Platinum Atoms and Nanoparticles Embedded Porous Carbons for Hydrogen Evolution Reaction

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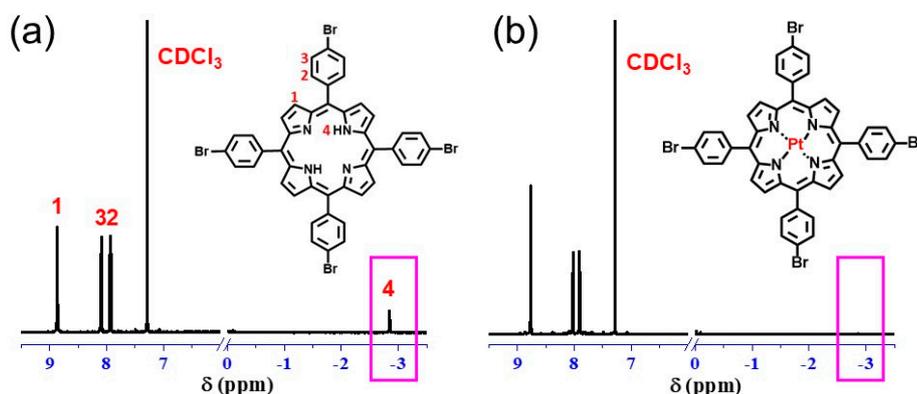
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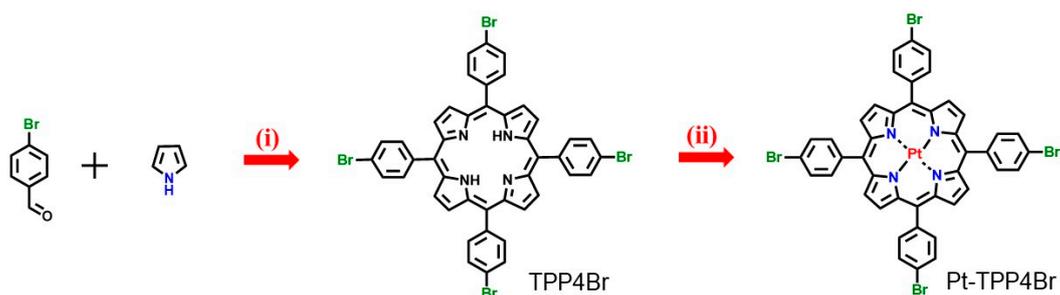
Scheme S1. Synthesis route to Pt-TPP4Br. (i) nitrobenzene and acetic acid; (ii) PtCl₂, PhCN.

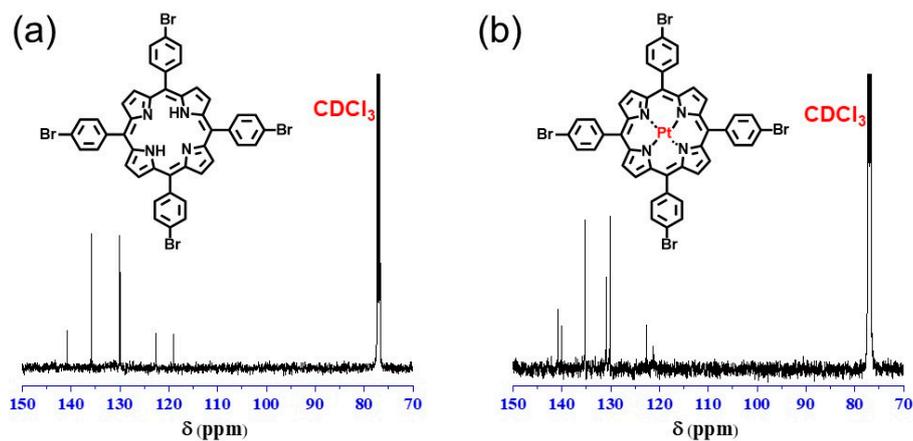**Figure S1.** ^{1}H NMR spectra of TPP4Br (**a**) and Pt-TPP4Br (**b**).

