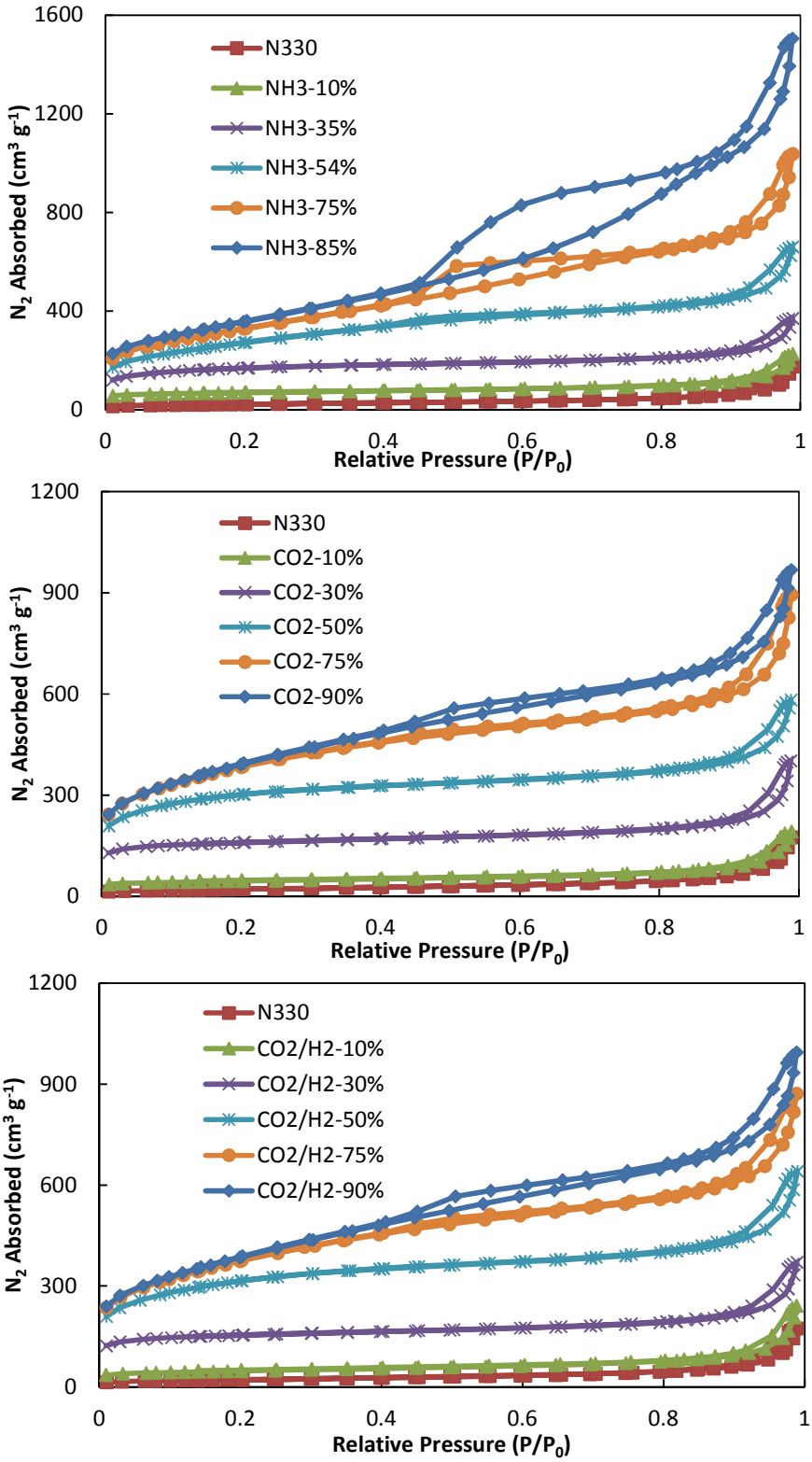

Figure S1: Nitrogen adsorption/desorption isotherms of different heat-treated carbon materials under (a) NH_3; (b) CO_2 and (C) CO_2/H_2 atmospheres with various mass losses.

