

## Supporting Information

### The Role of Phosphate Group in Doped Cobalt Molybdate: Improved Electrocatalytic Hydrogen Evolution Performance

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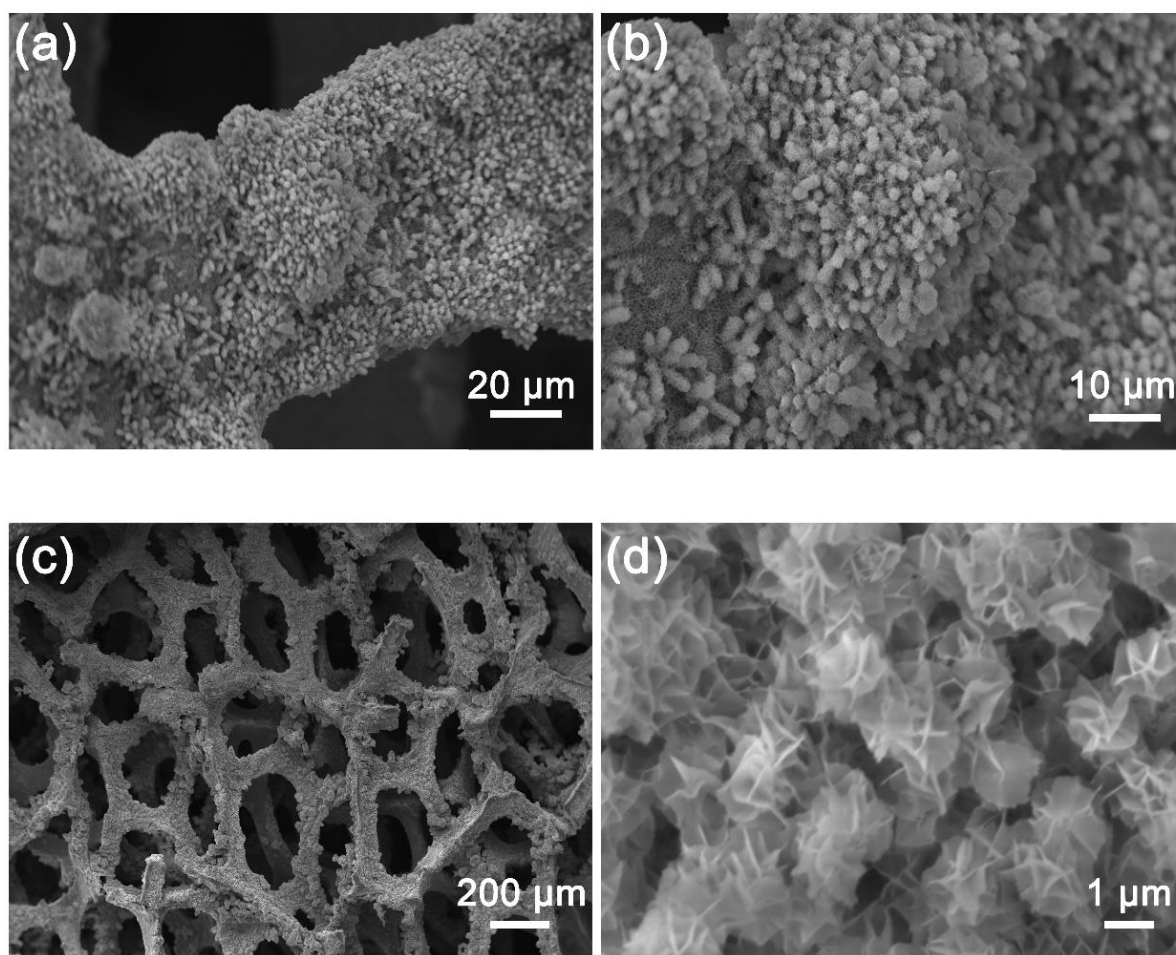
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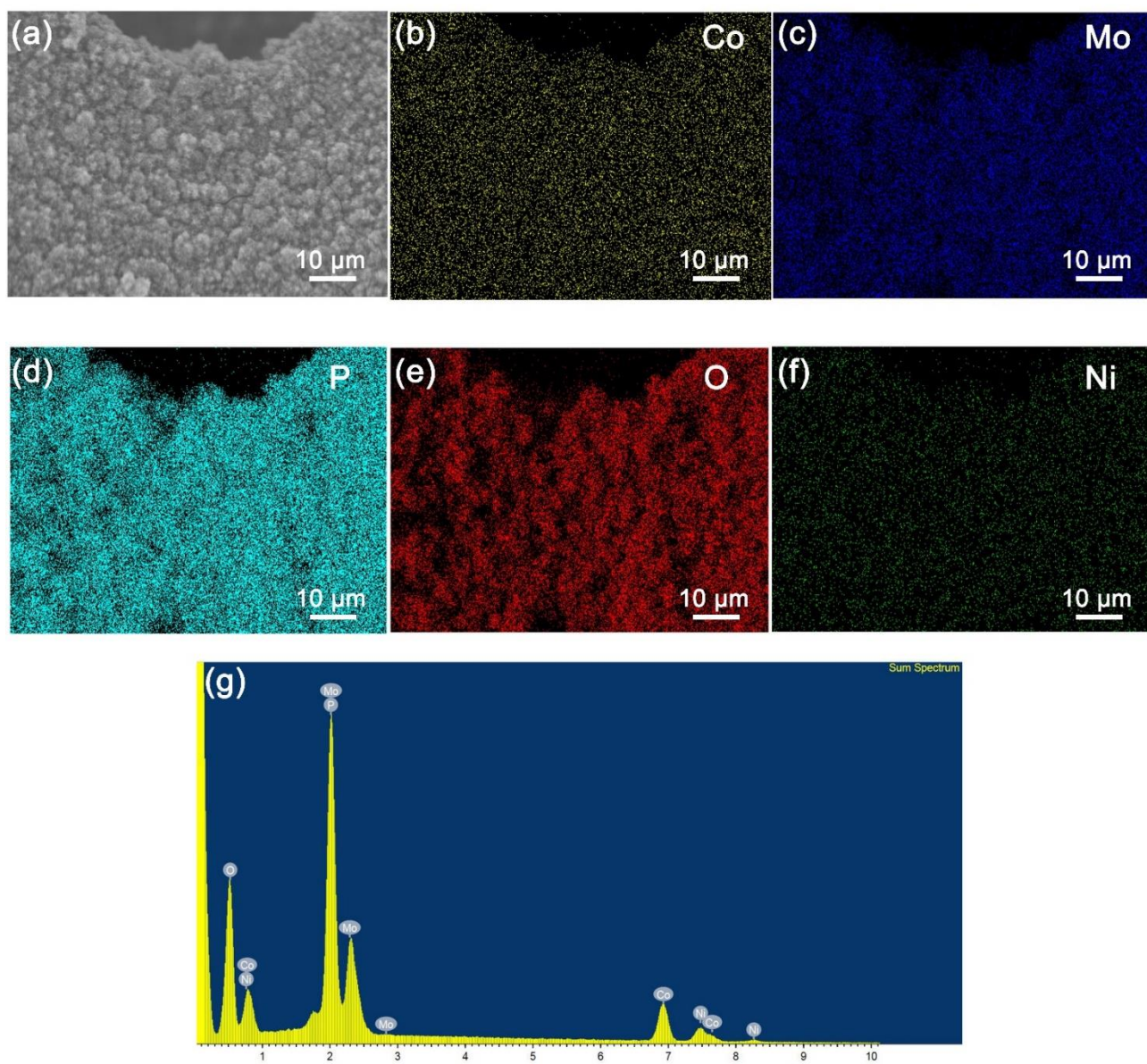
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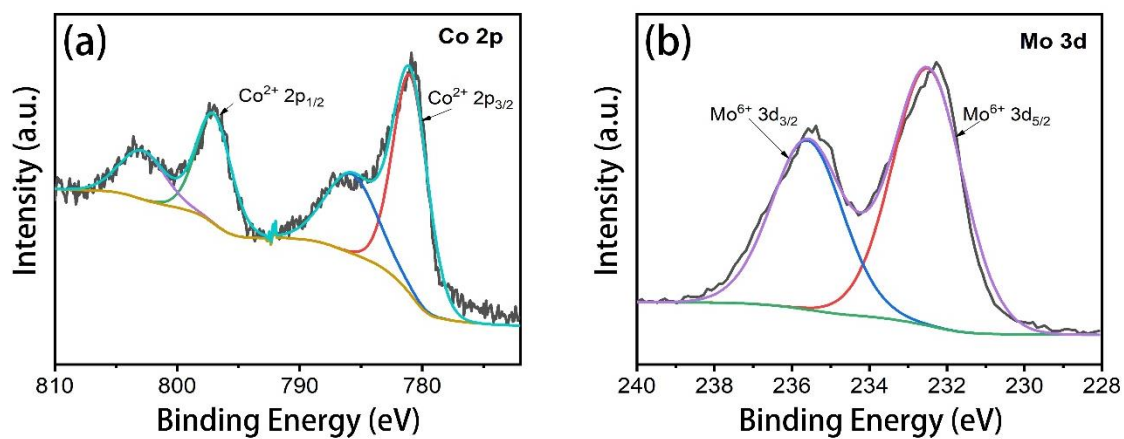