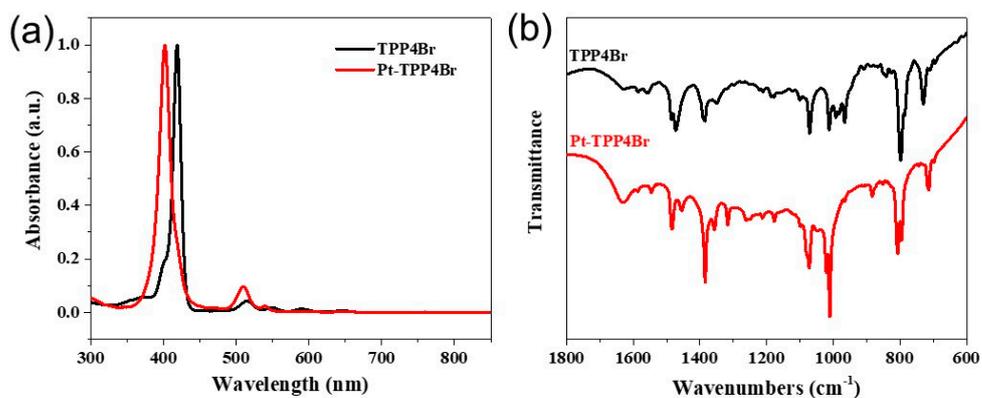**Figure S2.** ^{13}C NMR spectra of TPP4Br (**a**) and Pt-TPP4Br (**b**).

Figure S3. UV-vis spectra (**a**) and FTIR spectra (**b**) of TPP4Br and Pt-TPP4Br.

