Supporting Information

Earth-abundant elements doping for robust and stable solar-driven water splitting of FeOOH

Junqing Yan[1,a], Ping Li[1,a], Yujin Ji[1,c], Hui Bian[a], Youyong Li*[c] and Shengzhong (Frank) Liu*[a,b]

1: These authors contributed equally to this work

[a] *Key Laboratory of Applied Surface and Colloid Chemistry, National Ministry of Education; Shaanxi Engineering Lab for Advanced Energy Technology, School of Materials Science and Engineering, Shaanxi Normal University, Xi'an, 710119, People's Republic of China*

[b] *iChEM, Dalian Institute of Chemical Physics, Dalian National Laboratory for Clean Energy, Chinese Academy of Sciences, Dalian, 116023, P. R. China*

*E-mail: liusz@snnu.edu.cn

[c] *Institute of Functional Nano & Soft Materials (FUNSOM), Jiangsu Key Laboratory for Carbon-Based Functional Materials & Devices, Soochow University, Suzhou, Jiangsu 215123, People's Republic of China*

*Email: yyli@suda.edu.cn

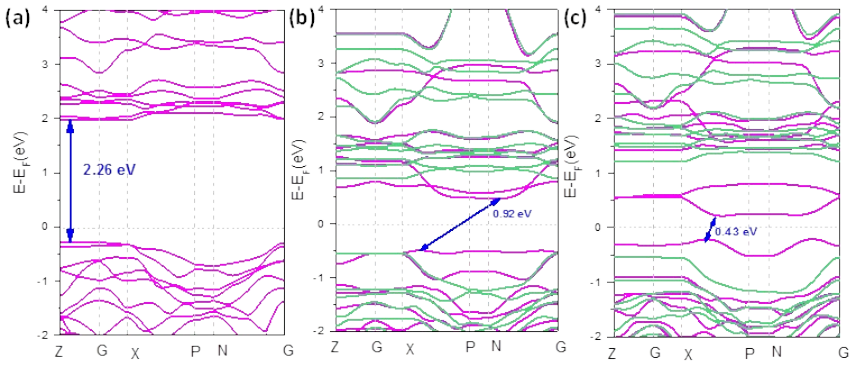

Figure S1. The calculated conduction & valance band structure of the bare (a), Ni (b) and Co (c) doped β-FeOOH.

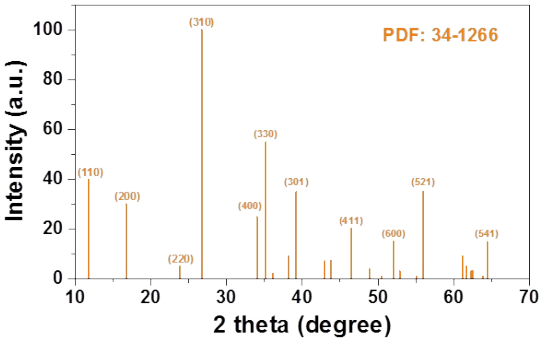

Figure S2. The standard XRD peaks of β-FeOOH.

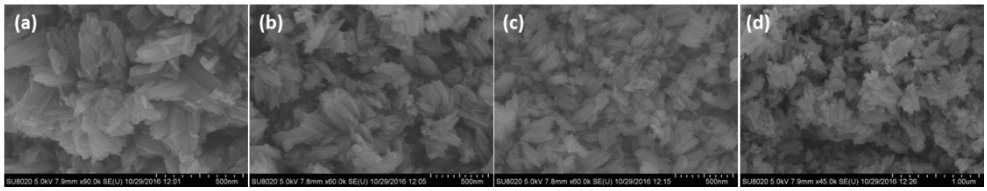

Figure S3. The SEM images of (a) 1%, (b) 3% Co-FeOOH and (c) 1%, (d) 3% Ni-FeOOH.

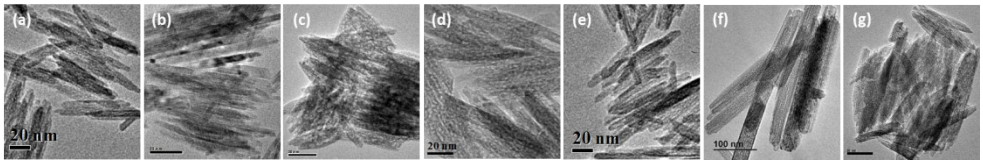

Figure S4. The TEM images of (a) β-FeOOH, (b)-(d) 1%, 2%, 3% Co-FeOOH and (e)-(g) 1%, 2%, 3% Ni-FeOOH.

