

Supplementary information

Investigation of enhanced electro-catalytic HER/OER performances of copper tungsten oxide@reduced graphene oxide nanocomposites in alkaline and acidic media

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Supplementary data:

Figure S-1: XRD analysis of pure (a) CuWO_4 nanoparticles and (b) rGO sheets.

Figure S-2. EDAX studies equipped with TEM (a) without sample and (b) with sample.

Figure S-3. CV curves of the CuWO_4 @rGO nanocomposites in 0.5M KOH for HER.

Figure S-4. CV curves of the CuWO_4 @rGO nanocomposites in 0.5M H_2SO_4 for HER.

Figure S-5. CV sweeps of the CuWO_4 @rGO nanocomposites in 0.5M KOH for OER.

Figure S-6. CV sweeps of the CuWO_4 @rGO nanocomposites in 0.5M H_2SO_4 for OER.

Figure S-7. Cyclic stability of the CuWO_4 @rGO electrodes in 0.5M KOH at 50 mV/s.

Figure S-8. Plot for energy loss during CA measurements at fixed anodic potentials with time.

Figure S-9. (a) FTIR, (b) SEM and (c) TEM analysis of CuWO_4 @rGO nanocomposites after electro-catalysis for OER in alkaline electrolyte.

Table S-1: Experimental details and results of the synthesized CuWO_4 @rGO nanocomposites for HER

Table S-2: Experimental details and results of the synthesized CuWO_4 @rGO nanocomposites for OER

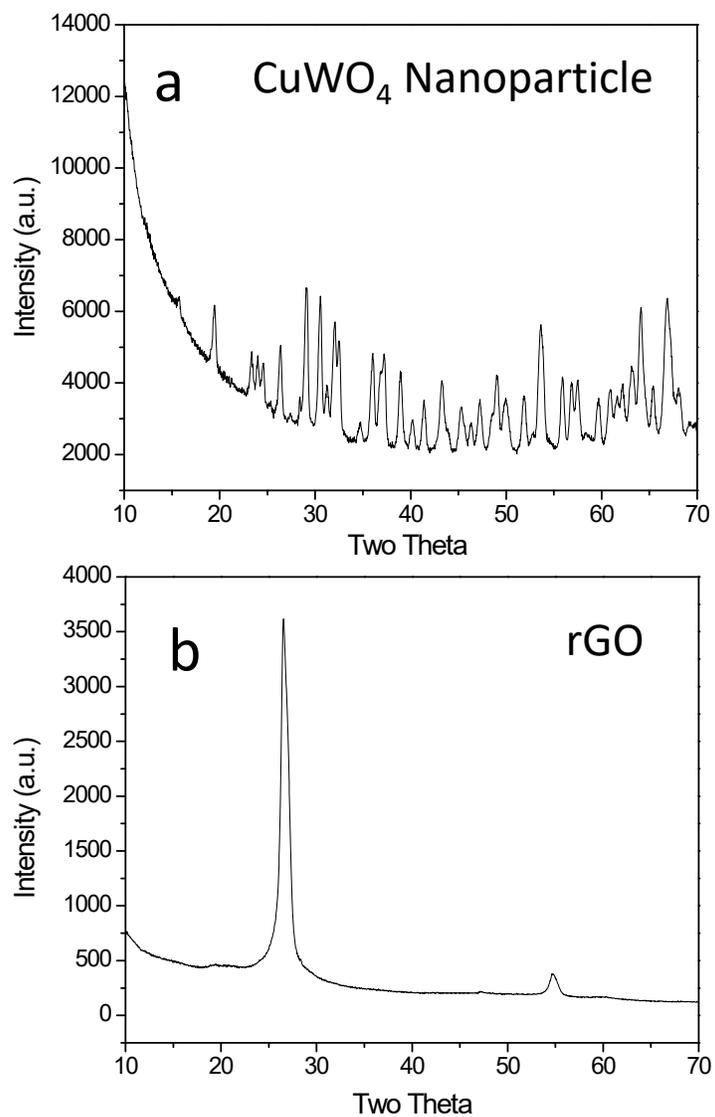


Figure S-1: XRD analysis of pure (a) CuWO₄ nanoparticles and (b) rGO sheets.