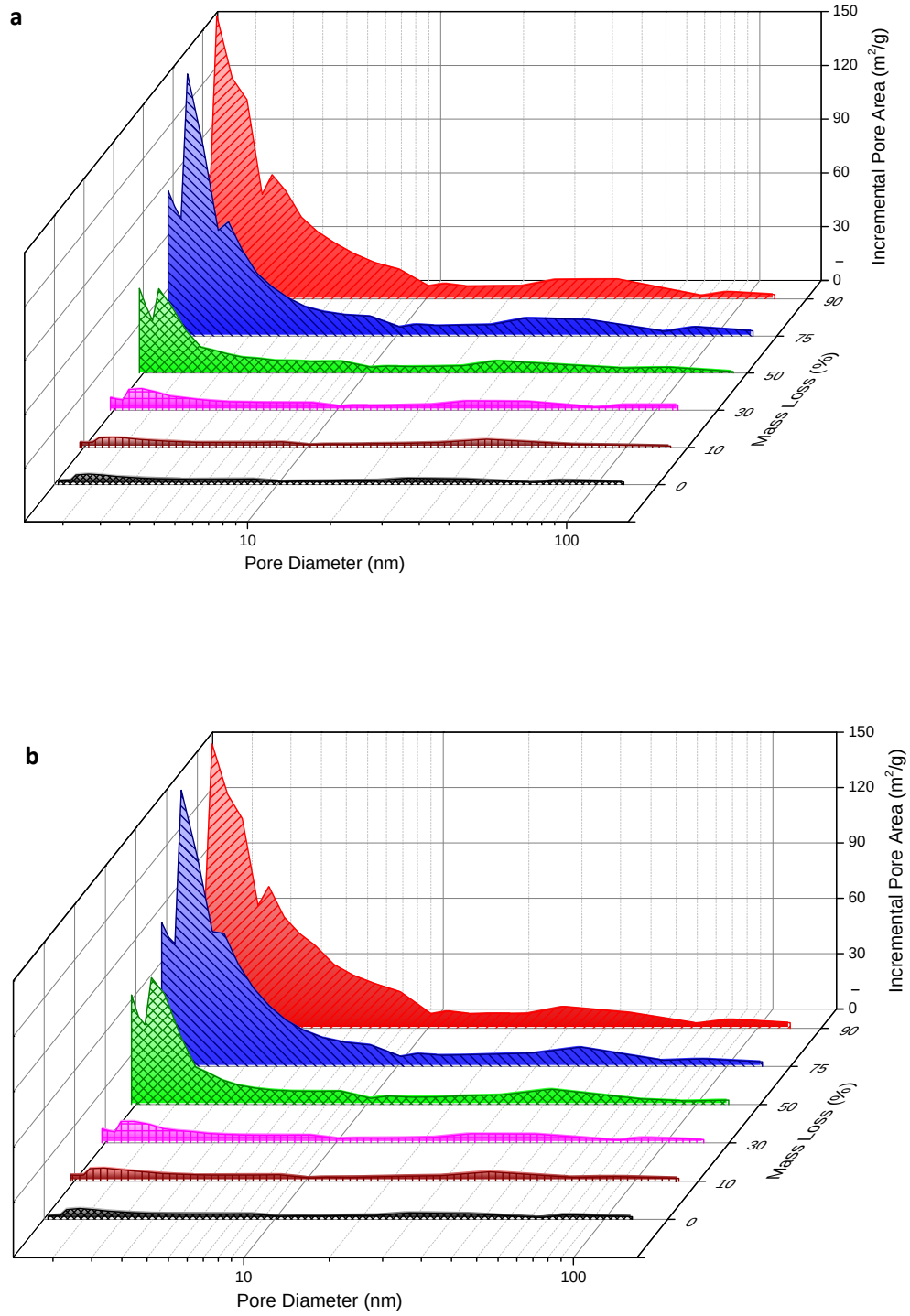

Figure S2: Pore size distribution plots for (a) CO_2- and (b) CO_2/H_2-treated carbon materials with different mass losses from 0 to 90%.

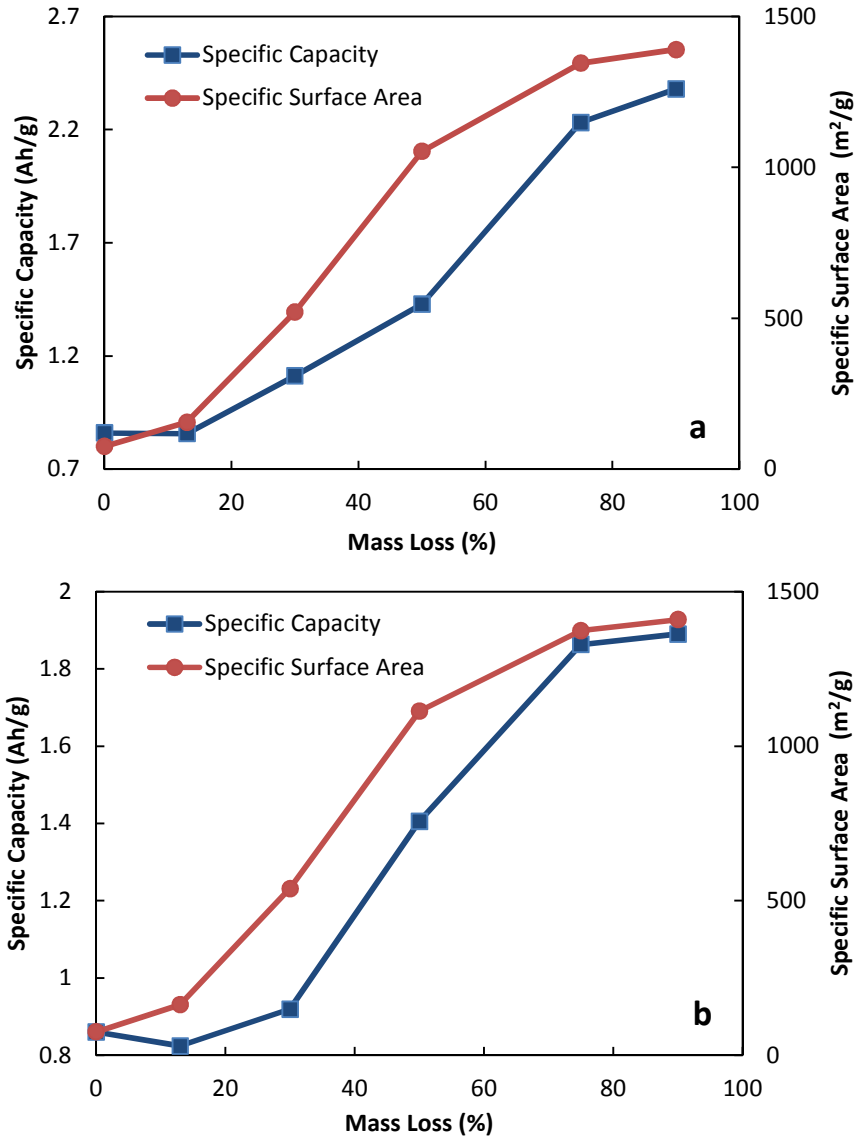

Figure S3: Plots of specific capacitance and specific surface area of the cathode electrode materials of the cells using (a) CO_2- and (b) CO_2/H_2-treated carbon materials as a function of mass loss.