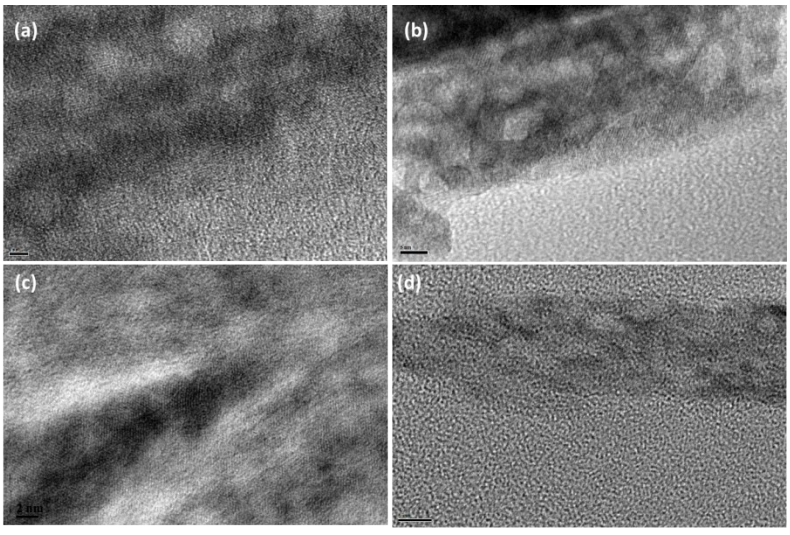

Figure S5. The HRTEM images of (a) 1%, (c) 3% Co-FeOOH and (c)-(d) 1%, 3% Ni-FeOOH.

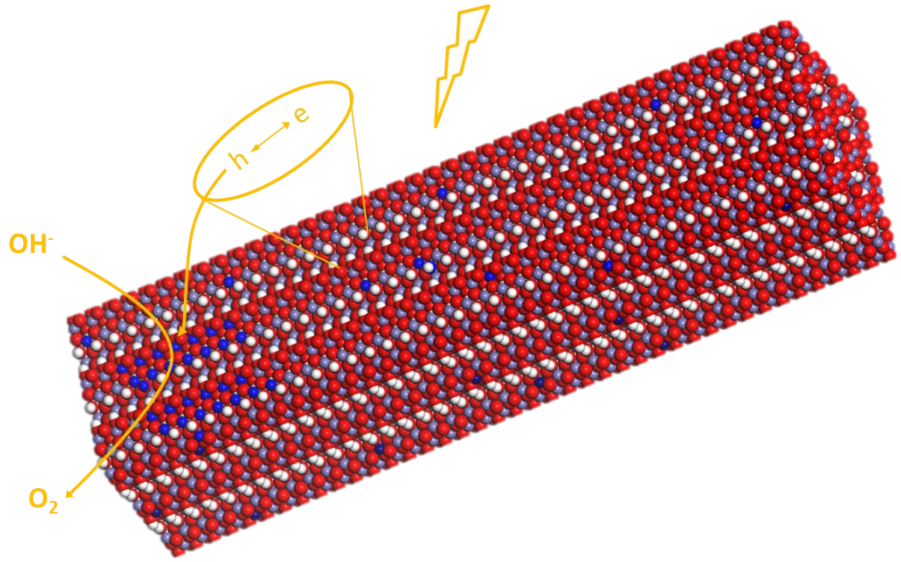

Figure S6. The model of doped β-FeOOH nanorod, the grey, red, white and blue atoms are Fe, O, H and M (Co or Ni), respectively. When the nanorod is excited by the incident light irradiation, hole-electron pairs will be generated and the photogenerated holes transfer to the CoOOH or NiOOH sites and then participate in the water oxidation reaction for oxygen evolution.

