Supporting Information

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

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Figure S1. SEM image of CNTs.
Figure S2. SEM image of pure CoSe$_2$. 

![SEM image of pure CoSe$_2$](image-url)
Figure S3. Grain size distribution of CoSe$_2$ nanoparticles of pure CoSe$_2$. 
Figure S4. (a) Polarization curves, and (b) histograms error bars of CoSe₂/CNT with different ratios.
Figure S5. CVs were scanned at various rates from 20 to 200 mV s\textsuperscript{–1}: (a) CoSe\textsubscript{2}/CNTs and (b) pure CoSe\textsubscript{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.
The exchange current density was taken as a function of the reciprocal of temperature, and the activation energy was calculated using the Arrhenius formula:\(^1\):

\[
\log j_0 = \log A_i - \frac{E_a}{(2.3RT)} \tag{S1}
\]

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.
In the Se 3d spectra, the SeOₓ 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$_2$SO$_4$ solution compared with other HER catalysts.

<table>
<thead>
<tr>
<th>Catalysts</th>
<th>$\eta_{10}$/mV</th>
<th>Stability test conditions (mA cm$^{-2}$)</th>
<th>Long cycle stability test time (h)</th>
<th>Ref</th>
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<tbody>
<tr>
<td>CoSe$_2$@HC</td>
<td>171.7</td>
<td>10</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>CoSe$_2$/GD</td>
<td>/</td>
<td>20</td>
<td>24</td>
<td>4</td>
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<td>CoSe$_2$</td>
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<td>CoSe$_2$/CNTs</td>
<td>153</td>
<td>30</td>
<td>48</td>
<td>Our work</td>
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References


