Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

WSe_2 and $W(Se_xS_{1-x})_2$ nanoflakes grown on carbon nanofibers for electrocatalytic hydrogen evolution reaction

MeiLing Zou, JiaDong Chen, LongFei Xiao, Han Zhu, TingTing Yang, Ming Zhang, MingLiang Du*

Key Laboratory of Advanced Textile Materials and Manufacturing Technology of the Ministry of Education, College of Materials and Textiles, Zhejiang Sci-Tech University, 310018, P. R. China

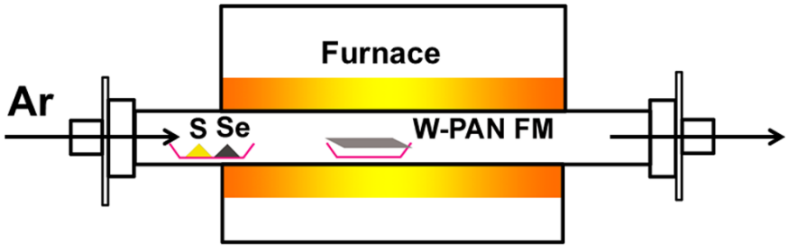

Figure S1. Schematic for the set-up used for the growth of $W(Se_xS_{1-x})_2$ nanoflakes on CFM.

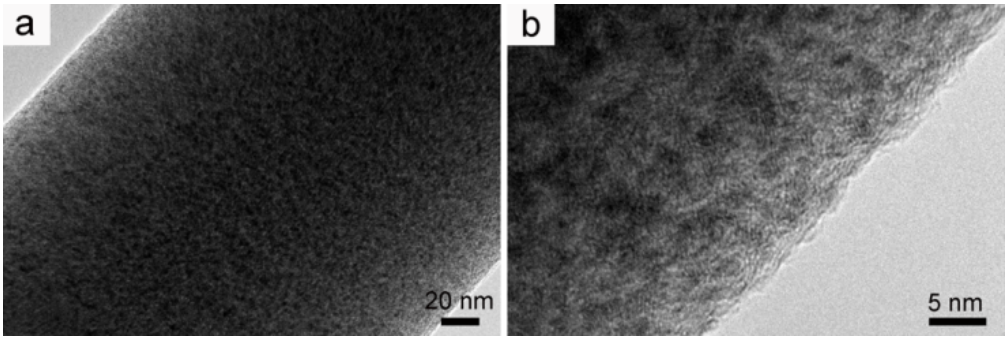

Figure S2. TEM images of WO_3-C-10.

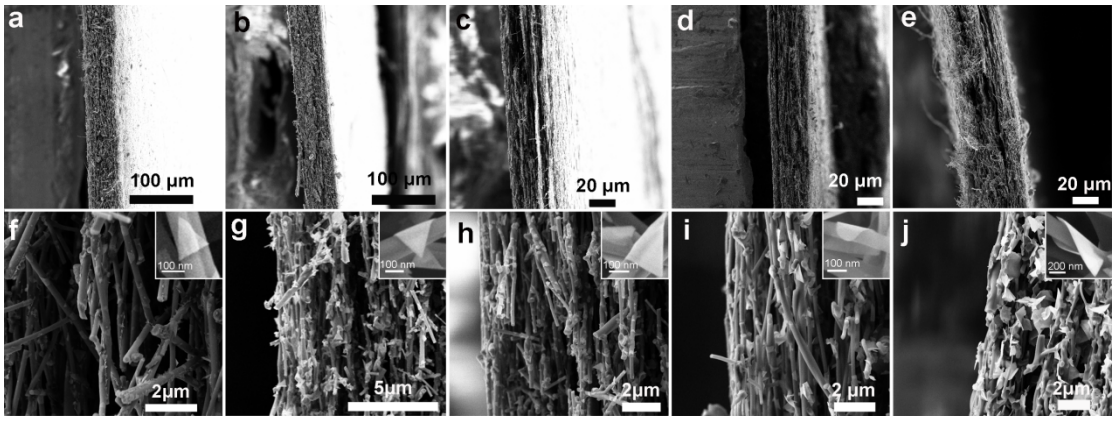

Figure S3. Cross-sectional SEM images of (a and f) WSe_2-C-10, (b and g) WSe_2-C-20, (c and h) WSe_2-C-30, (d and i) and (e and j) $W(Se_{0.2}S_{0.8})_2$-C-20. The insets in the figure f-j are magnified images of representative triangular nanoflakes.

