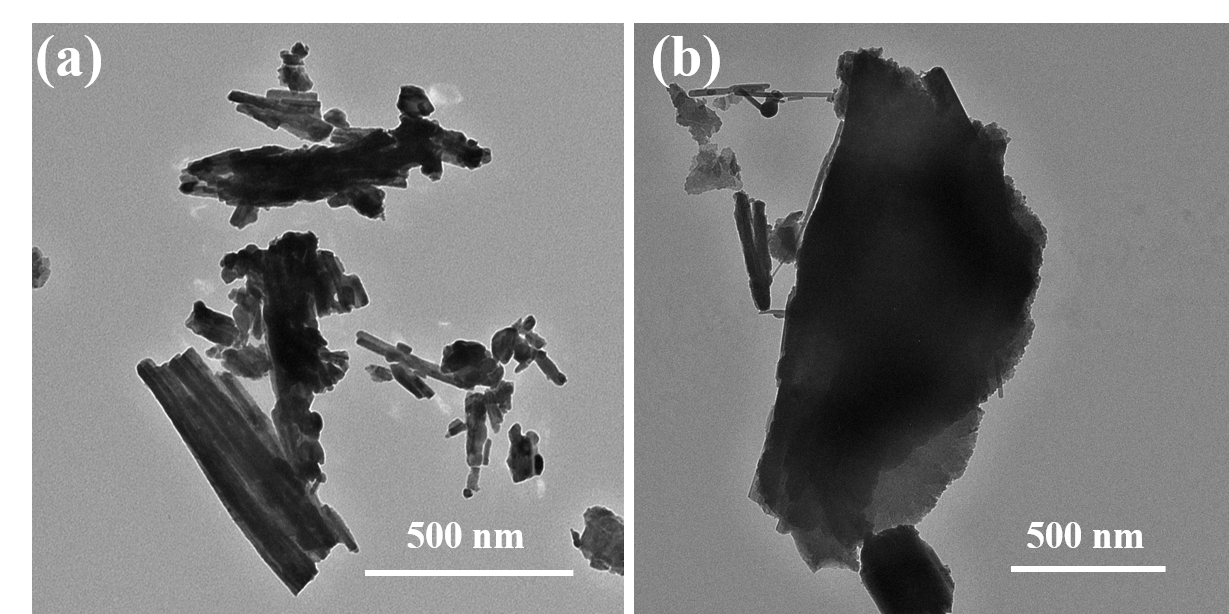
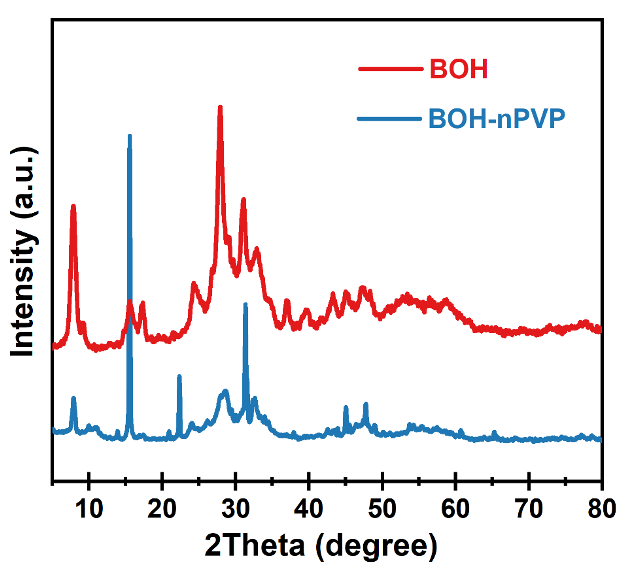
**Supporting Information**

**Anion-Exchange-Mediated Internal Electric Field: Boosting Photogenerated Carrier Separation and Utilization**

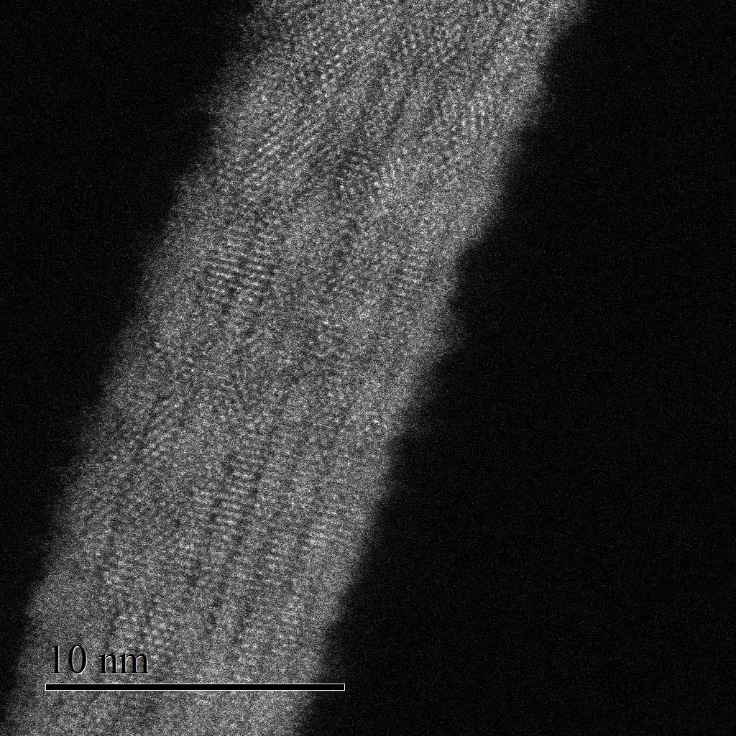
Tong Han1#, Xing Cao1#, Kaian Sun1#, Qing Peng1\*, Weng-Chon Cheong2, Zheng Chen 3, Rui Lin4, Di Zhao5, Zewen Zhuang1, Chen Chen1, Dingsheng Wang1, and Yadong Li1\*



