Electrospun carbon nanofiber@CoS$_2$ core/sheath hybrid as efficient all-pH hydrogen evolution electrocatalyst

Electronic Supplementary Information

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Calculation of loading ratio of the CoS$_2$ in CNF@CoS$_2$ hybrid:

Making a hypothesis that the mass percentage of CNF in CNF@CoS$_2$ hybrid is $x$ while that of CoS$_2$ in CNF@CoS$_2$ hybrid is $y$. Consequently, $x + y = 1$.

From the TGA curve of pure CoS$_2$, it can be found that through a complex phase change process, pure CoS$_2$ remains 74.3% of its original weight. In addition, from the TGA curve of pure CNF, it can be concluded that CNF has almost burned out at 700 °C in air atmosphere. Consequently, for CNF@CoS$_2$ hybrid with the residue weight percentage of 55.6%, equation can be listed as follows, $y \times 74.3\% + x \times 0 = 1 \times 55.6\%$.

According to the above two equations, $y$ can be calculated as 74.8 wt% while $x$ is 25.2 wt%, illustrating that CoS$_2$ accounts for the mass ratio of 74.8 wt% in the CNF@CoS$_2$ hybrid.
**Figure captions:**

**Fig. S1** FESEM image of CNF.

**Fig. S2** FESEM image of CNF@CoS$_2$-3 hybrid and its corresponding EDS mapping images.

**Fig. S3** FESEM image of CNF@CoS$_2$-9 hybrid in higher magnification.

**Fig. S4** FESEM image of CoS$_2$.

**Fig. S5** XRD patterns of the products collected after thermal treatment of CNF@CoS$_2$-3 hybrid at 700 °C and 900 °C.

**Fig. S6** Plots showing the extraction of the double layer capacitance ($C_{dl}$) for CNF@CoS$_2$-1 and CNF@CoS$_2$-9 hybrids at 0.2 V.

**Fig. S7** Nyquist plots of CNF@CoS$_2$-3 hybrid at various overpotentials in 0.5 M H$_2$SO$_4$.

**Fig. S8** FESEM image of CNF@CoS$_2$-3 hybrid after cycling for 2000 s at low and high magnifications.

**Fig. S9** FESEM image of CNF@CoS$_2$-3 hybrid after cycling test.

**Fig. S10** Time dependence of the current density for pure CoS$_2$ modified GCE recorded at -0.17 V versus RHE in 0.5 M H$_2$SO$_4$ solution.
Fig. S4
Fig. S5
Fig. S6
Fig. S8
Fig. S9

(residual Nafion solution in white arrow)
Fig. S10