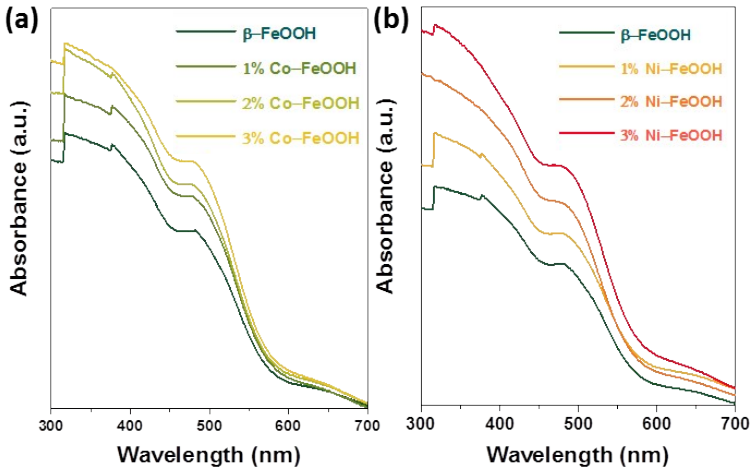

Figure S7. The absorption spectra of bare and doped β-FeOOH nanorod samples.

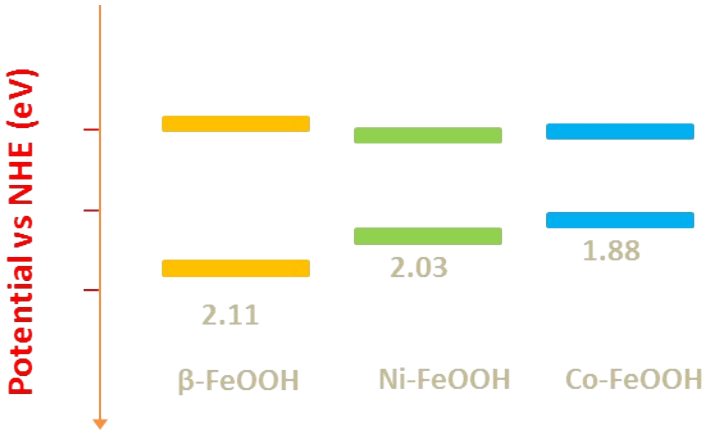

Figure S8. Schematic band structure of bare and doped β-FeOOH samples based on the UV-Vis spectra and UPS results.

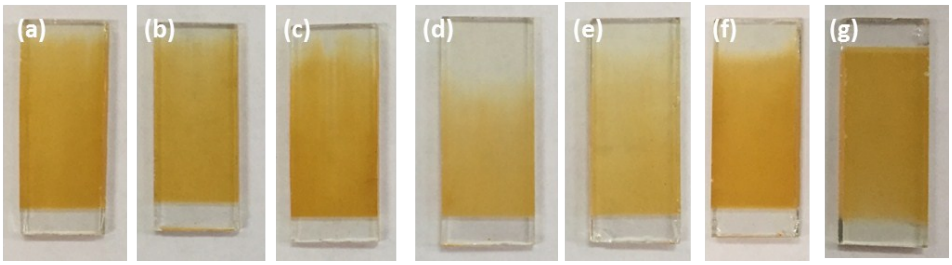

Figure S9. The photograph of bare and doped β-FeOOH electrodes, (a) β-FeOOH, (b)-(d) 1%-3% Co-FeOOH, (e)-(f) 1%-3% Ni-FeOOH.