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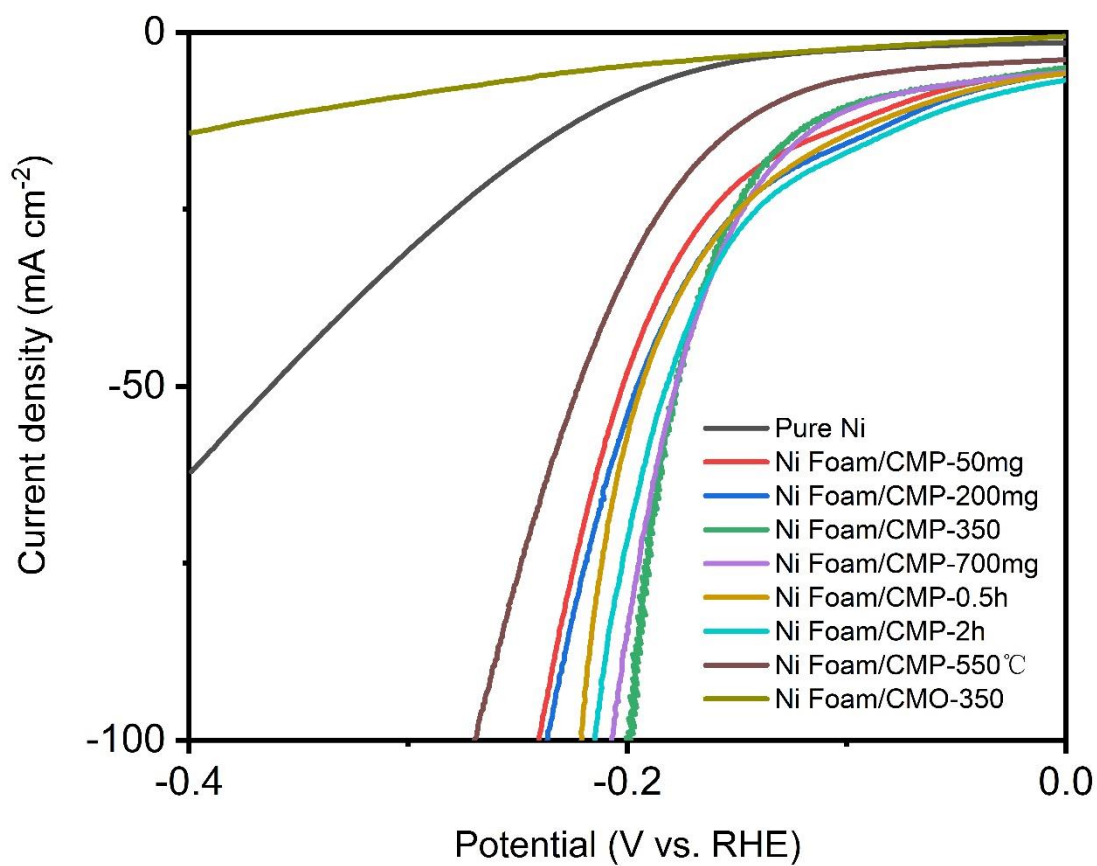
**Figure S1.** (a, b) SEM image of Ni Foam/CMO-350. (c, d) SEM image of Ni Foam/CMP-350.



