

Supporting Information

***In-situ* Growth of Porous Carbon with Adjustable Morphology on Black Phosphorus Nanosheets for Boosting Electrocatalytic H₂ and O₂ Evolution**

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Tab.S1 The element atomic ratio of the samples measured in the XPS test.

Name	PVP-BP-PC-1	PVP-BP-PC-2
	Atomic ratio %	Atomic ratio %
C 1s	62.62	52.91
P 2p	1.65	0.96
Co 2p	6.55	4.73
N 1s	27.43	26.96
O 1s	1.75	14.45

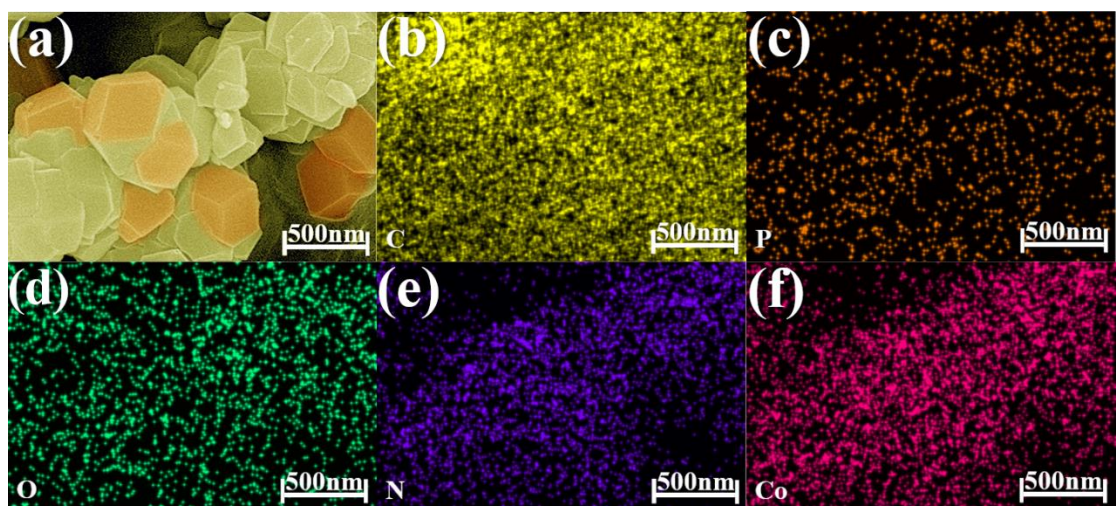


Fig.S1 The surface-scanning SEM of PVP-BP-PC-1.

