Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

Electronic Supplementary Information

Phosphorus doped hierarchical porous carbon: an efficient oxygen reduction electrocatalyst for *on-site* H_2O_2 production

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Experimental section

The treatment of Nafion 117 membrane: Firstly, the Nafion 117 membrane was treated in 5% hydrogen peroxide at 80 ℃ for 1 h, and then soaked in deionized water for 0.5 h. Then it was boiled in 5% dilute sulfuric acid (mass ratio) at 80 ℃ for 1 hour. Finally, it was soaked in deionized water for half an hour.

Preparation of catalyst ink: The catalyst ink is firstly prepared by dispersing 5 mg catalyst material in the mixture of ethanol (490 μL), deionized water (490 μL), and Nafion (20 μL). The solution is then sonicated for 30 min to get a uniform suspension. After that, 10 μL catalyst ink is coated on the carbon paper uniformly, and the electrode with 0.05 mg cm^{-2} electrocatalyst loading can be obtained after drying.

Disinfection experimental: Standard E. coli strains were stored at -20℃in 15% (vol/vol) glycerol. All culturing was carried out in lysogeny broth (LB) at 37℃ with shaking at 200 revolutions/min for 16 h. After a certain time of electrolysis, the electrolyte was taken out at a predetermined timed interval, and adjusted the pH value to neutral for disinfection. Then 4.5 mL of the electrolyte was mixed with 0.5 mL of the bacterial solution. After incubating for 30 min at room temperature, the mixture was diluted 100,000-fold in gradient immediately. Finally, 100 μL of diluted liquid was spread on an agar plate, and the number of colonies was counted after 24 h of inverted culture in a constant temperature incubator at 37 ℃.

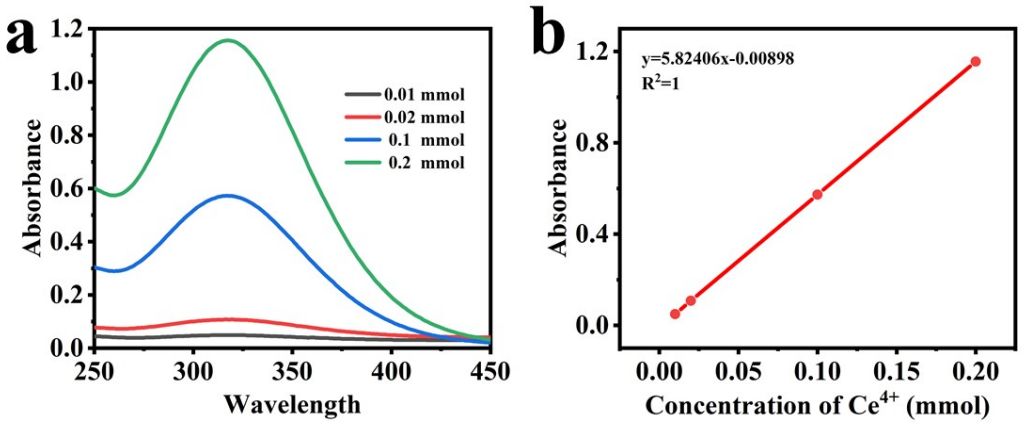

Fig. S1 (a) UV-vis spectra of Ce^{4+} solution with various concentrations and (b) corresponding standard curve.