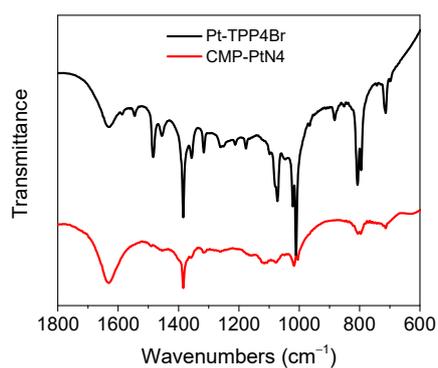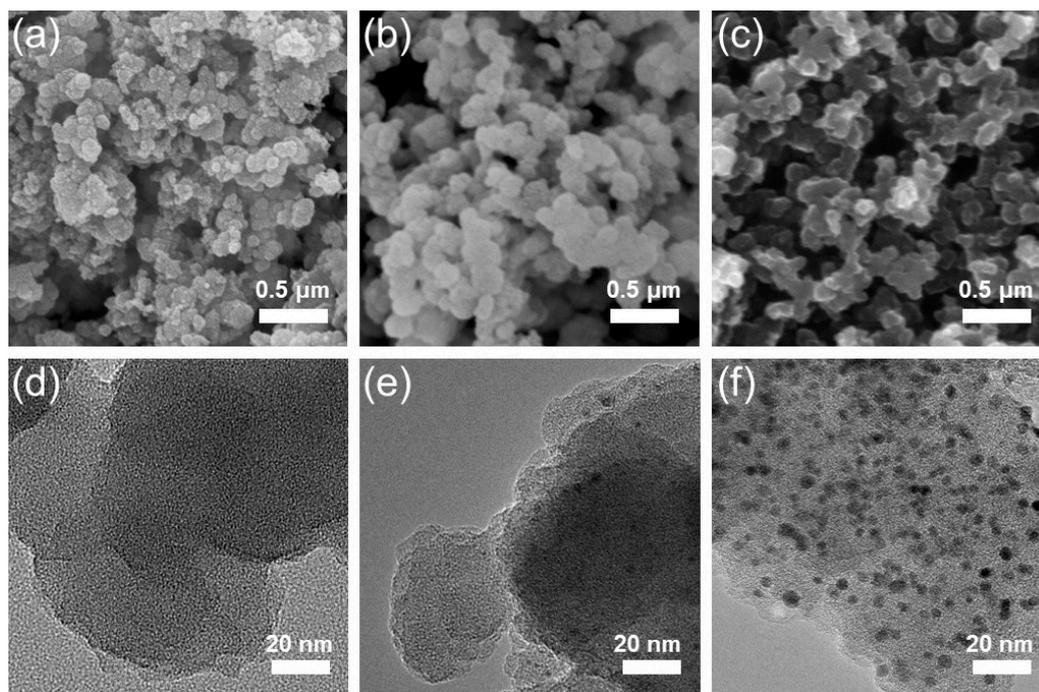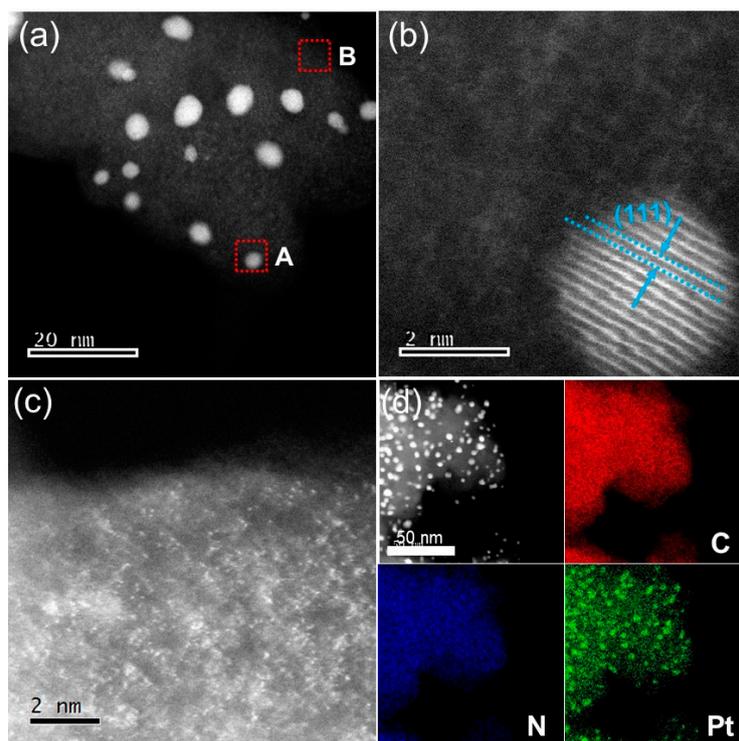**Figure S4.** Comparison of the FTIR spectra of Pt-TPP4Br and CMP-PtN4.

**Figure S5.** SEM images (**a**, **b**, **c**) and TEM images (**d**, **e**, **f**) for CMP-PtN4, PC-PtN4-600, and PC-PtN4-900, respectively.