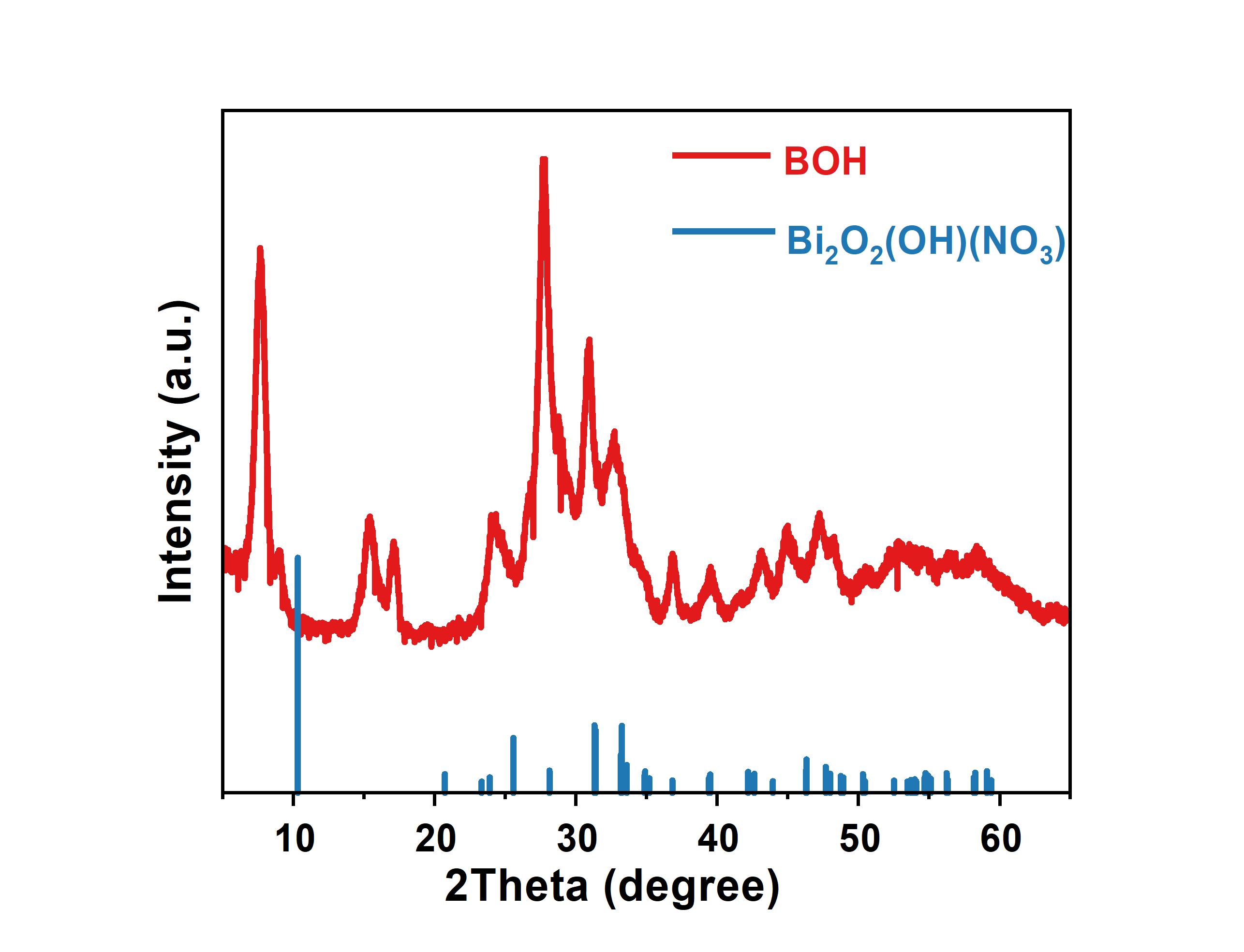
**Figure S1.** (a) TEM image of the hydrothermal product without mannitol; (b) TEM image of the hydrothermal product without PVP.



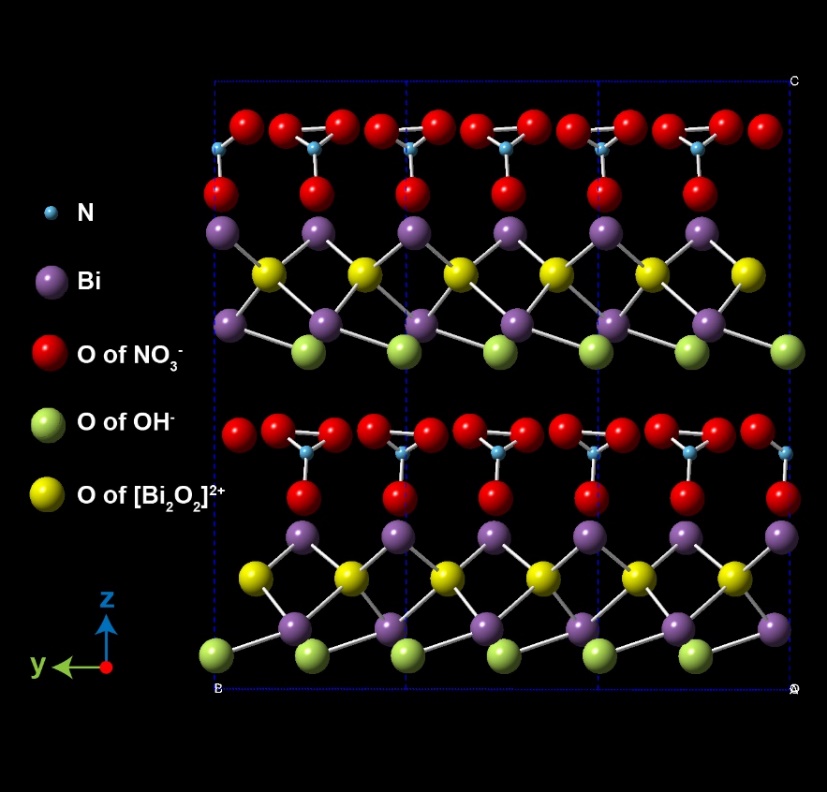
**Figure S2.** The XRD patterns of the BOH and BOH-nPVP.



