Supporting Information

Electronic configuration modulation of tin dioxide by phosphorus dopant for pathway change in electrocatalytic water oxidation

Hao Wan,[a] Xue Xiao,[b] Wei Ma,[a] Ying Zhang,[a] Xiaohe Liu,*[a,b] Yanyu Liu,*[c] Gen Chen,[b] Ning Zhang,[b] Yijun Cao,[a] Renzhi Ma*[d]

[a] School of Chemical Engineering, Zhengzhou University, Zhengzhou 450001, PR China. E-mail: liuxh@csu.edu.cn

[b] State Key Laboratory of Powder Metallurgy and School of Materials Science and Engineering, Central South University, Changsha, Hunan 410083, P.R. China.

[c] College of Physics and Materials Science, Tianjin Normal University, Tianjin 300387, PR China. E-mail: yyliu@tjnu.edu.cn

[d] World Premier International Center for Materials Nanoarchitectonics (WPI-MANA), National Institute for Materials Science (NIMS), Namiki 1-1, Tsukuba, Ibaraki 305-0044, Japan. Email: MA.Renzhi@nims.go.jp

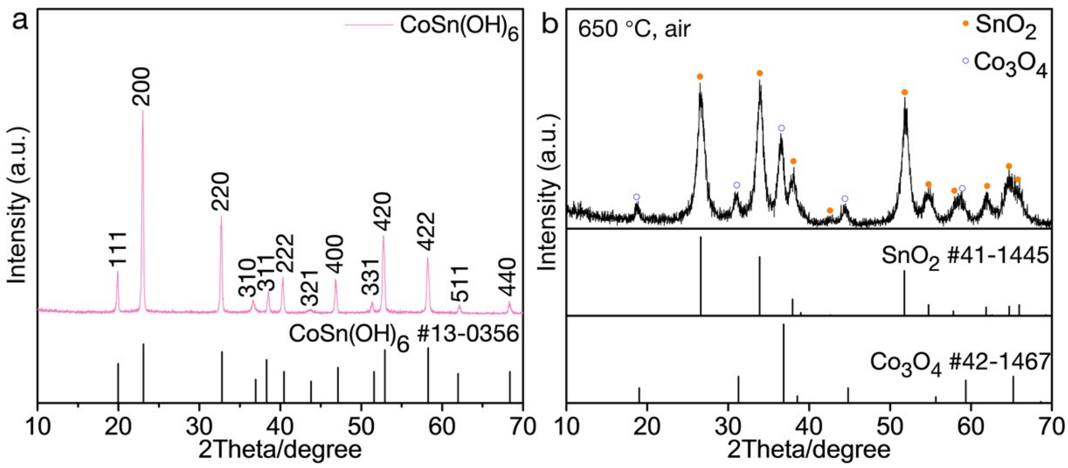

Fig. S1. XRD patterns of (a) $CoSn(OH)_6$ product which was prepared via the co-precipitation process, (b) calcined sample.

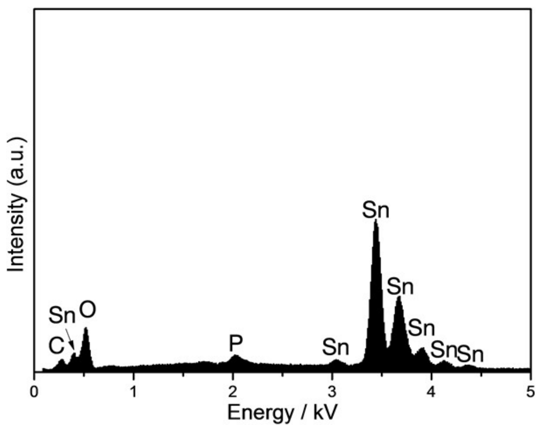

Fig. S2. EDX spectrum of P-SnO_2 product.

