Supporting Information

Green and Efficient Piezocatalytic Hydrogen Production Achieved by Modifying $SrBi_4Ti_4O_{15}$ with CdSe

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1. Experimental

1.1 Synthesis methods

The CdSe QDs were synthesized by imitating previous reported work[1]. In a typical routine utilizing a three-neck flask, in order to prepare the Se precursor, Na_2SO_3 (0.03 mol) and selenium powder (5.0 mmol) were added into 100 mL deionized water and refluxed under a nitrogen atmosphere at 80 °C for 6 h. After that, CdAc·$2H_2O$ (4 mmol) was dissolved in 50 mL of deionized water and then 100 mL Se precursor was added dropwise into the mixture at 500 μL/min using a peristaltic pump during reflux and insulation at 80 °C for 6 h. The crimson precipitates were centrifuged and washed with ethanol and deionized water repeatedly to remove the residual reactants, and dried at 60 °C in a vacuum oven, labeled as CS.

2.XPS-VB calculation

The small binding energy range of VB_{-XPS}[2] is used to calculate its valence band. It is reported that the work function of the sample and the contact potential difference (ΔV) have the following relationship: $\Delta V = \Phi - \varphi$ (Φ and φ are the work functions of the material and the XPS analyzer, respectively). So $E_{VB, NHE} = \varphi - 4.44\ eV + E_{VB, XPS}$ (φ is the work function of XPS analyzer as 4.44, where 4.44 eV is the energy difference from Fermi energy level to valence band relative to the standard hydrogen electrode at pH = 7, $E_{VB, NHE}$ is the position of energy band under the standard hydrogen electrode, and $E_{VB, XPS}$ is the position of the intersection of slope and X-axis).

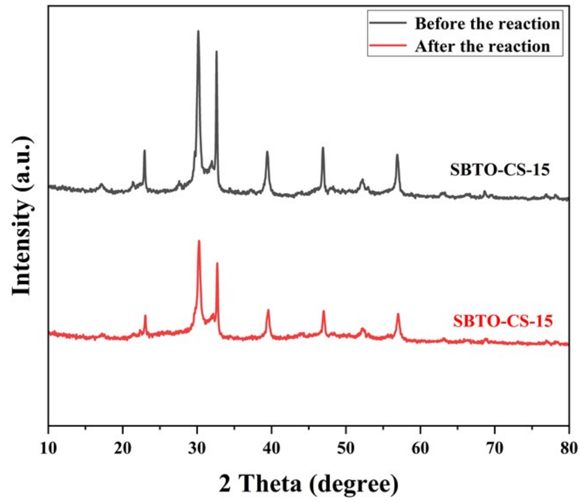

Fig. S1 XRD patterns of SBTO-CS-15 before and after reaction (reaction time is 3h).

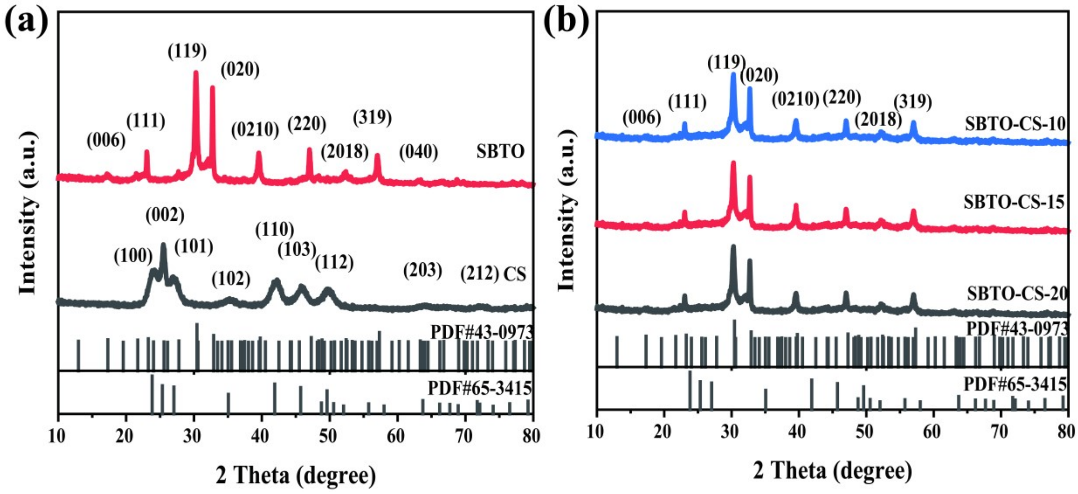

Fig. S2 (a) XRD patterns of pure SBTO, CS samples. (b) XRD patterns of SBTO-CS-10, 15, 20 samples.

