Electrochemical energy storage and adsorptive dye removal of platanus fruit derived porous carbon

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Fig. S1 a) SEM of a-PFC₂, b) SEM of a-PFC₃, and c) SEM of a-PFC₄.



Fig. S2 a) N_2 sorption isotherms and b) BJH pore size distributions of a-PFC₂, a-PFC₃, and a-PFC₄, inset in panel b): cumulative pore volume of a-PFCs.

Sample	BET surface area (m ² g ⁻¹)	Micropore surface area $(m^2 g^{-1})$	Total volume (cm ³ g ⁻¹)	Micropore volume (cm ³ g ⁻¹)	Micropore volume ratio (%)
PFC	242.9	216.2	0.12	0.09	74.39
a-PFC ₂	953.7	923.8	0.48	0.44	90.67
a-PFC ₃	1215.2	1139.1	0.65	0.58	88.38
a-PFC ₄	1513.2	1435.3	0.78	0.67	85.67

 Table S1 Structural characteristics of PFC and a-PFCs.

From Fig. S2a and table S1, N₂ adsorption-desorption isotherms for a-PFC₂, a-PFC₃, and a-PFC₄ all include an overwhelming fraction of micropores and limited meso- and macropores. Higher KOH activation dosage renders a high BET surface and total pore volume, but the micropores ratio slightly decreases, this trend suggests that a high KOH dosage will create more mesopores and macropores in a-PFC, we believe the too high KOH dosage will cause the further etching along micropore wall, thus widens the pore size and forms mesopores even macorpores, which can be evidenced by the higher probability with the pore size over 1 nm (Fig. S2b). The cumulative pore volume plots indicate that the micropores and smaller mesopores provide the predominant contribution to the total pore volume for all the samples.



Fig. S3: a) CVs of a-PFC₂, a-PFC₃, and a-PFC₄ electrodes at scan rate of 100 mV s⁻¹. b) Galvanostatic charge-discharge curves of a-PFC₂, a-PFC₃, and a-PFC₄ based symmetric capacitors in two-electrode mode at 1 A g⁻¹. c) Rate capability of a-PFC₂, a-PFC₃, and a-PFC₄ based symmetric capacitors. d) Nyquist plots of a-PFC₂, a-PFC₃, and a-PFC₄ electrodes, inset: magnified region at high frequency. e) Ragone plots of a-PFC₂, a-PFC₃, and a-PFC₄ based capacitors.

A-PFC₂, a-PFC₃, and a-PFC₄ electrodes demonstrated CV curves without apparent redox peaks, indicates the EDL capacitive behavior of the samples (panel a). Galvanostatic charging-discharging curves are all triangular shape with very low IR voltage drop, indicates the EDL capacitance characteristics (panel b). Among them, the longest discharging duration of a-PFC₃ cell evidences the highest specific capacitance, which is even slightly higher than that of cell based on a-PFC4, indicating the high BET surface is not the sole determining factor for capacitance. It is widely accepted that the EDL capacitance is dependent on both the conductivity and the accessible surface area of the electrode material. As for a-PFC₄, the much hollowed structure can offer more micropores and enlarged specific surface area, and the possibly more hydrophilic groups also facilitate the accessibility to electrolyte, beneficial for the charge accumulation at electrode/electrolyte interface. But the possibly low conductivity restrains the charge transfer and accumulation, deteriorates the total capacitance. From Fig. S3d, the lower R_s of a-PFC₂ electrode means the high conductivity, but the R_{ct} is higher, means the weaker ions accumulation at electrode surface. Whereas for a-PFC4 electrode, the higher ions accumulation at electrode/electrolyte interface can be accomplished from the low R_{ct} , but the high R_s is adverse for charge transfer, also limits the capacitance. Hence, the highest capacitive behavior of a-PFC₃ is reasonable considering the moderate R_s and R_{ct} . Due to the considerable conductivity, high

BET surface and efficient electrolyte diffusion pathways deriving from versatile pore feature containing micro-, meso- and macorpores, the rate capability is also the highest among a-PFCs (panel c). The highest capacitance and rate capability of a-PFC₃ further results in the highest energy densities and power densities at different current densities (panel e). From these results, a-PFC₃ capacitor possesses great potential for electrochemical energy storage.



Fig. S4 Absorption spectra of a) MB, b) MO, c) NG, d) CR and e) RhB with concentration of 20 g L⁻¹ before and after a-PFC₃ adsorption treatment. Inset: from left to right, photographs of original dye solution, remaining dye solution after a-PFC₃ adsorption treatment (10 mg in 180 mL of dye solution for 24 h) and deionized water.



Fig.S5 Pseudo-first-order kinetics plots of adsorption kinetics of MB on a-PFC₃.



Fig.S6 Frenderich isothermal plots of a-PFC₃ on MB adsorption at 20 °C.