Electronic Supplementary Information for:

Mechanistic insights into interfaces and nitrogen vacancies in cobalt hydroxide/tungsten nitride catalysts to enhance alkaline hydrogen evolution

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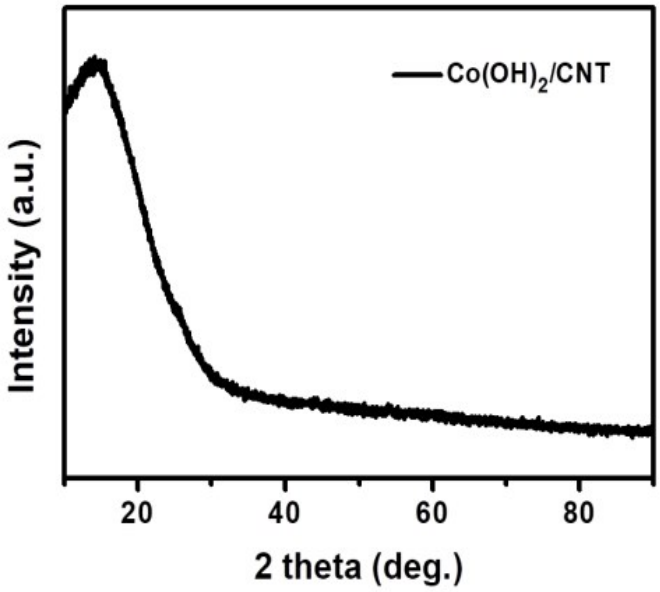

Fig. S1 XRD pattern of $Co(OH)_2$/CNTs.

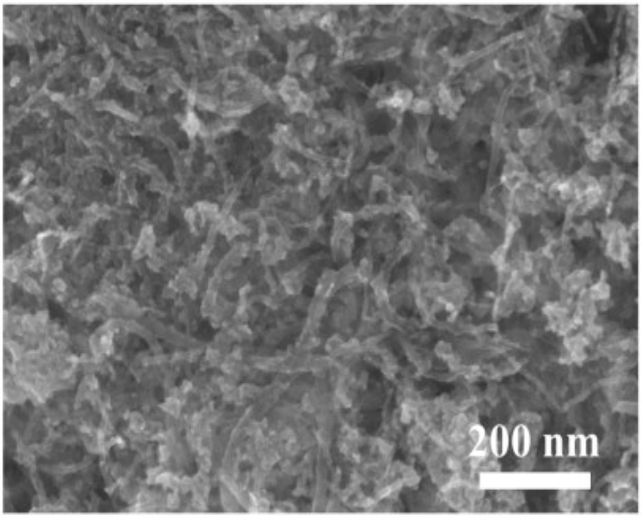

Fig. S2 SEM image of $Co(OH)_2$/*c*-WN_{1-x}/CNTs catalysts.