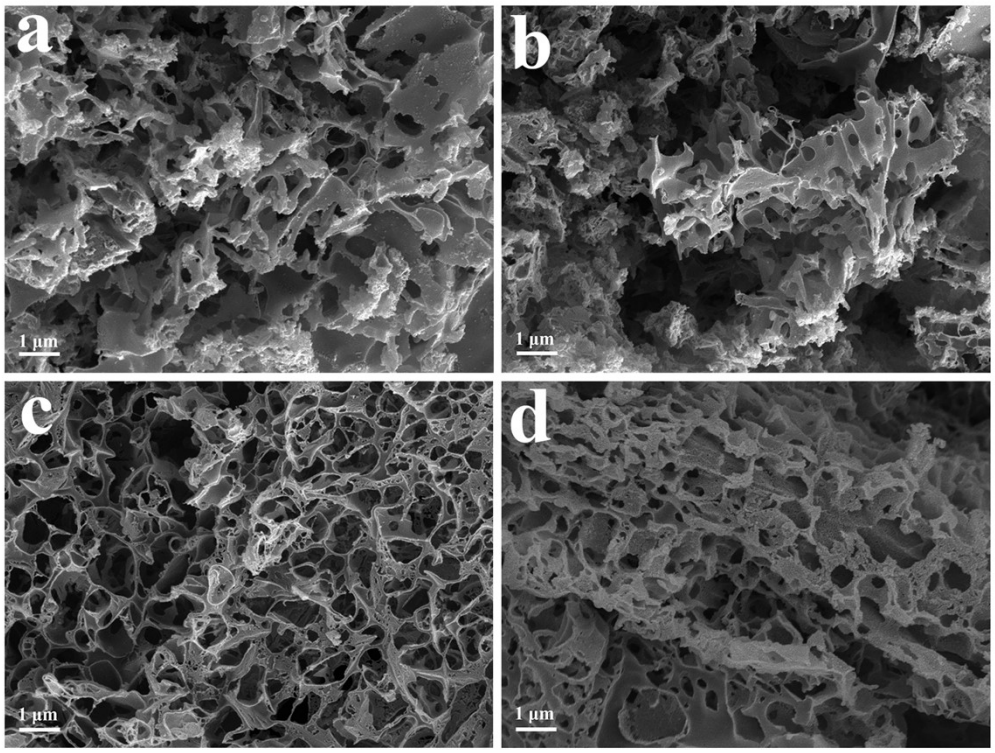

Fig. S2 (a-d) SEM images of P_x-MC: (a) P_{20}-MC; (b) P_{40}-MC; (c) P_{60}-MC; (d) P_{80}-MC.

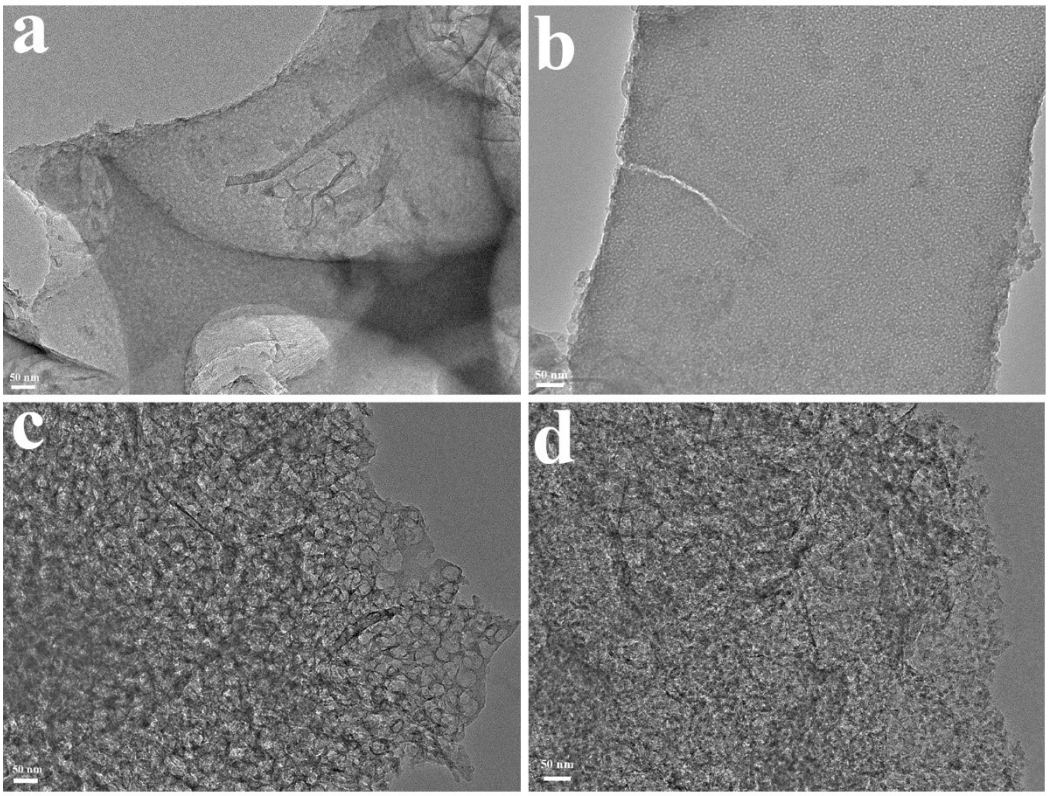

Fig. S3 (a-d) HRTEM images of P_x-MC: (a) P_{20}-MC; (b) P_{40}-MC; (c) P_{60}-MC; (d) P_{80}-MC.

