Electronic Supplementary Information

Design and fabrication of polypyrrole/expanded graphite 3D interlayers nanohybrids towards highly capacitive performance

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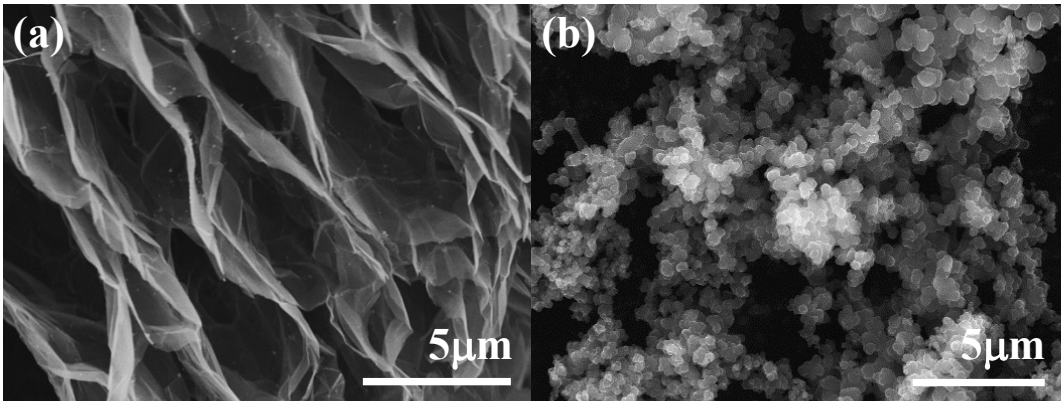

Fig. S1 The SEM images of (a) EG and (b) PPy

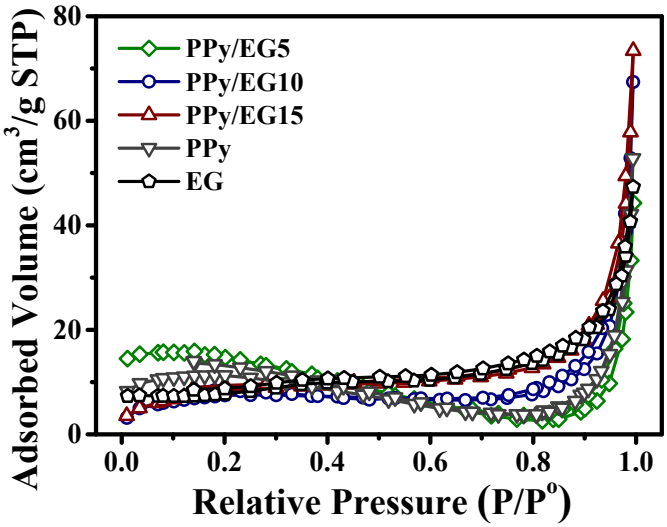

Fig. S2 N_2 adsorption-desorption isotherms of EG, PPy, PPy/EG15, PPy/EG10 and PPy/EG5 samples

Table S1 The specific surface area of EG, PPy, PPy/EG15, PPy/EG10 and PPy/EG5 samples

Sample	S_{BET} (m^2 g^{-1})
PPy	15.8
PPy/EG5	22.5
PPy/EG10	28.7
PPy/EG15	30.9
EG	26.3

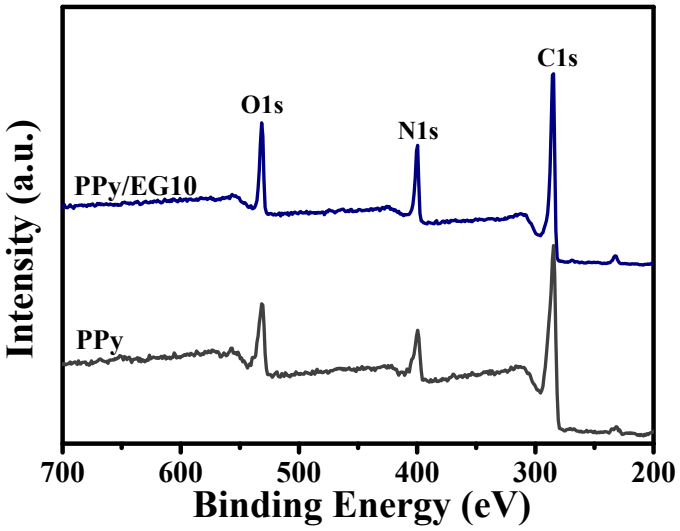

Fig. S3 XPS full-scan spectra of PPy and PPy/EG10 samples

Table S2 Elemental composition of the EG, PPy and PPy/EG10 samples

Sample	C1s(at.%)	O1s(at.%)	N1s(at.%)
PPy	71.89	12.49	15.62
EG	97.26	2.48	0.27
PPy/EG10	76.90	11.18	11.92

Table S3 The calculated values of R_s, R_{ct}, Z_w , C_{dl} and C_{ps} through CNLS fitting of the experimental impedance spectra based on the proposed equivalent circuit displayed in Fig. 6a

Samples	R_s (Ω cm^{-2})	R_{ct} (Ω cm^{-2})	Z_w (Ω cm^{-2})	C_{dl} (μF cm^{-2})	C_{ps} (mF cm^{-2})
EG	0.5516	0.071	0.1215	145.5	0.7768
PPy/EG5	0.5365	1.908	0.0614	20.94	1543
PPy/EG10	0.3699	1.839	0.1249	35.18	2839
PPy/EG15	0.8563	1.464	0.1904	23.04	1680
PPy	0.8665	2.944	0.1177	34.64	3254