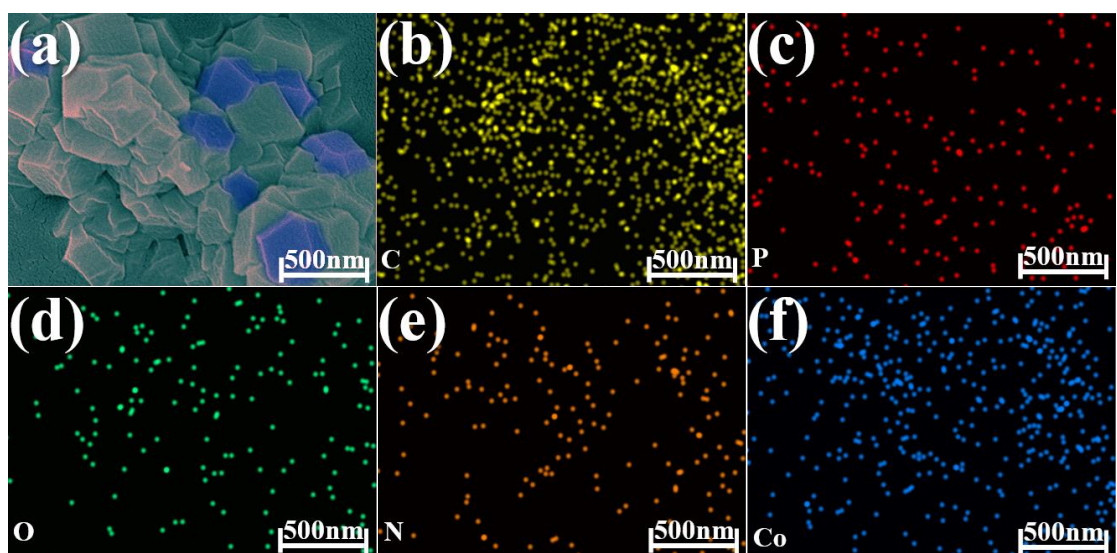


Fig.S2 The surface-scanning SEM of PVP-BP-PC-1.

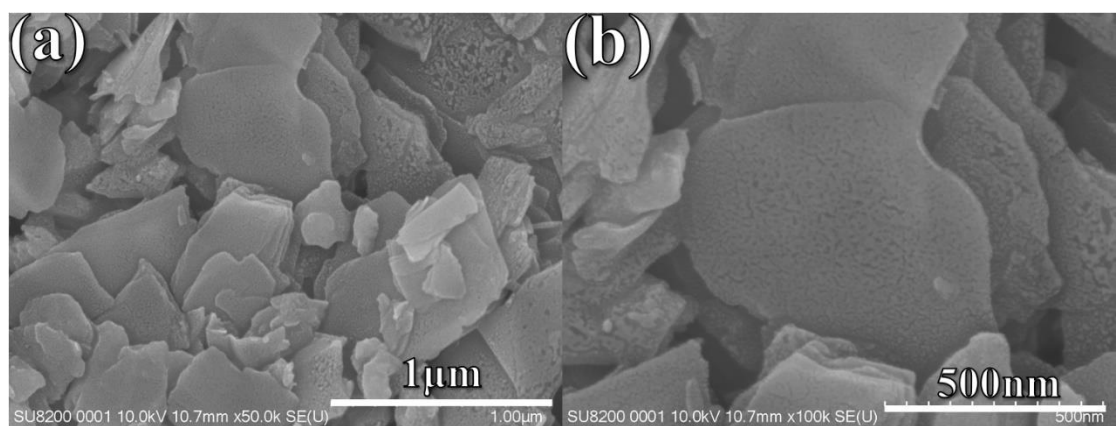


Fig.S3 The SEM images of PVP-BP with different magnifications.