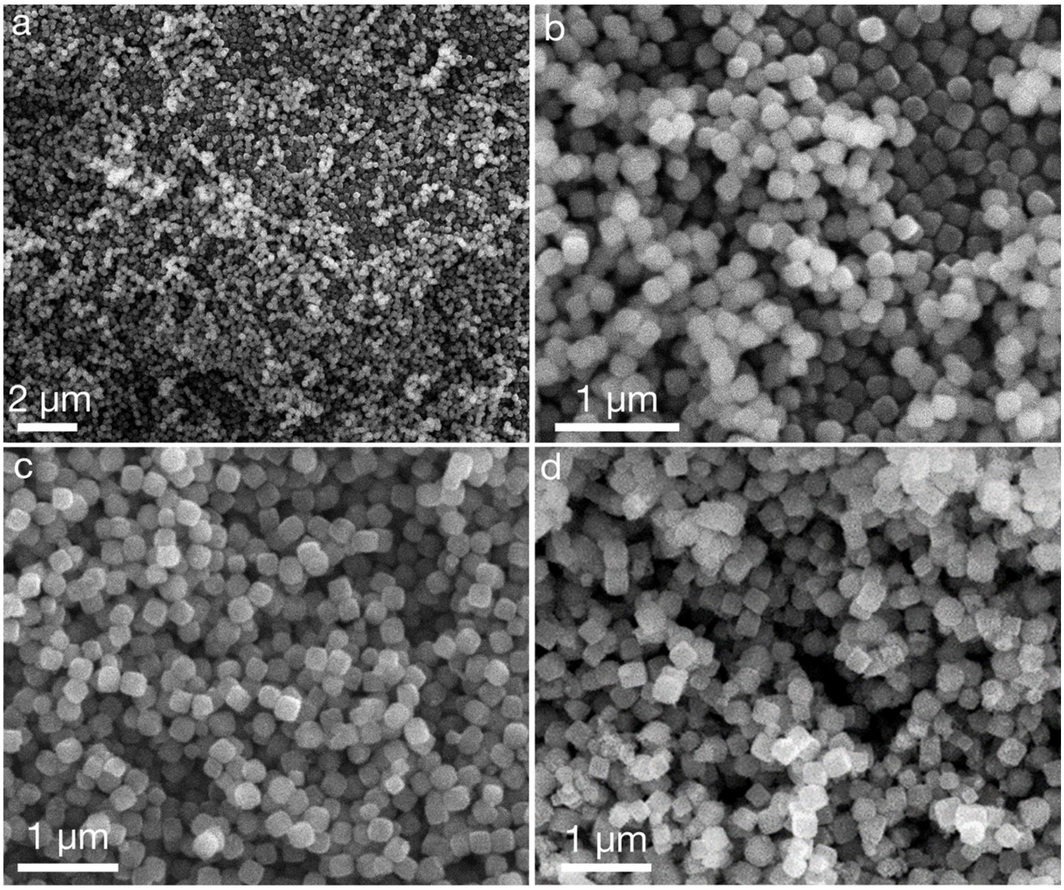

Fig. S3. SEM images of (a, b) $CoSn(OH)_6$, (c) calcined product and (d) acid-treated sample, i.e. SnO_2.

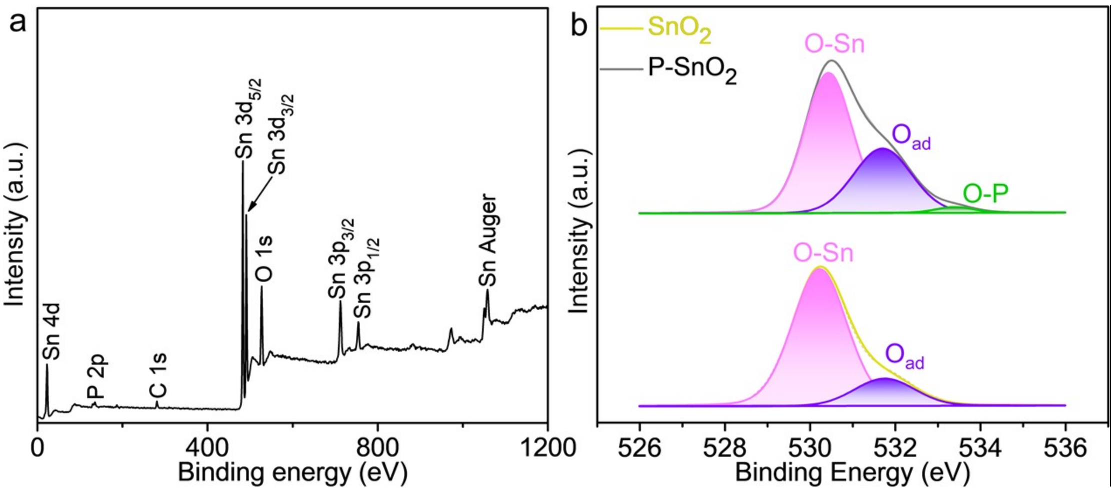

Fig. S4. (a) XPS survey spectrum of P-SnO_2 nanoparticles. (b) P 2p spectra of pristine and doped SnO_2 products. Comparing to the O 1s spectrum benchmark of pristine SnO_2 product, the peak locating at ~533.3 3V for P-SnO_2 sample should be ascribed to the oxidized P species.[1]