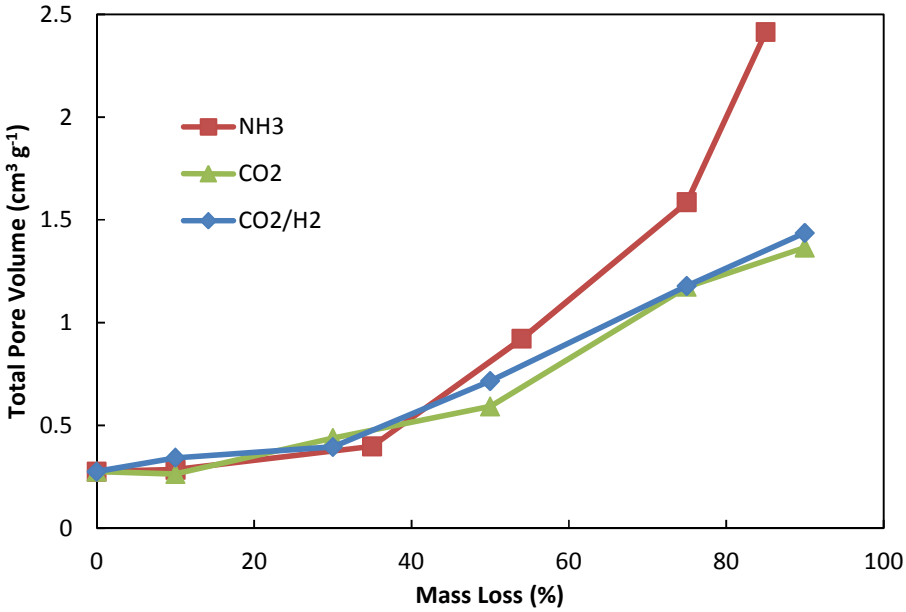

Figure S4: Total pore volume of different heat-treated carbon materials under NH_3; CO_2 and CO_2/H_2 atmospheres plotted versus mass losses.

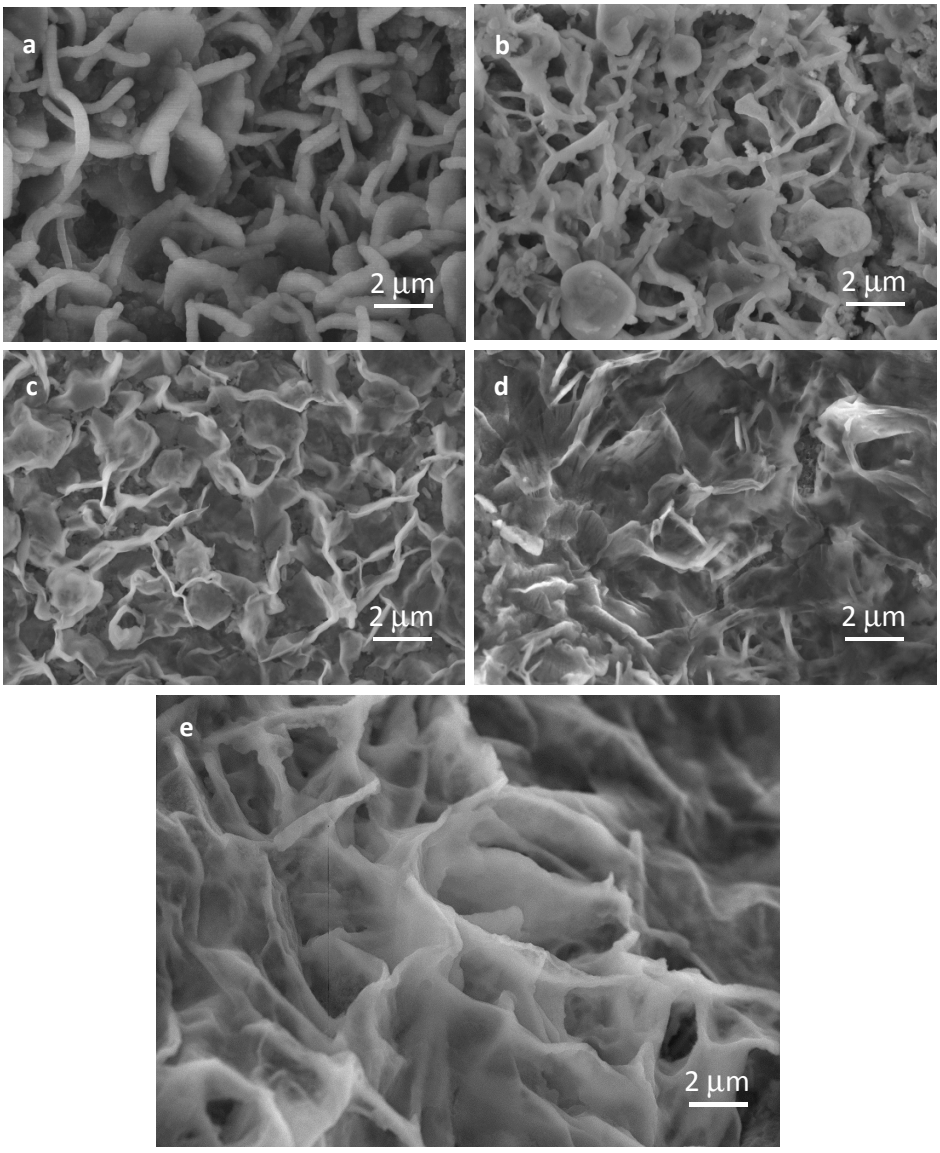

Figure S5: Morphology of discharge products of the Na-O_2 cells using different CO_2-treated carbon materials with 10 (a), 30 (b), 50 (c), 75 (d) and 90% (e) mass losses as cathode electrode.

