Supporting information

An efficient WSe2/Co0.85Se/Graphene hybrid catalyst for electrochemical hydrogen evolution reaction

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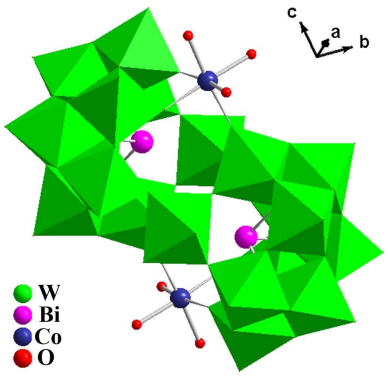


Figure S1. Crystal structure of $Na_{12}[Co(H_2O)_2(OH)_2\{Bi_2W_{22}0_{74}(OH)_2\}]_{48}H_{20}$

(Denoted as $Bi_2W_{22}Co_2$).

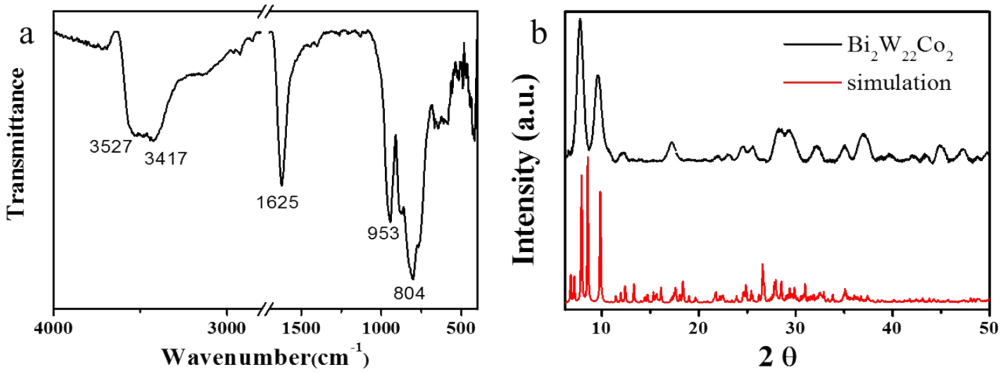
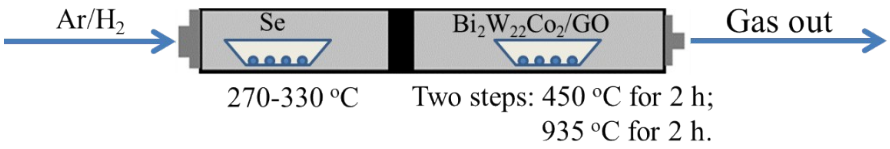


Figure S2. (a) FT-IR spectrum of $Bi_2W_{20}Co_2$; (b)XRD patterns of $Bi_2W_{20}Co_2$ powder and simulated curve from cif data.



Scheme S1. Synthetic procedure of Co-WSe_2/rGO with different amount of rGO *via* CVD selenization.

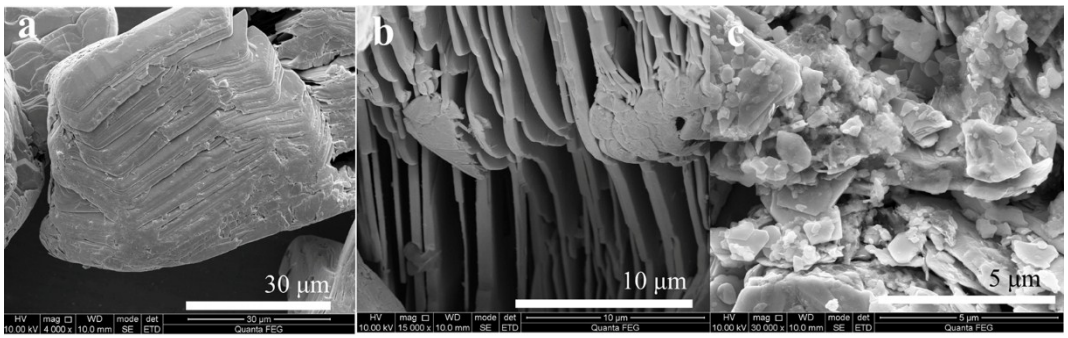


Figure S3. SEM images of (a) as-synthesized Co-WSe_2/rGO_2 and sonicated at (b) 10 and (c) 30 mins, respectively. The initial morphology is bulk aggregate with layered structures, and ethanol facilitated exfoliation took place during sonication. As shown in (b), sheet-like structures were formed, and the whole aggregated became loose. Finally, the as-synthesized was exfoliated into irregular sheet-like aggregates.

