Supporting Information

Low Pt-loaded electrode electrochemical synthesized from bulk metal for electrocatalytic applications

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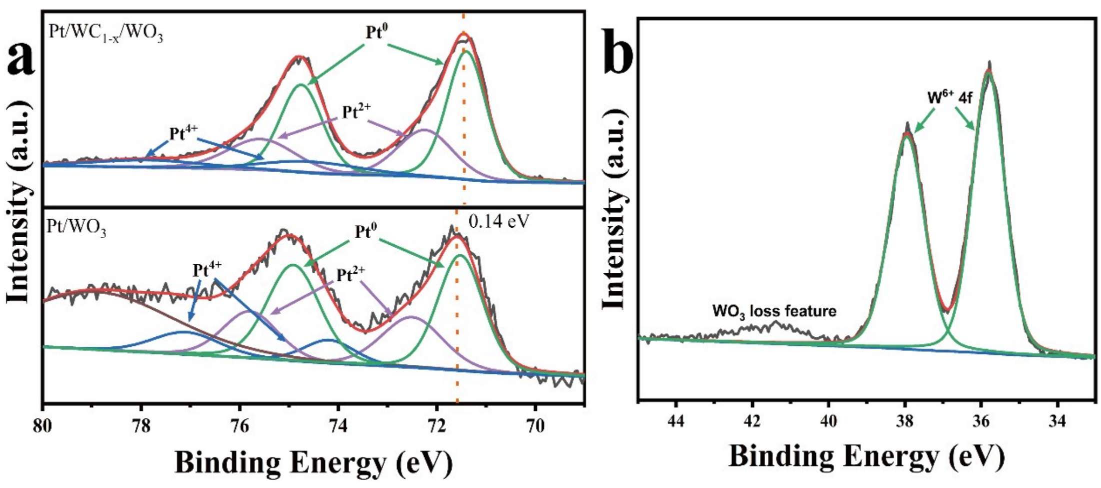

Fig. S1. XPS spectra : (a)Pt 4f for $Pt/WC_{1-x}/WO_3$ and Pt/WO_3, (b)W 4f for Pt/WO_3.

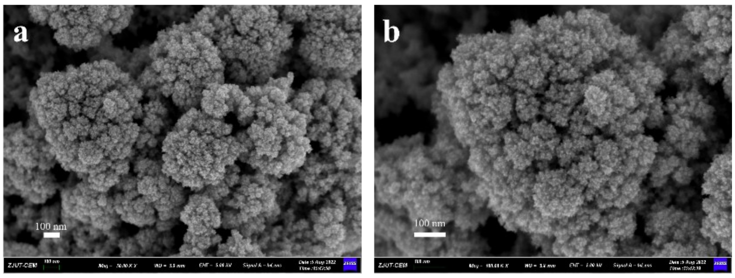

Fig. S2. (a-b) SEM images of the Pt/WO_3 nanocomposites.

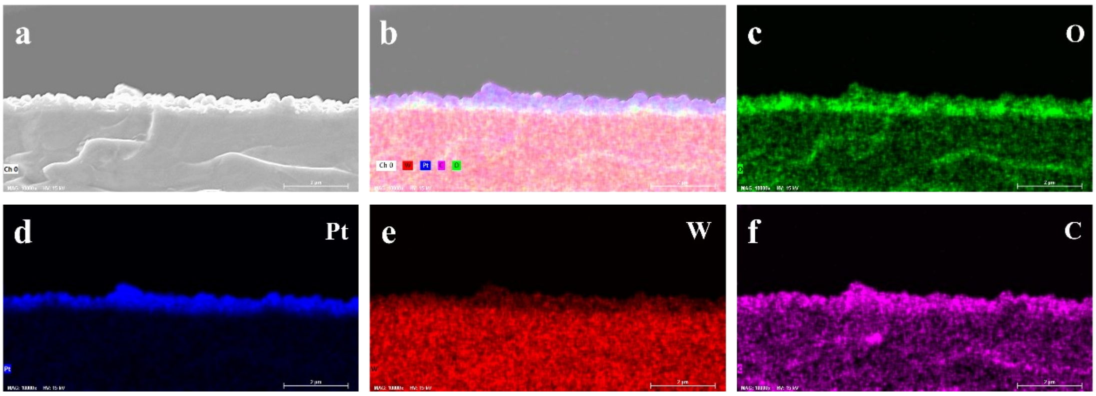

Fig. S3. (a-f) EDS element mapping images of $Pt/WC_{1-x}/WO_3$.