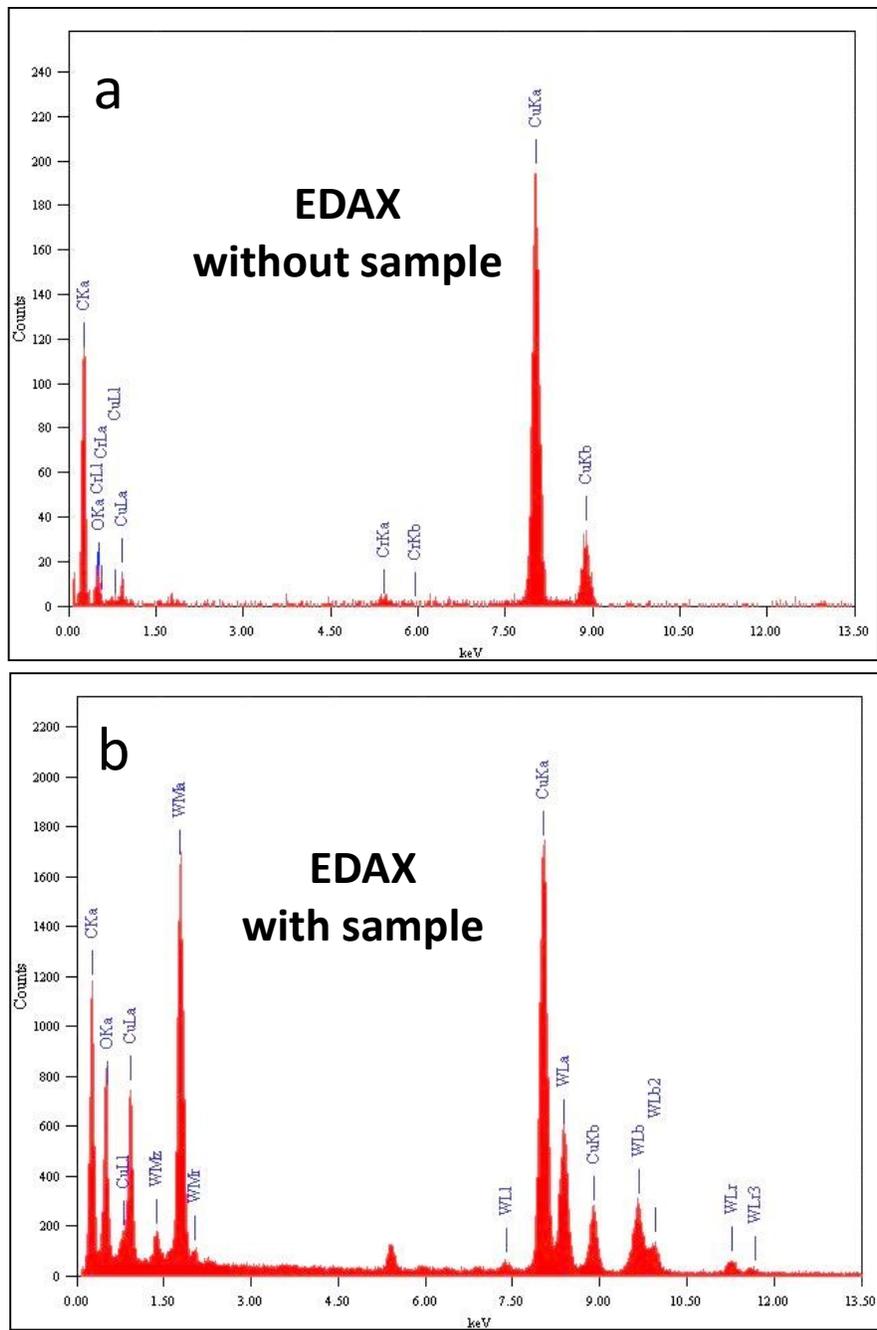


Figure S-2. EDAX studies equipped with TEM (a) without sample and (b) with sample.

