

Supporting Information

Design and synthesis of 3D flexible film electrode based on sodium carboxymethyl cellulose-polypyrrole@reduced graphene oxide composite for supercapacitor

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Synthesis of GO. Firstly, 70 ml 98% H₂SO₄ was added in a 500 ml beaker. Meanwhile, 3 g of flake graphite and 1.5 g of sodium nitrate were added in the beaker and the resulting mixture was stirred for 15 mins under ice bath. Then 9 g of potassium permanganate and 3 g of potassium ferrate were slowly added into the above solution, and continue to stir in the ice bath for 90 mins. After the reaction is completed, transfer to a 30-40 °C water bath and stirred for 3 h. Then 150 mL of deionized water was slowly added to the solution, and transfer the beaker to an oil bath at 90 °C for 20 mins. After completion, take out the beaker and added 500 mL of deionized water to stir evenly. And quickly added 15 ml of 30% hydrogen peroxide, result in the color of the solution was changed from dark brown to bright yellow. Finally, it was washed once with 250 ml of hydrochloric acid having a solubility of 1:10, and the washed with deionized water until the PH of the solution reached neutral. And the obtained solid dissolve in 500 ml of deionized water, and centrifuge for 0.5 h at a speed of 4000 rpm. The obtained solution was the GO dispersions.

Synthesis of CMC-PPy. Firstly, 100 mg CMC was dispersed in a mixture of 10 ml HCl (1 M) and 1 ml pyrrole monomer, and deionized water was added until to obtained 40 ml mixture, followed by ultrasound for 30 mins. Then, 1.28 g $(\text{NH}_4)_2\text{S}_2\text{O}_8$ was dissolved in 10 ml deionized water, added to the reaction mixture and stirred for 12 h under ice bath for oxidative polymerization. After the completion, it was filtered and washed with deionized water several times, then placed in a 70 °C oven to dry overnight, and finally the CMC-PPy composite was obtained. PPy was synthesized under the same conditions, except that CMC was not added.

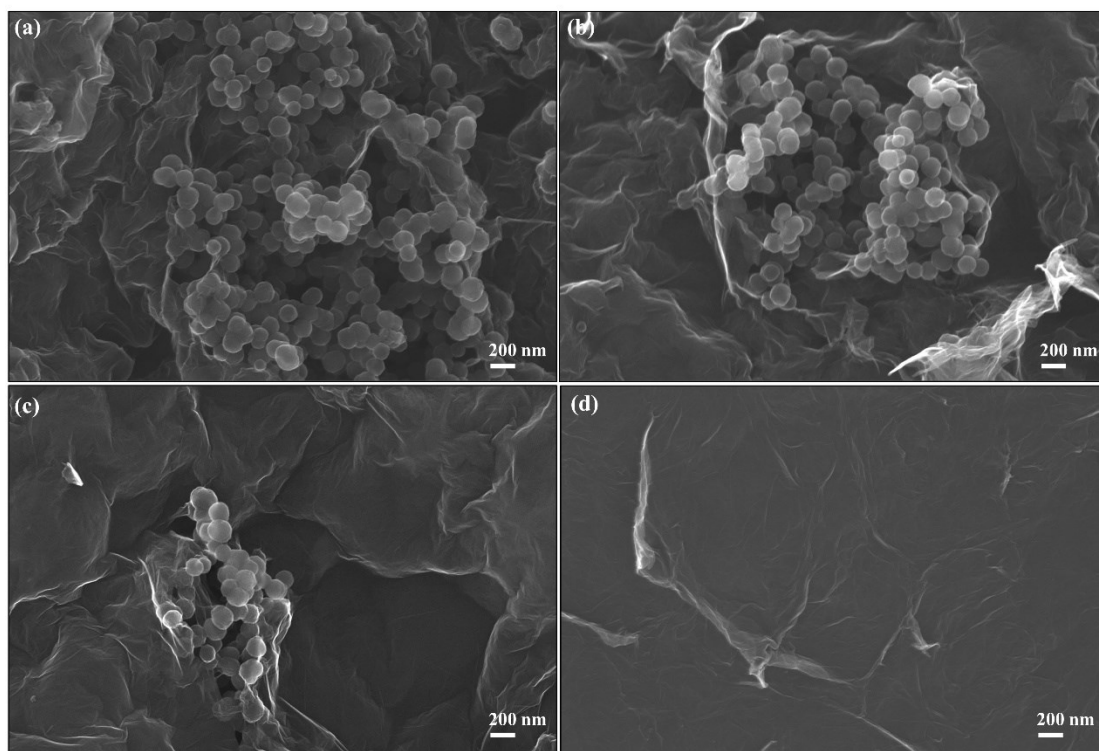


Fig. S1 SEM image of (a) S-CPR_{2:3}, (b) S-CPR_{1:3}, (c) S-CPR_{1:6} and (d) S-R film.

Table S1

Electrochemical performance comparison between some literature reports and this work

Electrode material	Electrolyte	Specific	Current density	Cyclic stability	Ref.
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		capacitance			
PPy/GO	1 M KCl, 2-electrode	154.5 mF cm ⁻²	1 mA cm ⁻²	107.5 % after 5000 cycles	1
PPy-GO/CNTs	1 M KCl, 2-electrode	142.2 mF cm ⁻²	1 mA cm ⁻²	97.3 % after 5000 cycles	2
rGO/PPy	1 M KCl, 3-electrode	419 mF cm ⁻²	0.2 mA cm ⁻²	95.7 % after 10000 cycles	3
rGO/MnFe ₂ O ₄ /PPy	1 M H ₂ SO ₄ , 2-electrode	395 mF cm ⁻²	5 mV s ⁻¹		4
PPy/CG/CNT	1 M KCl, 2-electrode	196.7 mF cm ⁻²	0.5 mA cm ⁻²	98.1 % after 5000 cycles	5
PPy/FCC	5 M LiCl, 3-electrode	341.2 mF cm ⁻²	1mA cm ⁻²	96 % after 10000 cycles	6
T-Fe ₂ O ₃ /PPy NAs	1 M Na ₂ SO ₄ , 3-electrode	382.4 mF cm ⁻²	0.5 mA cm ⁻²	97.2 % after 5000 cycles	7
Co-BC90	3M KOH 3-electrode	158.5 mF cm ⁻²	0.25 mA cm ⁻²	99% after 3000 cycles	8
Ag@PPy@MnO ₂	0.1M Na ₂ SO ₄ , 3-electrode	426.3 mF cm ⁻²	1mA cm ⁻²	98.7% after 10000 cycles	9
g-C ₃ N ₄ /PPy	6M KOH, 3-electrode	289.6 mF cm ⁻²	0.4 mA cm ⁻²	99% after 10000 cycles	10
G-PPy/GP	1 M KCl, 2-electrode	173.0 mF cm ⁻²	0.2 mA cm ⁻²	90.5% 5000 cycles	11
PPy/CNTs	1 M KCl, 2-electrode	185.3 mF cm ⁻²	0.5 mA cm ⁻²	88.5% 10000 cycles	12
CNK-900	1 M Na ₂ SO ₄ 3-electrode	204 F g ⁻¹	0.5 A g ⁻¹	92% after 1000 cycles	13
S-CPR _{1:1}	1 M Na ₂ SO ₄ 3-electrode	489 mF cm ⁻² , 191 F g ⁻¹	0.5 mA cm ⁻²	101.6 % after 1000 cycles	This work

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