Three-dimensional Hierarchical Self-Supported NiCo2O4 Carbon Nanotube Core-Shell Networks as High Performance Supercapacitor Electrodes

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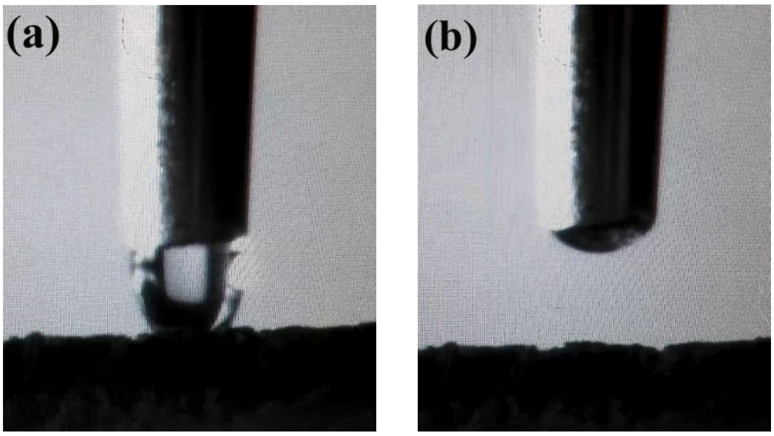

Figure S1 Camera-captured image of water droplet on CNT/NF substrate before and after air plasma treatment: a) before and b) after air plasma treatment. In both two cases, it is difficult to measure the contact angle of water droplet on pristine CNT/NF substrate and air plasma-treated CNT/NF substrate due to the highly porous feature of CNT/NF substrate. However, we can distinguish their subtle difference in wetting ability. For pristine CNT/NF substrate, the water droplet can slowly approaches to it and then spread along the sample surface. Figure S1a is the camera-captured image of water droplet as it contact with the pristine CNT/NF substrate, indicating a moderate wetting ability. After treated by air plasma, the water droplet instantly penetrates into CNT/NF substrate and immediately disappears, indicating its excellent wetting ability.

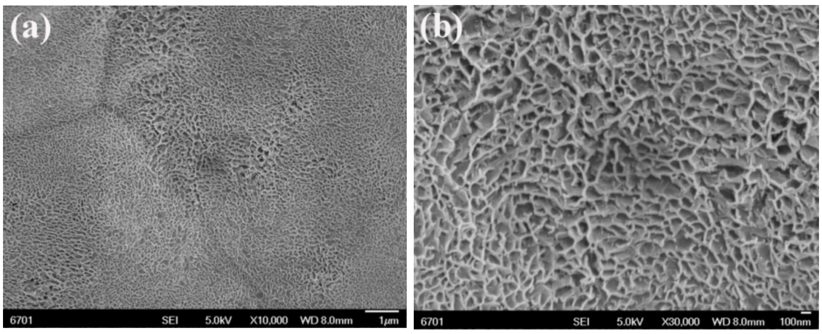

Figure S2 (a) the low and (b) high magnification FESEM images of vertically aligned $NiCo_2O_4$ nanosheets on NF surface.

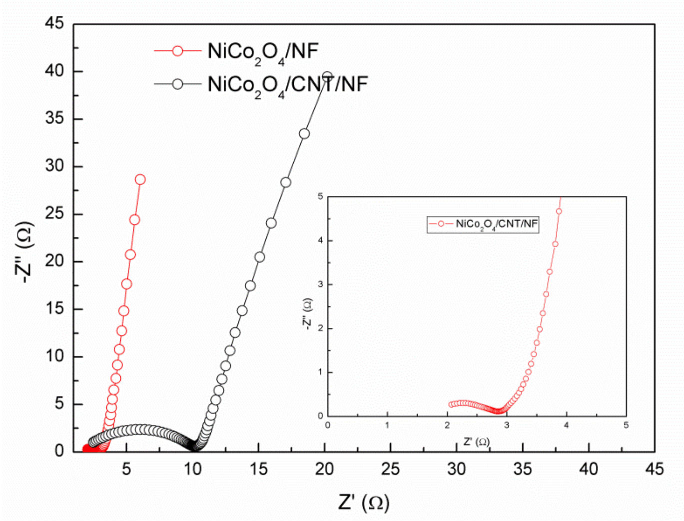

Figure S3 EIS spectra of $NiCo_2O_4$/CNT/NF electrode and $NiCo_2O_4$/NF electrode measured at 0.24 V in an alternating current frequency ranging from 0.01 to 3×10^4 Hz with an excitation signal of 5 mV. The inset image is EIS spectrum of $NiCo_2O_4$/CNT/NF electrode at high-/medium frequency region.