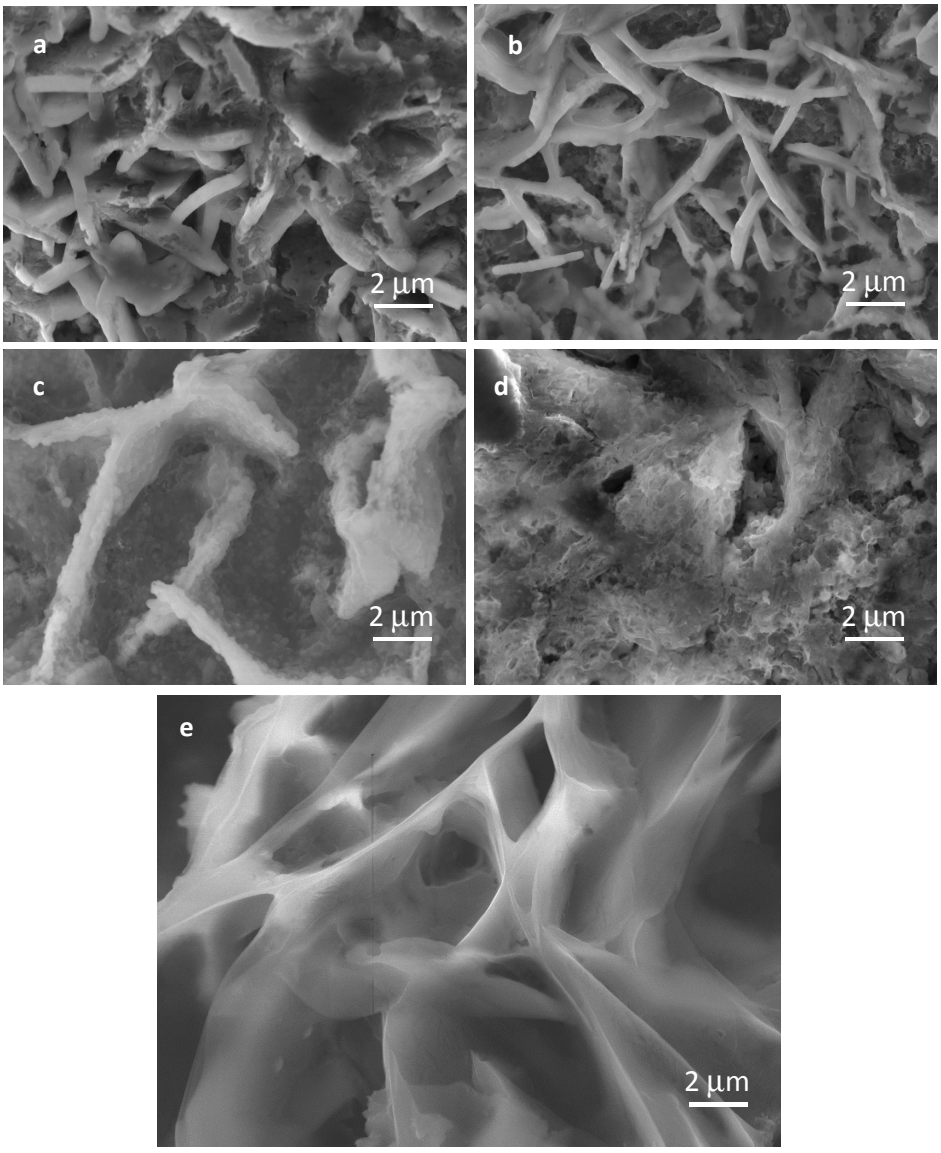

Figure S6: Morphology of discharge products of the Na-O_2 cells using different CO_2/H_2-treated carbon materials with 10 (a), 30 (b), 50 (c), 75 (d) and 90% (e) mass losses as cathode electrode.

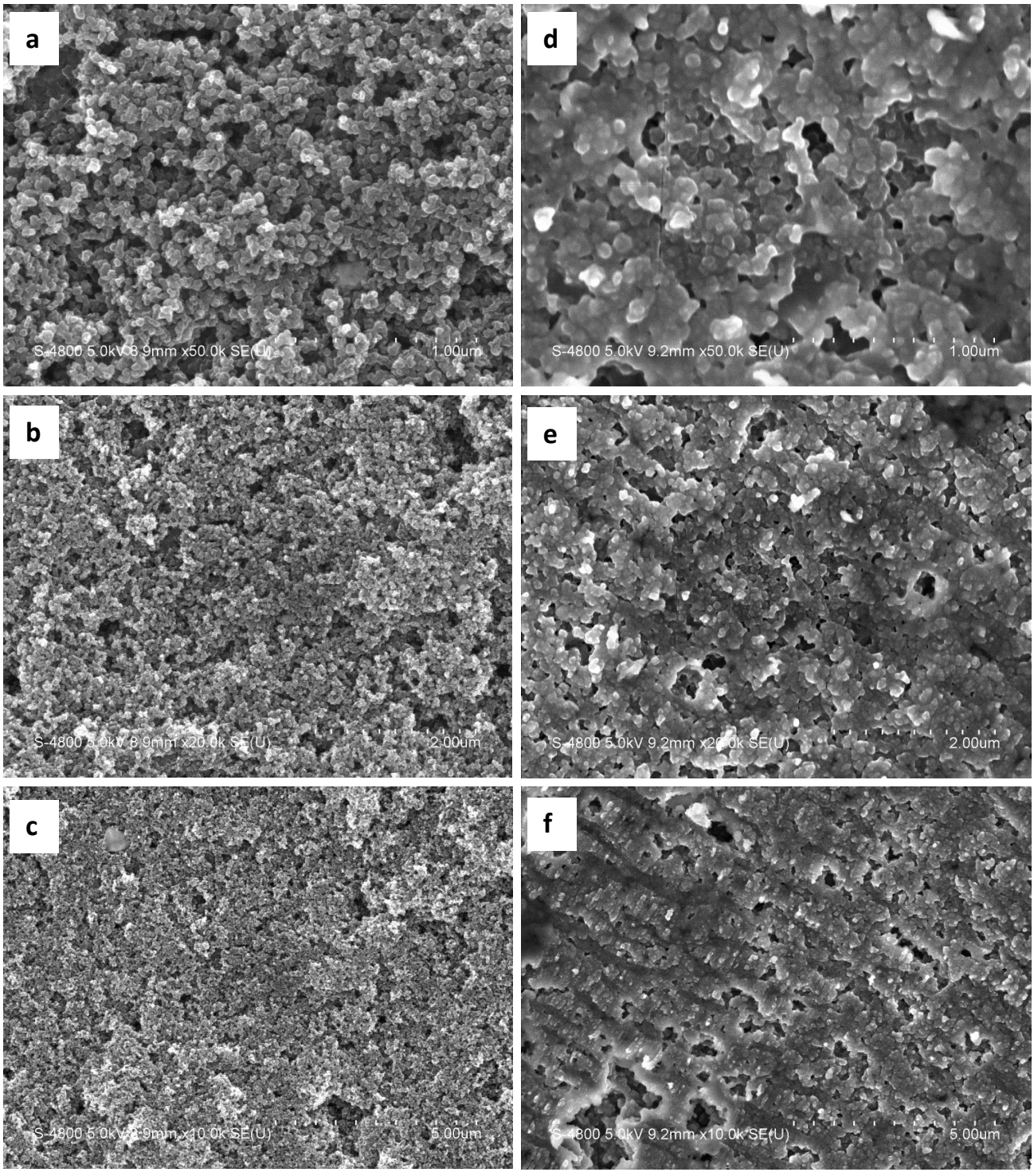

Figure S7: SEM micrographs of carbon (NH_3-heat treated with 85% mass loss) electrode before discharge (a-c) and after charge (d-f) with different magnifications.