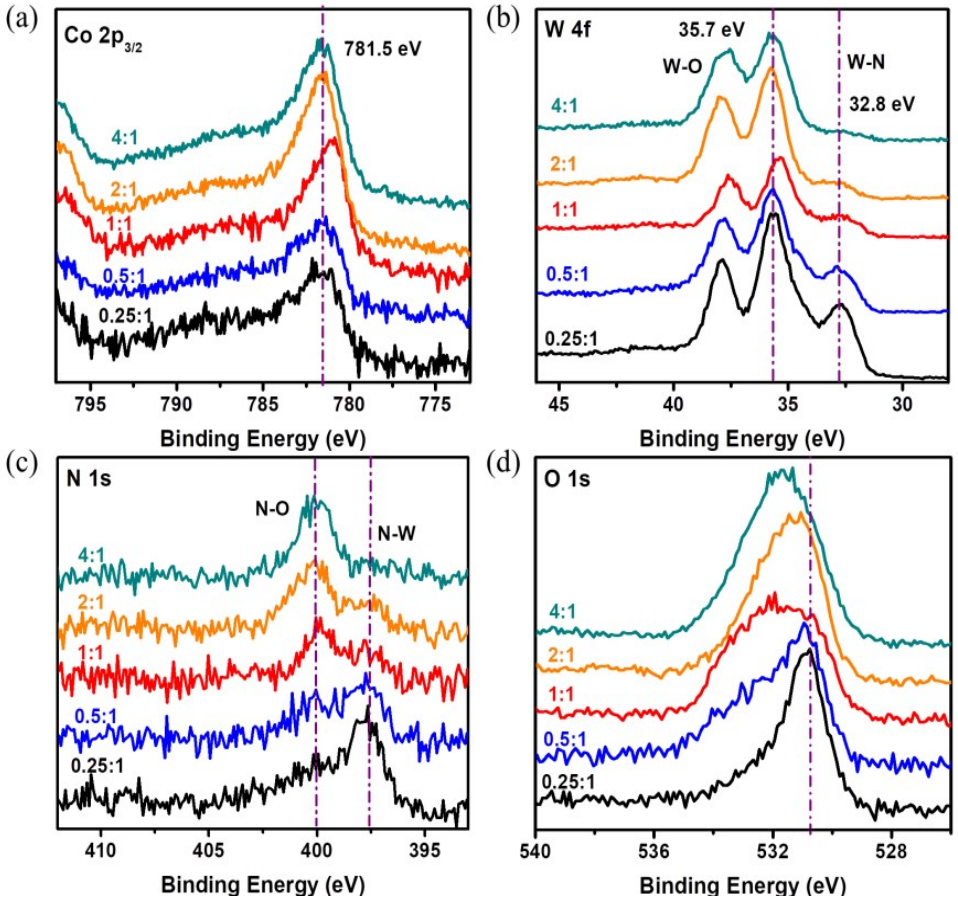

Fig. S3 XPS spectra of (a) Co $2p_{3/2}$; (b) W4f; (c) N1s and (d) O1s of $Co(OH)_2$/*c*-WN_{1-x}/CNTs catalysts with different mole ratios.

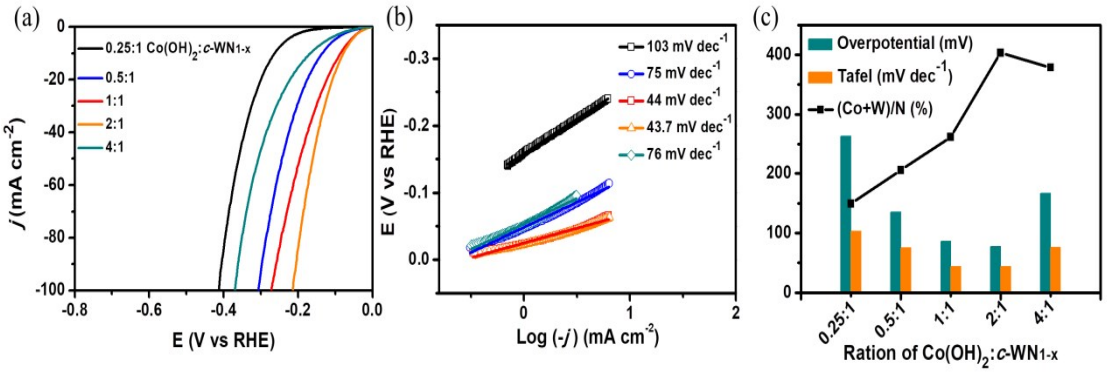

Fig. S4 (a) Polarization curves; (b) Tafel slope and (c) Histogram of overpotential for achieving current density of 10 mA cm^{-2}, Tafel slope and dot plot of surface atomic ration ((Co+W)/N) for $Co(OH)_2$/*c*-WN_{1-x}/CNTs catalysts with different mole ratios.