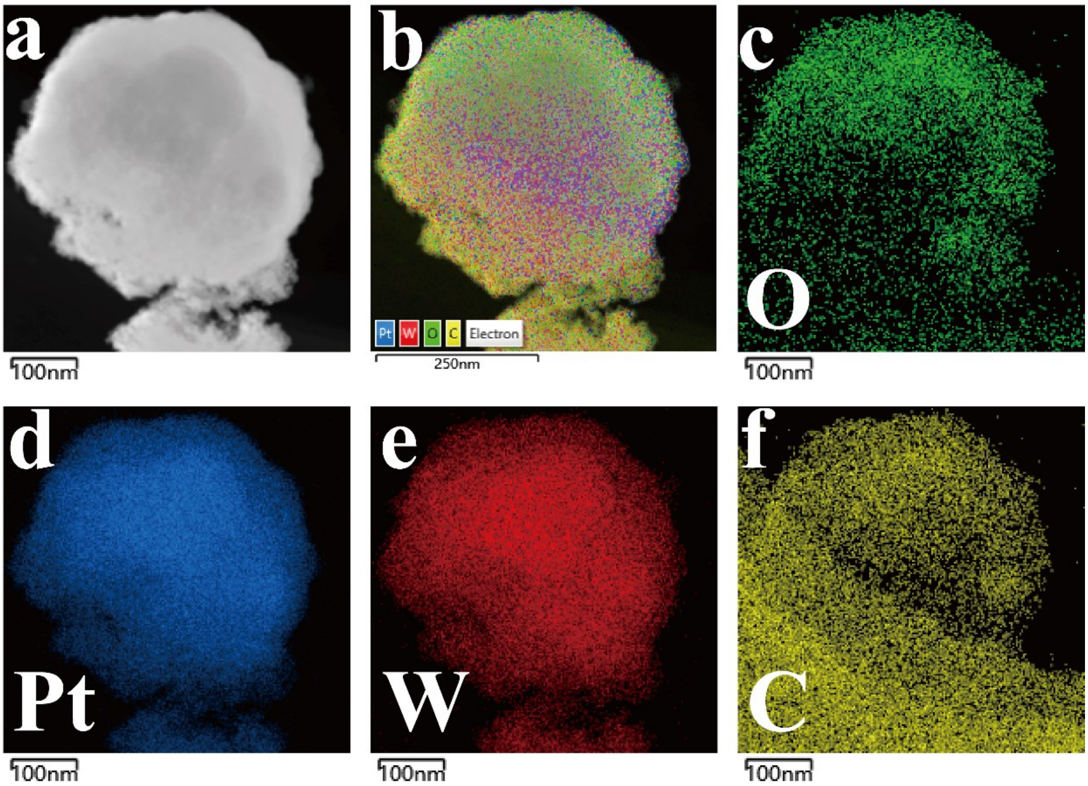

Fig. S4. (a-f) HAADF-STEM and corresponding elements mapping images of $Pt/WC_{1-x}/WO_3$.

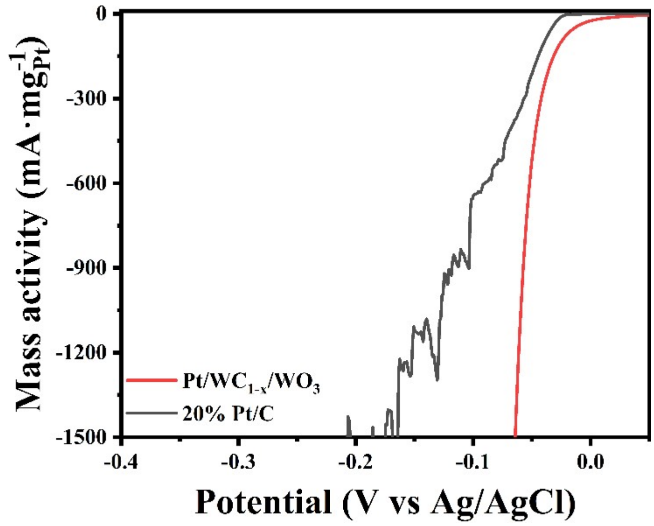

Fig. S5. Current densities normalized Pt mass at different potentials for Pt/WC_{1-x}/WO_3 and Pt/C.

