Electronic Supplementary Information

Designed Synthesis of WC-based Nanocomposites as Lowcost, Efficient and Stable Electrocatalysts for Hydrogen Evolution Reaction

Zepeng Lv^{1,2}, Dong Liu¹, Weiqian Tian³, Jie Dang^{1,2,*}

¹College of Materials Science and Engineering, Chongqing University, Chongqing 400044, PR China

²Chongqing Key Laboratory of Vanadium-Titanium Metallurgy and New Materials,

Chongqing University, Chongqing 400044, PR China

³Department of Fibre and Polymer Technology, KTH Royal Institute of Technology,

Teknikringen 56, 10044 Stockholm, Sweden

*Corresponding author: Jie Dang

E-mail: jiedang@cqu.edu.cn

Phone: +86-23-65112631; Fax: +86-23-65112631

Address: College of Materials Science and Engineering, Chongqing University,

Chongqing 400044, PR China

Zepeng Lv ORCID: https://orcid.org/0000-0001-5696-9978

Jie Dang ORCID: https://orcid.org/0000-0003-1383-8390



Figure S1. XRD patterns of final products obtained in Ar atmosphere. (0-WC)



Figure S2. XRD patterns of final products obtained in H₂ atmosphere.



Figure S3. SEM images of (a) GO (graphene oxide) and final products at (b) 900°C, (c) 800°C, (d) 700°C, (e) 600°C.



Figure S4. TEM image of WC@rGO obtained at 900°C.



Table S1. BET surface areas of the final products obtained under different conditions.

Figure S5. XPS spectra of the Pt-WC@rGO: (a) survey, (b) W 4f, (c) O 1s, (d) C 1s, (e) Pt 4f and (f) the XRD patterns of the catalysts (rGO-supported Pt-WC/WC nanoparticles).



Figure S6. (a) TEM images of Pt-WC@rGO and the selected area electron diffraction (SAED) patterns of Pt-WC@rGO layers (inset); (b) HAADF-STEM images of Pt-WC@rGO; and Mapped images from the corresponding EDS analysis of Pt-WC@rGO; (c) EDS analysis of Pt-WC@rGO; (d) HRTEM images of Pt-WC@rGO.



Figure S7. XPS survey spectrum of the WC@rGO and GO.



Figure S8. Electrochemically active surface area measurements. CV curves measured from 2 to 6 mV s⁻¹ of corresponding materials in (a) 0.5 M H₂SO₄ and (b) 1.0 M KOH. The capacitive currents (Δj) were plotted as a function of scan rate, and the plot was linear-fitted to calculate double layer capacitance (C_{dl}) by the equation of C_{dl}=slope/2.



Figure S9. Nyquist plots of different electrodes at an overpotential of 180 mV in 1.0M KOH.

Electrolyte	Electrode	$R_{s}\left(\Omega ight)$	$R_{ct}(\Omega)$
0.5M H ₂ SO ₄	WC@rGO	1.60	9.41
	WC	2.13	15.24
	Mo ₂ C	1.84	25.95
	GO	1.48	15.65
	Pt@C	1.20	11.68
	Pt-WC@rGO	2.07	8.15
1.0M KOH	WC@rGO	1.75	11.09
	WC	1.97	9.05
	Mo ₂ C	2.54	12.12
	GO	1.49	14.38
	Pt@C	1.76	11.06
	Pt-WC@rGO	2.25	8.63

Table S2. Electrochemical properties of different electrocatalysts.