Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

In situ integration of cobalt diselenide nanoparticles on CNTs realizing durable hydrogen evolution

Hongfeng Ye, Xuejiao Zhou, Zhitao Shao, Jing Yao, Wenjie Ma, Lili Wu*, and Xinzhi Ma*

Key Laboratory for Photonic and Electronic Bandgap Materials, Ministry of Education, School of Physics and Electronic Engineering, Harbin Normal University, Harbin 150025, People's Republic of China.

* Corresponding authors: E-mail:wll790107@hotmail.com; maxz@hrbnu.edu.cn.

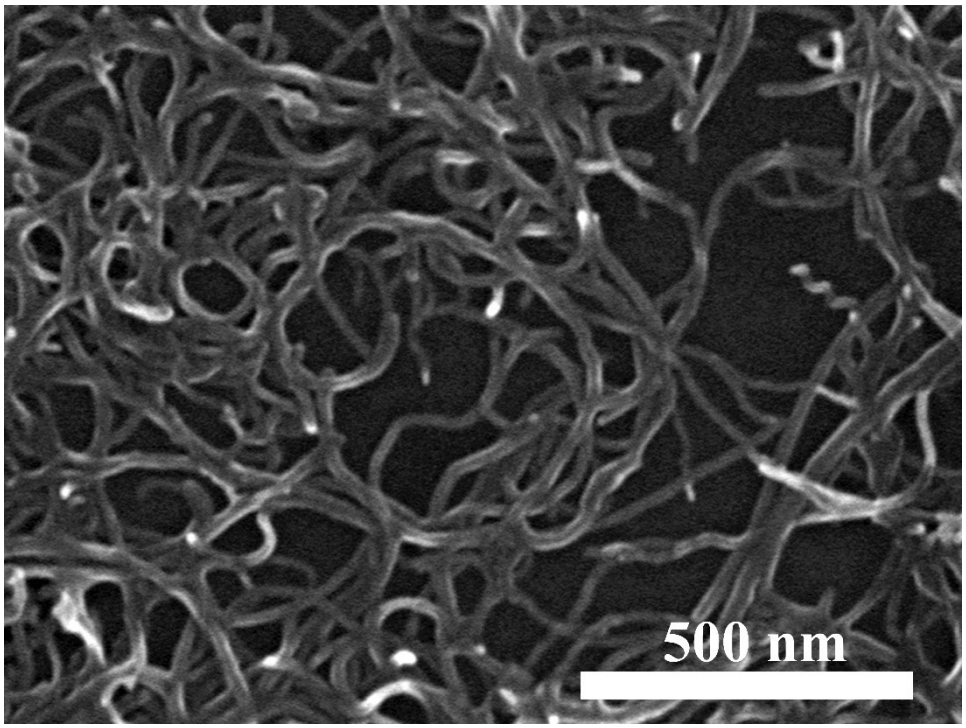

Figure S1. SEM image of CNTs.