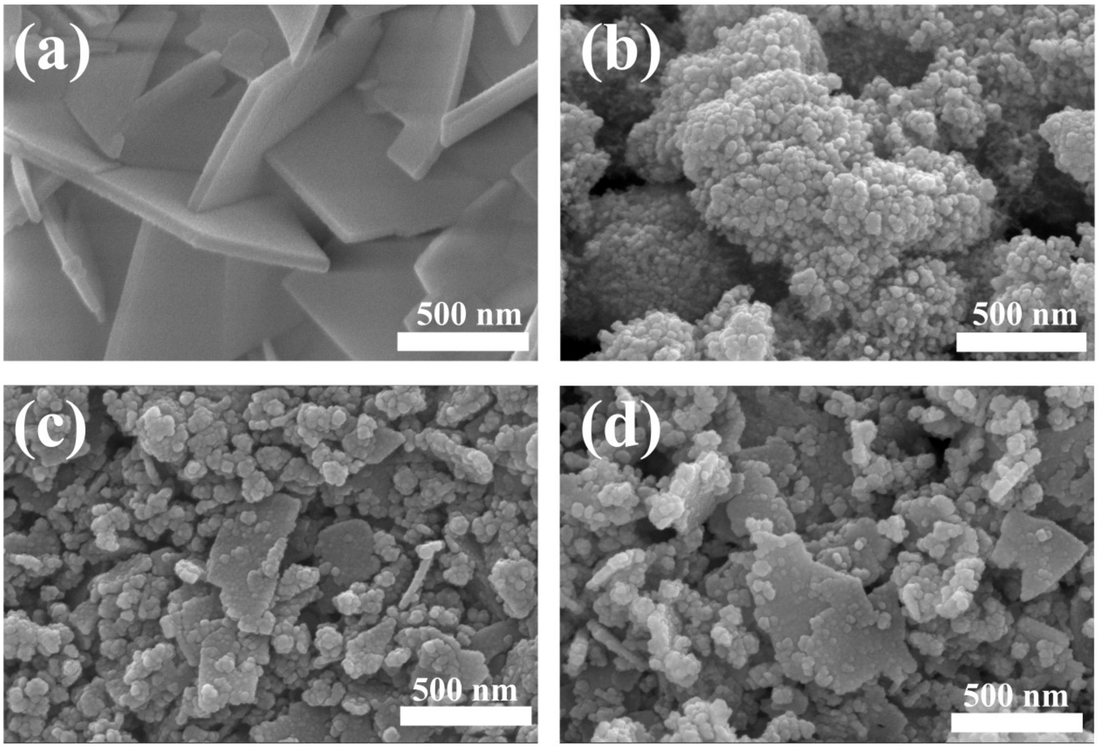

Fig S3. SEM images of (a) pure SBTO and (b) CS. (c-d) SEM images of SBTO-CS-15 (at different regions).