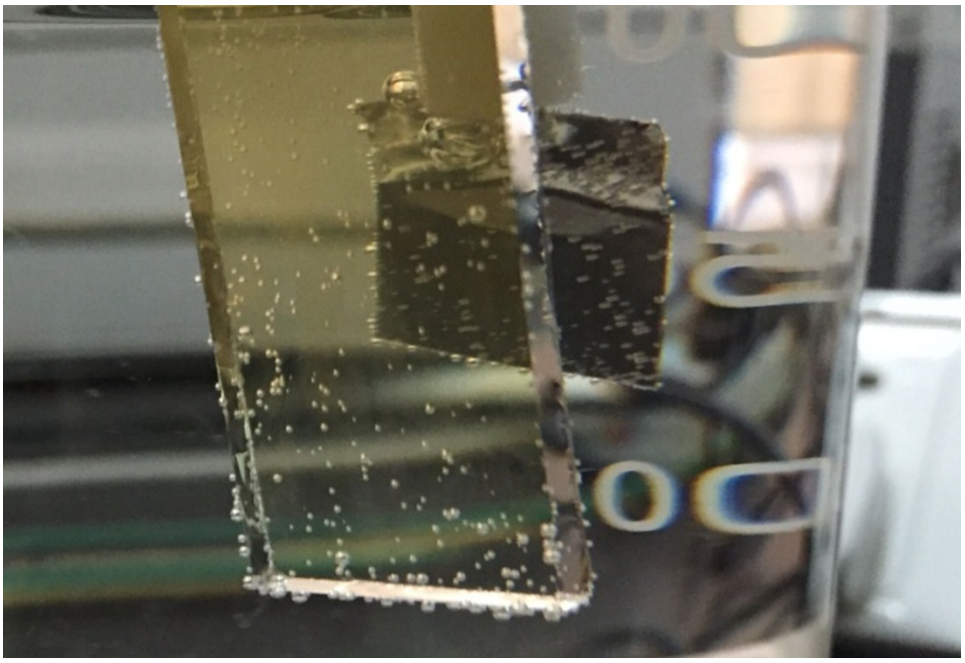

Figure S10. The photograph of oxygen evolution based on β-FeOOH photoanode in the 1 M NaOH solution; the bias voltage is 1.0 V and the wavelength of incident light is 420 nm.

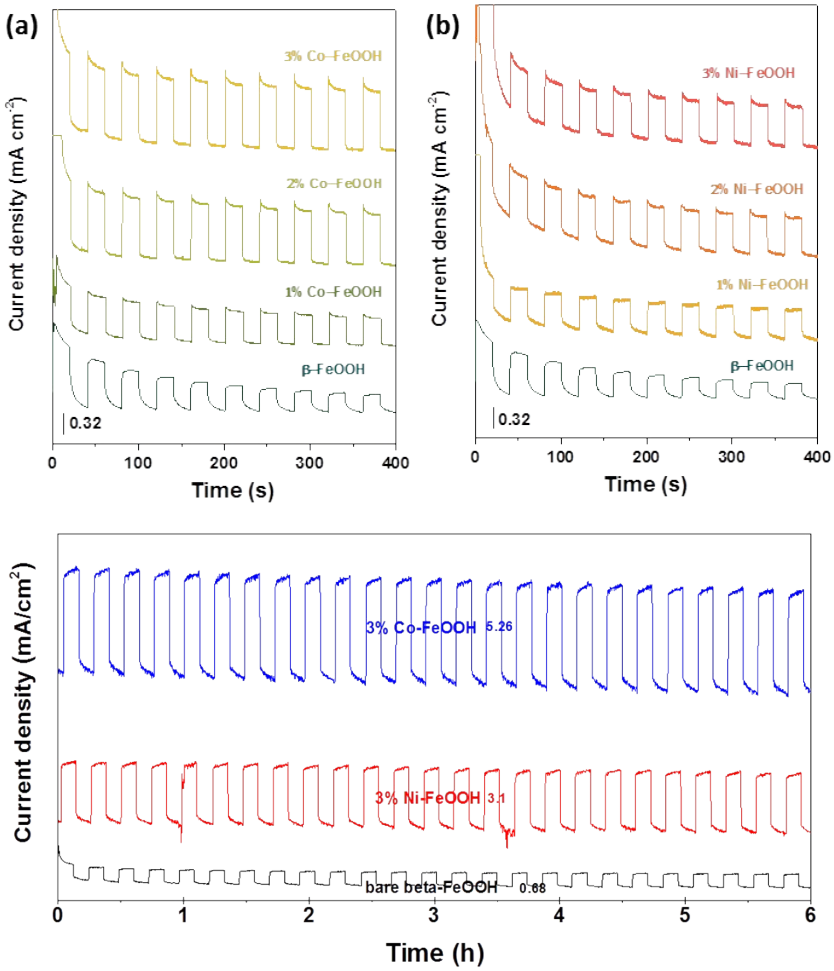

Figure S11. The I-t response based on β-FeOOH series of photoanodes in the 1 M NaOH solution; the bias voltage is 1.0 V and the wavelength of incident light is 420 nm. The below gives the long-time stability of the samples under the same test condition.