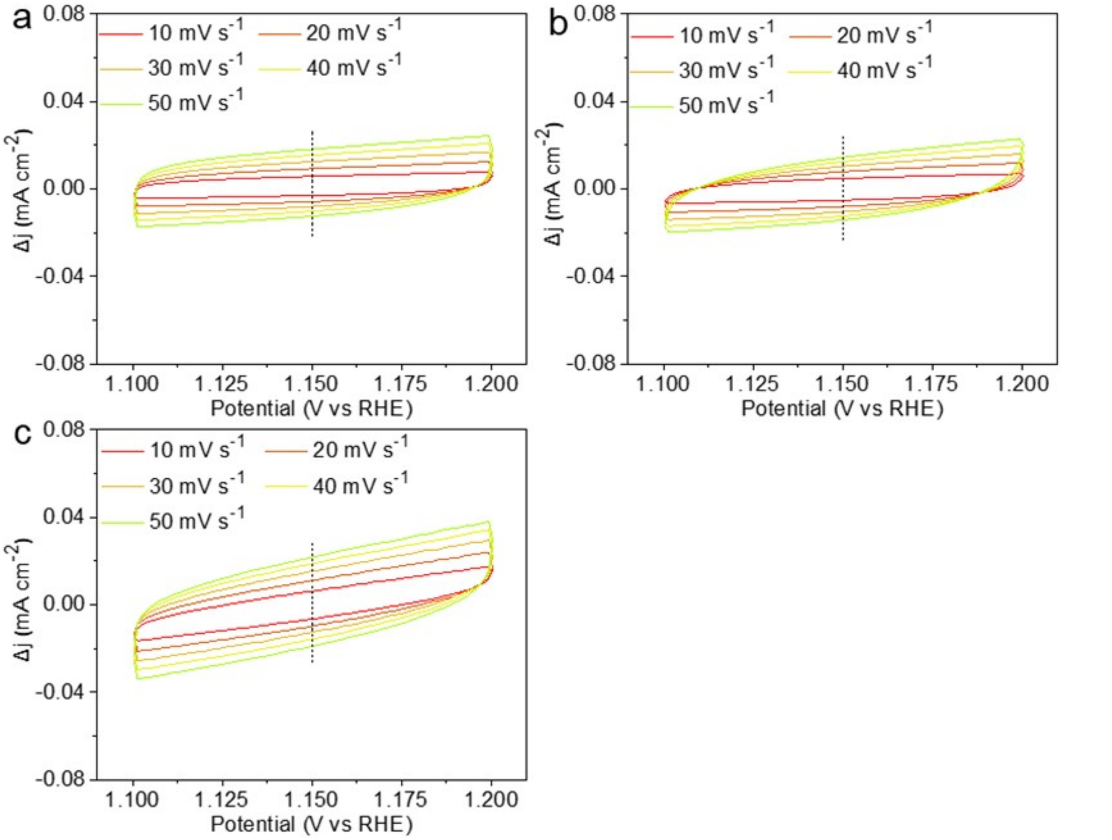

Fig. S5. Cyclic voltammetry (CV) curves of (a) $CoSn(OH)_6$, (b) SnO_2 and (c) P-SnO_2 nanoparticles at incremental scan rates.

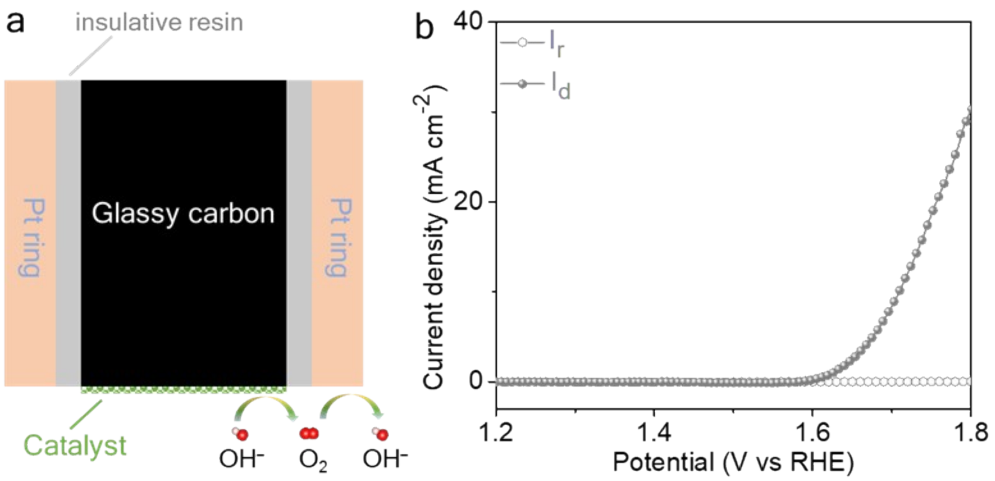

Fig. S6. (a) Scheme for the reaction process on a RRDE with the presence of an external voltage. (b) Rotating ring-disk electrode (RRDE) voltammogram at the ring voltage of 1.50 V vs RHE for the estimation of electron transfer number.