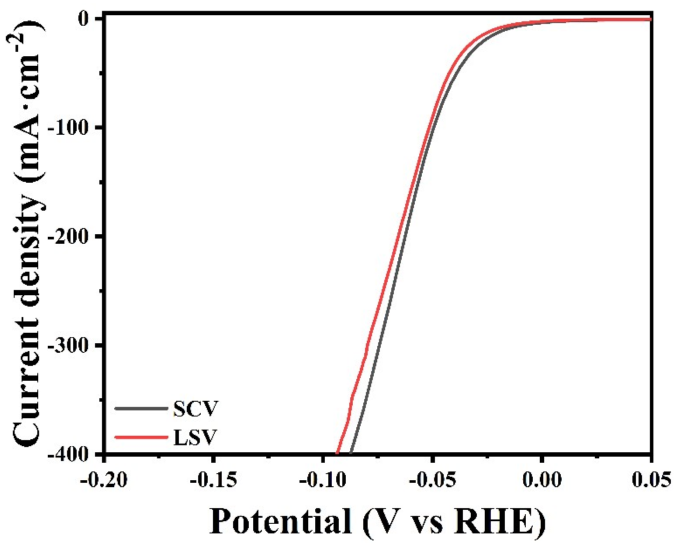

Fig. S6. SCV and LSV curves of Pt/WC_{1-x}/WO_3

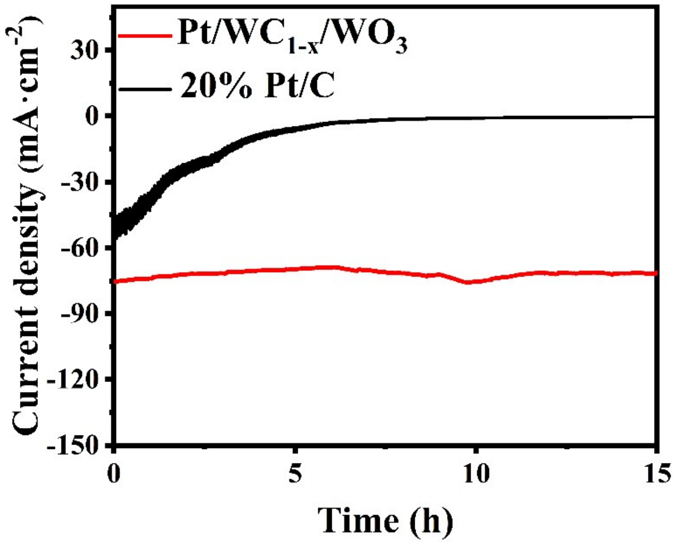

Fig. S7. Comparison of $Pt/WC_{1-x}/WO_3$ and 20% Pt/C chronoamperometry curves (i–t).

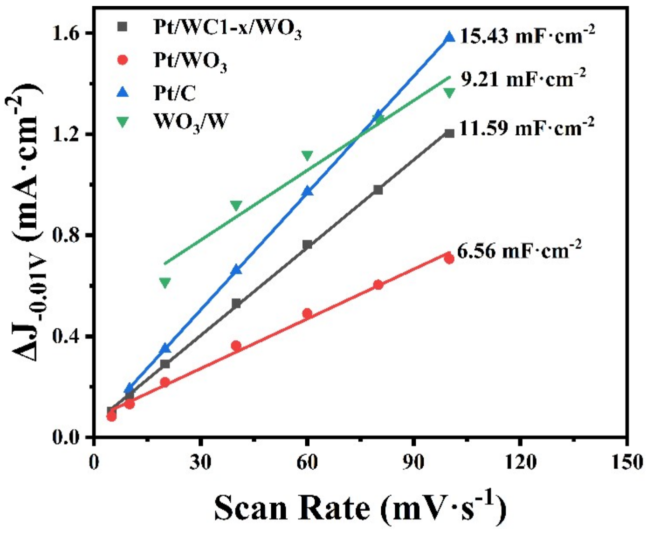

Fig. S8. Double-layer capacitances (C_{dl}) for HER comparison of $Pt/WC_{1-x}/WO_3$, along with 20% Pt/C, and Pt/WO_3.