Figure S6. Morphology and elemental analysis of PC-PtN4-900. HAADF-STEM image (**a**). High-resolution HAADF-STEM images acquired from the select area A (**b**) and B (**c**) in (**a**). The HAADF-STEM image and corresponding elemental mapping of C, N, Pt (**d**).
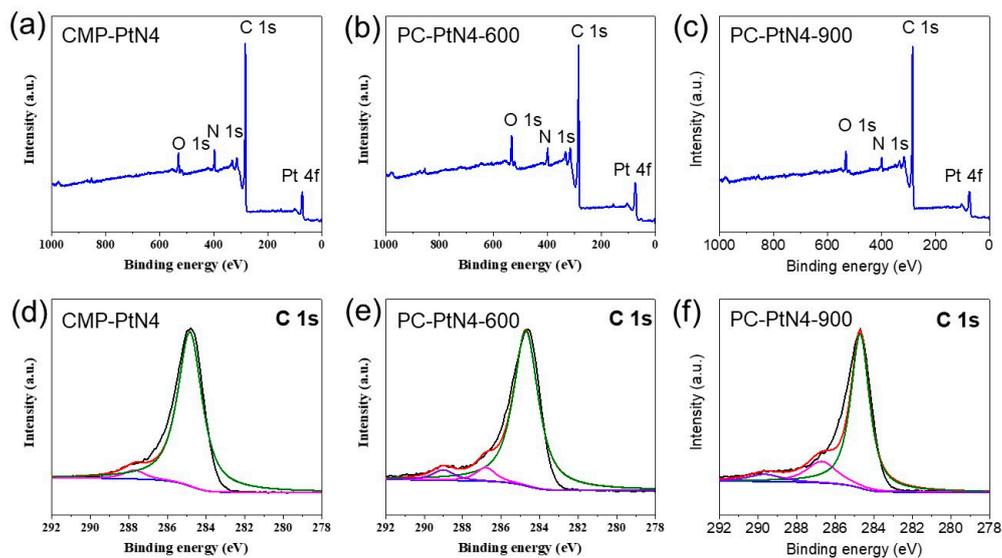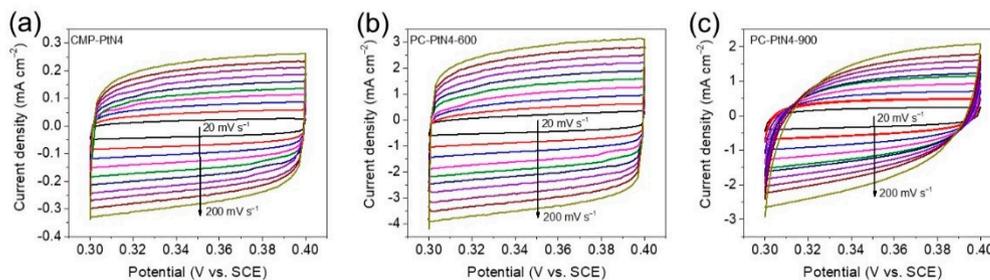
Figure S7. XPS survey (**a**, **b**, **c**) and C 1s XPS spectra (**d**, **e**, **f**) for CMP-PtN4, PC-PtN4-600, and PC-PtN4-900, respectively.
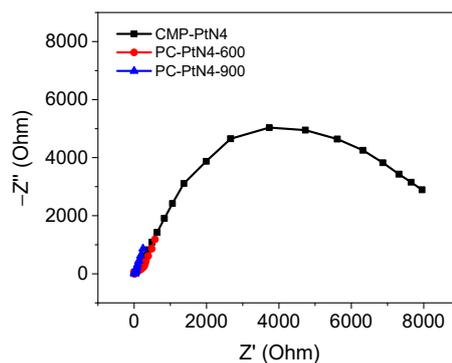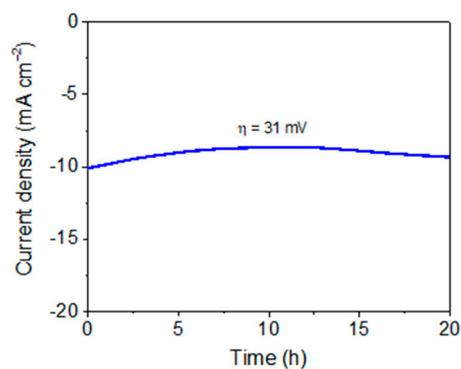

**Figure S8.** Nyquist plots of CMP-PtN4, PC-PtN4-600, and PC-PtN4-900.
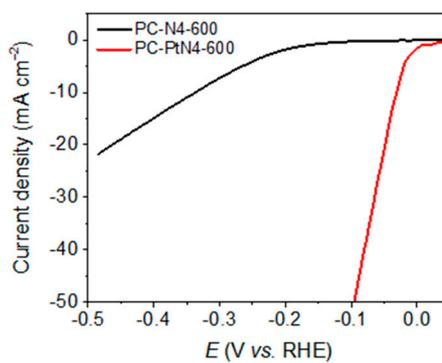
Figure S9. HER polarization curves of PC-PtN4-600 compared with PC-N4-600.