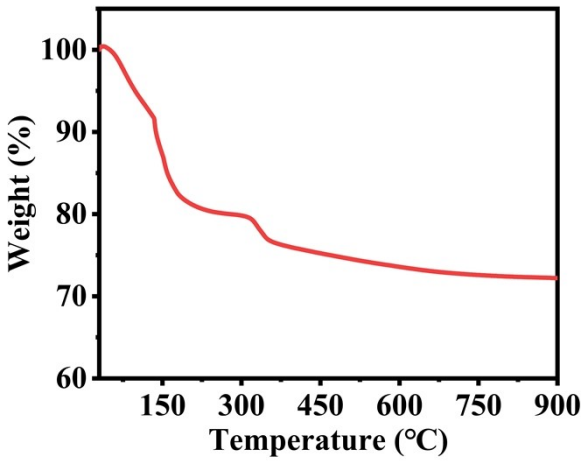

Fig. S4 The thermogravimetric analysis (TGA) of SP.

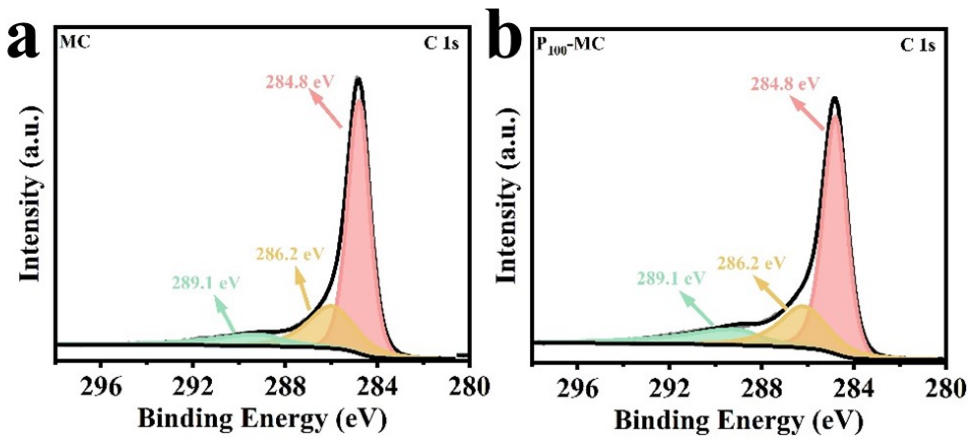

Fig. S5 (a-b) High-resolution XPS spectra of C 1s: (a) MC; (b) P_{100}-MC.

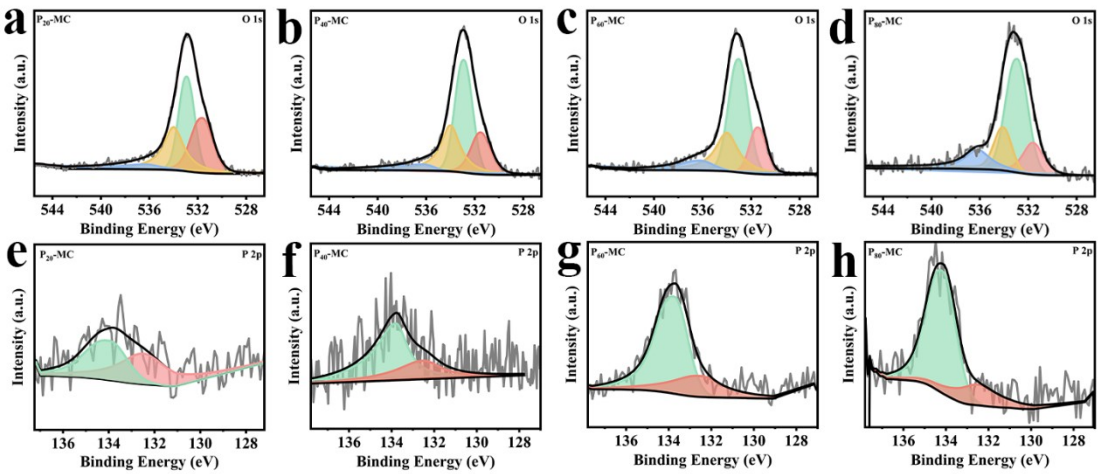

Fig. S6 The O 1 s (a~d) and P 2p (e~h) XPS spectra of P_x-MC.