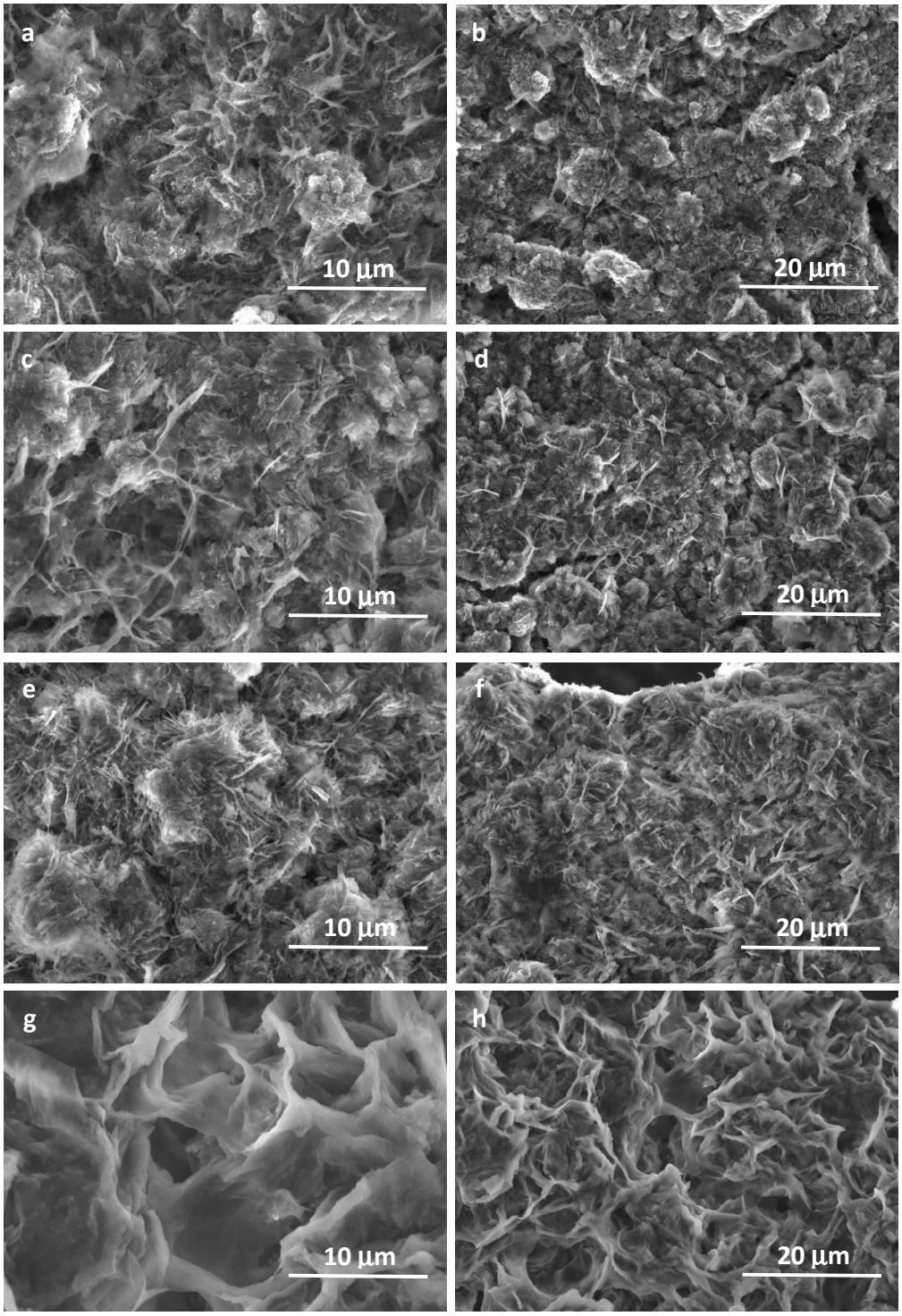

Figure S8: SEM micrographs with different magnifications of discharge products of the Na-O_2 cell using NH_3-treated carbon material with 85% mass loss as cathode electrode after 8 (a, b), 16 (c, d), 24 (e, f) and 36 (g, h) hours of discharge.