Figure S10. CV curves of CMP-PtN4 (**a**), PC-PtN4-600 (**b**), and PC-PtN4-900 (**c**) with different scan rates from 20 to 200 mV s^{-1} in the region of 0.3–0.4 V vs SCE.

Figure S11. The time-dependent current density curve of PC-PtN4-600 was obtained at a constant overpotential of $\eta = 31$ mV for 20 h under acidic conditions (0.5 M H_2SO_4).
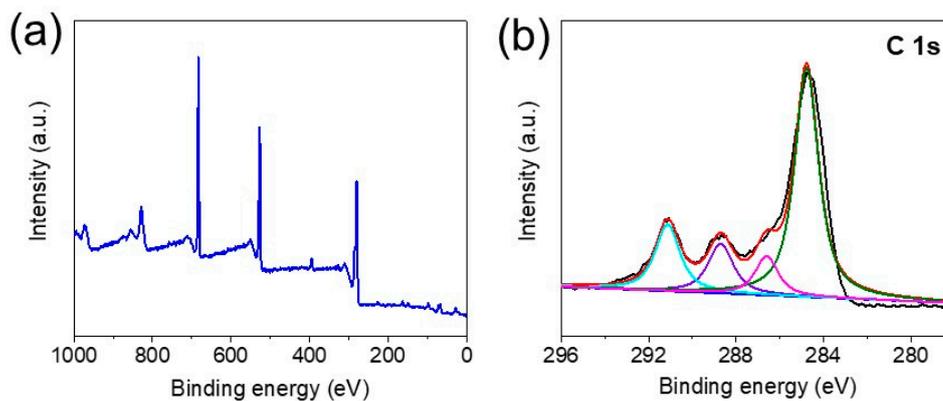
Figure S12. XPS survey (**a**) and C 1s XPS spectrum (**b**) of PC-PtN4-600 after stability test.
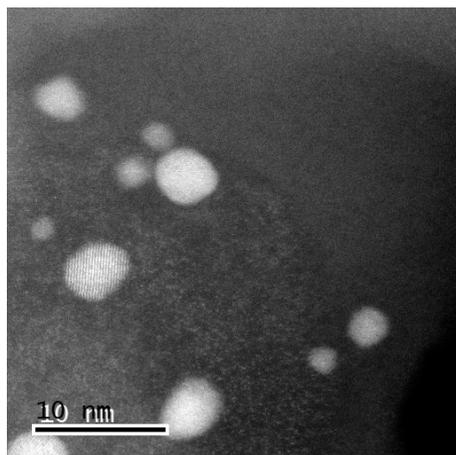
Figure S13. HAADF-STEM image of PC-PtN4-600 after ADT.

Table S1. C, N and Pt content of the as-prepared samples calculated by XPS.

Sample	C (wt.%)	N (wt.%)	Pt (wt.%)
CMP-PtN4	72.22	9.02	18.77
PC-PtN4-600	74.32	6.98	18.70
PC-PtN4-900	74.80	6.26	18.94

Table S2. Textural parameters of the as-prepared samples based on nitrogen physisorption.

Sample	S_{BET} $(m^2\ g^{-1})$	S_{micro} $(m^2\ g^{-1})$	V_{total} $(cm^3\ g^{-1})$	V_{micro} $(cm^3\ g^{-1})$	D (nm)
CMP-PtN4	681	531	0.50	0.29	2.9
PC-PtN4-600	429	371	0.24	0.19	3.9
PC-PtN4-900	236	152	0.22	0.08	3.5