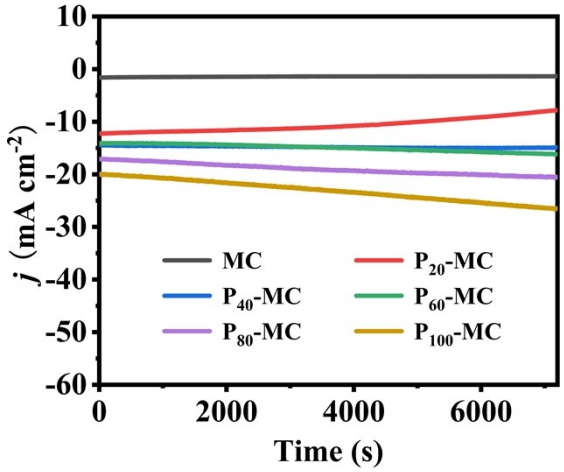

Fig. S7 Time-dependent current density curves over MC and P_x-MC at 0.3 V for 7200 s in 0.1 M KOH.

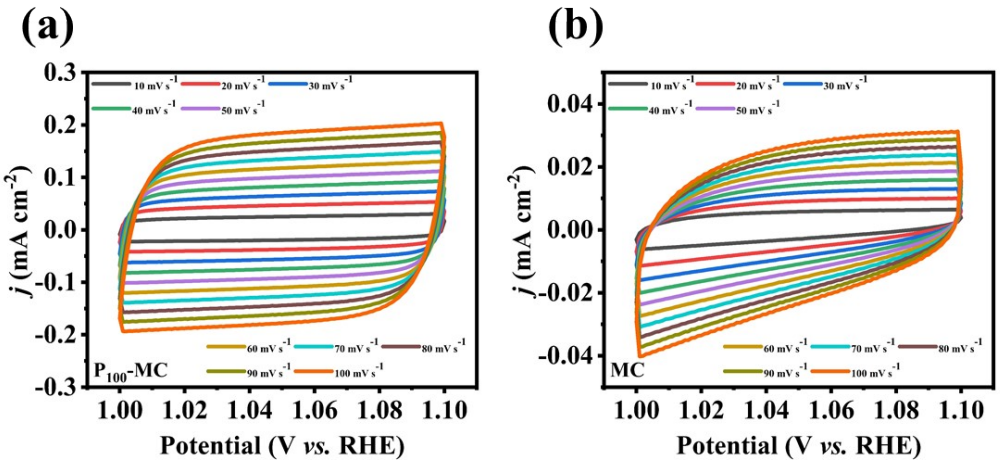

Fig. S8 CV curves of P_{100}-M and MC in 0.1 M KOH at various scanning rates.

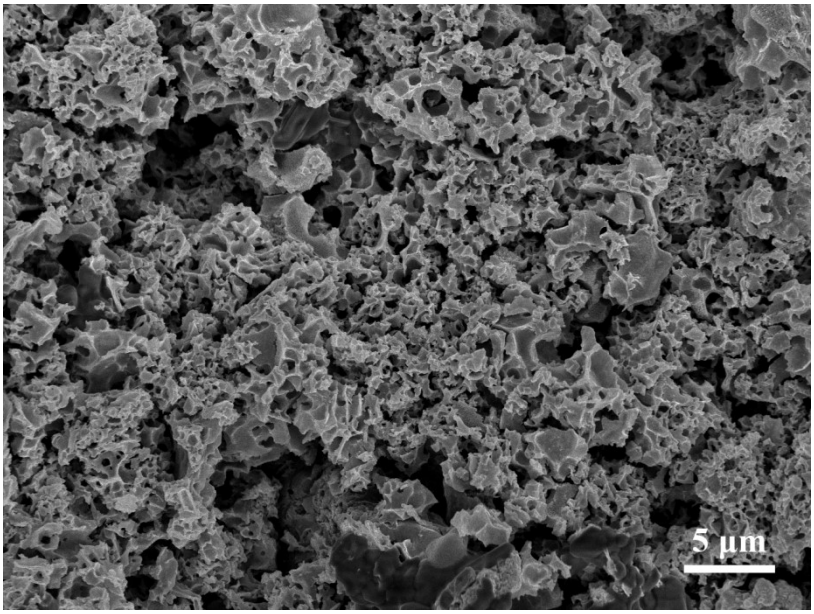

Fig. S9 The SEM image of P_{100}-MC after stability test.

