

Supporting information for

**Rational synthesis of MnO₂/conducting polypyrrole@carbon nanofibers
triaxial nano-cables for high-performance supercapacitor**

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I. Morphological and structural characterization of MnO₂/PPy coatings on CNF under different synthetic conditions

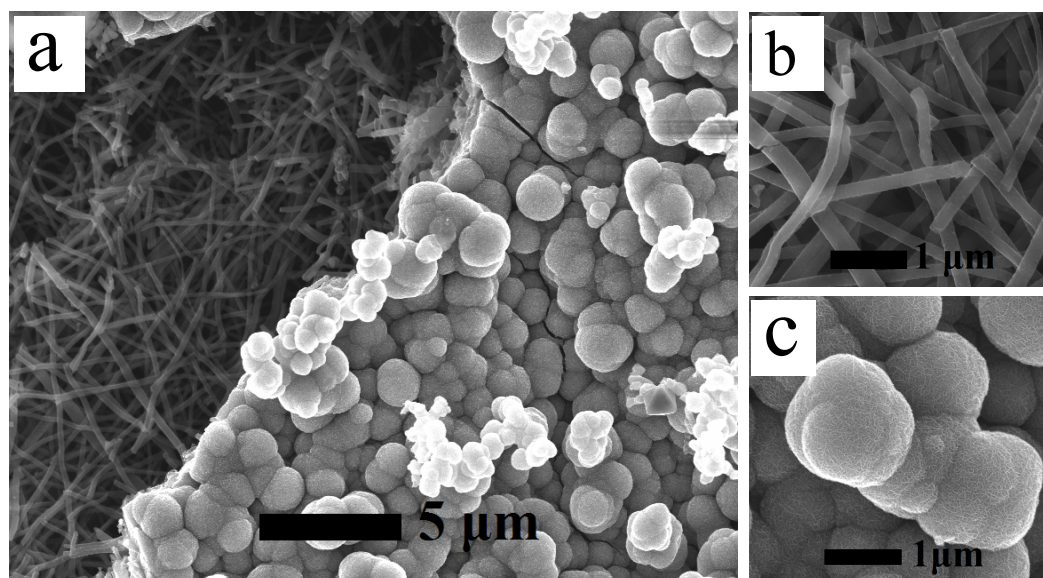


Figure S1 SEM images of MnO₂/PPy coatings on CNF without HNO₃ functionalization.

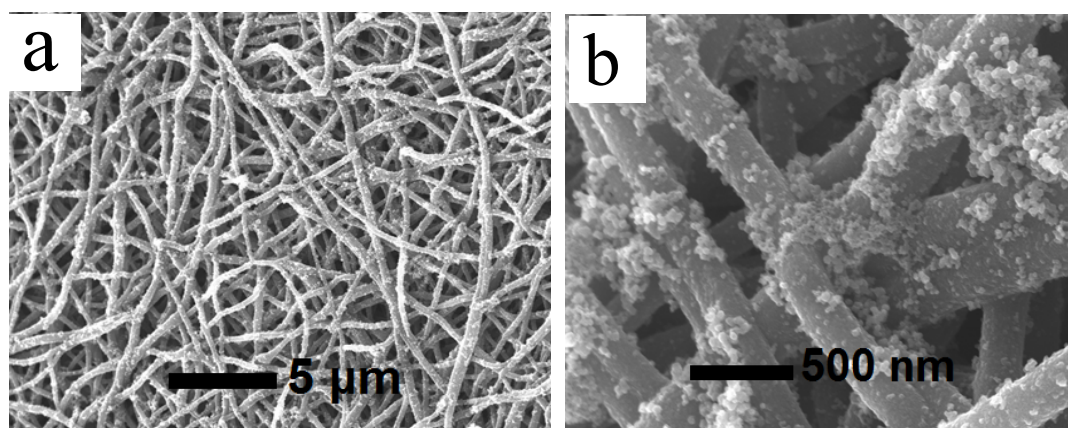


Figure S2 SEM images of MnO₂/PPy coatings on CNF prepared without natural drying.