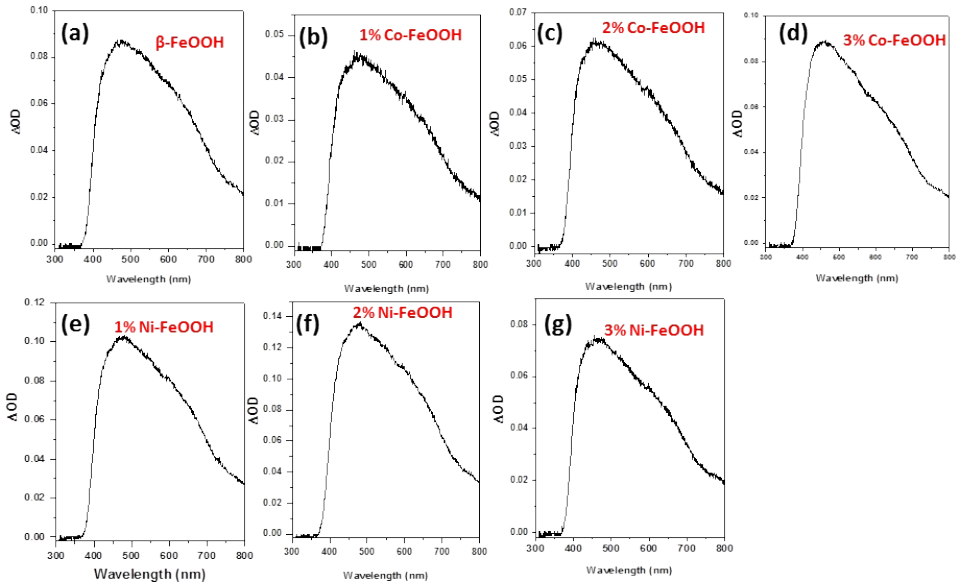

Figure S12. Transient absorption spectrum of studied samples in a methanol/water (1:9 vol%) mixed solution.

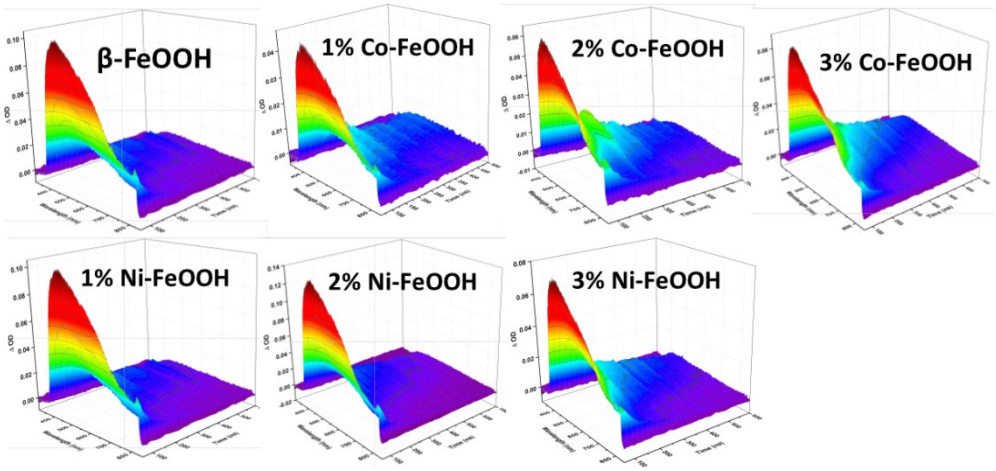

Figure S13. The transient absorption spectrum mapping of the studied samples.

Table S1. Fitting results of the EIS plots (Figure 8), the measurement was carried out at the 1.0 V.

Sample	R_s (ohm/cm^2)	R_{ct} (ohm/cm^2)	R_{trap} (ohm/cm^2)
β-FeOOH	67.5	91.3	604
1% Co-FeOOH	58.6	37.8	140
2% Co-FeOOH	61.5	29.1	67.6
3% Co-FeOOH	55.9	21.8	45.1
1% Ni-FeOOH	64.0	32.9	90.9
2% Ni-FeOOH	60.6	23.5	53.9
3% Ni-FeOOH	56.5	23.1	45.8