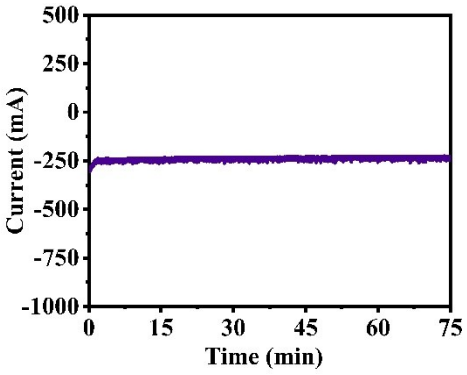

Fig. S10 Time-dependent current density curves over P_{100}-MC at 0.1 V *vs.* RHE for 75 min in 1 M KOH.

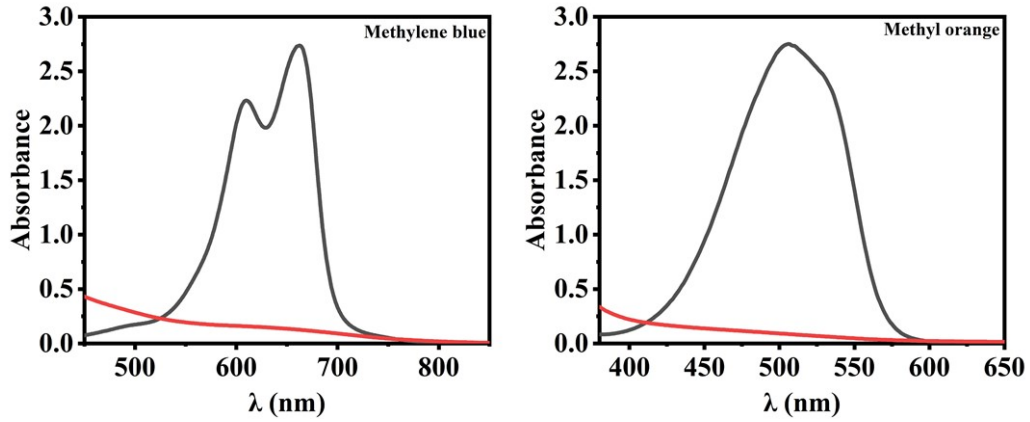

Fig. S11 The UV-vis spectra of MB (left) and MO (right).

Table S1 Comparison of P_{100}-MC with reported catalysts for H_2O_2 production.

Material	Electrolyte	Productivity (mol h^{-1} $g_{cat.}^{-1}$)	FE(%)	Ref.
HNCS	0.1 M KOH	0.62 @0.4 V *vs.* RHE	80% @0.4 V *vs.*RHE	[1]
G-COF-950	0.1 M KOH	1.29 @0.1 V *vs.* RHE	70% @0.1 V *vs.*RHE	[2]
O-P/N-900	0.1 M KOH	0.70 @0.1 V *vs.* RHE	87% @0.1 V *vs.*RHE	[3]
PANI/CDs-Co-2	0.1 M KOH	3.50 @0 V *vs.* RHE	87% @0 V *vs.*RHE	[4]
Ni-NPs/BCCF-20.7	0.1 M KOH	0.17 @0.2 V *vs.* RHE	90% @0.2 V *vs.* RHE	[5]
DGLC	0.1 M KOH	0.36 @0.1 V *vs.* RHE	100% @0.1 V *vs.* RHE	[6]
NHCSs	0.1 M KOH	7.32 @0.5 V *vs.* RHE	97 % @0.5 V *vs.* RHE	[7]
P-Ni/MC	0.1 M KOH	4.40 @0.15 V *vs.* RHE	98% @0.15 V *vs.* RHE	[8]
W_1/NO-C	0.1 M KOH	1.20 @0.2 V *vs.* RHE	95%@0.2 V *vs.* RHE	[9]
Br-Ni MOF	0.1 M KOH	0.60 @0.4 V *vs.* RHE	86%@0.4 V *vs.* RHE	[10]
NOC-6M	0.1 M KOH	0.55 @0.55 V *vs.* RHE	93% @0.55 V *vs.* RHE	[11]
P_{100}-MC	0.1 M KOH	8.41 @0.3 V *vs.* RHE	~99% @0.3 V *vs.* RHE	This work

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