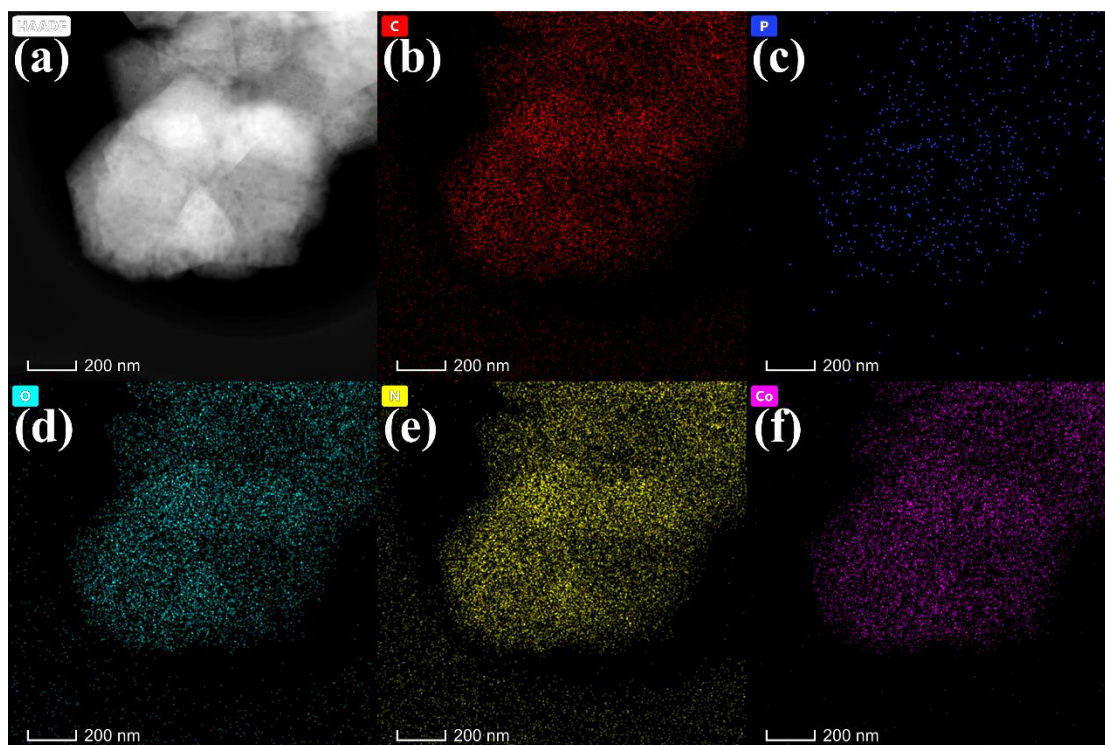


Fig.S4 (a) The STEM-HAADF image. (b-f) The corresponding elements mappings of PVP-BP-PC-1.

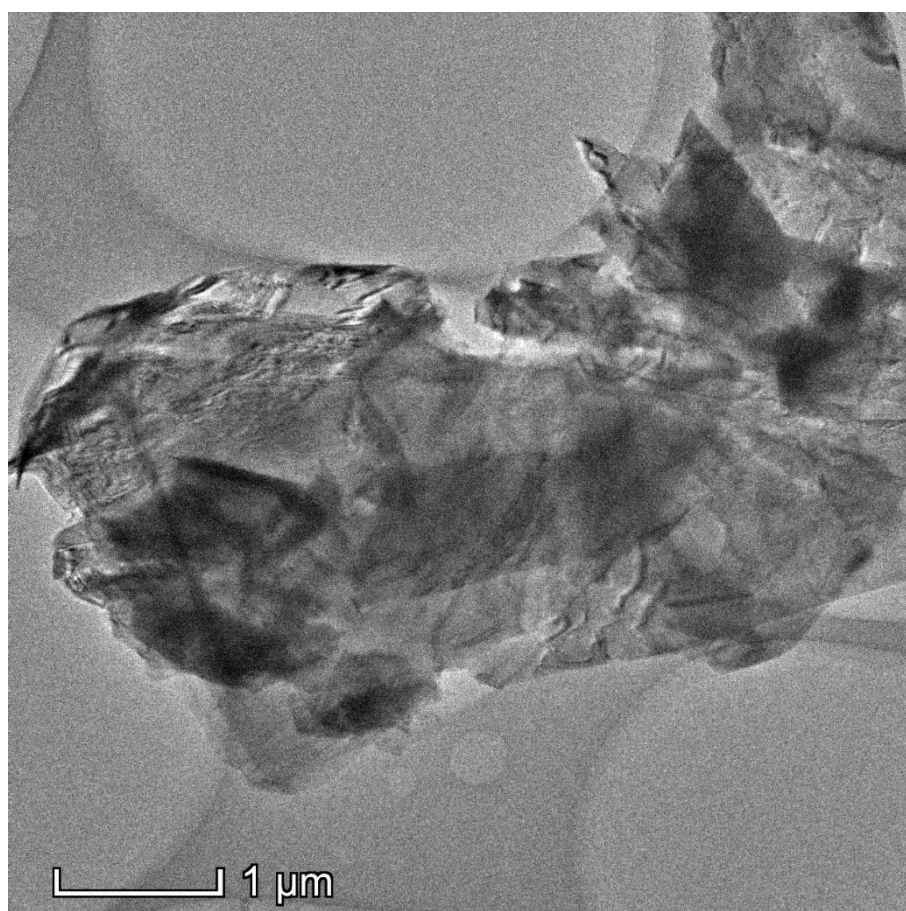


Fig.S5 The low-magnification TEM image of PVP-BP.