Table S1. The x value of the $W(Se_xS_{1-x})_2$-C-y determined by different methods.

	x value calculated from EDS	x value obtained from XPS
$W(Se_{0.4}S_{0.6})_2$-C-10	0.41	0.38
$W(Se_{0.2}S_{0.8})_2$-C-20	0.22	0.26

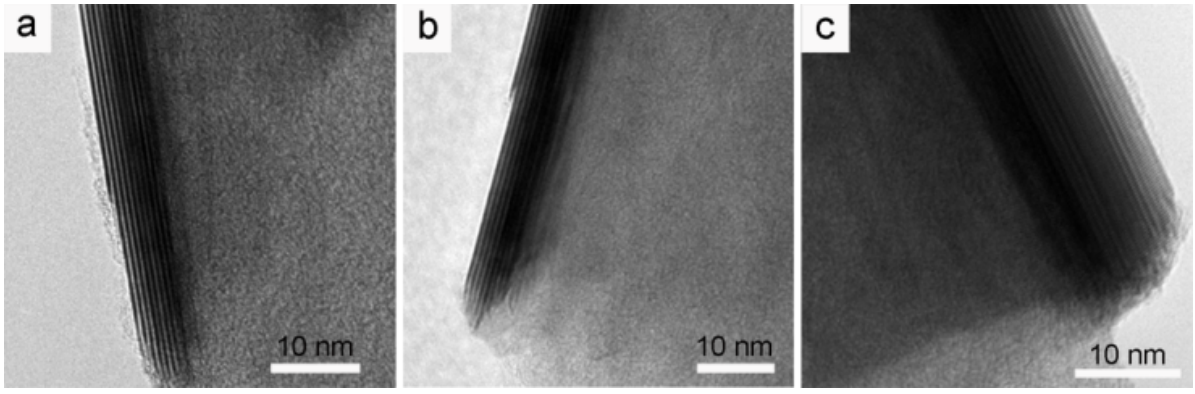

Figure S4. TEM images of (a) WSe_2-C-10, (b) WSe_2-C-20, (c) WSe_2-C-30 to detect the thickness of the WSe_2 nanoflakes.

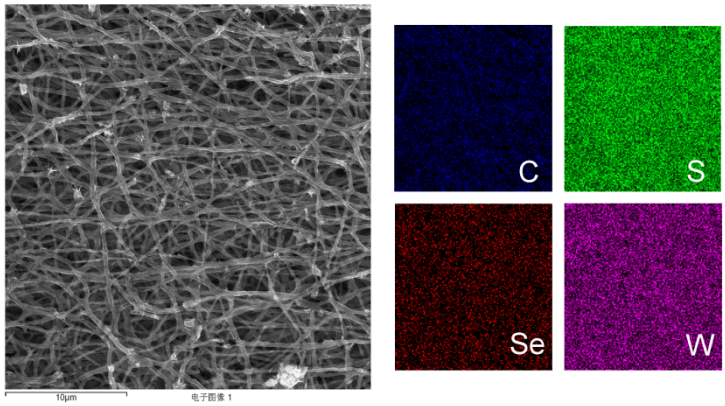

Figure S5. Element maps of $W(Se_{0.4}S_{0.6})_2$-C-10 taken from SEM analysis.

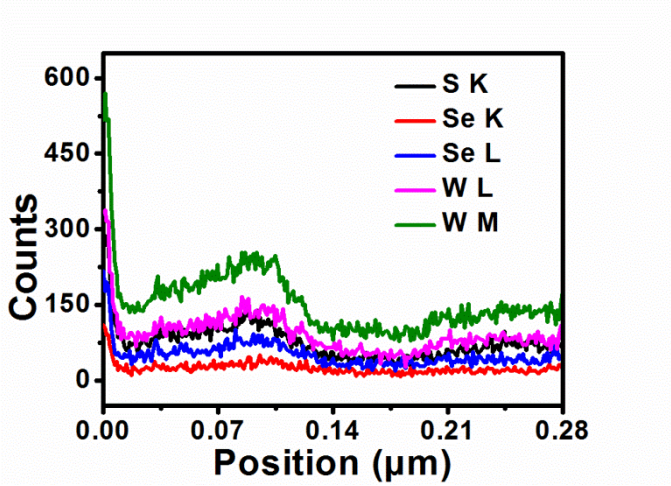

Figure S6. EELS spectra of the selected region in figure 2e.

Figure S7. Digital photograph of the catalyst mat.