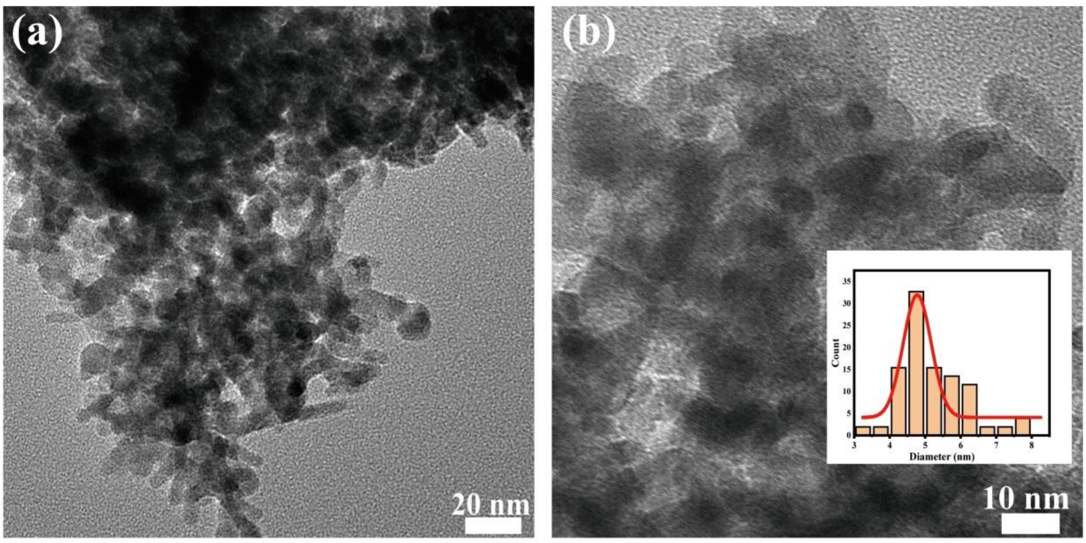

Fig. S4 (a-b) TEM images of CS QDs. (b) a higher magnification image of CS and the insert shows the particles size distribution.

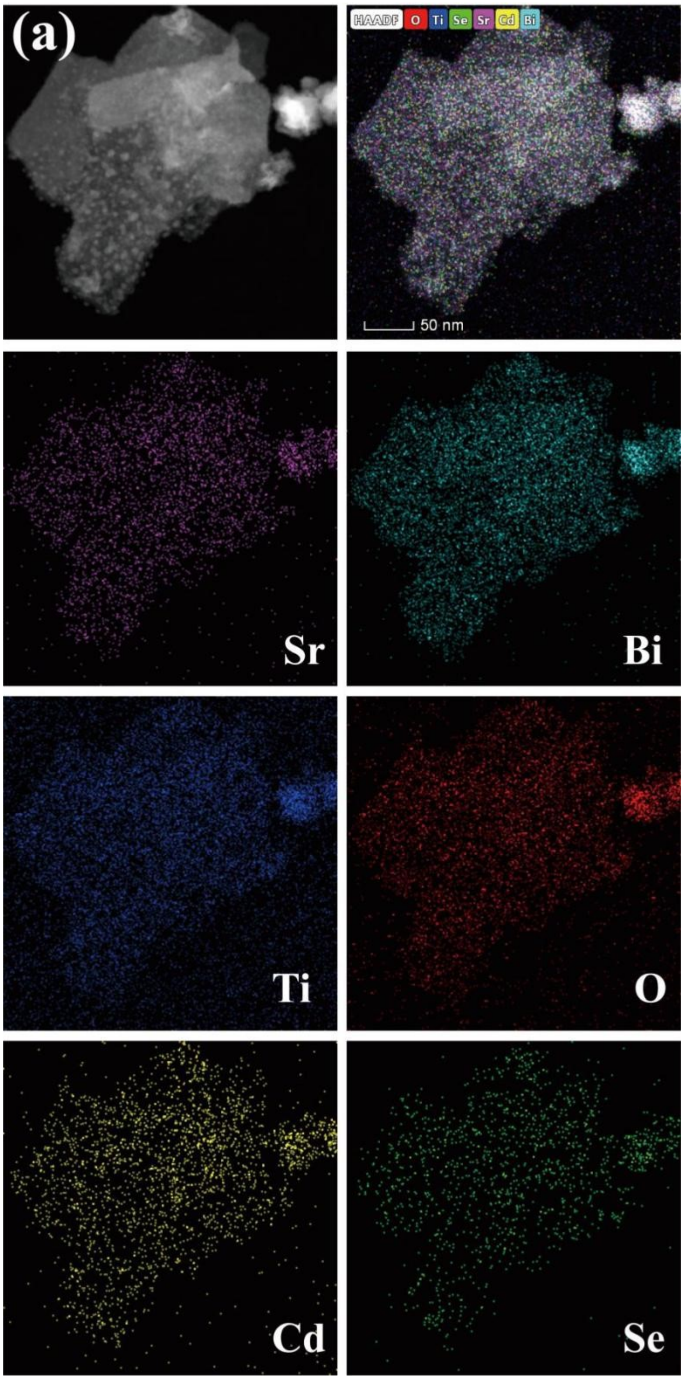

Fig. S5 EDS-mapping data of SBTO-CS-15 (Scanning for Sr, Bi, Ti, O, Cd, Se elements.)