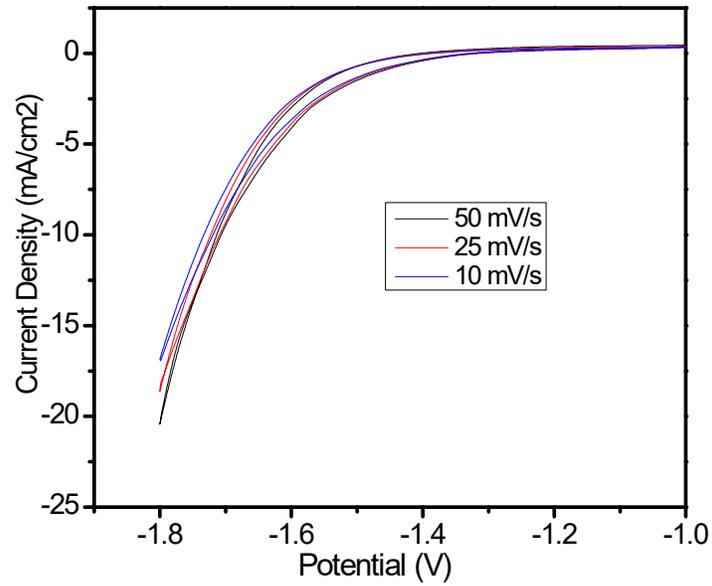


Figure S-3. CV curves of the CuWO₄@rGO nanocomposites in 0.5M KOH for HER.

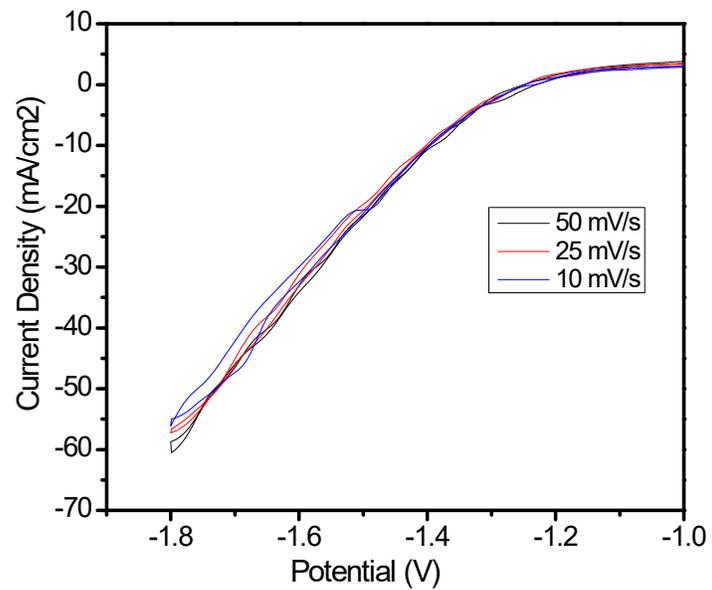


Figure S-4. CV curves of the CuWO₄@rGO nanocomposites in 0.5M H₂SO₄ for HER.