**Figure S2.** EDX mapping images of Ni foam/CMP-350.

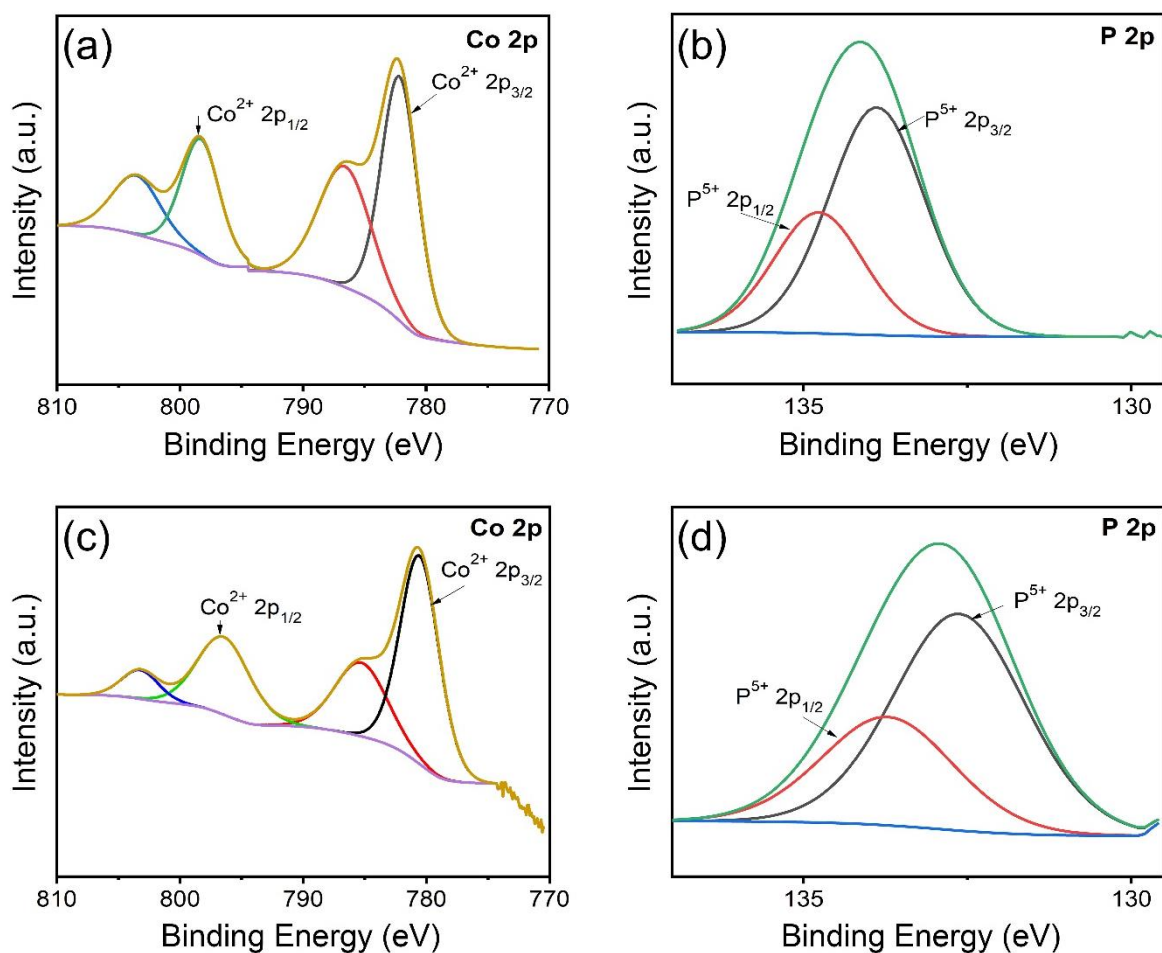


**Figure S3.** XPS spectra of (a) Co, (b) Mo of Ni Foam/CMO-350

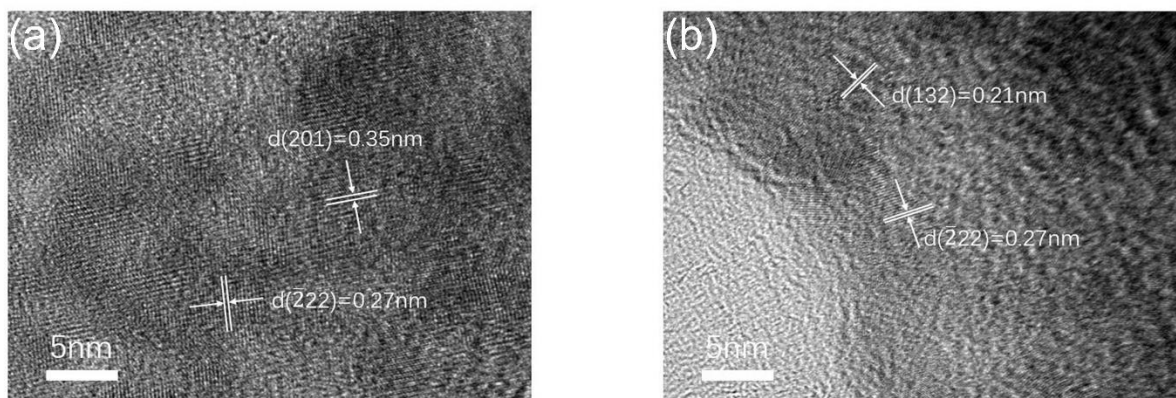