Table S4 The calculated values of R_s, R_{ct}, Z_w , C_{dl} and C_{ps} through CNLS fitting of the experimental impedance spectra based on the proposed equivalent circuit displayed in Fig. 7a

Samples	R_s (Ω cm^{-2})	R_{ct} (Ω cm^{-2})	Z_w (Ω cm^{-2})	C_{dl} (μF cm^{-2})	C_{ps} (mF cm^{-2})
EG	1.201	0.257	0.2211	478.7	43.7
PPy/EG5	1.058	2.847	0.2526	22.23	1532
PPy/EG10	1.008	1.926	0.2461	30.84	2353
PPy/EG15	1.251	1.653	0.1883	25.49	1230
PPy	1.047	2.352	0.1373	19.64	3441

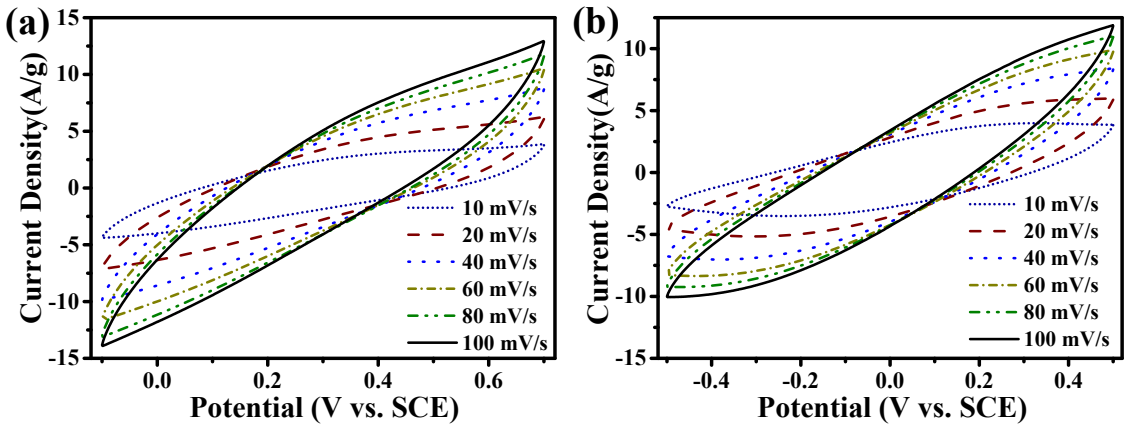

Fig. S4. The CV curves of PPy/EG10 electrode at the scan rate from 10~100 mV s^{-1} in (a) 1 M H_2SO_4 and (b) 1 M KCl electrolytes

Table S5 The electrochemical properties of EG, PPy, PPy/EG15, PPy/EG10 and PPy/EG5 samples

Sample	1 M H_2SO_4 electrolyte			1 M KCl electrolyte		
	C_g (F g^{-1})	Rate Capability (%)	Capacitance Retention (%)	C_g (F g^{-1})	Rate Capability (%)	Capacitance Retention (%)
PPy	293.6	33.8%	67.6%	266.9	33.4%	69.4%
PPy/EG5	376.4	54.7%	---	353.6	55.1%	---
PPy/EG10	454.3	75.9%	83.9%	442.7	73.3%	86.3%
PPy/EG15	402.5	78.4%	---	399.8	76.2%	--
EG	49.6	52.7%	95.9%	42.2	51.3%	96.8%

Table S6 Specific capacitance of different carbon based PPy nanohybrids in three-electrode system

Material	Electrolyte	Current density ($A\ g^{-1}$)	Specific capacitance ($F\ g^{-1}$)	Ref.
Graphene/PPy nanotube aerogel	1 M H_2SO_4	0.5	253	[13]
PPy/sulfonated graphene	1 M H_2SO_4	0.3	310	[14]
Cellulose carbon aerogel/PPy	1 M H_2SO_4	0.5	387.6	[57]
PPy/modified GO	2 M $NaNO_3$	1.0	202	[15]
Activated Carbons/PPy	1M Na_2SO_4	1.0	82.3	[24]
rGO/PPy aerogel	6 M KOH	0.5	304	[36]
PPy/EG	1 M H_2SO_4	1.0	454.3	This work
	1 M KCl	1.0	442.7	

Table S7 Specific capacitance, power density and energy density of different carbon based PPy nanohybrids in two symmetric electrode system

Material	Electrolyte	Current density ($A\ g^{-1}$)	Specific capacitance ($F\ g^{-1}$)	Power density ($kW\ kg^{-1}$)	Energy density ($Wh\ kg^{-1}$)	Ref.
PPy/sulfonated graphene	1M KCl	0.3	253	0.1089	4.3	[14]
				3.6	2.8	
PPy/modified GO	2 M $NaNO_3$	1.0	87	0.825	10	[15]
Graphene oxide/carbon dots/PPy	1M LiCl	0.5	216.8	0.25	30.1	[29]
PPy/EG	1 M Et_4NBF_4-PC	1.0	342.4	1.0	47.5	This work
				20	23.9	