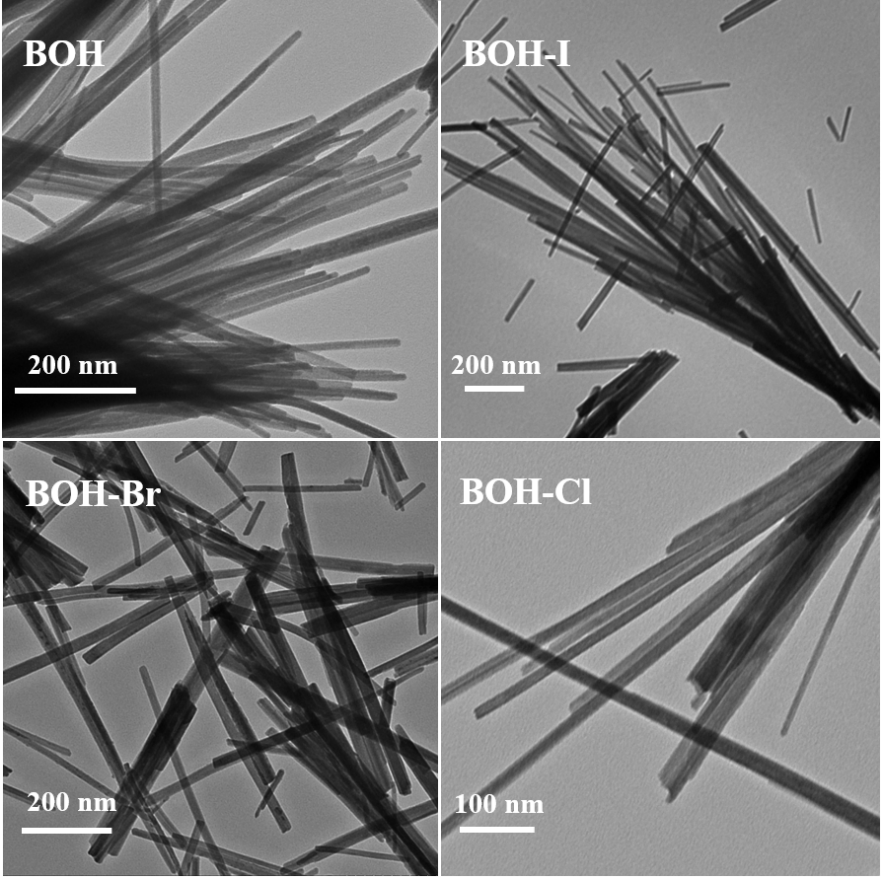
**Figure S3.** Atomic-resolution HAADF-STEM image of BOH.



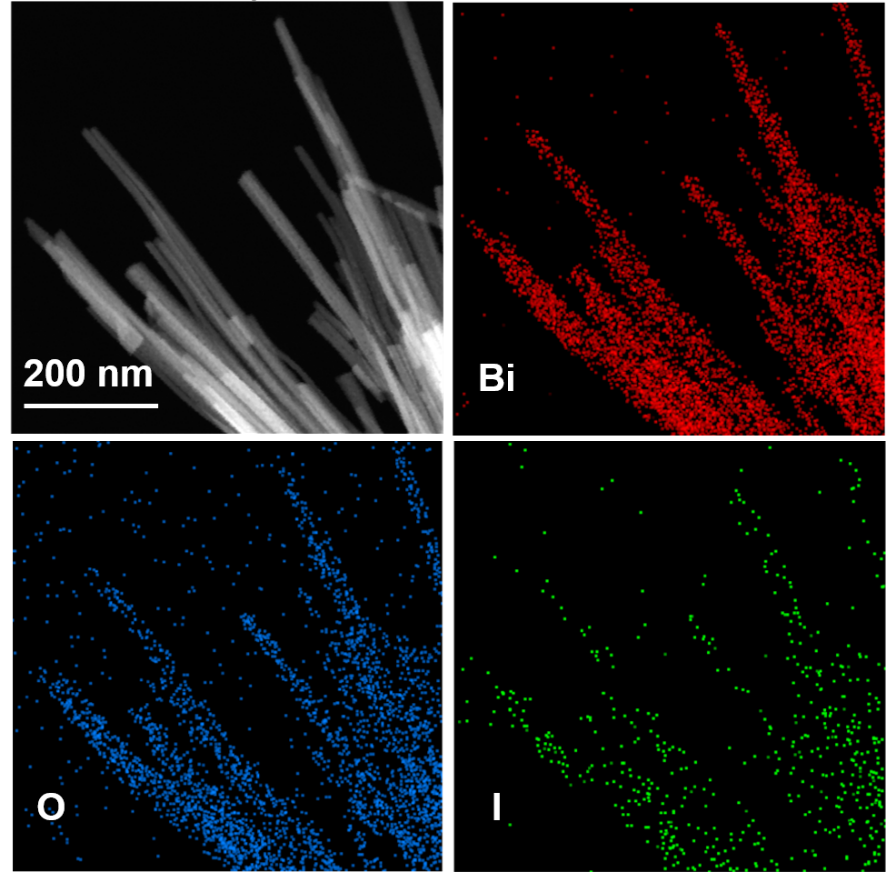
**Figure S4.** The XRD patterns of the BOH and Bi2O2(OH)(NO3).