**Figure S4.** Polarization curves of electrodes in 1M KOH.

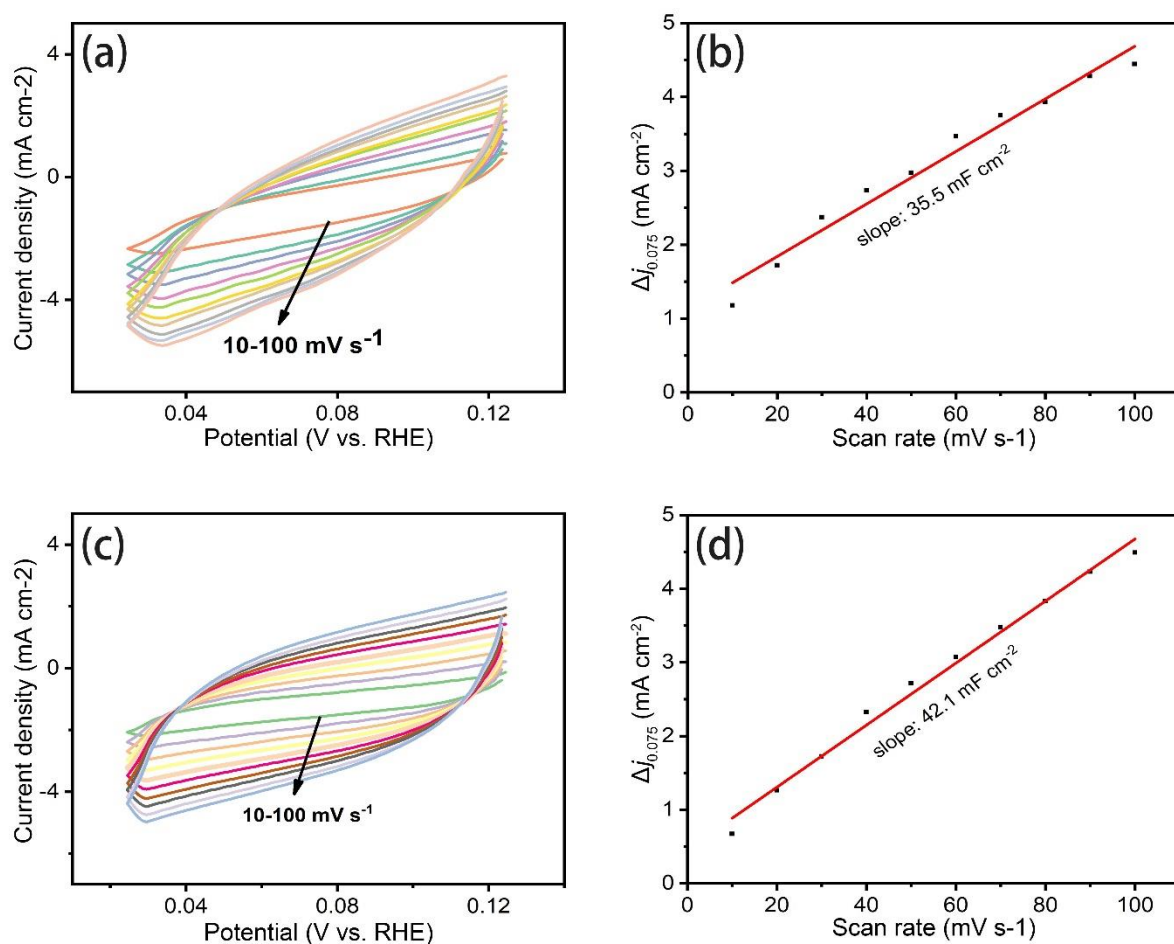




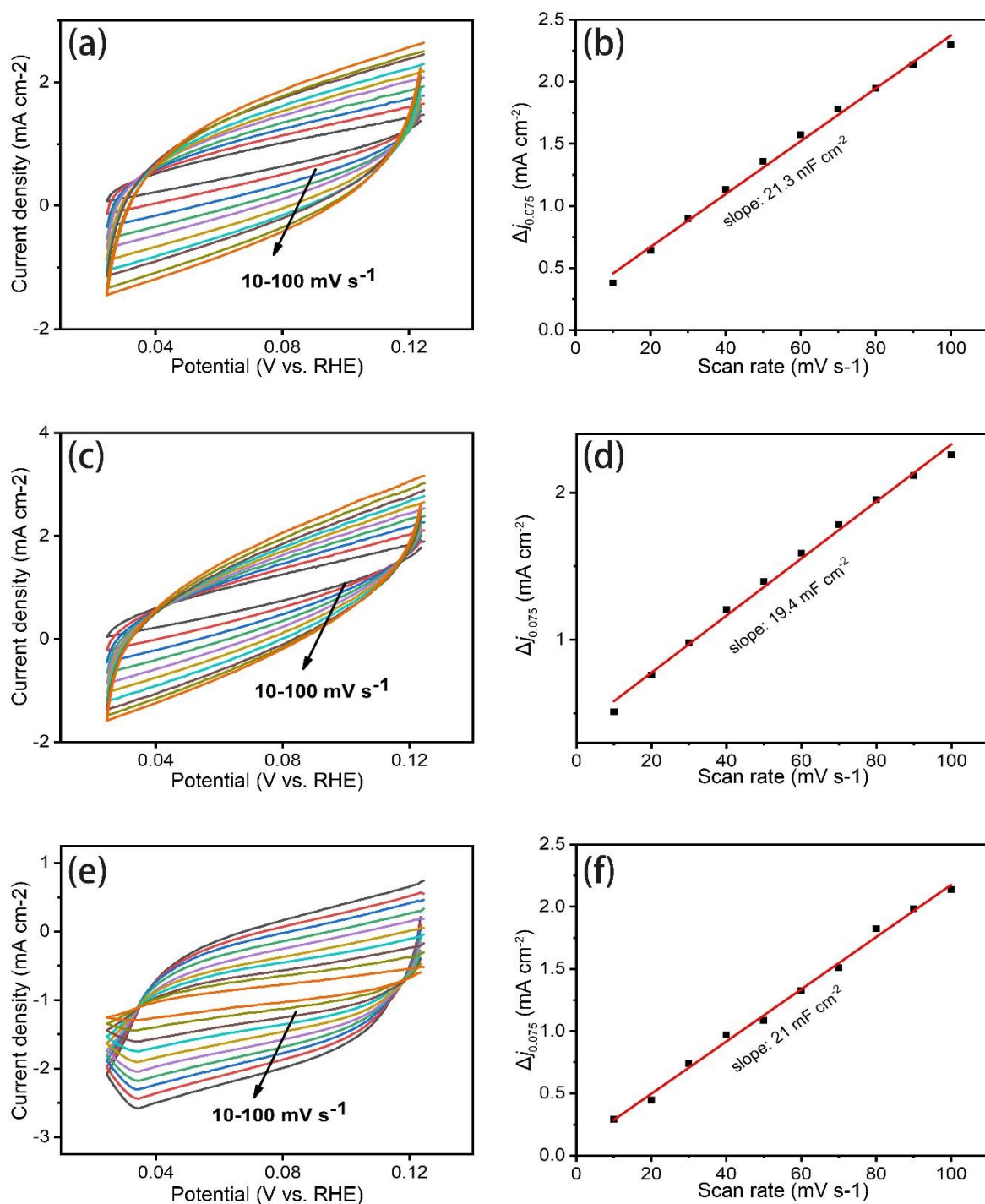
**Figure S5.** XPS spectra of Ni foam/CMP-350 before (a) Co 2p, (b) P 2p