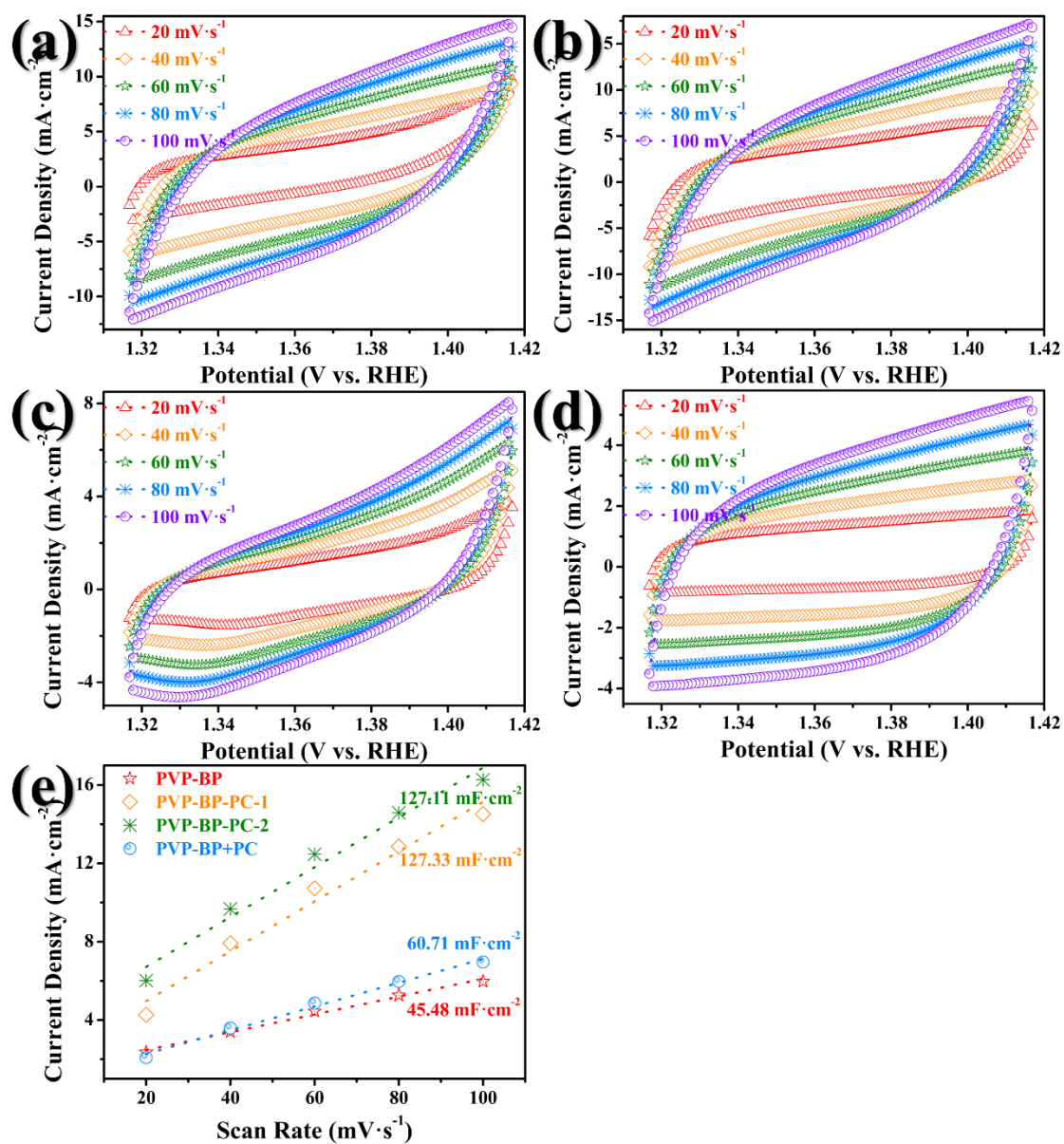


Fig.S6 (a-d) The CV curves of PVP-BP-PC-1, PVP-BP-PC-2, PVP-BP+PC and PVP-BP at different scan rates from 20 $\text{mV} \cdot \text{s}^{-1}$ to 100 $\text{mV} \cdot \text{s}^{-1}$, respectively. (e) The plots of the $\Delta J = (J_a - J_c)$ at 1.3668 V (vs. RHE) against the scan rates.

Tab.S2 The electrocatalytic OER performance of BP-based materials.

Catalysts	Electrolyte	Overpotential (mV) at current density of 10 mA·cm ⁻²	Tafel slope (mV·dec ⁻¹)	R _{ct} (Ω)	Ref.
BP/Ti	0.1M KOH	370	91.52	263.4	[1]
BP/CNT	0.1M KOH	370	72.88	191.4	[1]
Few-layer BP pristine	1M KOH	NA	88	1257	[2]
Few-layer BP 0–500rpm	1M KOH	NA	424	NA	[2]
Few-layer BP 500–1000rpm	1M KOH	NA	212	NA	[2]
Few-layer BP 1000–1500rpm	1M KOH	NA	83	NA	[2]
Few-layer BP above 1500rpm	1M KOH	NA	75	NA	[2]
Co/BP	1M KOH	310	61	NA	[3]
Co(OH) ₂ /BP 5:1	1M KOH	276	57	NA	[4]
S-doped BP	1M KOH	410	75	NA	[5]
Ni ₃ N/BP-AG	1M KOH	233	42	NA	[6]
Ni ₃ N/Ni ₂ P/BP	1M KOH	247	78	14.44	[7]