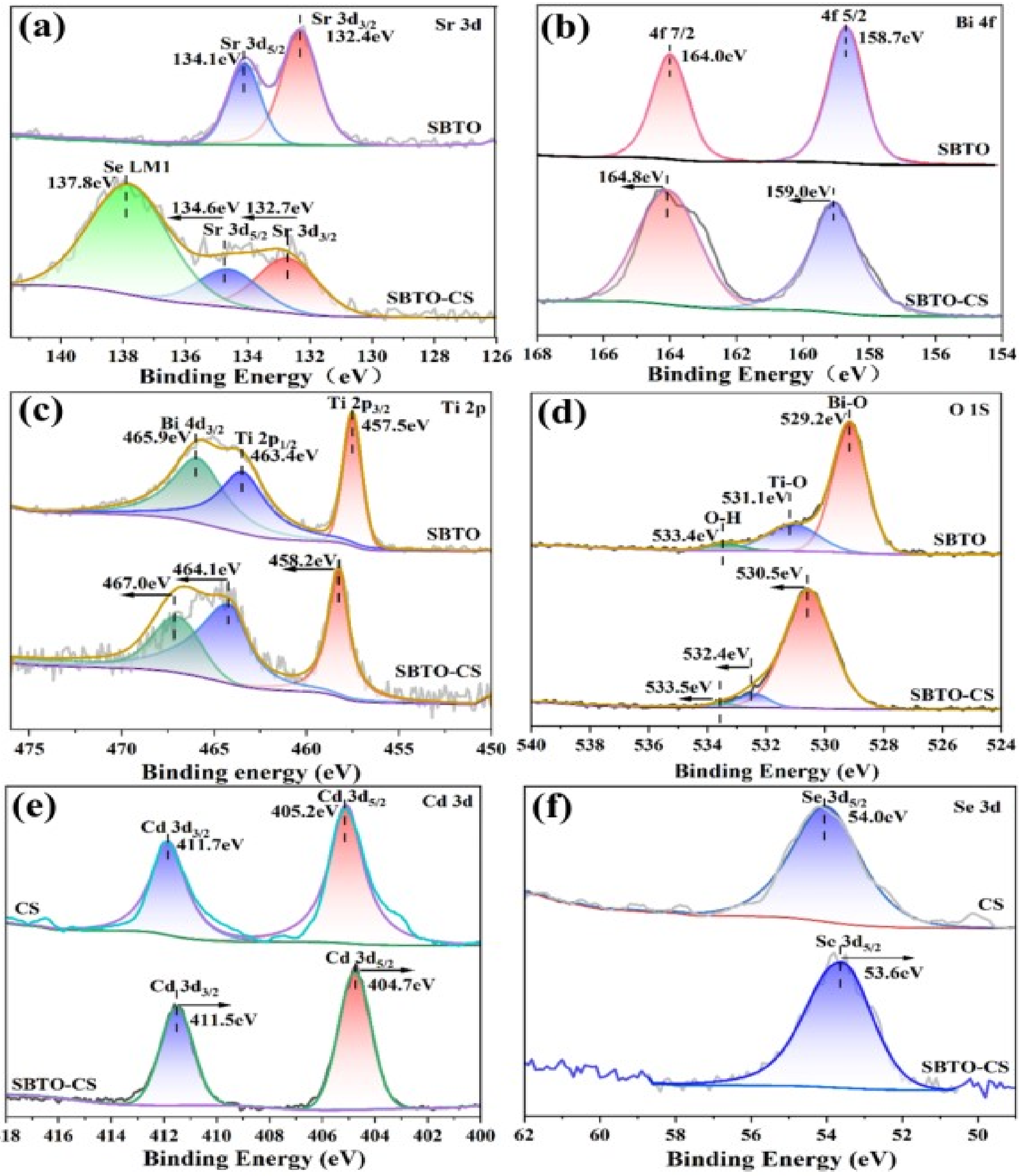

Fig. S6 XPS patterns of (a) Sr, (b) Bi, (c) Ti, (d) O, (e) Cd, and (f) Se elements collected form the pure SBTO, CS and SBTO-CS-15 samples (before reactions). The names of the samples are marked on these curves.