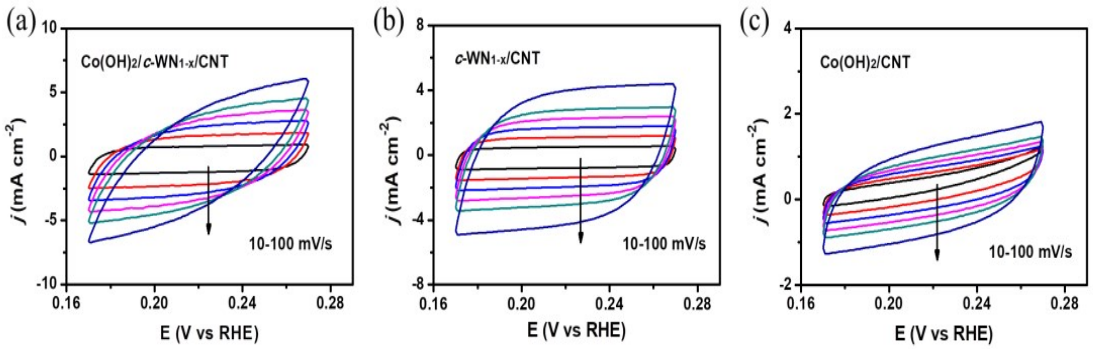

Fig. S5 CV curves of (a) $Co(OH)_2$/*c*-WN_{1-x}/CNTs, (b) *c*-WN_{1-x}/CNTs and (c) $Co(OH)_2$/CNTs in the range of 0.166-0.266 V *vs.* RHE with different scan rates.

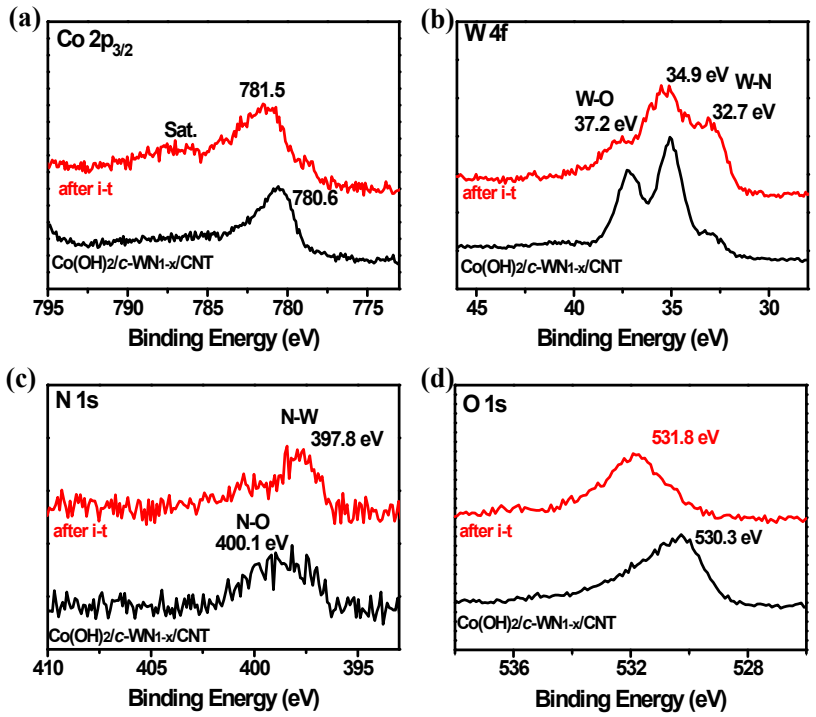

Fig. S6 XPS spectra of (a) Co $2p_{3/2}$; (b) W4f; (c) N1s and (d) O1s of $Co(OH)_2$/*c*-WN_{1-x}/CNTs catalysts before and after *i-t* for 10 min.

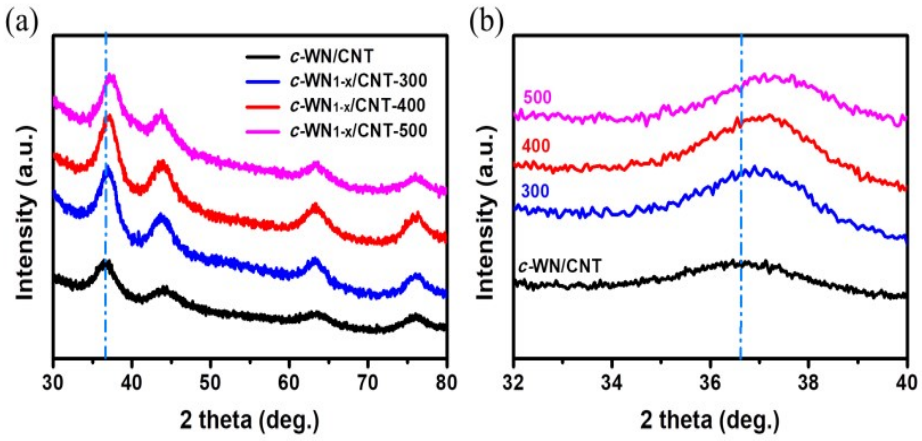

Fig. S7 XRD patterns of *c*-WN/CNTs and *c*-WN_{1-x}/CNTs annealed at 300, 400 and 500 ℃ under H_2 flow.