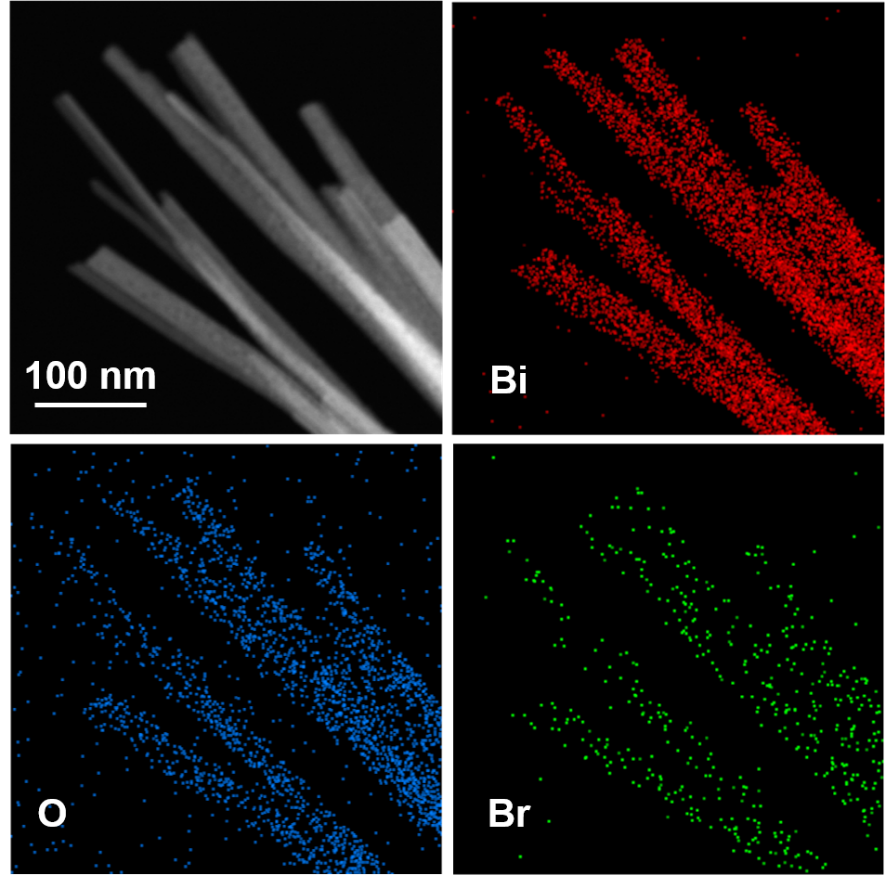
**Figure S5.** Two-dimensional model structure of Bi2O2(OH)(NO3), viewed down the x-axis.



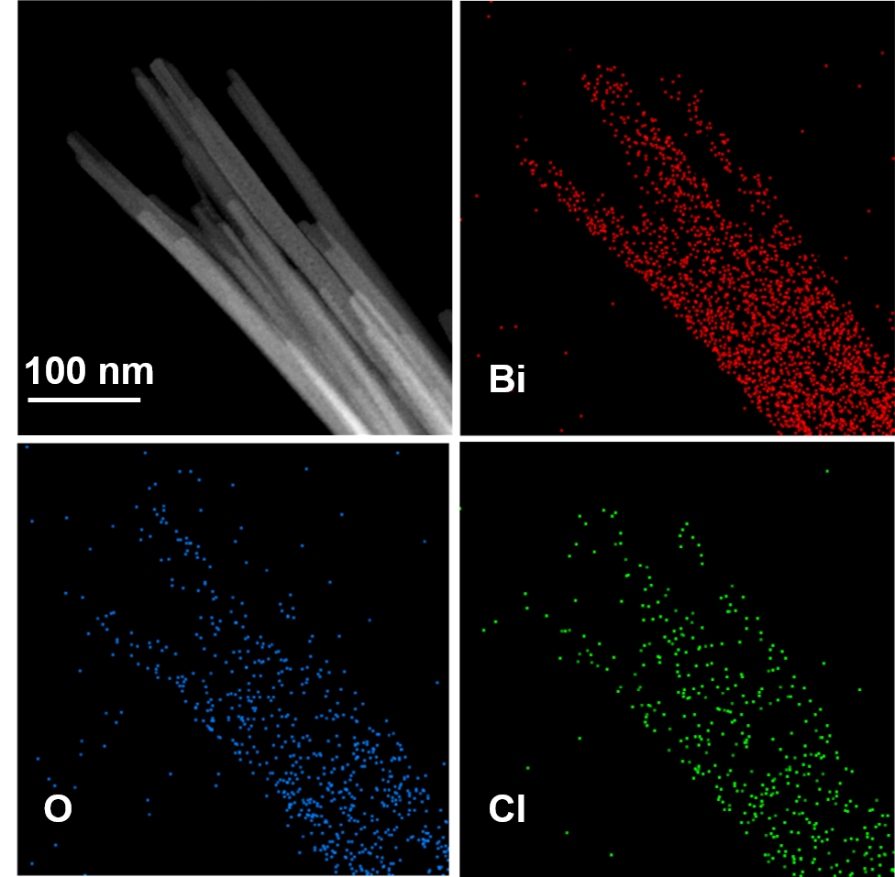
**Figure S6.** TEM images of BOH samples before and after halide-anion exchange.