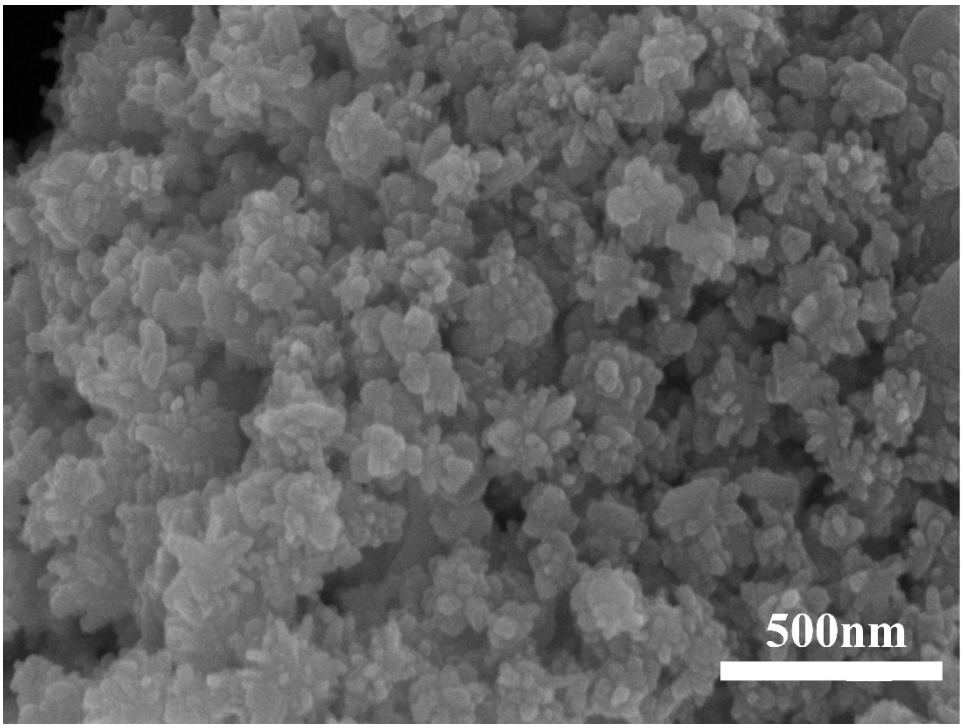

Figure S2. SEM image of pure $CoSe_2$.

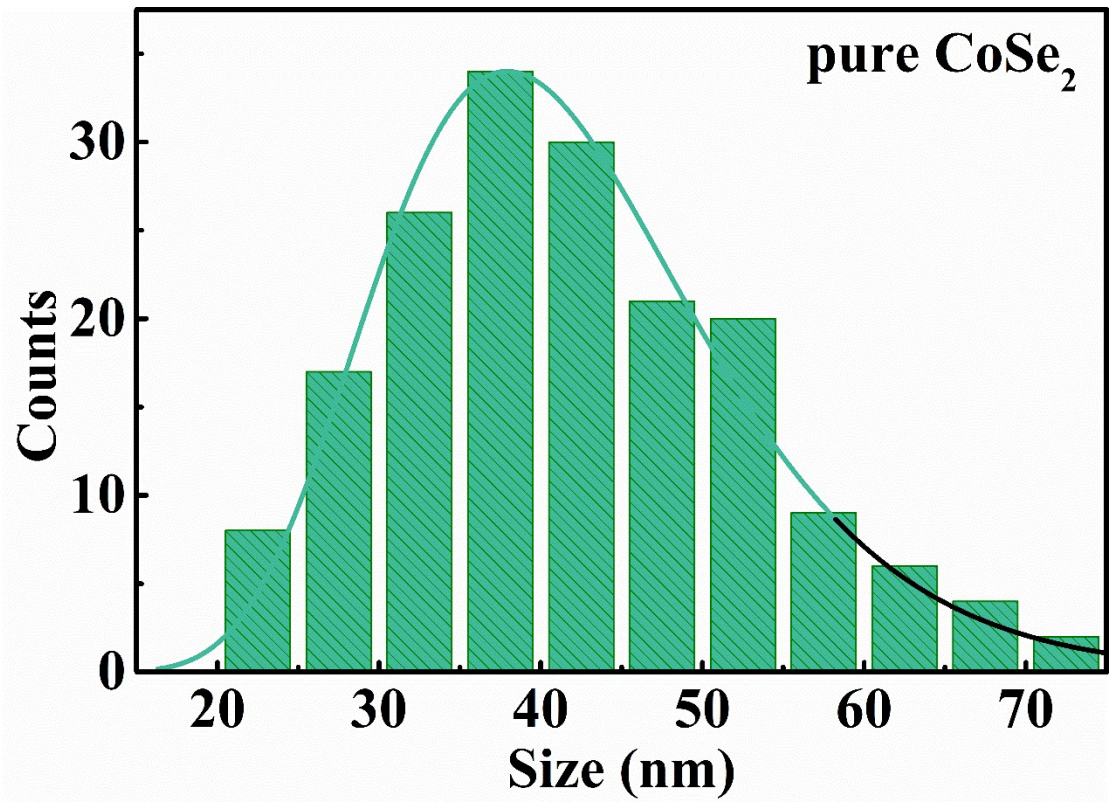

Figure S3. Grain size distribution of $CoSe_2$ nanoparticles of pure $CoSe_2$.