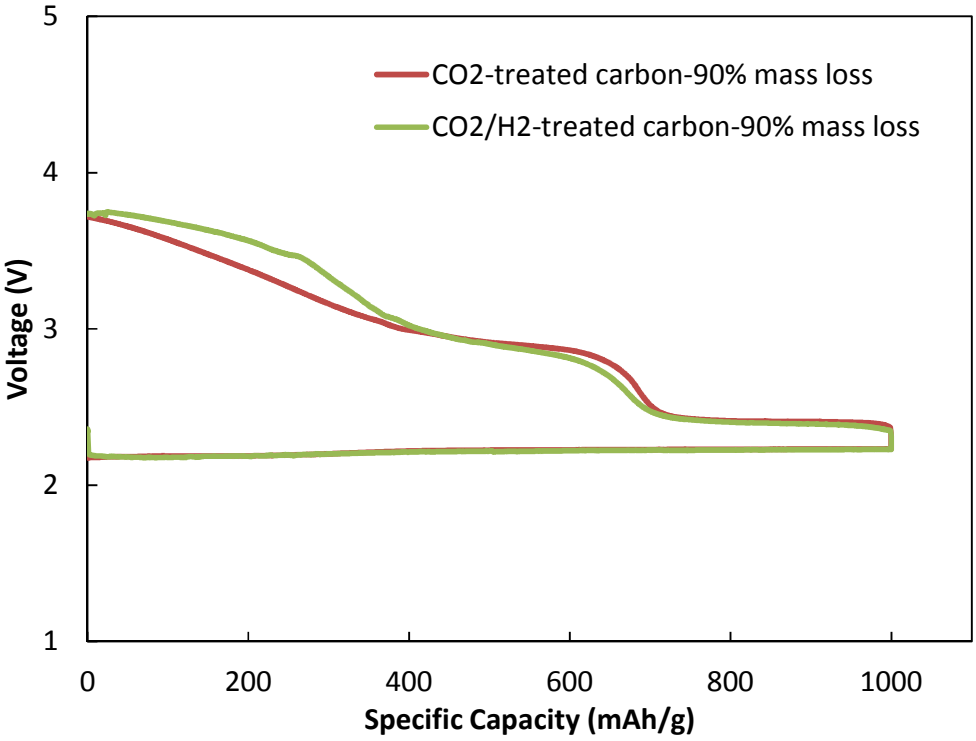

Figure S9: Limited discharge and charge curves of Na-O_2 cells using CO_2- and CO_2/H_2-treated carbon materials with 90% mass loss as cathode electrode.

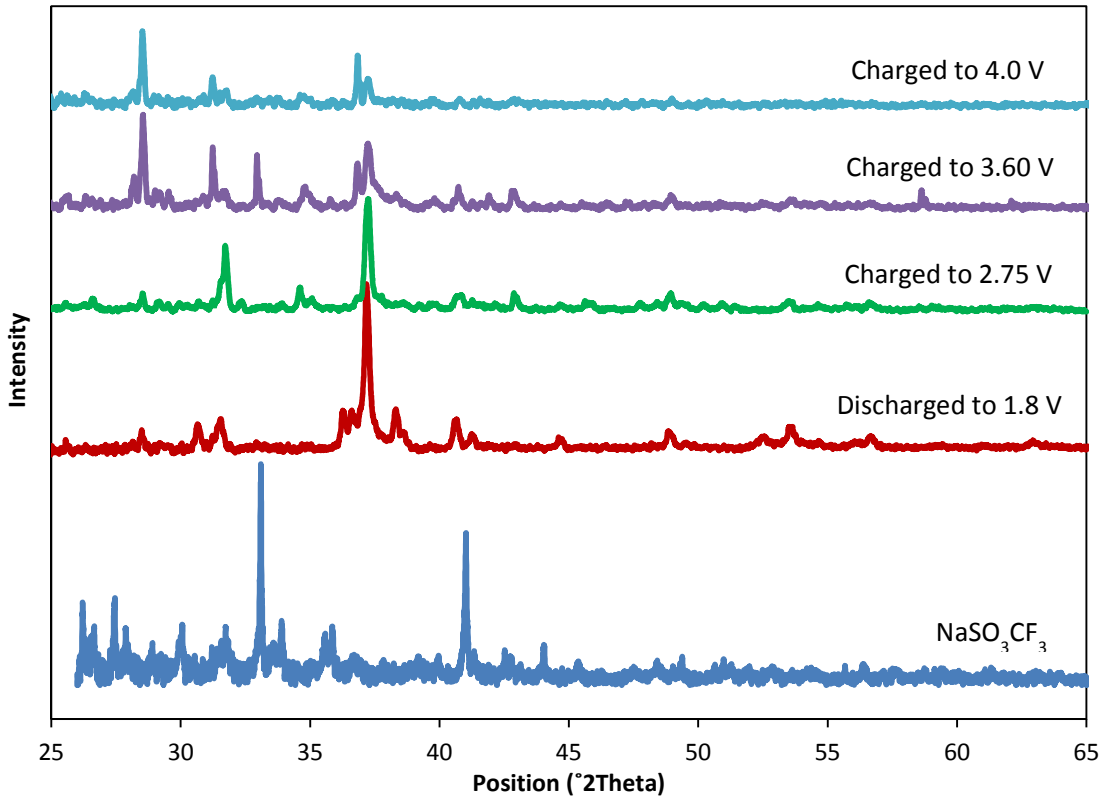

Figure S10: XRD patterns of positive electrode after discharge of the Na-air cell to 1.8 V and also after charge to 2.75, 3.60 and 4.0 V (corresponding to the various charging steps indicated in Fig. 6a). The XRD pattern of $NaSO_3CF_3$ is also presented for comparison purposes.

Appearance of new peaks at 28.8˚ and 31.2˚ in the cathodes charged to 3.6 and 4.0 V might be related to the decomposition products of electrolyte salt ($NaSO_3CF_3$).