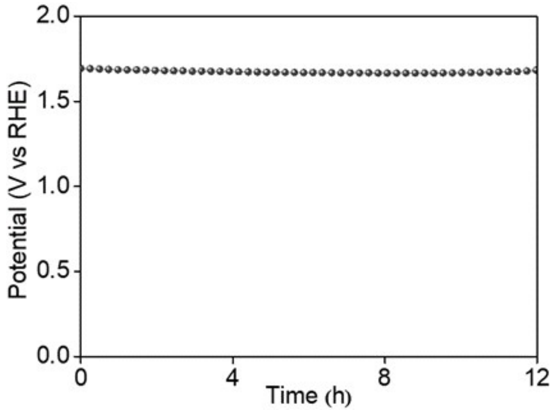

Fig. S7. Chronopotentiometry investigation at a constant current density of 10 mA cm^{-2} for P-SnO_2 product.

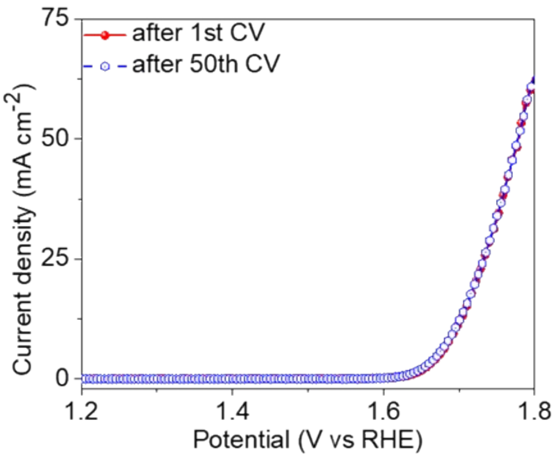

Fig. S8. LSV curves for P-SnO_2 product after the 1st and 50th CV scan. These two curves were rather similar, revealing the satisfactory electrochemical stability during continuous electrocatalysis.

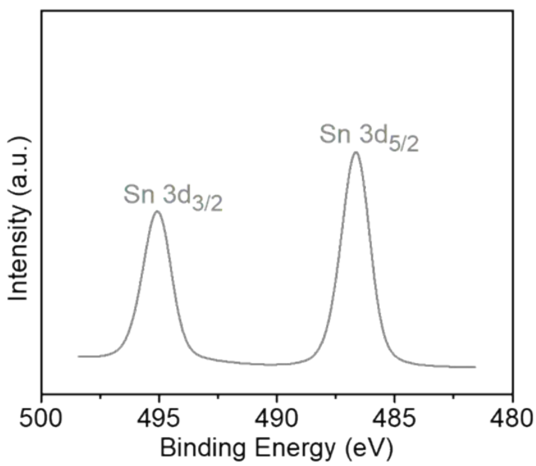

Fig. S9. Sn 3d spectrum of P-SnO_2 product after a chronopotentiometry measurement for 1000s. Typical peak features of SnO_2 phase were also detected, confirming the structural stability during electrocatalysis.

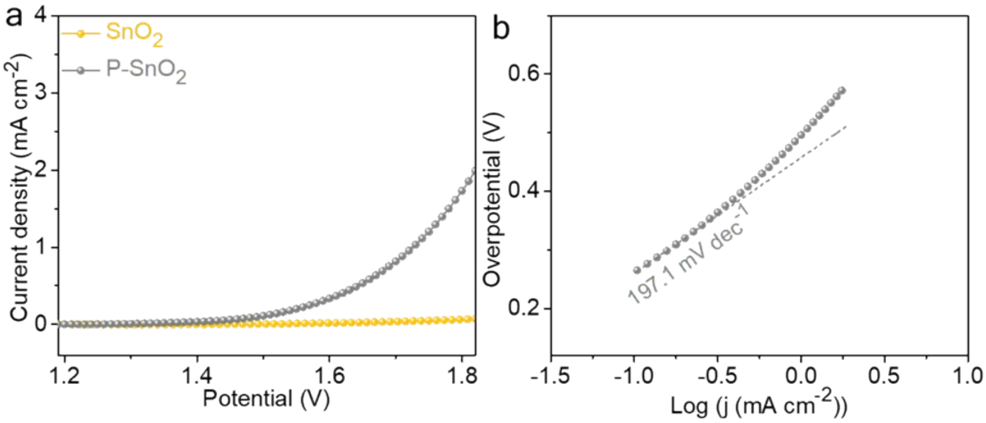

Fig. S10. Water oxidation activity in 1.0 M H_2SO_4 solution. (a) LSV curves, (b) Tafel plot.

References

[1] X. Zhou, X. Liao, X. Pan, M. Yan, L. He, P. Wu, Y. Zhao, W. Luo and L. Mai, Unveiling the role of surface P-O group in P-doped Co_3O_4 for electrocatalytic oxygen evolution by on-chip micro-device, *Nano Energy* 2021, **83**, 105748.