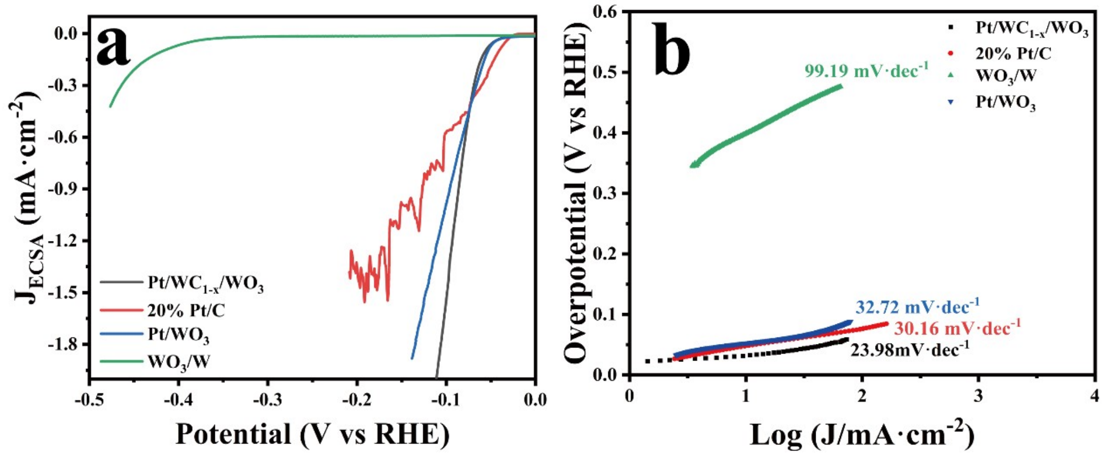

Fig. S9. (a) LSV curves normalized by ECSA; (b) Tafel plots of the LSV curves normalized by geometric area.

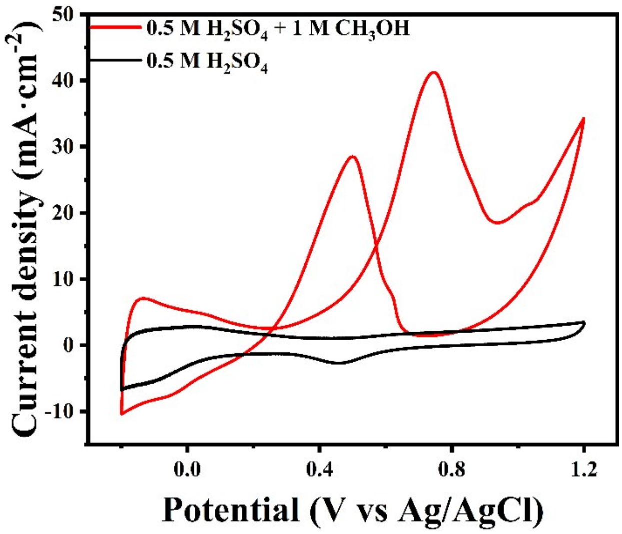

Fig. S10. CV curves of $Pt/WC_{1-x}/WO_3$ in 0.5 M H_2SO_4 + 1 M CH_3OH and 0.5 M H_2SO_4.