and after (c) Co 2p, (d) P 2p stability test ( $j = 10\text{mA cm}^{-2}$ , 48h).



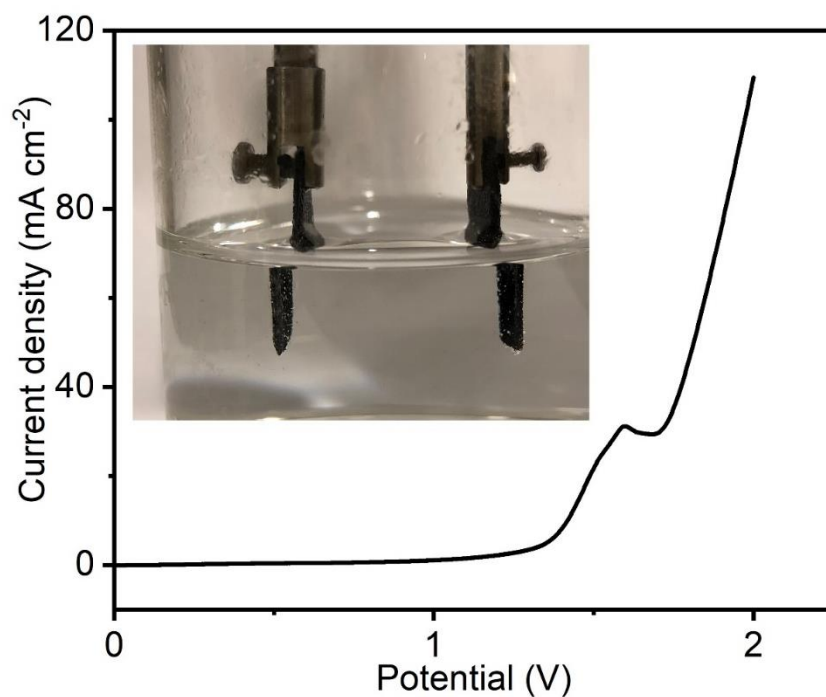
**Figure S6.** TEM images of Ni Foam/CMP-350 before (a) and after (b) stability test.