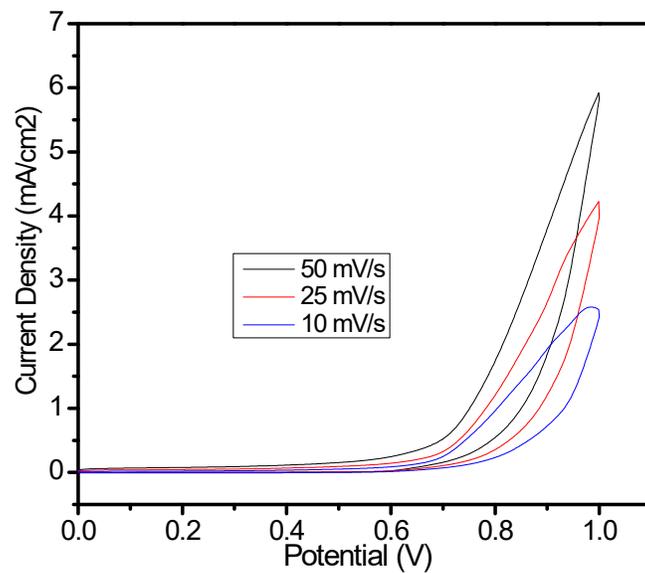


Figure S-5. CV sweeps of the CuWO₄@rGO nanocomposites in 0.5M KOH for OER.

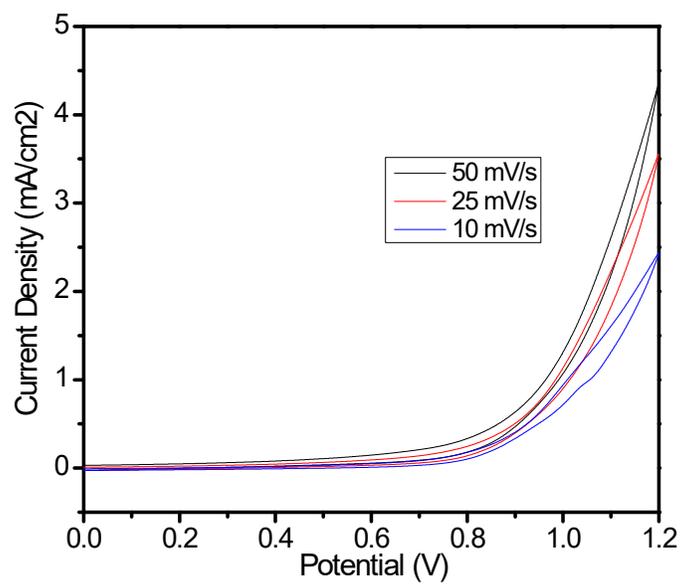


Figure S-6. CV sweeps of the CuWO₄@rGO nanocomposites in 0.5M H₂SO₄ for OER.

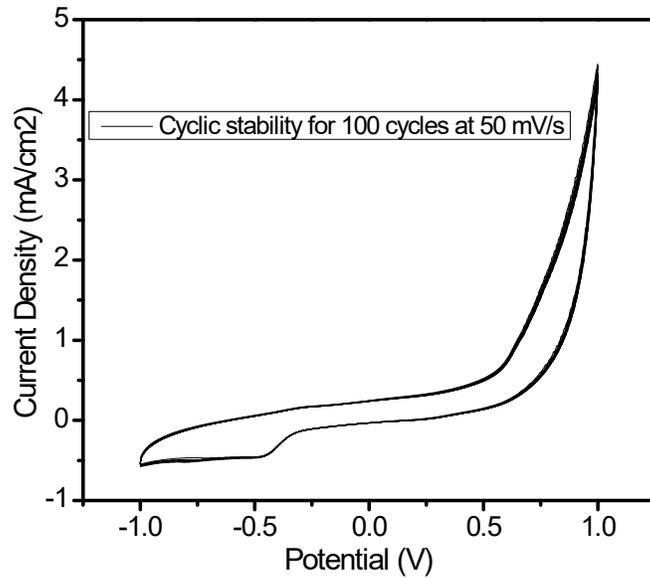


Figure S-7. Cyclic stability of the CuWO₄@rGO electrodes in 0.5M KOH at 50 mV/s.