N-doped BPQDs	1M NaOH	430	48	295	[8]
CoO _x /BPQDs	1M KOH	360	58	NA	[9]
PVP-BP-PC-1	1M KOH	418	79.63	20.88	This work
PVP-BP-PC-2	1M KOH	433	75.51	225.5	This work

Tab.S3 The electrocatalytic HER performance of BP-based materials.

Catalysts	Electrolyte	Overpotential (mV) at current density of 10 mA·cm ⁻²	Tafel slope (mV·dec ⁻¹)	R _{ct} (Ω)	Ref.
BP-Pt/graphene	1M KOH	21	46.9	NA	[10]
BP-Pt/C	1M KOH	31.6	52.6	NA	[10]
PtRu NCs/BP	1M KOH	22	19	2.85	[11]
Pt NCs/BP	1M KOH	64	43	31.7	[11]
BP(Co)	0.5M H ₂ SO ₄	294	107	NA	[12]
BP(Mo)	0.5M H ₂ SO ₄	522	112	NA	[12]
BP(Ni)	0.5M H ₂ SO ₄	691	116	NA	[12]
30%Cu/BP	0.5M H ₂ SO ₄	90	139	NA	[13]
NH ₂ -BP	1M KOH	290	63	41.2	[14]
CH ₂ COO-BP	0.1M NaOH	690	370	NA	[15]
CN-BP	0.5M H ₂ SO ₄	148	79	24	[16]
Ni ₂ P/BP	0.5M H ₂ SO ₄	107	38.6	NA	[17]
Ni ₂ P NP/BP	0.5M H ₂ SO ₄	185	81	80.9	[18]
PVP-BP-PC-1	1M KOH	190	97.86	20.88	This work
PVP-BP-PC-2	1M KOH	238	71.54	225.5	This work

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