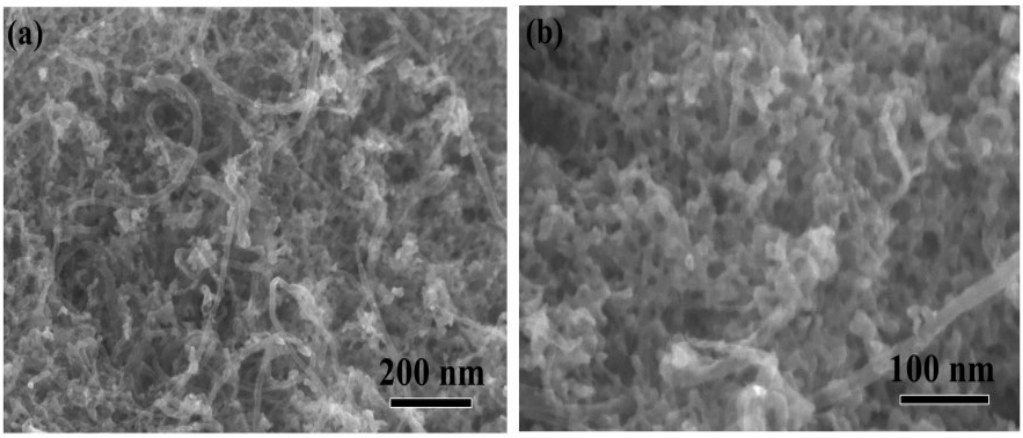

Fig. S8 SEM images of *c*-WN_{1-x}/CNTs at different magnifications.

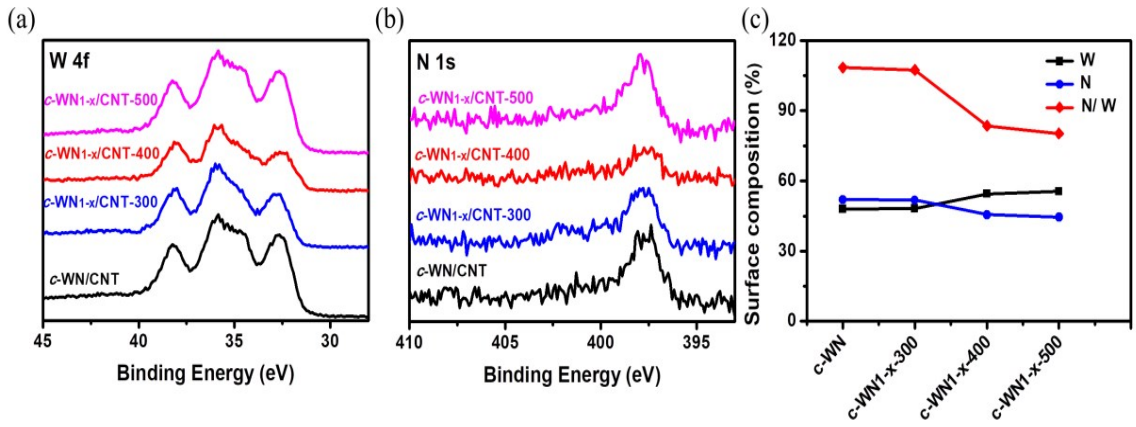

Fig. S9 XPS spectra of (a) W4f; (b) N1s and (c) surface element composition of *c*-WN/CNTs and *c*-WN_{1-x}/CNTs annealed at 300, 400 and 500 ℃ under H_2 flow.

