

Supporting Information

Rapid Synthesis of Size-Tunable Transition Metal Carbide Nanodots under Ambient Condition

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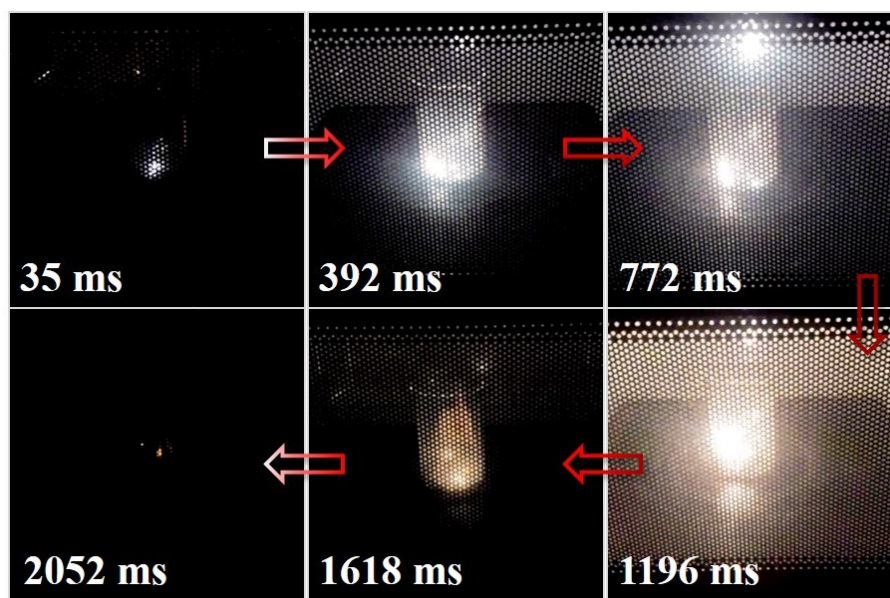


Figure S1. Optical images of the sample during microwave treatment with the time interval labeled as two seconds.

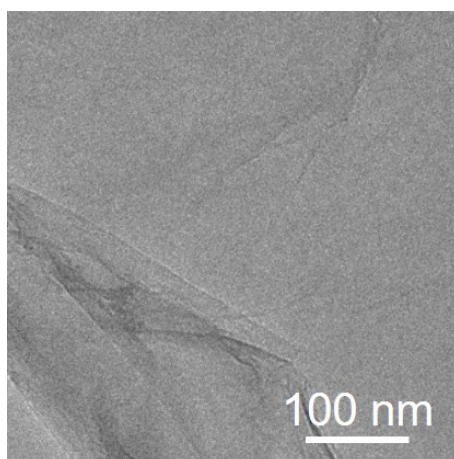


Figure S2. The TEM image of pure GO sample.