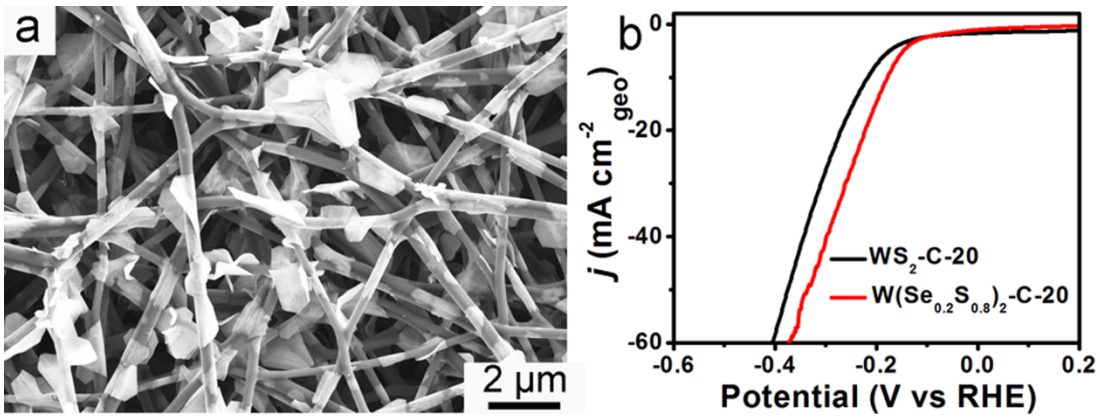

Figure S8. (a) SEM image of WS_2-C-20 and (b) the polarization curves of WS_2-C-20 and $W(Se_{0.2}S_{0.8})_2$-C-20

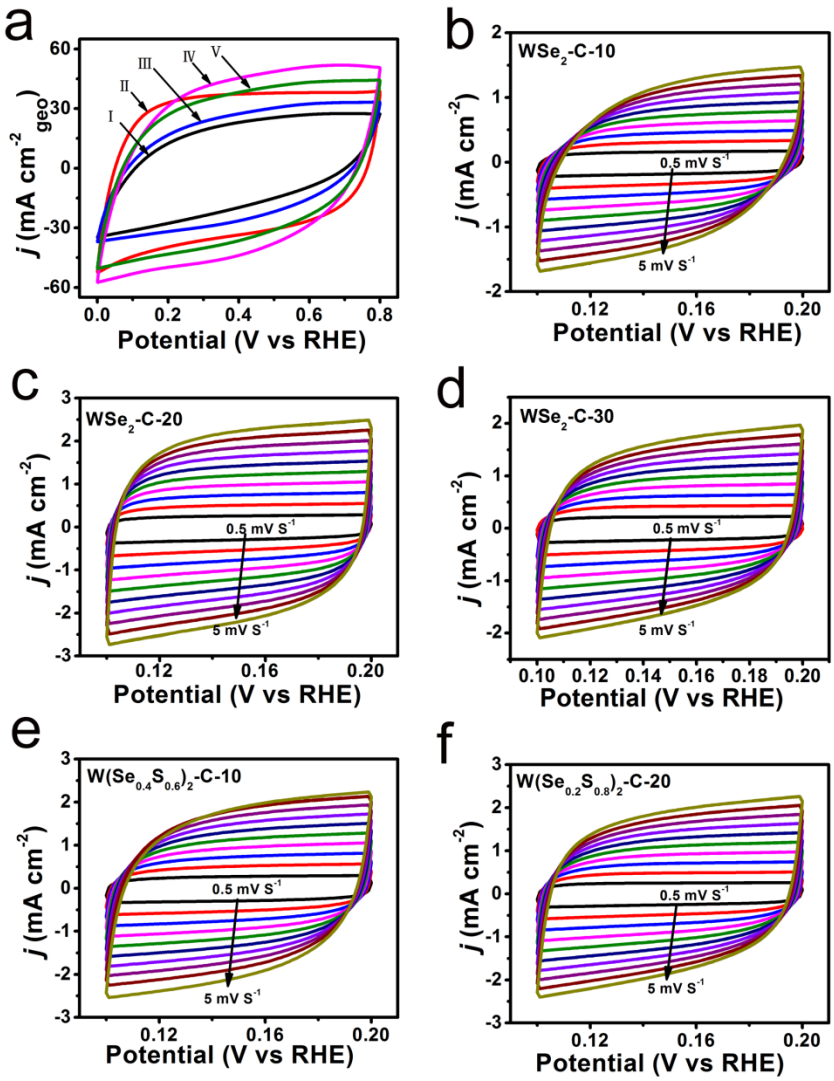

Figure S9. (a) CV plots of the catalytic electrodes at 100 mV s^{-1} after 400 cycles in 0.5 M H_2SO_4: (Ⅰ) WSe_2-C-10, (Ⅱ) Se_2-C-20, (Ⅲ) WSe_2-C-30, (Ⅳ) $W(Se_{0.4}S_{0.6})_2$-C-10 and (Ⅴ) $W(Se_{0.1}S_{0.9})_2$-C-20. CV curves (b) WSe_2-C-10, (c) WSe_2-C-20, (d) WSe_2-C-30, (e) $W(Se_{0.4}S_{0.6})_2$-C-10 and (f) $W(Se_{0.2}S_{0.8})_2$-C-20 electrode at various scan rates (0.5-5 mV s^{-1}).