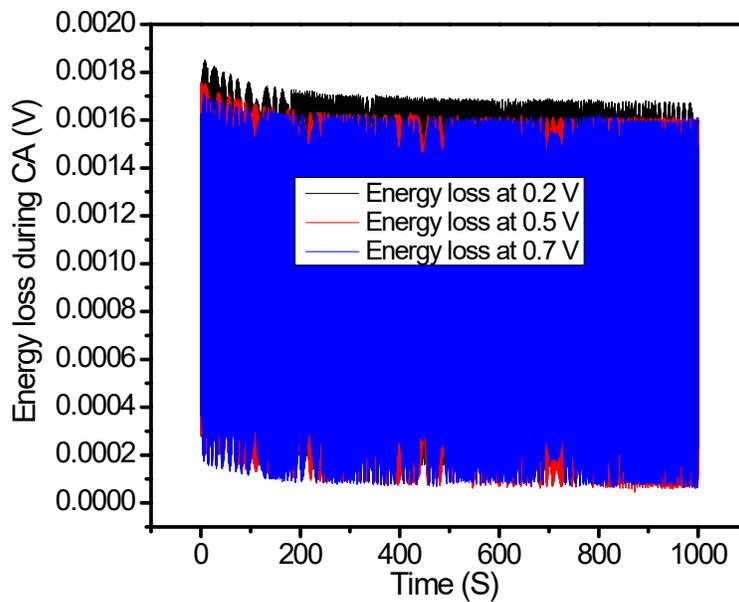


Figure S-8. Plot for energy loss during CA measurements at fixed anodic potentials with time.