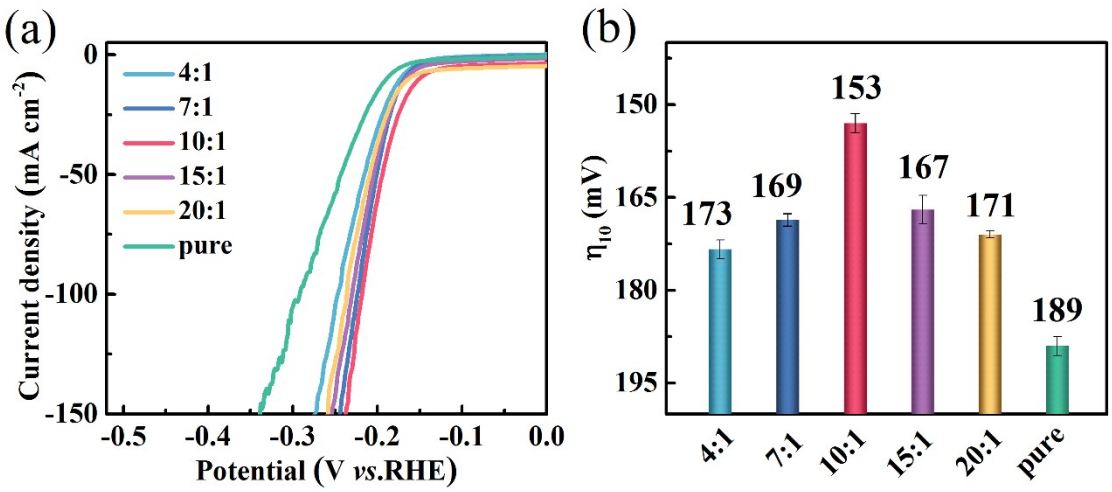

Figure S4. (a) Polarization curves, and (b) histograms error bars of $CoSe_2$/CNT with different ratios.

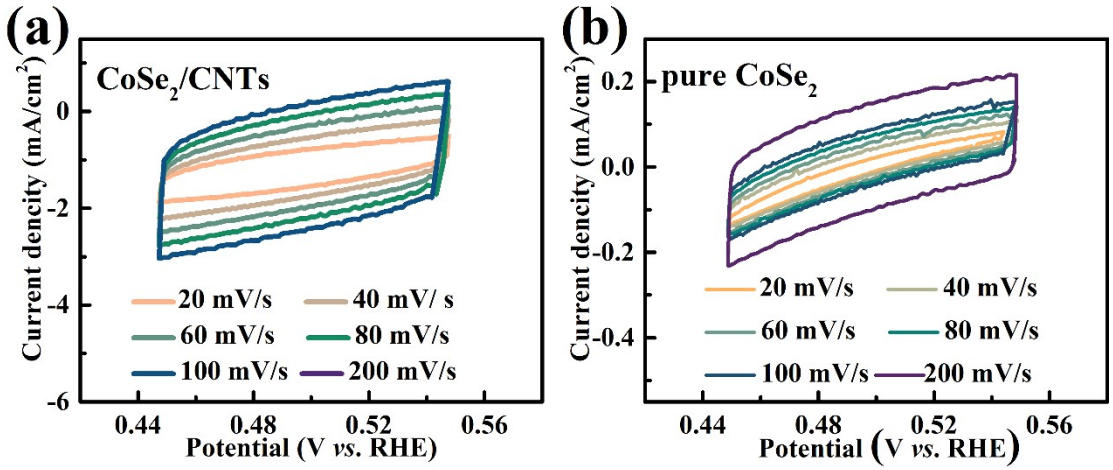

Figure S5. CVs were scanned at various rates from 20 to 200 mV s^{-1}: (a) $CoSe_2$/CNTs and (b) pure $CoSe_2$.