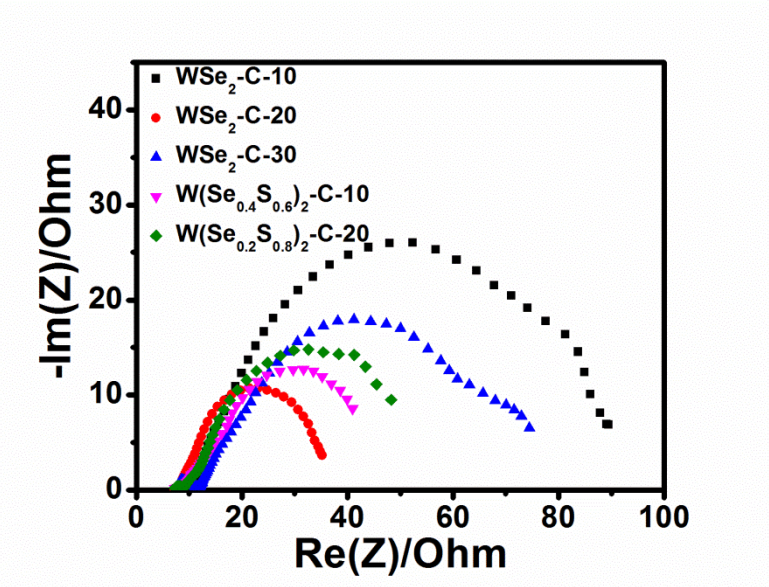

Figure S10. Impedance spectra of the indicated electrodes at η = 150 mV.

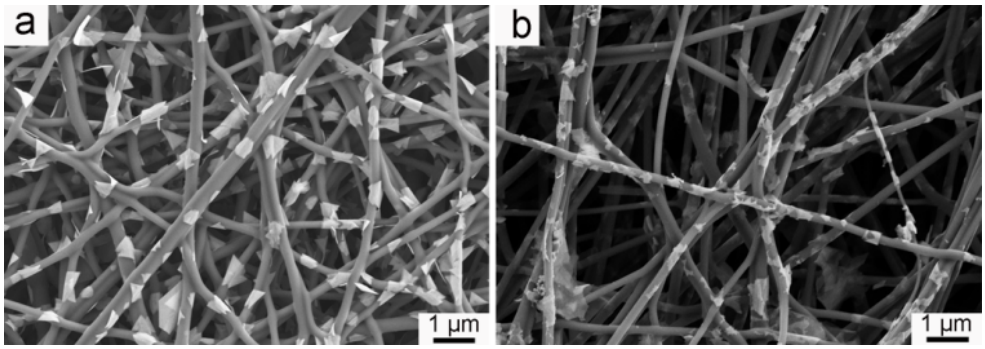

Figure S11. Representative SEM images of (a) WSe_2-C-20 and (b) $W(Se_{0.4}S_{0.6})_2$-C-10 after chronoamperometric response test for 12h.

Table S2. Summary of some state-of-the-art HER electrocatalysts.

Material	Morphology	Conductions [electrolyte, loading]	η_{10} [mV]	Tafel solpe [mV dec^{-1}]	Exchange current density [mA cm^{-2}]	ref
$WS_{2(1-x)}Se_{2x}$	monolayer	0.5M H_2SO_4 N/A	150	85	N/A	42
$MoS_{1.0}Se_{1.0}$	few layer	0.5M H_2SO_4 0.18 mg cm^{-2}	200	56±3	0.32	33
MoSSe	nanoflakes	0.5M H_2SO_4 0.28 mg cm^{-2}	164±2	48±3	N/A	32
$MoS_{4/3}Se_{2/3}$	nanoflakes	0.5M H_2SO_4 0.28 mg cm^{-2}	172±1	66±1	N/A	32
$MoS_{2/3}Se_{4/3}$	nanoflakes	0.5M H_2SO_4 0.28 mg cm^{-2}	171±2	55±1	N/A	32
WSe_2	dendritic	0.5M H_2SO_4 2.2 mg cm^{-2}	228	80	0.015	28
$W(S_{0.48}Se_{0.52})_2$	nanotube	1M H_2SO_4 N/A	260	105	0.029	27
WSe_2	vertical sheets	0.5 H_2SO_4 N/A	300	77.4	N/A	26
$MoSe_2$	vertical sheets	0.5 H_2SO_4 N/A	250	59.8	0.00038	26
WS_2	exfoliated 1T	0.5 H_2SO_4 0.1-0.2 μg cm^{-2}	210	55	0.02	43
$W(Se_{0.4}S_{0.6})_2$	triangular	0.5 H_2SO_4 N/A	174	106	0.229	present work
WSe_2	triangular	0.5 H_2SO_4	98	158	0.24	present work