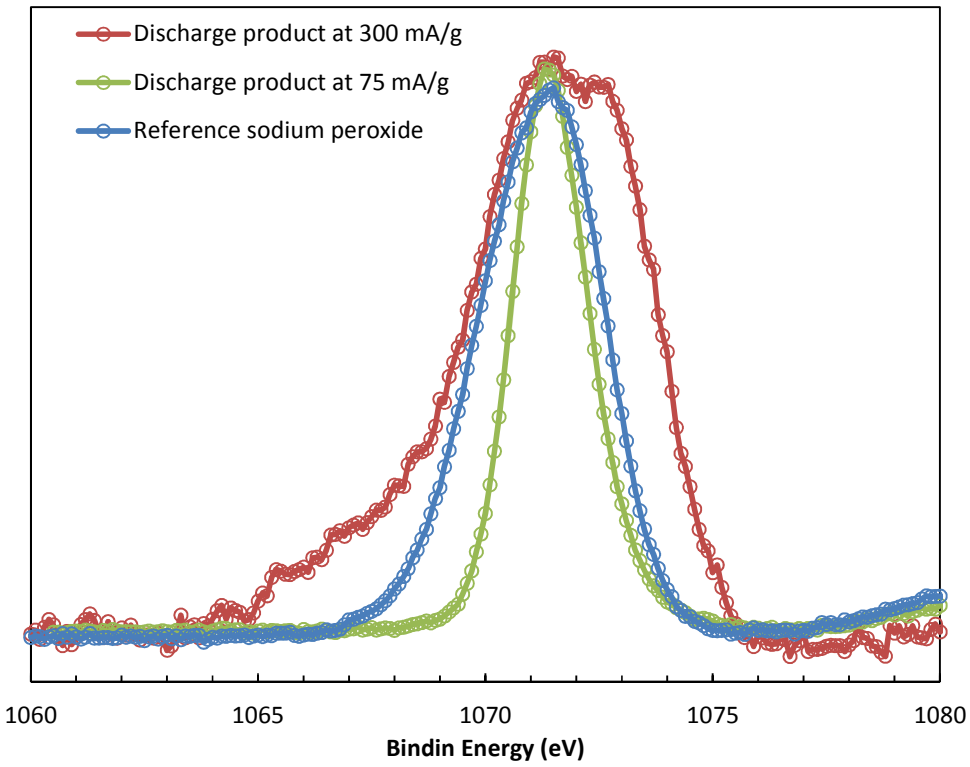

Figure S11: Sodium 1s spectra of reference sodium peroxide (a); and discharged products resulted at current densities of 75 (b) and 300 mA g^{-1} (c).

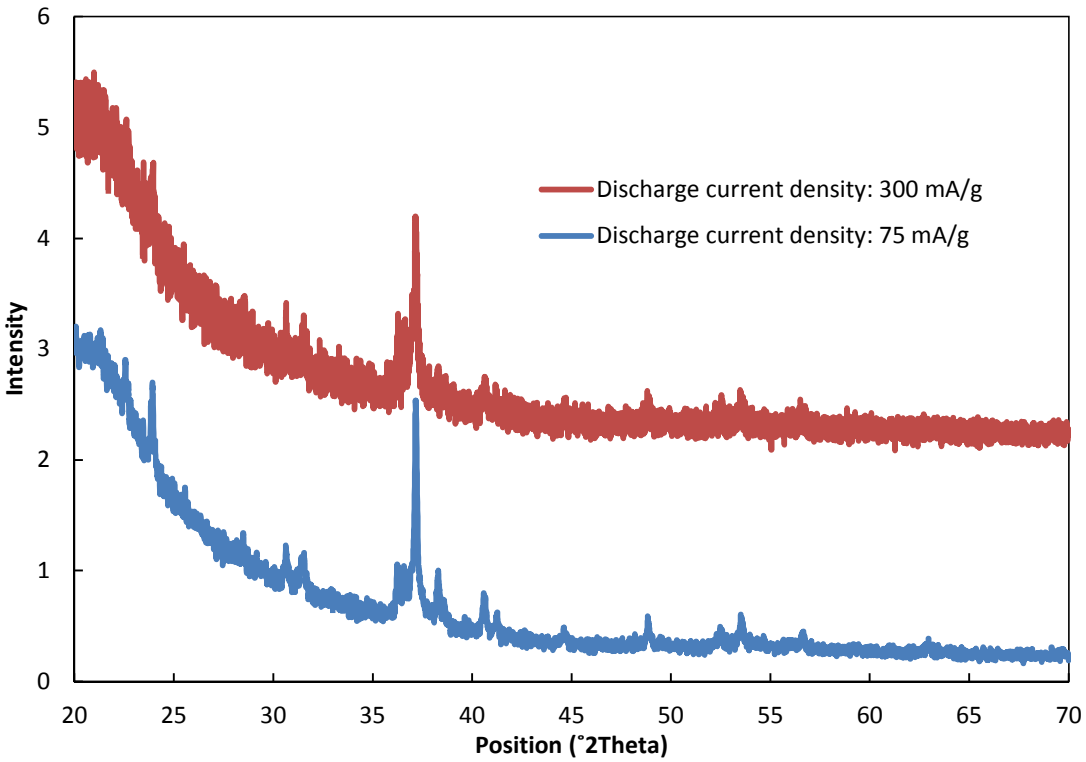

Figure S12: XRD patterns of positive electrode materials after discharge of the cell to 1.8 at different current densities of 75 and 300 mA g^{-1}