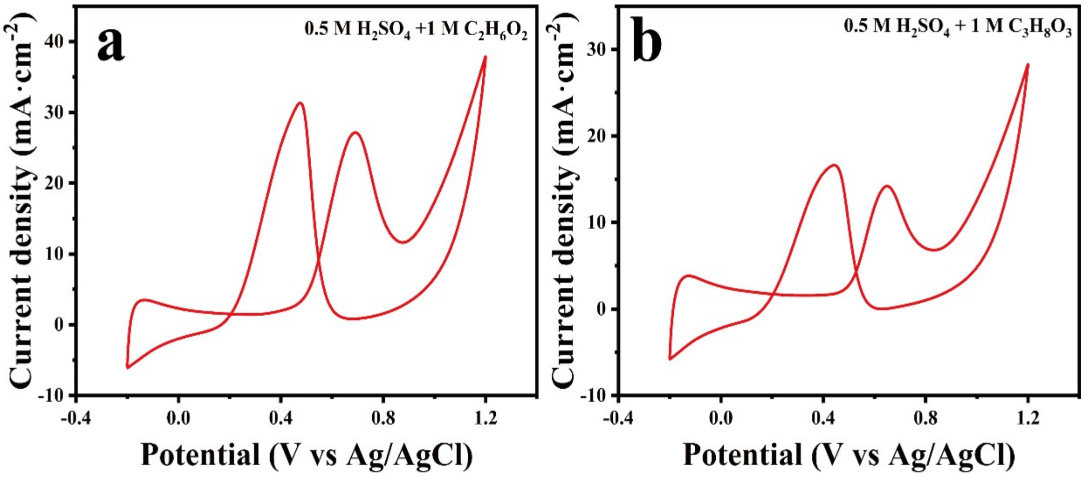

Fig. S11. (a) CV curves of $Pt/WC_{1-x}/WO_3$ in 0.5 M H_2SO_4 + 1 M $C_2H_6O_2$ normalized by the surface geometric area; (b) CV curves of $Pt/WC_{1-x}/WO_3$ in 0.5 M H_2SO_4 + 1 M $C_3H_8O_3$ normalized by the surface geometric area.

Table S1 ICP-OES of $Pt/WC_{1-x}/WO_3$.

(m_0-Sample quality, V_0- constant volume, C_0- Test Solution Element Concentration, C_1- Concentration of elements in digestion solution/original sample solution, C_x- Sample Elemental Content)

	m_0 (g)	**V_0 (mL)**	**test element**	**C_o (mg/L)**	**dilution factor**	**C_1 (mg/L)**	**C_x (mg/kg)**	**W (%)**
$Pt/WC_{1-x}/WO_3$	0.0571	25	Pt	1.40	1	1.40	610.90	0.06%

Table S2 Summary of recently reported catalysts for MOR in acidic electrolytes.

catalyst	electrolyte	Mass activity (A·mg-1 Pt)	Ref
$Pt/WC_{1-x}/WO_3$	0.5 M H_2SO_4 +1 M CH_3OH	1.18	This work
20% Pt/C	0.5 M H_2SO_4 +1 M CH_3OH	0.48	This work
Au@Ni@PtNiAu	0.5 M H_2SO_4 +1 M CH_3OH	0.35	Nano Energy 2018, 52, 22-28
Pt-Au NWs	0.1 M $HClO_4$ +1 M CH_3OH	1.04	Nano Lett. 2023, 23, 7, 2758–2763
Pt-Ag DSNCs	0.5 M H_2SO_4 +1 M CH_3OH	0.567	Appl. Catal. B Environ. 2021, 282,119595
$PtNi_3$-NGA	0.5 M H_2SO_4 +1 M CH_3OH	0.98	Green Chem. 2023. 25. 3198
CoFe@Pt-NCs	0.5 M H_2SO_4 +1 M CH_3OH	0.91	J. Mater. Chem. A, 2022, 10, 13345
$Pt_1/Ti_{0.8}W_{0.2}N_xO_y$	0.5 M H_2SO_4 +1 M CH_3OH	0.56	Electrochim. Acta 432 (2022) 141161
PtPdCo MHNPs	0.5 M H_2SO_4 +1 M CH_3OH	0.91	Nanoscale 2019, 11, 4781-4787
CuNi@PtCu OCs	0.1 M $HClO_4$+1.0 M CH_3OH	1.01	Angew. Chem. Int. Ed. 2021, 133, 7753-7758
AL-Pt/Pt_3Ga	0.5 M H_2SO_4 +1 M CH_3OH	1.094	J. Am. Chem. Soc. 2018, 140, 2773-2776
PtBi/fcc-Pt NSs	0.1 M $HClO_4$+0.1 M CH_3OH	1.1	ACS Catal. 2018, 8, 5581-5590
GDY@PtCu	0.5 M H_2SO_4 +1 M CH_3OH	0.7	Nano Today 39 (2021) 101213
Pt-Pt_5P_2 PNCs	0.5 M H_2SO_4 +1 M CH_3OH	1.37	Adv. Funct. Mater. 2022, 32, 2205985
PtCo/N-CNT-M	0.5 M H_2SO_4 +1 M CH_3OH	0.767	Nanoscale, 2022, 14,14199–14211