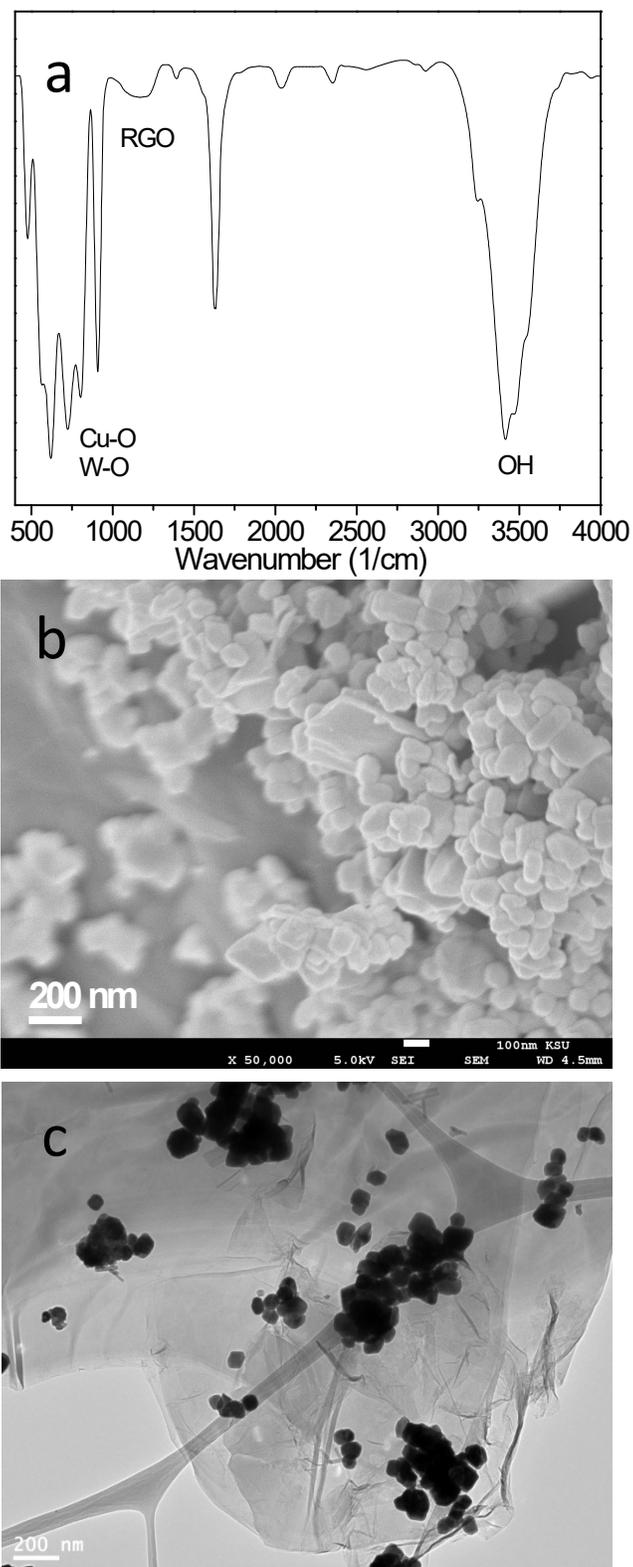


Figure S-9. (a) FTIR, (b) SEM and (c) TEM analysis of CuWO₄@rGO nanocomposites after electro-catalysis for OER in alkaline electrolyte.

Table S-1: Comparison of present experimental details and results of the synthesized $\text{CuWO}_4@\text{rGO}$ nanocomposites for HER against previous reports.

Electrolyte	Working Electrode	Reference Electrode	Tafel	References
0.5M KOH	Glassy Carbon with $\text{CuWO}_4@\text{rGO}$ nanocomposites	Ag/AgCl	~212 mV/dec	Present work
0.5M H_2SO_4	Glassy Carbon with $\text{CuWO}_4@\text{rGO}$ nanocomposites	Ag/AgCl	~192 mV/dec	Present work
0.5M H_2SO_4	Glassy Carbon with ZnMoO_4	Ag/AgCl	~230 mV/dec	Materials Letters, 2021, 284, 128996
0.1 M KOH	Glassy Carbon with $\text{NiWO}_4@\text{rGO}$	Ag/AgCl	~250 mV/dec	Materials Letters, 2019, 240, 51-54
0.1 M KOH	Glassy Carbon with NiWO_4	Ag/AgCl	~475 mV/dec	Materials Letters, 2019, 240, 51-54
1 M KOH	Screen-printed carbon electrodes with SrWO_4	Hg/HgO	138 – 167 mV/dec	Journal of the Taiwan Institute of Chemical Engineers, 2021, 126, 145-153
0.5 M H_2SO_4	Carbon paper with commercial CoWO_4 and $\text{CoWO}_{4-x}@\text{C}$	Hg/HgO	225 – 254 mV/dec	Applied Catalysis B: Environmental, 2019, 259, 118090

Table S-2: Comparison of present experimental details and results of the synthesized $\text{CuWO}_4@\text{rGO}$ nanocomposites for OER against previous reports.

Electrolyte	Working Electrode	Reference Electrode	Tafel	References
0.5M KOH	Glassy Carbon with $\text{CuWO}_4@\text{rGO}$ nanocomposites	Ag/AgCl	~110 mV/dec	Present work
0.5M H_2SO_4	Glassy Carbon with $\text{CuWO}_4@\text{rGO}$ nanocomposites	Ag/AgCl	~315 mV/dec	Present work
1.0 M KOH	Glassy Carbon with CuWO_4 nanoparticles	Ag/AgCl	~190 mV/dec	ChemElectroChem, 2018, 5, 3938-3945
0.5 M KOH	Glassy Carbon with $\text{Cu-Ni}@\text{rGO}$ nanoparticles	Ag/AgCl	~190 mV/dec	Materials Letters, 2020, 260, 126969
0.5 M KOH	Glassy Carbon with Cu-Ni nanoparticles	Ag/AgCl	~378 mV/dec	Materials Letters, 2020, 260, 126969
1 M KOH	Screen-printed carbon electrodes with SrWO_4	Hg/HgO	~218 mV/dec	Journal of the Taiwan Institute of Chemical Engineers, 2021, 126, 145-153
1 M KOH	Ni Foam with $\text{NiCo}_2\text{O}_4@\text{NiWO}_4$	Ag/AgCl	~217 mV/dec	International Journal of Hydrogen Energy, 2019, 44, 2883-2888
1 M KOH	Glassy carbon electrode with $\text{Bi}_2\text{WO}_6/\text{TiO}_2\text{-Ag}$	Ag/AgCl	~231 mV/dec	Applied Surface Science, 2021, 569, 150918