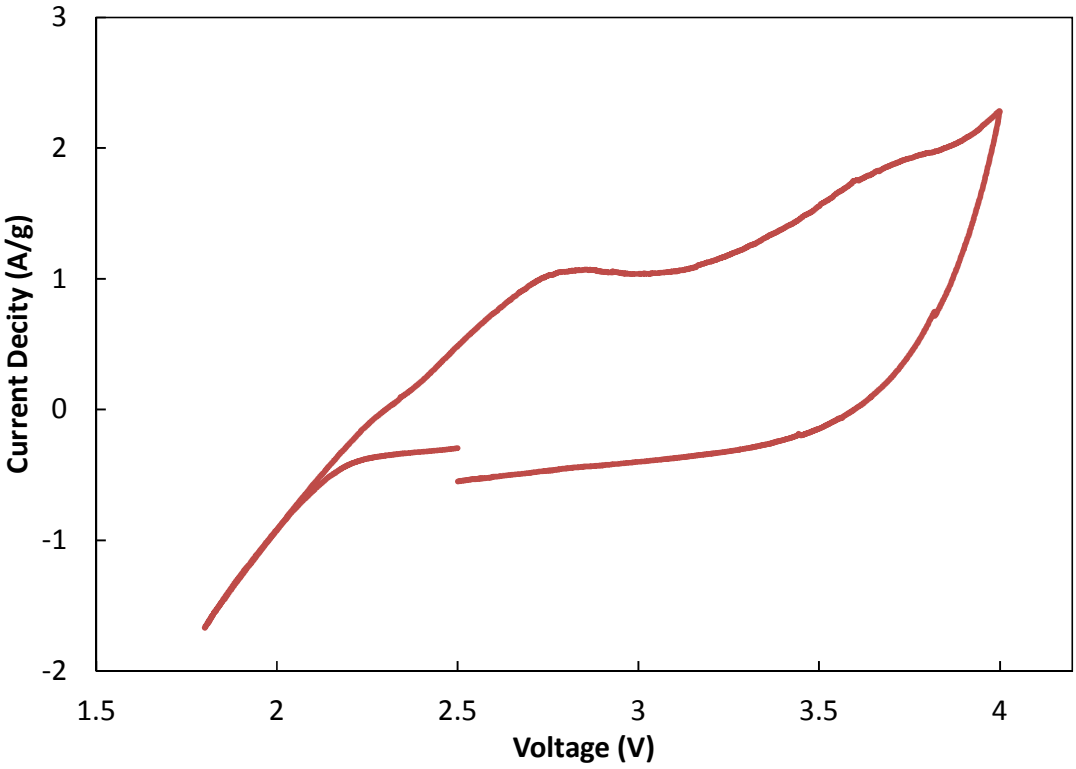

Figure S13: Cyclic voltammograms of Na-air cell recorded at a potential sweep rate of 10 mV s^{-1} in a potential range of 1.8 to 4.0 V. The CV recording was started by the cathodic sweep from 2.5 to 1.8 V followed by the anodic sweep from 1.8 to 4.0 V and terminated to the start point.

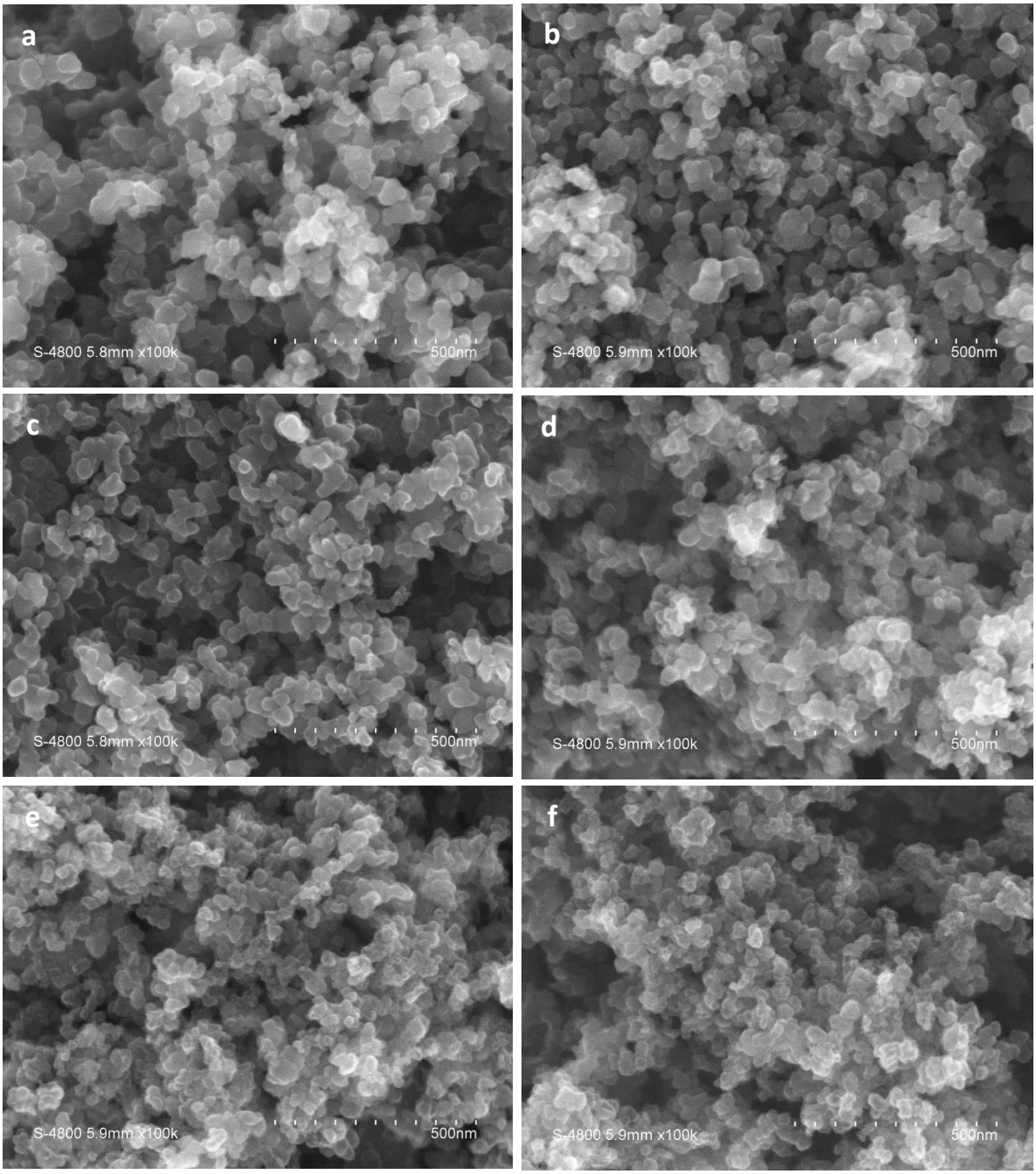

Figure S14: SEM micrographs of (a) N330 and NH_3-treated carbon black with (b) 13%, (c) 35%, (d) 50%, (e) 75% and (f) 85% mass losses.

Table S1: BET specific surface area values of heat-treated carbon materials under different atmospheres.

NH_3		CO_2		CO_2/H_2	
Mass Loss (%)	Specific Surface area (m^2/g)	Mass Loss (%)	Specific Surface area (m^2/g)	Mass Loss (%)	Specific Surface area (m^2/g)
0	75.48	0	75.48	0	75.48
10	233.13	13	155.30	13	163.22
35	582.71	30	520.80	30	538.58
54	705.98	50	1053.49	50	1112.68
75	1177.98	75	1345.54	75	1373.25
85	1281.90	90	1390.14	90	1409.22