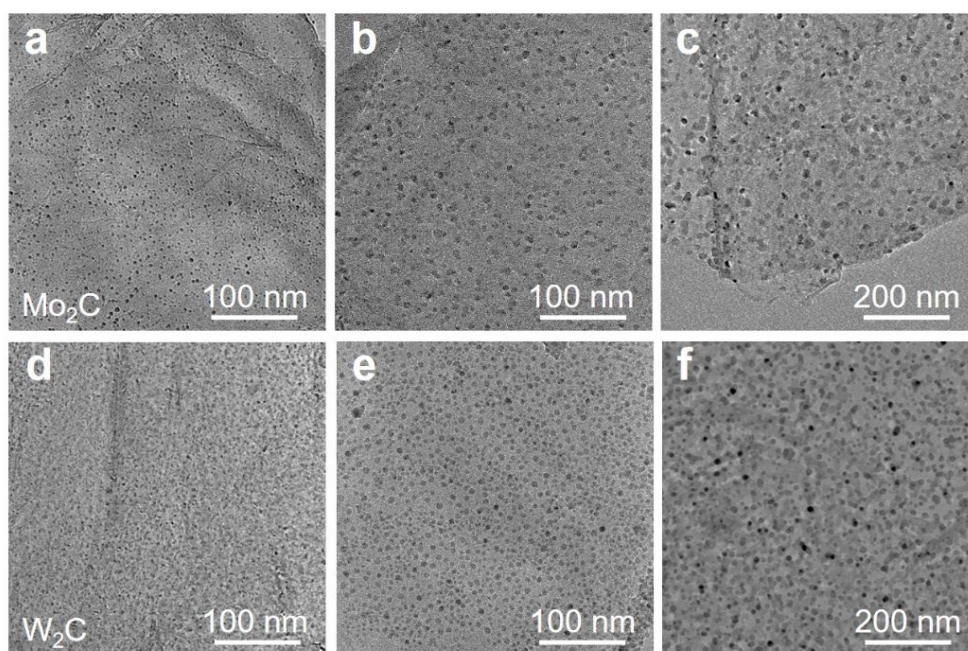


Figure S3. (a-c) TEM images of Mo₂C nanodots achieved by different concentrations of peroxomolybdic acid: (a) 0.3 mL, (b) 0.5 mL, (c) 0.7 mL, respectively. (d-f) TEM images of W₂C nanodots achieved by different concentrations of peroxotungstic acid: (d) 0.3 mL, (e) 0.5 mL, and (f) 0.7 mL, respectively.

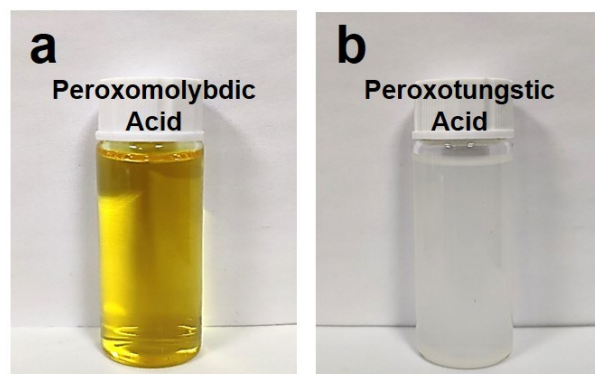


Figure S4. The optical images of (a) Peroxomolybdic acid and (b) Peroxotungstic acid

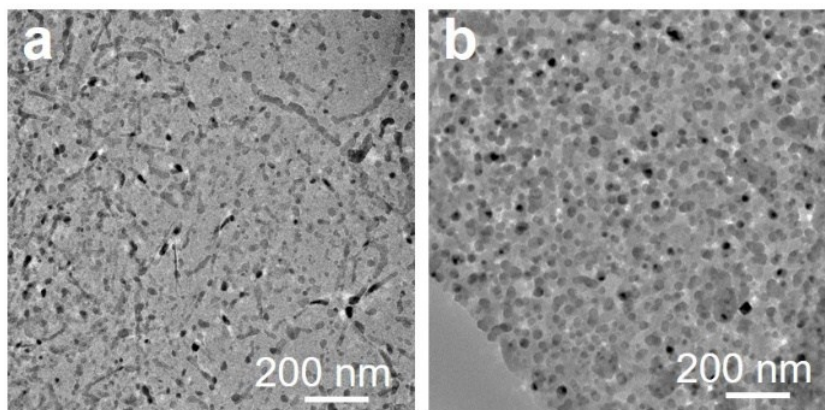


Figure S5. (a) TEM images of Mo_2C achieved by 1 mL peroxomolybdic acid after 120 s microwave treatment. (b) TEM images of W_2C nanodots achieved by 1 mL peroxotungstic acid after 90 s microwave treatment.

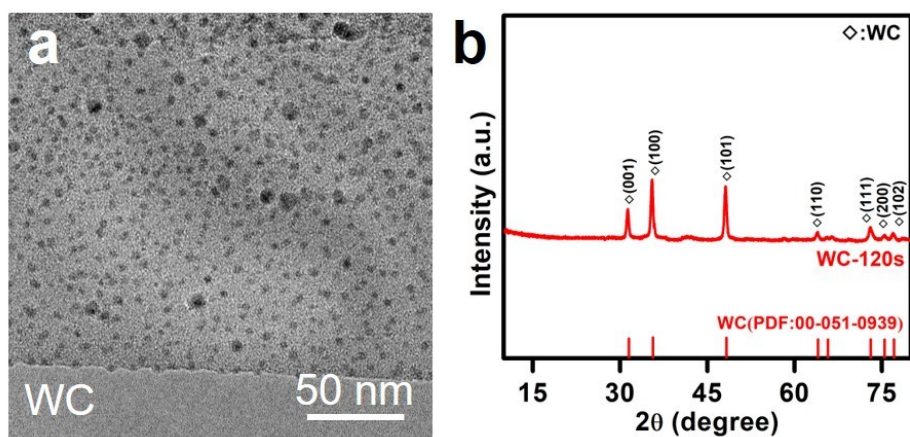


Figure S6. (a) TEM images of WC nanodots achieved by 0.3 mL peroxotungstic acid after 120 s microwave time. (b) XRD pattern of the as-synthesized WC nanodots.