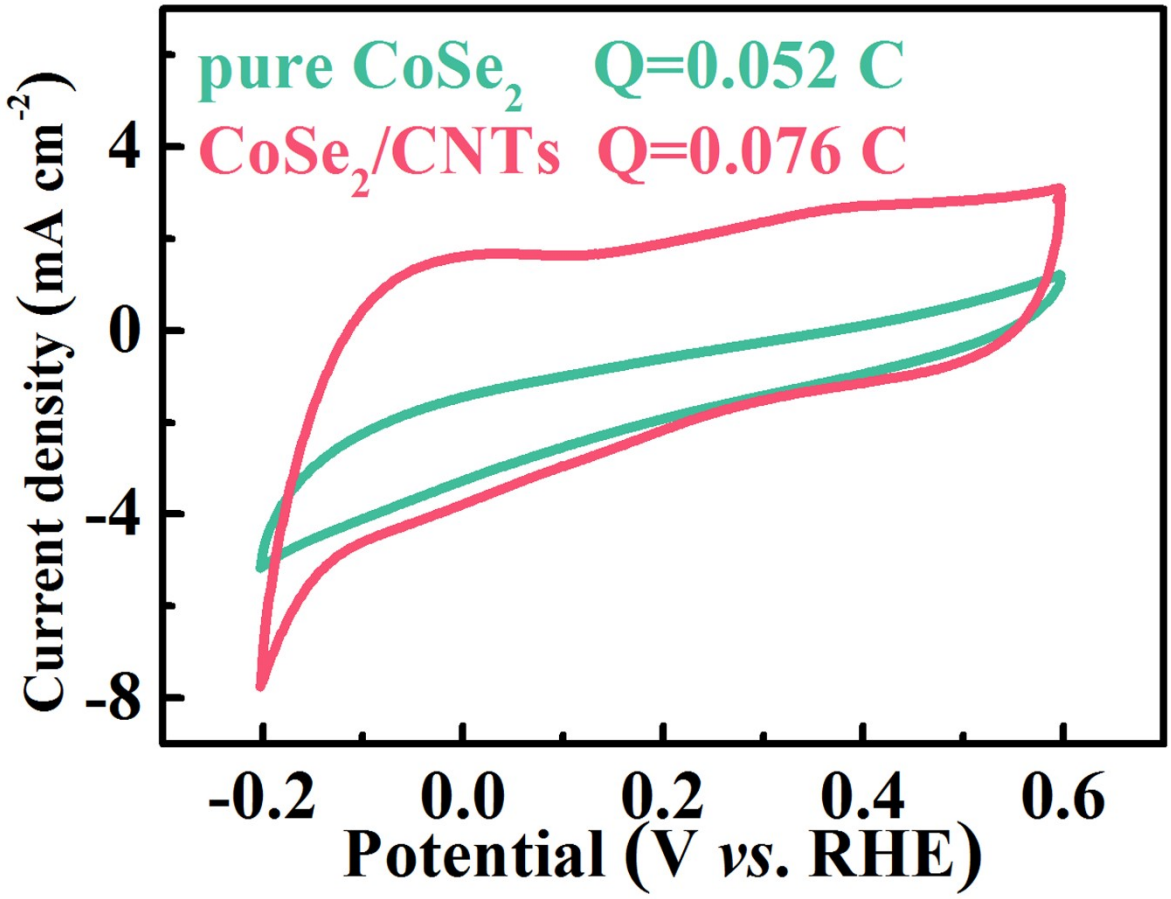

Figure S6. Cyclic voltammetry cycling of Pure $CoSe_2$ and $CoSe_2$/CNTs in pH = 7 phosphate buffer with a scan rate of 50 mV s^{-1} range from -0.2 to 0.6 V vs. RHE.