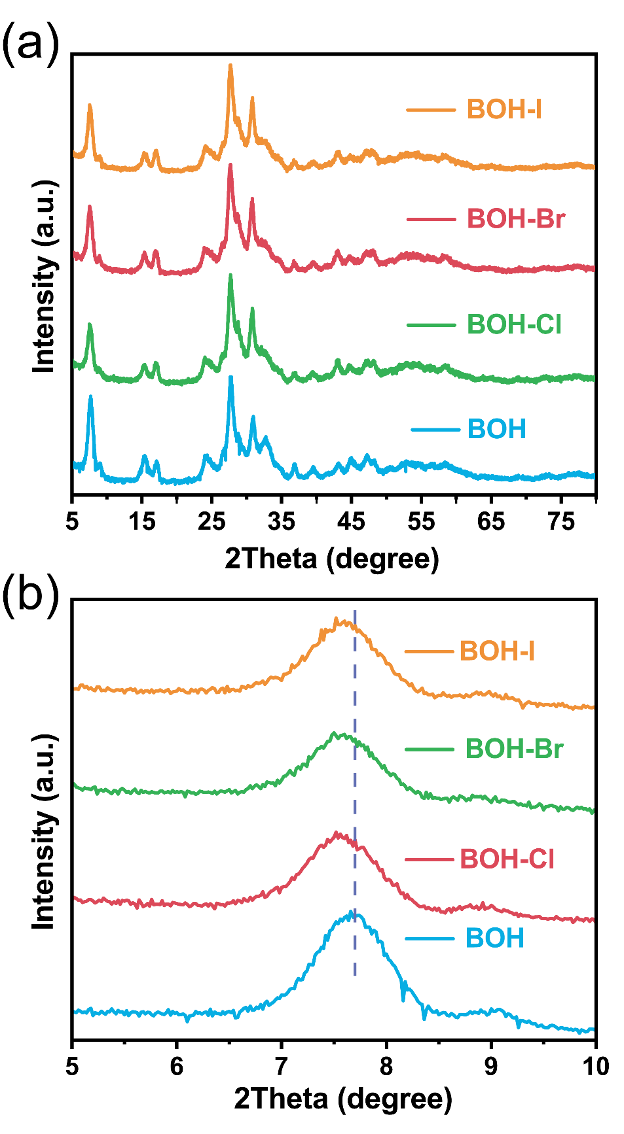
**Figure S7.** The EDS mapping of BOH-I.



**Figure S8.** The EDS mapping of BOH-Br.



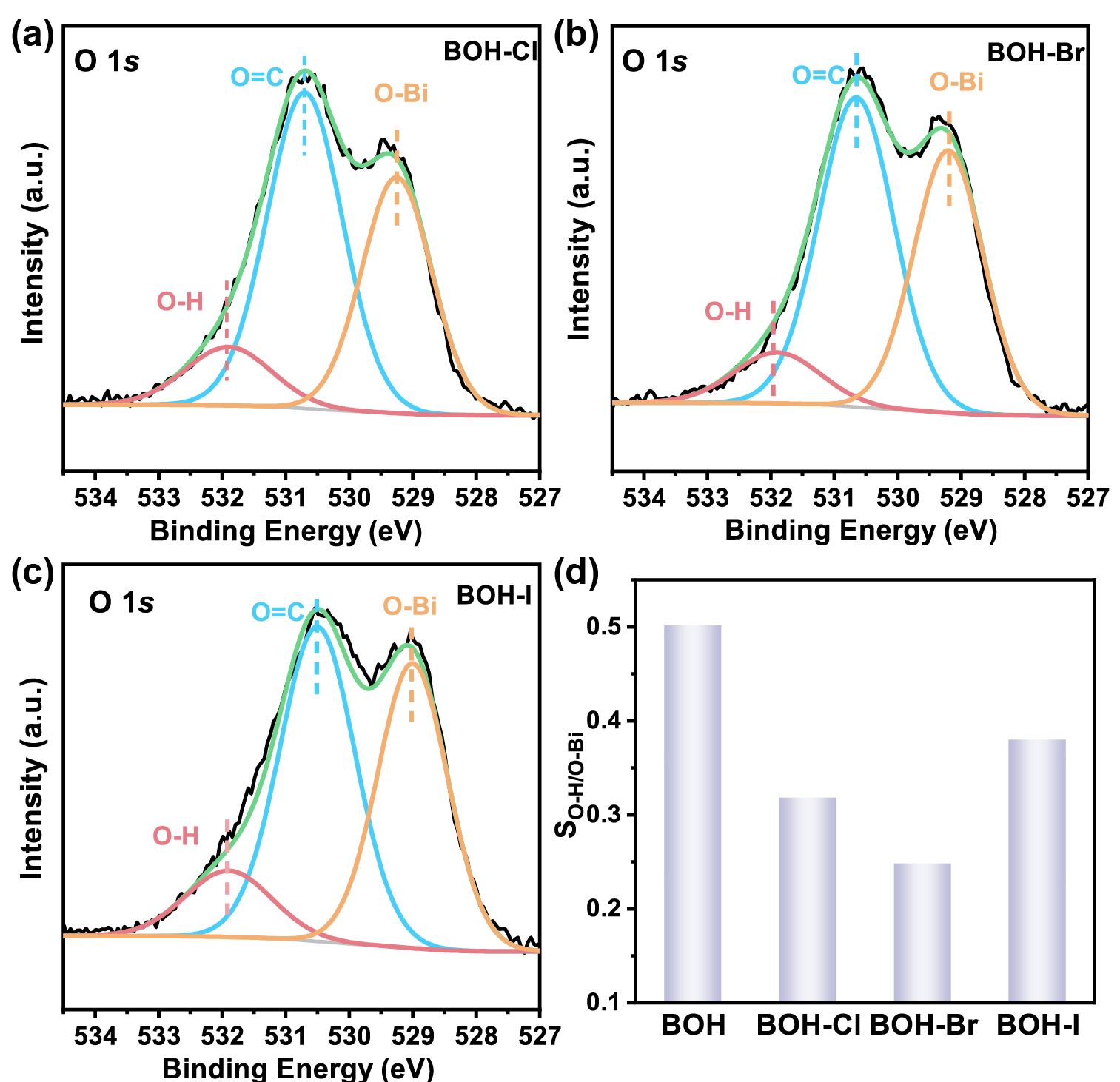
**Figure S9.** The EDS mapping of BOH-Cl.