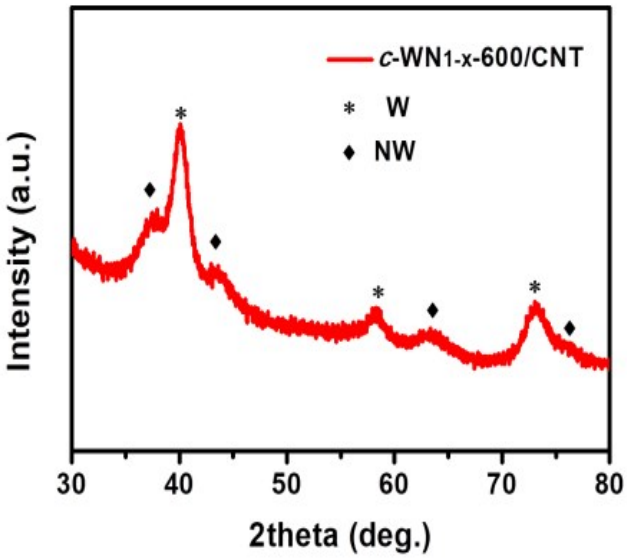

Fig. S10 XRD patterns of *c*-WN_{1-x}/CNTs annealed at 600 ℃ under H_2 flow.

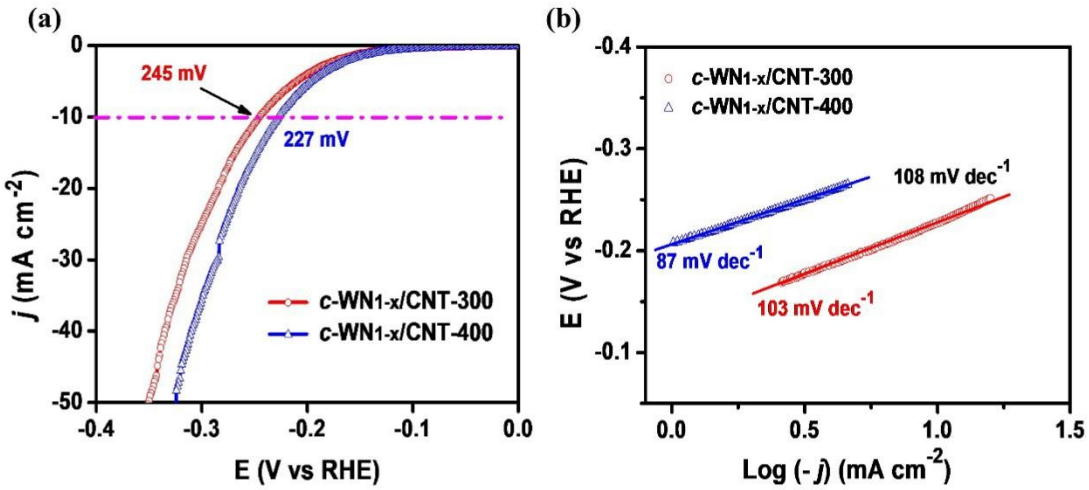

Fig. S11 (a) Polarization curves; (b) Tafel slope of *c*-WN_{1-x}/CNTs annealed at 300 and 400 ℃ under H_2 flow.

Table S1 Comparison of hydrogen evolution performance for different tungsten-based electrocatalysts for water splitting.

Catalysts	Loading (mg/cm^2)	Electrolyte	η_{10} (mV)	Refs.
WN NW/CC (hex)		1 M KOH	130	*J. Mater. Chem. A* 2017, 5, 19072-19078
WN NA/CC (orthorhombic)	2.5	1 M KOH	285	*Electrochimica Acta* 154, 2015, 345-351
W_2C-NC-WN (hex)	0.2	1 M KOH	145	*Int. J. Hydrogen Energy* 43, 1, 2018,16-23
WON@NC NAs/CC (cubic)	7.7	1 M KOH	130	*ChemSusChem* 2015, 8, 2487-2491
W/N doped C	0.204	0.1 M KOH	85	*Adv. Mater.* 2018, 30, 1800396
$Ni_{0.54}W_{0.26}Se$	0.45	1 M KOH	162	*Chem. Asian J.* 2018, 13, 2040-2045
Ni/WC@NC	0.7	1 M KOH	77	*Energy Environ. Sci.* 2018, 11, 2114-2123
h-WN/$Co_{2.45}$	0.196	1 M KOH	76	*J. Mater. Chem. A* 2018, 6, 10967-10975
WC_x NWs		1 M KOH	122	*J. Mater. Chem. A* 2017, 5, 13196-13203
WP/W		1 M KOH	133	*Chem. Eng. J.* 2017, 327, 705-712
$Co(OH)_2$/*c*-WN_{1-x}/CNT	1.6	1 M KOH	78	this work