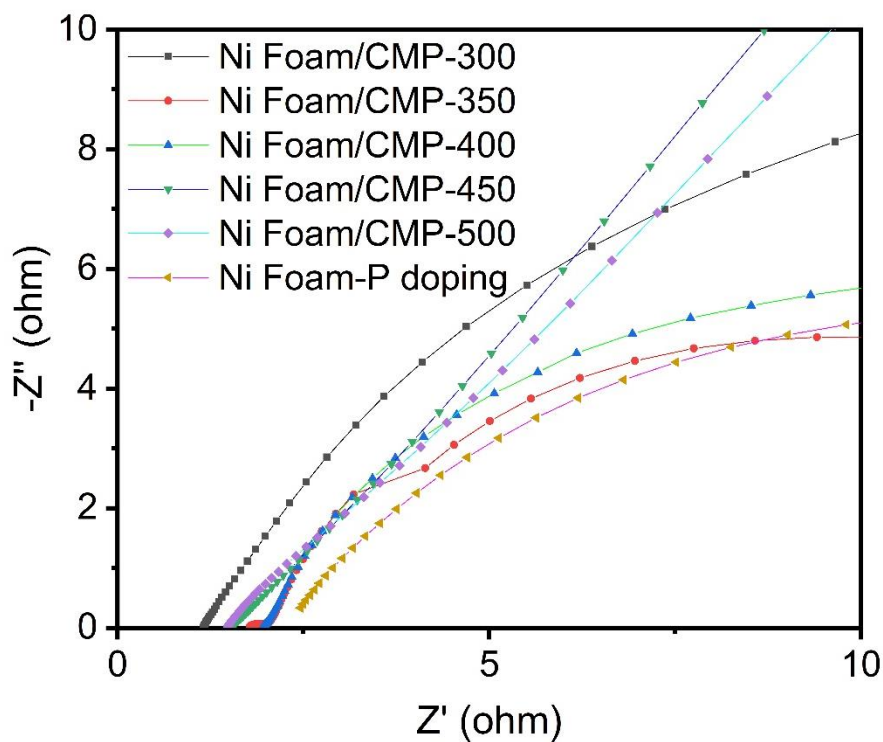
**Figure S7.** (a) CVs of Ni Foam/CMP-350 with different scan rates from 10 to 100 mV s<sup>-1</sup>. (b) The capacitive current at 0.075 V as a function of the scan rate for Ni Foam/CMP-350. (c) CVs of Ni Foam/CMP-500 with different scan rates from 10 to 100 mV s<sup>-1</sup>. (d) The capacitive current at 0.075 V as a function of the scan rate for Ni Foam/CMP-500.



**Figure S8.** (a) CVs of Ni foam/CMP-300 with different scan rates from 10 to 100 mV s<sup>-1</sup>. (b) The capacitive current at 0.075 V as a function of the scan rate for Ni foam/CMP-300. (c) CVs of Ni foam/CMP-400 with different scan rates from 10 to 100 mV s<sup>-1</sup>. (d) The capacitive current at 0.075 V as a function of the scan rate for Ni foam/CMP-400. (e) CVs of Ni foam/CMP-450 with different scan rates from 10 to 100 mV s<sup>-1</sup>. (f) The capacitive current at 0.075 V as a function of the scan rate for Ni foam/CMP-450.