**Figure S10.** The XRD patterns of the BOH and BOH-X.



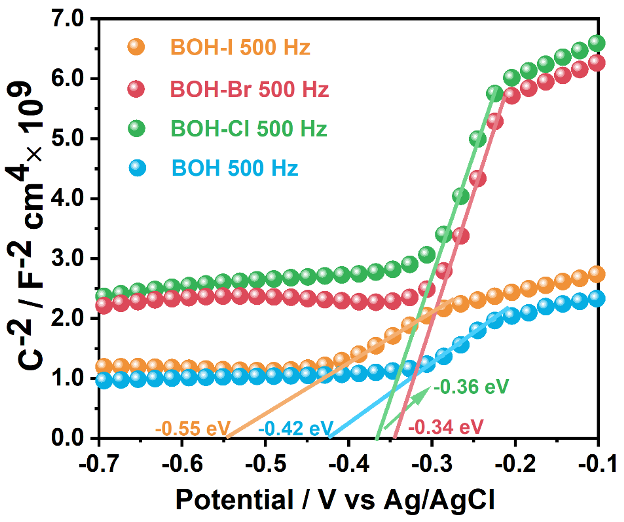
**Figure S11.** (a) XPS spectra of Bi in the samples before and after ion exchange; (b–d) XPS spectra of halogens in the BOH-I, BOH-Br and BOH-Cl, respectively.



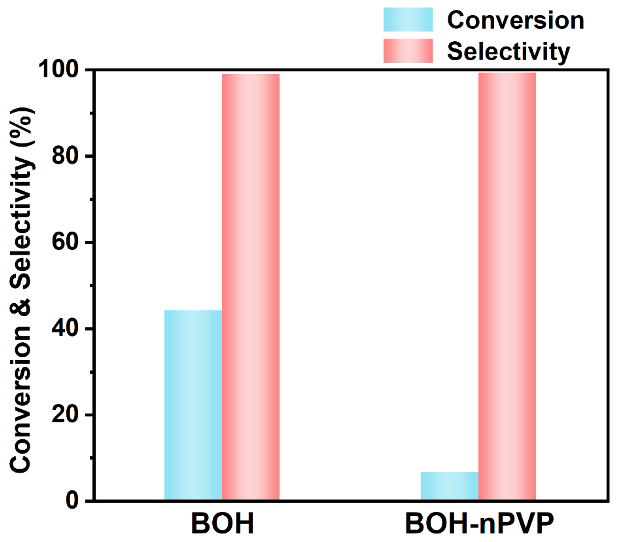
**Figure S12.** (a–c), XPS spectra of O in the ion-exchanged samples; (d) the ratios of O–H bond before and after ion exchange.



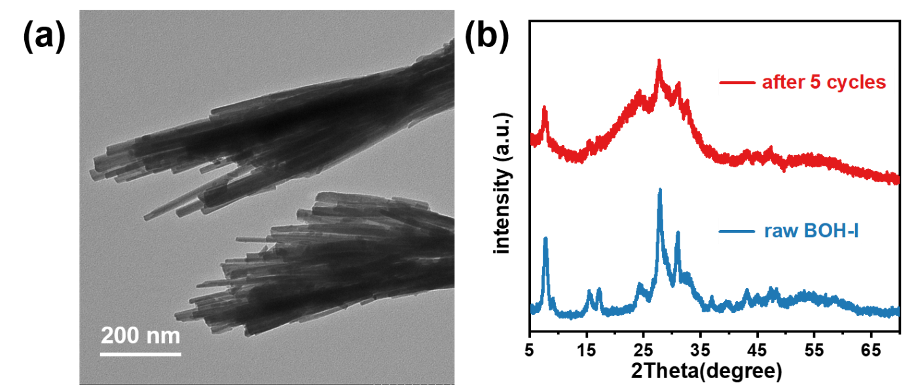
**Figure S13.** (a) High-resolution XPS spectra of I 3d (a) and N 1s (b) for BOH-I with Ar+ sputtering at different depths.



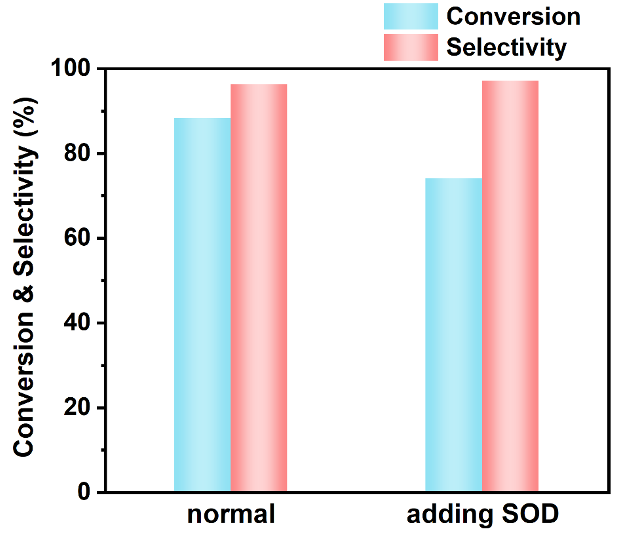
**Figure S14.** Mott–Schottky plots of the samples before and after ion exchange.