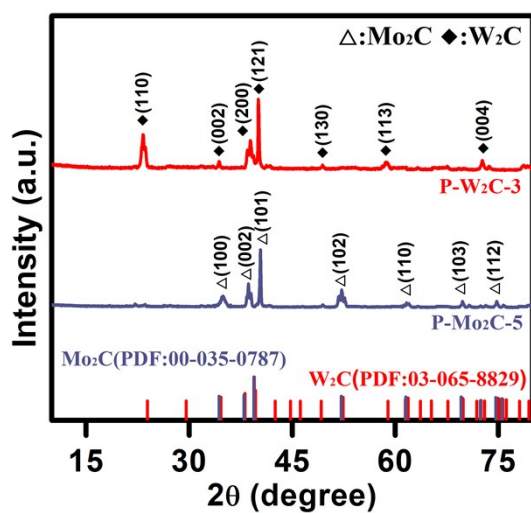


Figure S7. The XRD patterns of the hybrid composites fabricated by precursors of phosphomolybdic acid and phosphotungstic acid after microwave treatment for 120 s and 90 s, respectively.

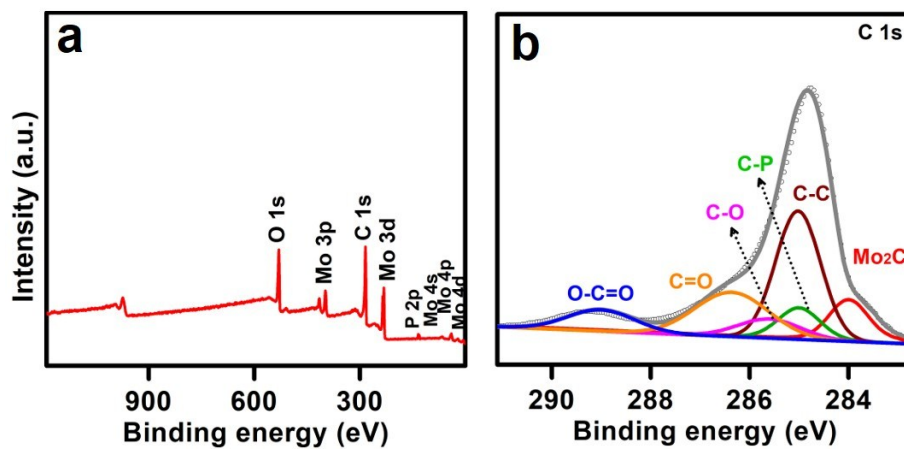


Figure S8. (a) The XPS survey spectra and (b) High-resolution XPS spectra of C 1s for P-Mo₂C-5 sample.

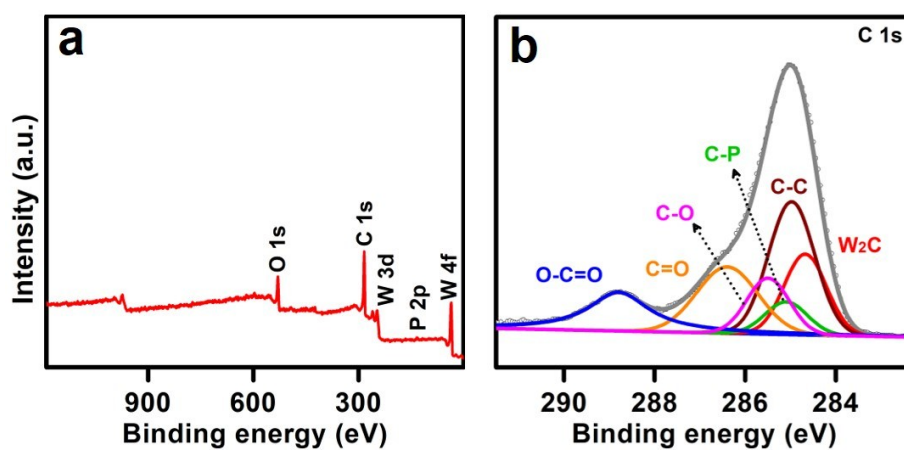


Figure S9. (a) The XPS survey spectra and (b) High-resolution XPS spectra of C 1s for P-W₂C-3 sample.