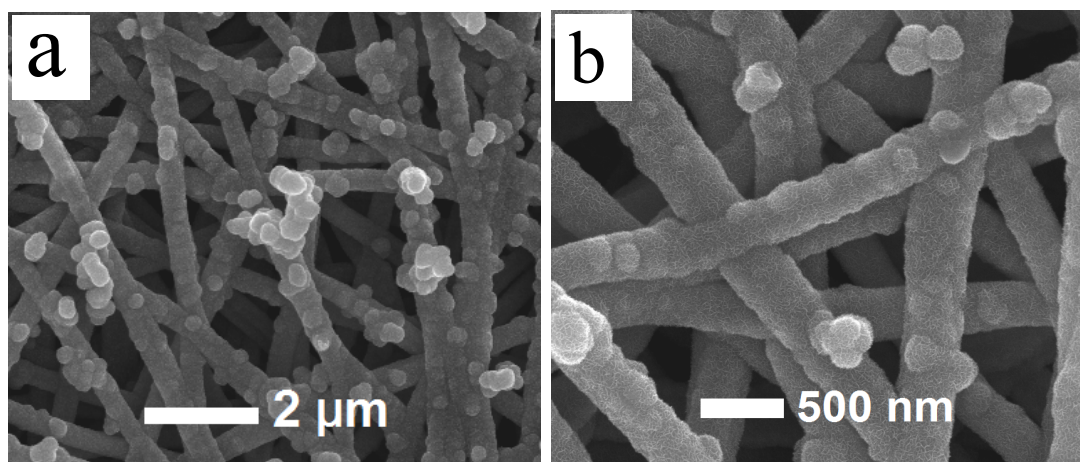


Figure S3 SEM images of MnO₂/PPy@CNF using acidic KMnO₄ as oxidants.

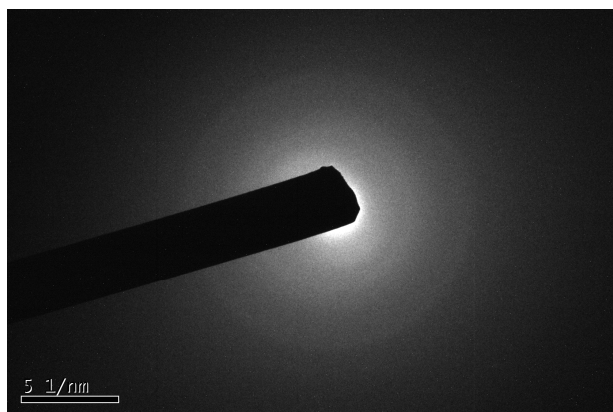


Figure S4 Selected area electron diffraction of hybrid MnO₂/PPy@CNF composite. The diffuse rings indicate the amorphous structure of MnO₂/PPy nanocoatings.

II. Electrochemical performance

To demonstrate the capacitance contribution of pure CNFs substrate to the hybrid composites electrodes, both cyclic voltammogrammetry (CV) and galvanostatic charging/discharging tests were performed on the pure CNFs substrate, as shown in Figure S5. We can see the rectangular shape of the CVs keeps very well at high scan rate of 100 mV s⁻¹ and the maximum specific capacitance of the pure CNFs substrate at the scan rate of 2 mV s⁻¹ from CV curve is ~3 F g⁻¹. This result is also confirmed by the galvanostatic charging/discharging test (Figure S5(c)).