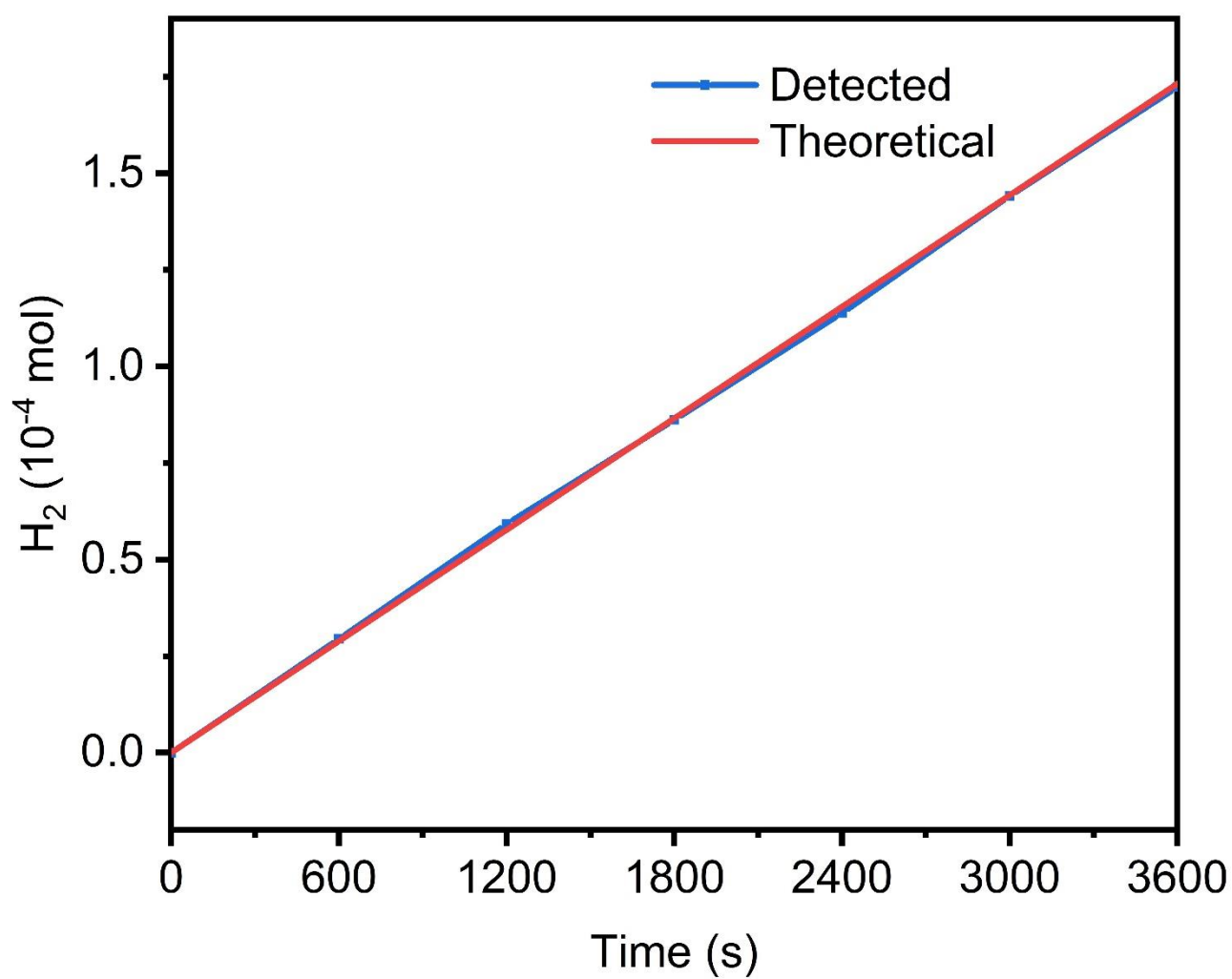


**Figure S9.** Polarization curve of Ni Foam/CMP-350 catalyst for overall water splitting in 1M KOH at a scan rate of 2mV/s. Ni Foam/CMP-350 electrodes were used as both working and counter electrodes. Inset: Graph of two-electrodes cell during reaction.



**Figure S10.** Nyquist plots of electrochemical impedance spectra (EIS) of sample electrodes recorded in 1M KOH solution.





**Figure S11.** The theoretical (red) and detected (blue) values represent the expected and observed amount of  $H_2$  produced versus time for Ni foam/CMP-350.

**Table S1.** The XPS quantitative results of Ni foam/CMP electrodes prepared at different conditions.

Sample	Co:P
Ni foam/CMP-0.5h	1:3.63
Ni foam/CMP-2h	1:3.38
Ni foam/CMP-50mg	1:1.48
Ni foam/CMP-200mg	1:2.59
Ni foam/CMP-500mg	1:3.66
Ni foam/CMP-700mg	1:5.16

**Table S2.** Experimental and computational lattice parameters for  $\beta$ -CoMoO<sub>4</sub> and P-doped  $\beta$ -CoMoO<sub>4</sub>.

Computational and experimental values match well, and there is little overall change after P-doping.

	<b>a / Å</b>	<b>b / Å</b>	<b>c / Å</b>	<b><math>\alpha</math> / °</b>	<b><math>\beta</math> / °</b>	<b><math>\gamma</math> / °</b>
<b>CoMoO<sub>4</sub></b>	10.21	9.27	7.022	90.0	106.9	90.0
<b>Experimental</b>						
<b>CoMoO<sub>4</sub></b>	10.26	9.31	7.07	90	107.4	90
<b>Computational</b>						
<b>P-CoMoO<sub>4</sub></b>	10.14	9.29	6.97	90	107.0	90
<b>Computational</b>						