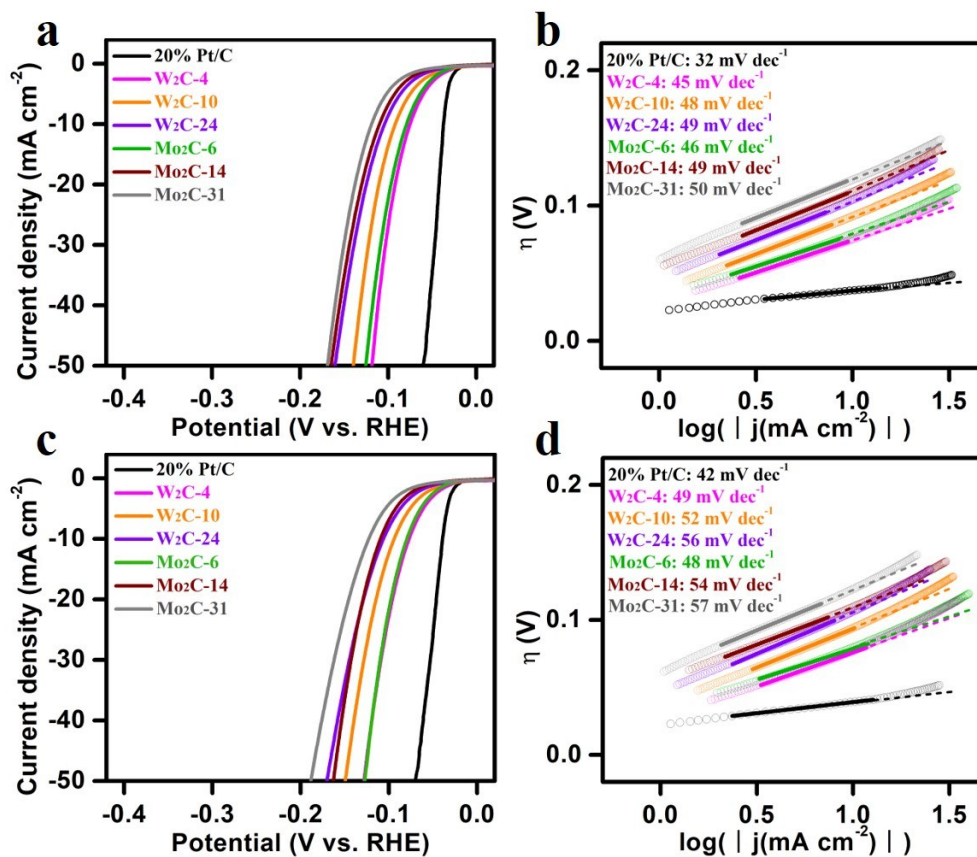


Figure S10. (a) Polarization curves and (b) Tafel plots of 20% Pt /C, W₂C-4, W₂C-10, W₂C-24, Mo₂C-6, Mo₂C-14 and Mo₂C-31 samples in 0.5 M H₂SO₄. (c) Polarization curves and (d) Tafel plots of 20% Pt /C, W₂C-4, W₂C-10, W₂C-24, Mo₂C-6, Mo₂C-14 and Mo₂C-31 samples in 0.1 M KOH.

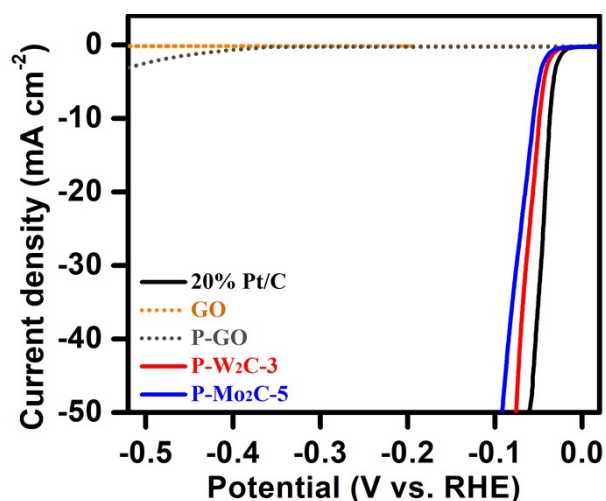


Figure S11. Polarization curves of 20% Pt /C, pure GO, P-doped GO, P-W₂C-3 and P-Mo₂C-5 samples in 0.5 M H₂SO₄.