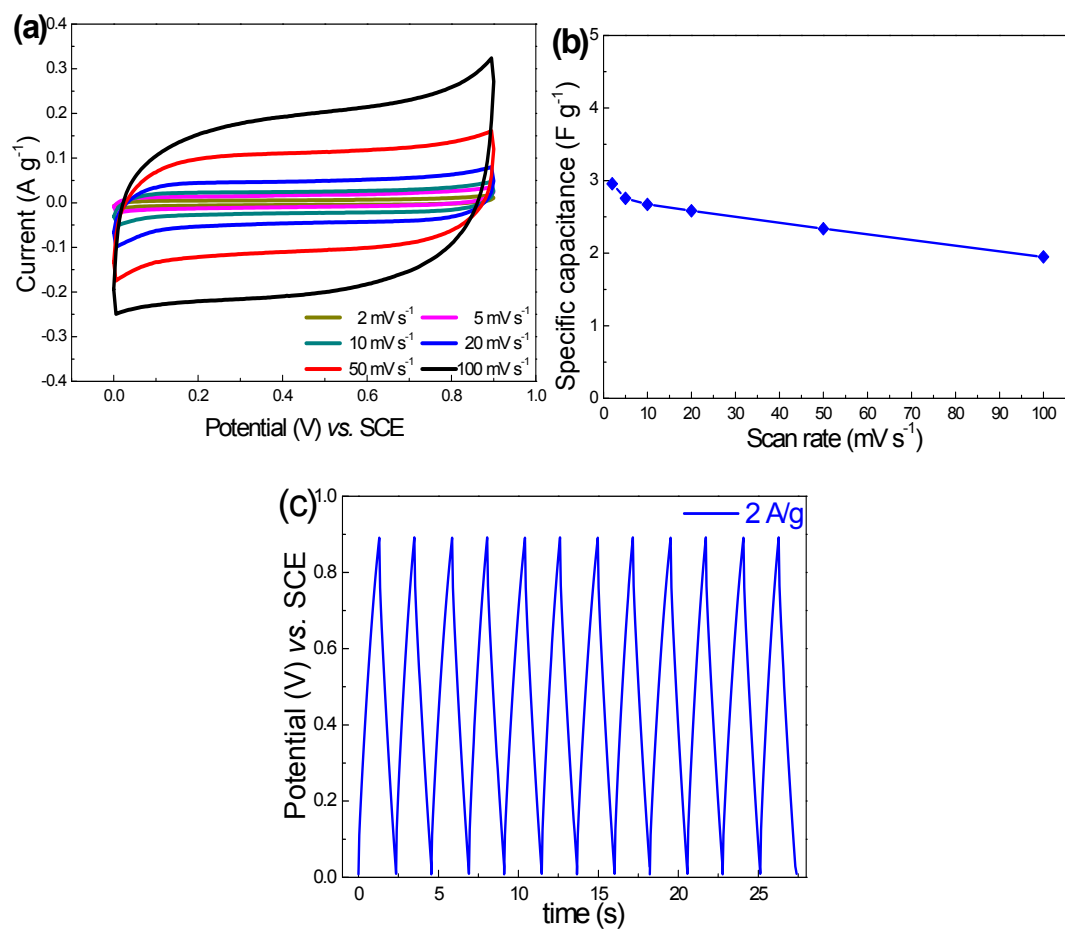


Figure S5 (a) CV curves of pure CNF substrate at various scan rates, (b) Specific capacitance as a function of scan rate. (c) Galvanostatic charging/discharging curves of pure CNF substrate at the current density of 2 A g^{-1} .