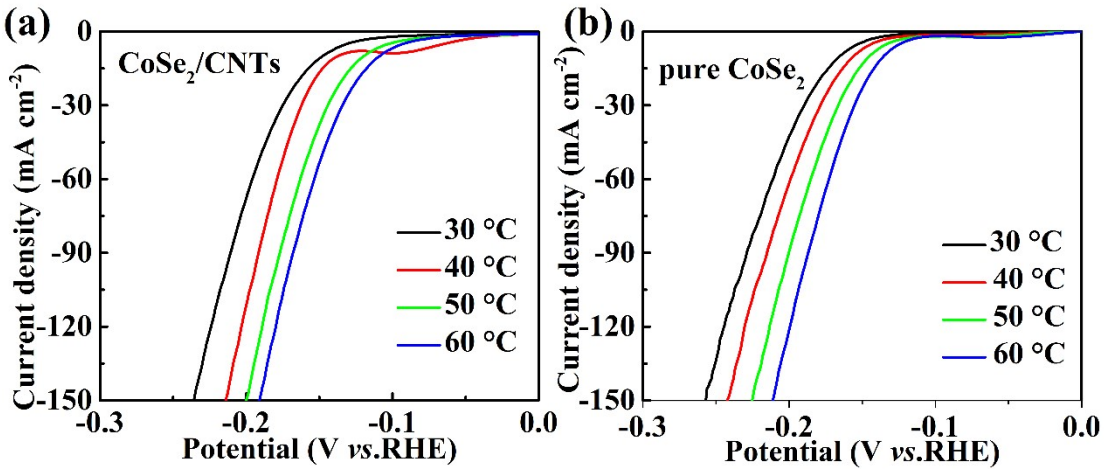

Figure S7. Polarization curves at different temperatures (a) $CoSe_2$/CNTs and (b) pure $CoSe_2$.

The exchange current density was taken as a function of the reciprocal of temperature, and the activation energy was calculated using the Arrhenius formula[1]:

$$\log j_0 = \log A_i - E_a / (2.3RT) \quad \text{(S1)}$$

Where A_i is the pre-Arrhenius factor. According to the slope of the Arrhenius curve, the E_a values of pure $CoSe_2$ and $CoSe_2$/CNTs electrocatalysts are 48.043 kJ mol^{-1} and 17.342 kJ mol^{-1}, respectively.

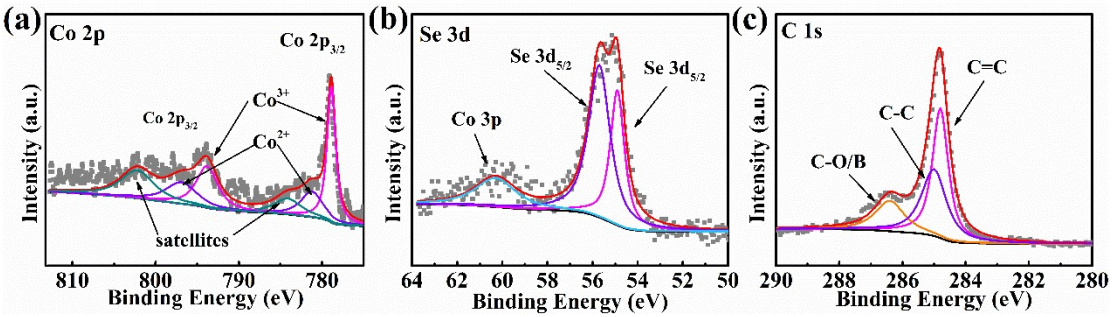

Figure S8. (a) Co 2p, (b) Se 3d and Polarization curves, and (c) B 1s XPS spectra of $CoSe_2$/CNT composite after cycling measurement.

In the Se 3d spectra, the SeO_x characteristic peak at 59.3 eV, caused by the oxidation of a slight excess of metallic selenium, disappears after the long cycle.[2]

Table S1. The stability of $CoSe_2$/CNTs in 0.5 M H_2SO_4 solution compared with other HER catalysts.

Catalysts	$\eta_{10/\ mV}$	Stability test conditions (mA cm^{-2})	Long cycle stability test time (h)	Ref
$CoSe_2$@HC	171.7	10	12	[3]
CoSe2/GD	/	20	24	[4]
$CoSe_2$	272	20	8	[5]
$CoSe_2$/CNTs	**153**	**30**	**48**	**Our work**

References

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