Peak	Position BE (eV)	Atomic Conc %	Mass Conc %
O 1s	530.700	7.20	4.85
C 1s	284.550	82.25	21.63
P 2p	132.200	1.26	1.64
Mo 3d	230.050	9.29	71.88

Table S1. The ratios of O, C, P, Mo elements of XPS in phosphorus doped Mo₂C and graphene composites.

Peak	Position BE (eV)	Atomic Conc %	Mass Conc %
O 1s	530.550	8.27	6.09
C 1s	284.400	80.53	5.05
P 2p	133.000	0.84	1.20
W 4f	33.100	10.36	87.66

Table S2. The ratios of O, C, P, W elements of XPS in phosphorus doped W₂C and graphene composites.

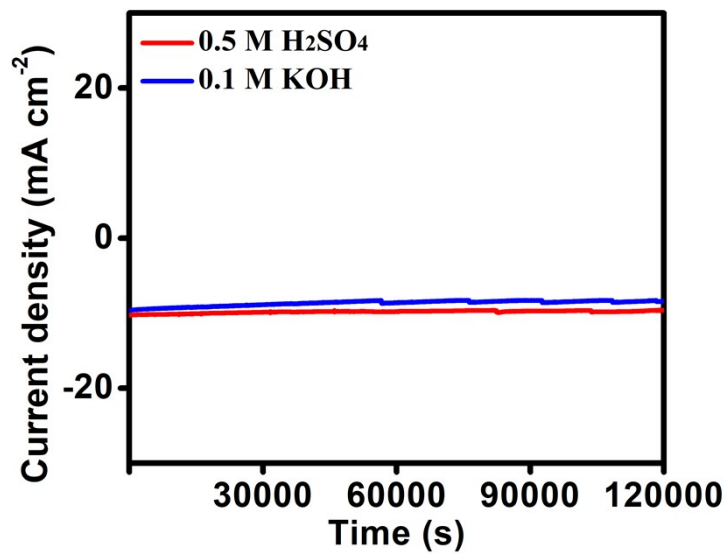


Figure S12. The long-term durability tests of P-W₂C-3 sample at $\eta=60$ mV.

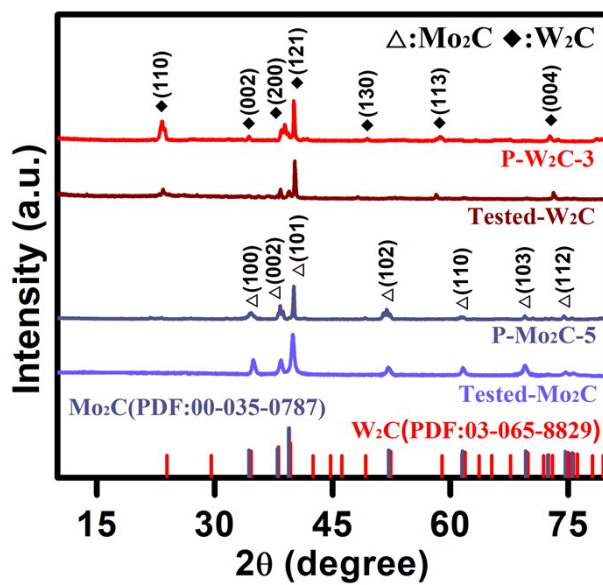


Figure S13. The XRD patterns of P-W₂C-3 and P-Mo₂C-5 before and after stability test in acid media.

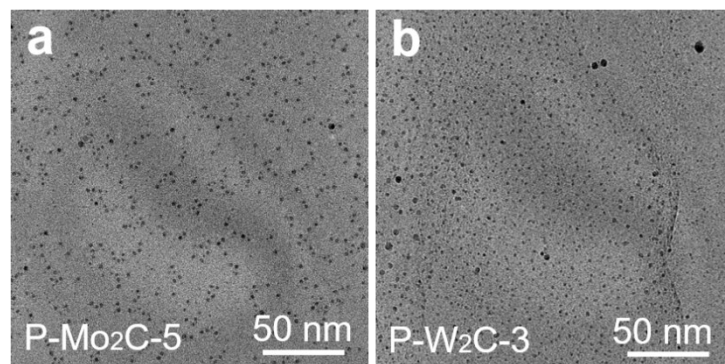


Figure S14. (a) TEM image of the P-Mo₂C-5 sample after HER in 0.5 M H₂SO₄. (b) TEM image of the P-W₂C-3 sample after stability test in 0.5 M H₂SO₄.