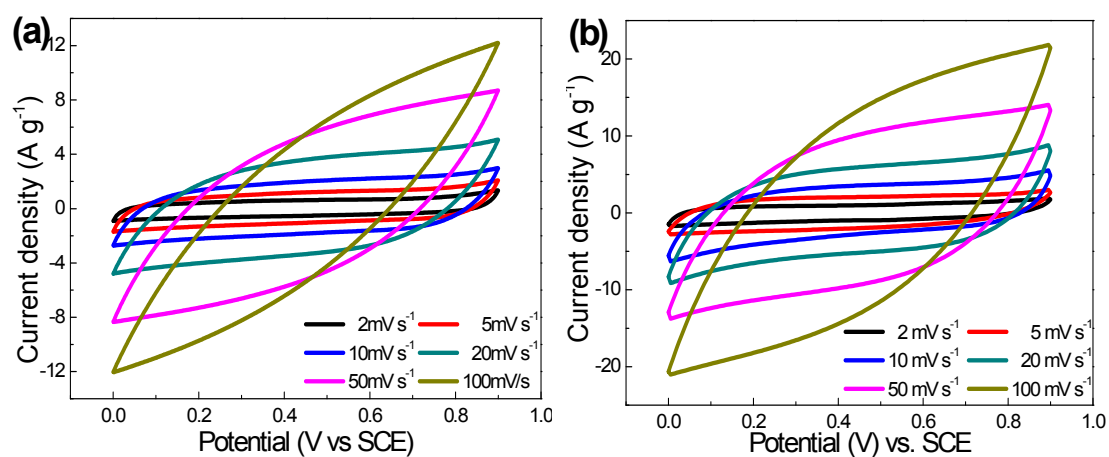


Figure S6 CV curves of (a) $\text{MnO}_2@\text{CNF}$ and (b) $\text{PPy}@\text{CNF}$ at various scan rates.

Table S1. Comparison of areal specific capacitance of binder-free MnO₂-based electrodes.

Technique ^[a]	Electrode		Mass loading (mg cm ⁻²)	Specific Capacitance		Ref.	Note
	Active Material ^[b]	Substrate ^[c]		Gravimetric (F g ⁻¹)	Areal (F cm ⁻²)		
RD	MnO ₂ /PEDOT/CNT	Au foil	1.50	200	0.30	1	5 mA cm ⁻²
ED	MnO ₂ /PEDOT/Graphene	CMF	1.32	380	0.50	2	0.1 mA cm ⁻²
RD	MnO ₂ /PPy/CNT	Ti foil	1.00	281	0.28	3	20 mV s ⁻¹
ED	MnO ₂	CNT/PMF	8.30	337	2.80	4	0.05 mV s ⁻¹
ED	MnO ₂	CNT/PMF	3.80	142	0.54	4	5 mV s ⁻¹
ED	MnO ₂ /CNT	Ta foil	2.10	200	0.42	5	1 A g ⁻¹
ED	MnO ₂ /CNT	-	0.26	516	0.13	6	0.077 A g ⁻¹
ED	MnO ₂ /CNT	-	0.38	710	0.27	7	2 mV s ⁻¹
ED	MnO ₂ /CNT	CNT/Pt-Si	0.10	471	0.05	8	10 mV s ⁻¹
RD	MnO ₂ /CNT	SS	0.08	869	0.07	9	2.5 A g ⁻¹
ED	MnO ₂ /CNT	Graphite	0.18	450	0.08	10	10 mV s ⁻¹
RD+TR	MnO ₂ /Graphene	-	0.30	315	0.95	11	2 mV g ⁻¹
ED	MnO ₂ /Graphene	PMF	0.07	256	0.02	12	0.5 A g ⁻¹
RD	MnO ₂ /CF	CP	13.64	110	1.50	13	2 mV s ⁻¹
RD+HT	MnO ₂ /Co ₃ O ₄	SS	1.50	480	0.72	14	2.7 A g ⁻¹
RD	MnO ₂	SnO ₂ -SS	0.08	637	0.05	15	2 mV s ⁻¹
ED	MnO ₂	CMF	0.54	425	0.23	16	0.13 mA cm ⁻²
ED	MnO ₂	TiN-Ti	0.09	681	0.06	17	2 A g ⁻¹
RD	MnO ₂	CNF	0.68	419	0.29	18	2 mV s ⁻¹
ED	MnO ₂	Graphite	1.20	240	0.29	19	2 mV s ⁻¹
ED	MnO ₂	CNT@Si	0.016	642	0.01	20	10 mV s ⁻¹
ED	MnO ₂	NCC	0.45	304	0.14	21	2 A g ⁻¹
RD	MnO ₂ /PPy	CNF	2.00	698	1.40	This work	2 mA cm ⁻²

[a] RD=Redox Deposition, ED=ElectroDeposition, TR=Thermal Reduction, HT=Hydrothermal Treatment. [b] PEDOT=poly(3,4-ethylenedioxythiophene), PPy=polypyrrole, CNT=carbon nanotube, CF=carbon nanofoam. [c] CMF=Carbon Microfiber, SS=Stainless Steel, PMF=Polyester Microfiber, CP=Carbon Paper, NCC=Nickel Current Collect.

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