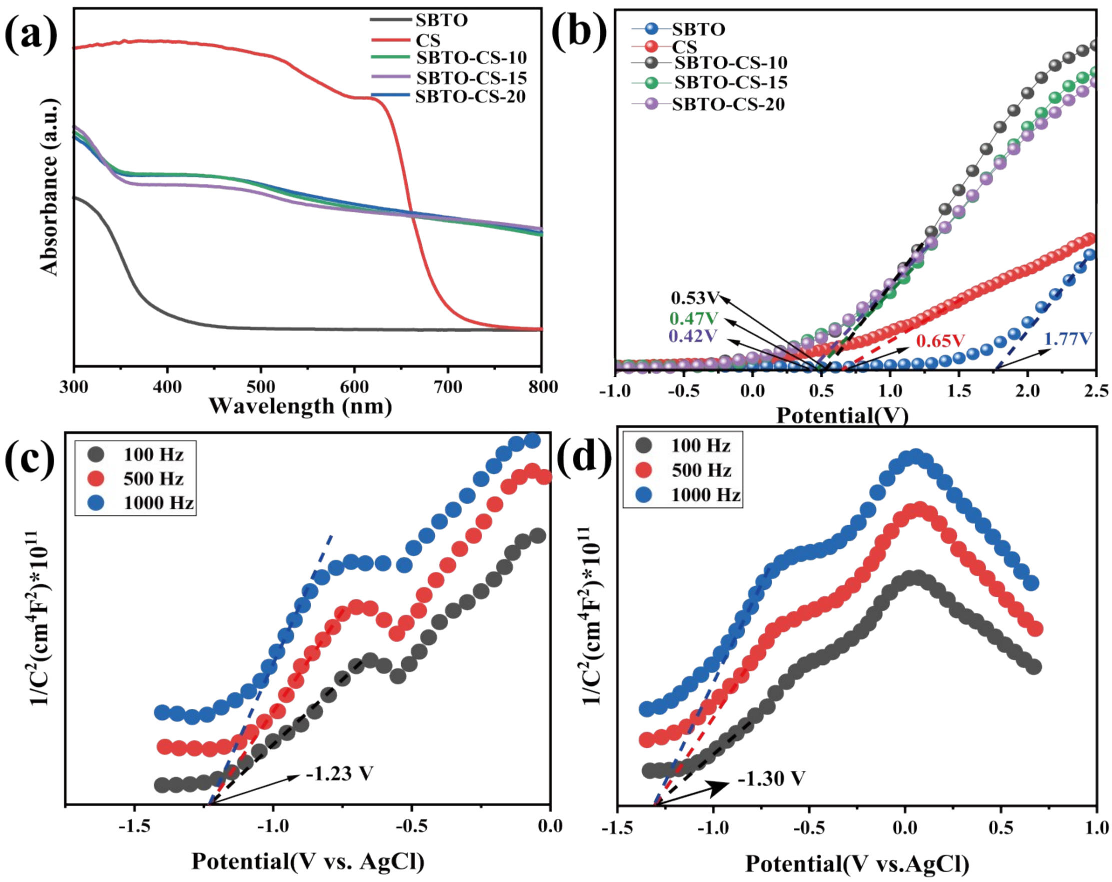

Fig. S7 (a) the UV-Vis absorption spectra, (b) VB-XPS diagrams for SBTO, CS, SBTO-CS-10, 15, 20. (c-d) Mott Schottky curves of (c) SBTO-CS-10 and (d) SBTO-CS-20.