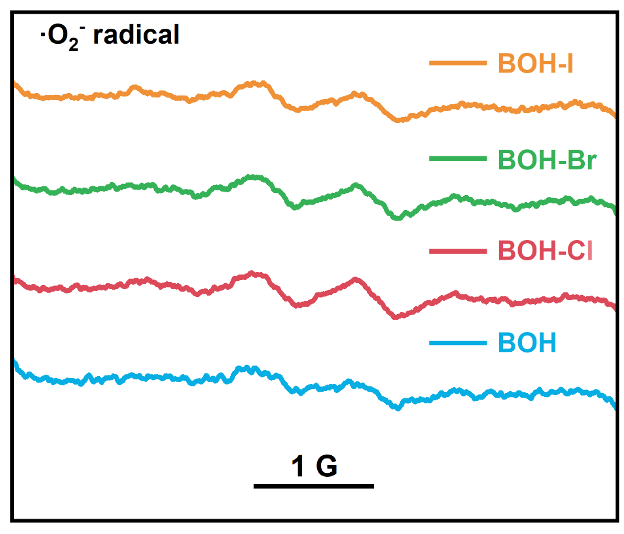
**Figure S15.** Catalytic performances of the normal BOH and BOH-nPVP.



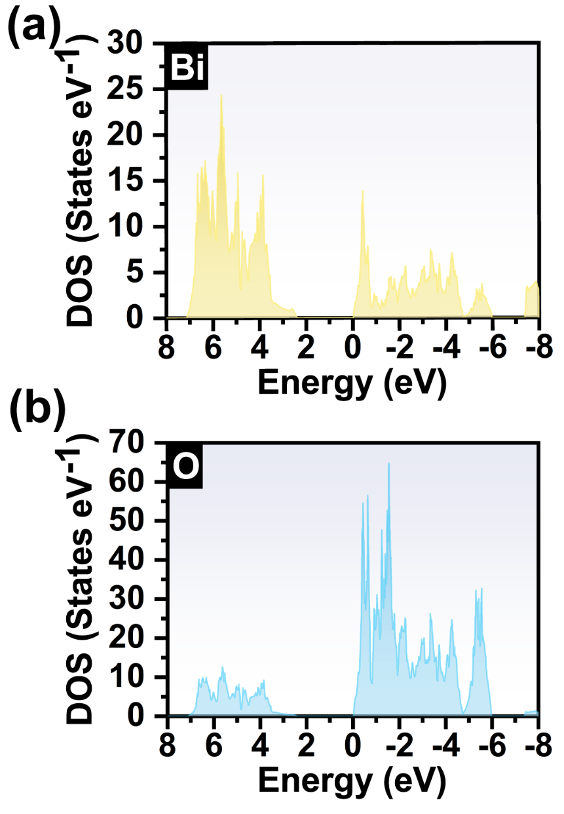
**Figure S16.** TEM image (a) and XRD patterns (b) of BOH-I after 5 catalytic cycles.



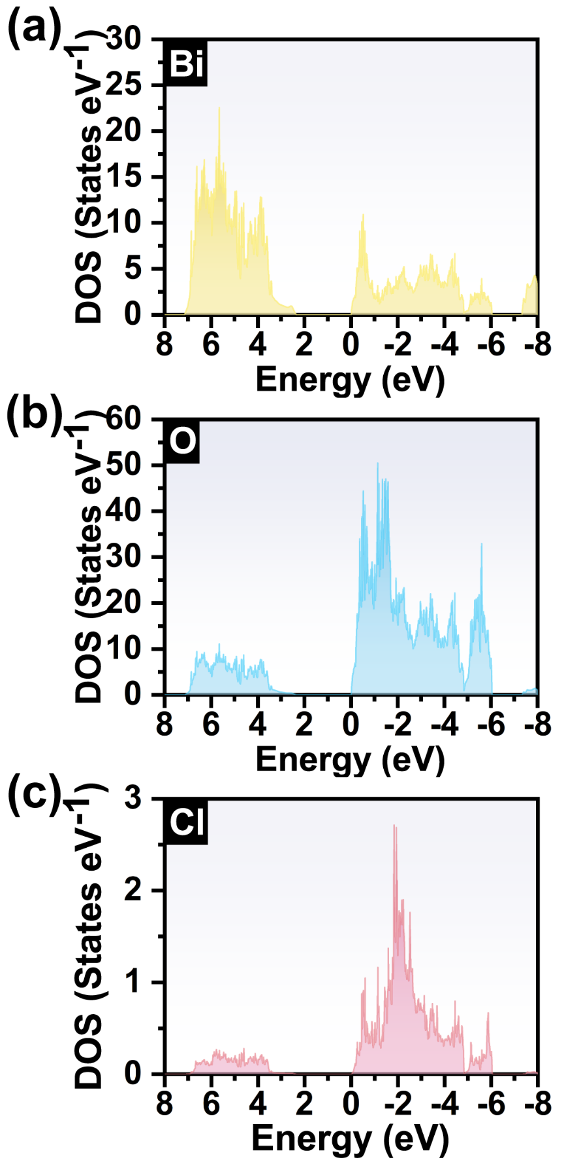
**Figure S17.** Catalytic performances of the normal BOH-I and after addition of superoxide dismutase (SOD).