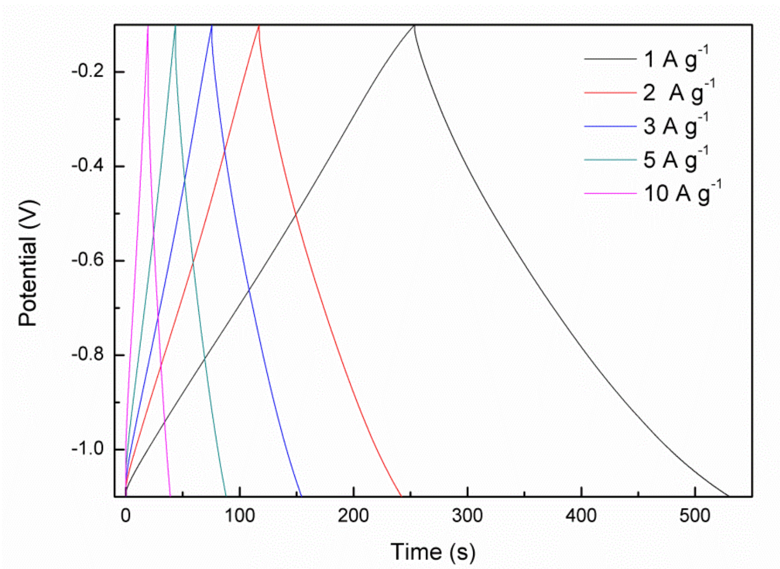

Figure S4 CDC curves of commercial AC at various current densities. The commercial AC electrode demonstrated the capacitance of 275, 250, 237, 222 and 197 F g^{-1} at current density of 1, 2, 3, 5, 10 A g^{-1}.

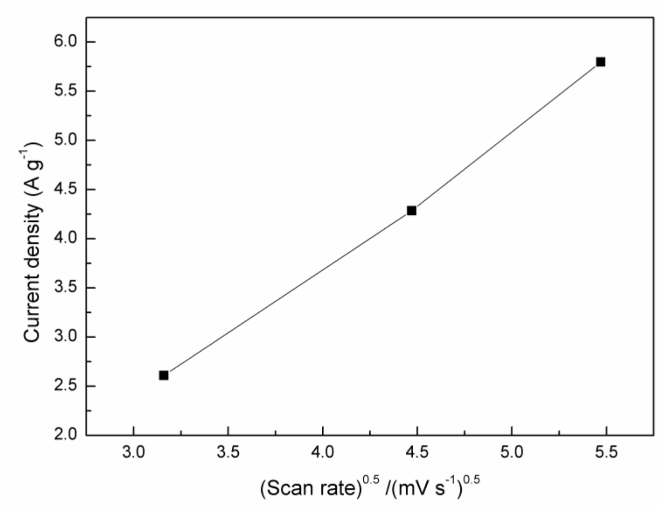

Figure S5 Relationship between the square root of scan rate and current density for assembled asymmetric device.

Table S1 Comparison of the electrochemical performance of the as-prepared NiCo2O4/CNT/NF electrode with the reported ones

Material	Specific capacitance	Rate capability	Cycling stability	Loading mass	Electrode process	Ref.
Porous $NiCo_2O_4$	658 F g^{-1} (1 A g^{-1})	530 F g^{-1} (10 A g^{-1})	98.5% (1000 cycles @ 10 A g^{-1})	1 mg/cm^2	Slurry and coating	30
Flower-like $NiCo_2O_4$	658 F g^{-1} (1 A g^{-1})	515 F g-1 (20 A g^{-1})	No observable degradation (10000 cycles at varying current densities)	--	Slurry and coating	52
$NiCo_2O_4$ nanorods	490 F g^{-1} (2 mA)	-	7% (1000 cycles @ 2 mA)	0.3 mg/cm^2	In situ growth	50
$NiCo_2O_4$ nanowires	245 F g^{-1} (1 A g^{-1})	191 F g^{-1} (10 A g^{-1})	115% (1000 cycles @ 10 A g^{-1})	0.52 mg/cm^2	In situ growth	53
$NiCo_2O_4$ nanowires	760 F g^{-1} (1 A g^{-1})	532 F g^{-1} (20 A g^{-1})	81% (3000 cycles @ 10 A g^{-1})	1 mg/cm^2	Slurry and coating	24
$NiCo_2O_4$ /graphene	835 F g^{-1} (1 A g^{-1})	635 F g^{-1} (20 A g^{-1})	108% (4000 cycles @ 2 A g^{-1})	~1.68 mg/cm^2 ($NiCo_2O_4$)	Slurry and coating	54
Nickel Cobalt oxide/SWCNT	1642 F g^{-1} (0.5 A g^{-1})	879 F g^{-1} (20 A g^{-1})	94% (2000 cycles @ 0.5 A g-1)	0.5 mg/cm^2	In situ growth	55
Self-standing $NiCo_2O_4$ nanosheet	895 F g^{-1} (1 A g^{-1})	685 F g^{-1} (20 A g^{-1})	73% (2000 cycles @ 5 A g^{-1})	0.54 mg/cm^2	In situ growth	56
$NiCo_2O_4$/vertically aligned CNT	695 F g^{-1} (1 A g^{-1})	576 F g^{-1} (20 A g^{-1})	91% (1500 cycles @ 4 A g^{-1})	0.62 mg/cm^2	In situ growth	33
$NiCo_2O_4$/CNT	1533 F g^{-1} (3 A g^{-1})	1335 F g^{-1} (30 A g^{-1})	102% (2500 cycles @ 3, 5, 10, 3 A g^{-1})	0.78 mg/cm^2	In situ growth	This work