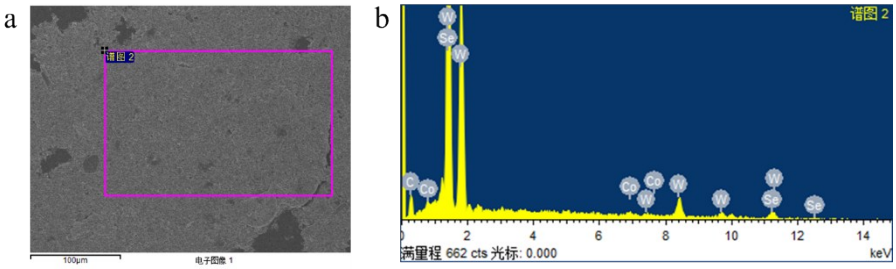


Figure S4. (a) Low magnification image of Co-WSe_2/rGO_2; (b) EDS profile of Co-WSe_2/rGO_2 in the selected area of a.

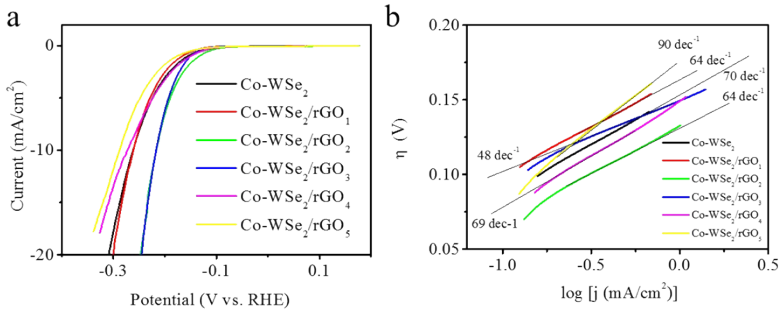


Figure S5. (a) Polarization curves of Co-WSe_2/rGO composites as a function of rGO contents. (b) Corresponding tafel curves of Co-WSe_2/rGO composites.

Table S1. Comparisons of our Co-WSe_2/rGO composites and previous HER catalysts.

Sample	Loading mass (mg/cm^2)	η_{10} (mV)	Tafel slope (dec^{-1})	j_0 (mA/cm^2)	reference
WSe_2/W foil	—	350	—	—	[1]
WSe_2/Si NWs	—	300	77.4	~4.5×10^{-3}	[2]
$WS_{2(1\ x)}Se_{2x}$	0.21	298	99	29×10^{-3}	[3]
Exfoliated WSe_2	0.057	800	120	3.6×10^{-5}	[4]
3D dendritic WSe_2	2.2-2.5	228	80	15×10^{-3}	[5]
$WS_{2(1\ x)}Se_{2x}$ nanoflakes on CF	—	158	98	0.240	[6]
thin films of tungsten selenides	—	245	98	—	[7]
Metallic $WS_{2(1-x)}Se_{2x}$ Nanoribbons	0.3	170	78	0.025	[8]
Monolayer $WS_{2(1-x)}Se_{2x}$	—	80 (onset potential)	85	—	[9]
Co-WSe_2/rGO_1	0.56	260	64	4.81×10^{-3}	This work
Co-WSe_2/rGO_2	0.56	217	64	15.3×10^{-3}	This work
Co-WSe_2/rGO_3	0.56	217	48	0.7×10^{-3}	This work
Co-WSe_2/rGO_4	0.56	273	68	11.6×10^{-3}	This work
Co-WSe_2/rGO_5	0.56	290	90	6.98×10^{-3}	This work

η_0: Onset potential was obtained at current density of 0.5 mA/cm^2;

η_{10}: Over potential was obtained at current density of 10 mA/cm^2;

J_0: Exchange current density for the catalysts were obtained from the Tafel curves by using the extrapolation method.

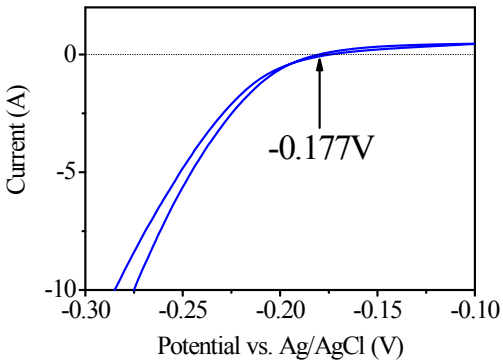


Figure S6. Cyclic voltammetry curve of the calibrated Ag/AgCl electrode.

References

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