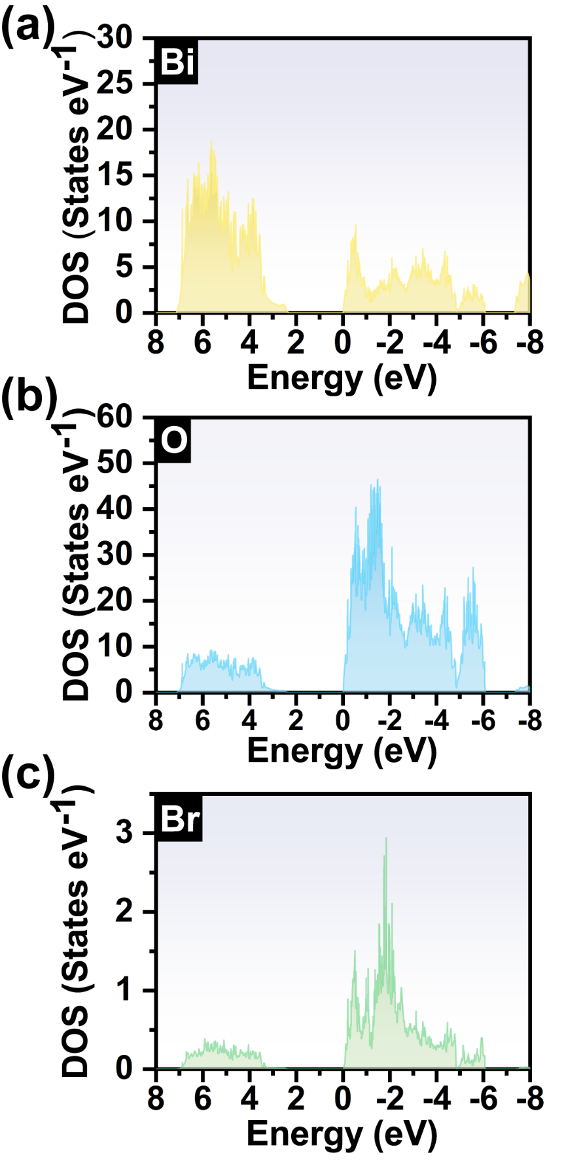


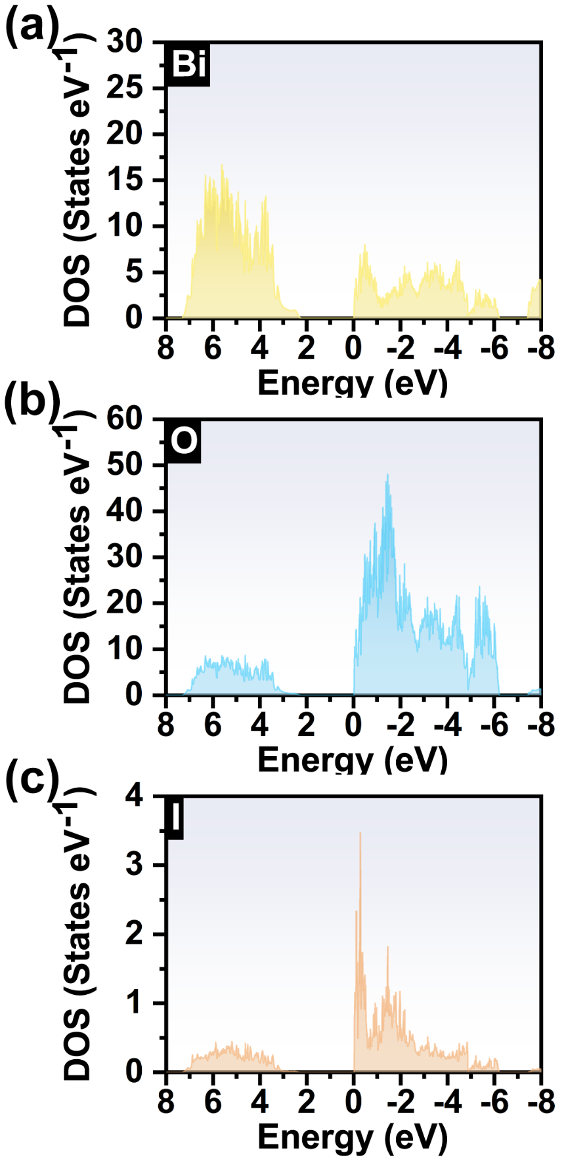
**Figure S18.** EPR spectra for the samples before and after ion exchange, with DMPO as scavenger.



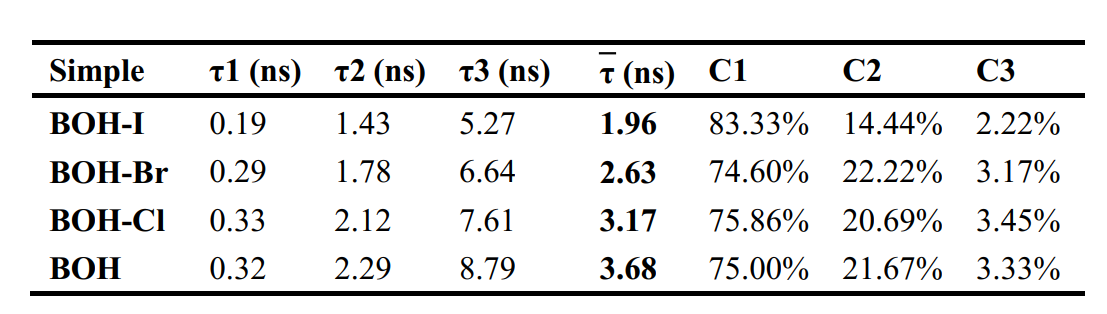
**Figure S19.** The calculated density of state of BOH: (a) and (b) show the contribution of bismuth and oxygen element to valence bands and conduction bands, respectively.

  
**Figure S20.** The calculated density of state of BOH-Cl: (a), (b) and (c) show the contribution of bismuth, oxygen and chlorine element to valence bands and conduction bands, respectively.

 **Figure S21.** The calculated density of state of BOH-Br: (a), (b) and (c) show the contribution of bismuth, oxygen and bromine element to valence bands and conduction bands, respectively.



**Figure S22.** The calculated density of state of BOH-I: (a), (b) and (c) show the contribution of bismuth, oxygen and iodine element to valence bands and conduction bands, respectively.

**Table S1.** The average PL lifetimes of BOH and BOH-X determined from the transient PL spectra.