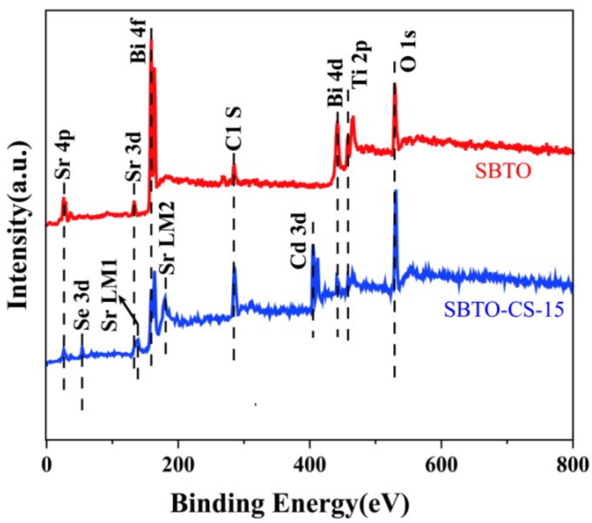

Fig. S8 XPS spectra of two materials.

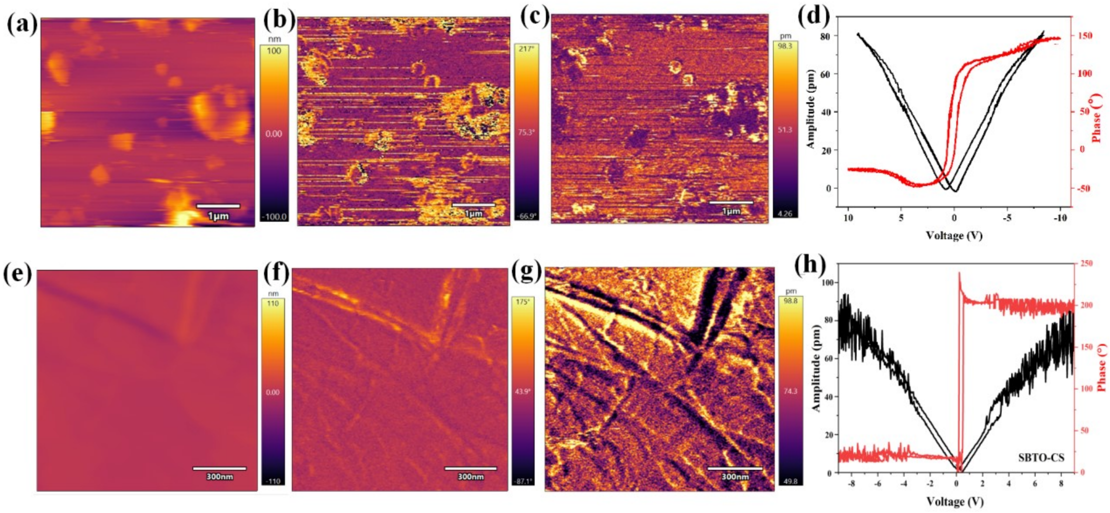

Fig. S9 PFM images of (a–d) pristine SBTO and (e-h) SBTO-CS: (a, e) topography image; (b, f) phase image; (c, g) amplitude image and (d, f) amplitude butterfly loops (black) and phase hysteresis loops (red).

References

[1] D. Zhong, W. Liu, P. Tan, A. Zhu, L. Qiao, Y. Bian, J. Pan, Efficient hydrogen generation of indium doped BaTiO3 decorated with CdSe quantum dots: Novel understanding of the effect of doping strategy, International Journal of Hydrogen Energy 44(3) (2019) 1627-1639. https://doi.org/10.1016/j.ijhydene.2018.11.113

[2] X. Li, B. Kang, F. Dong, Z. Zhang, X. Luo, L. Han, J. Huang, Z. Feng, Z. Chen, J. Xu, B. Peng, Z.L. Wang, Enhanced photocatalytic degradation and H2/H2O2 production performance of S-pCN/WO2.72 S-scheme heterojunction with appropriate surface oxygen vacancies, Nano Energy 81 (2021). https://doi.org/10.1016/j.nanoen.2020.105671