

## Electronic Supplementary Information

# A Phase Transition-Induced Photocathodic p-CuFeO<sub>2</sub> Nanocolumnar Film by Reactive Ballistic Deposition

*P.V.R.K. Ramacharyulu,<sup>a</sup> Yong Ho Lee,<sup>b</sup> Kenta Kawashima,<sup>c</sup> Duck Hyun Youn,<sup>d</sup> Jun-Hyuk Kim,<sup>e</sup>  
Bryan R. Wygant,<sup>c</sup> C. Buddie Mullins,<sup>c</sup> and Chang Woo Kim<sup>a,b,\*</sup>*

<sup>a</sup> Department of Nanotechnology Engineering, College of Engineering, Pukyong National University, Busan, 48513, Republic of Korea.

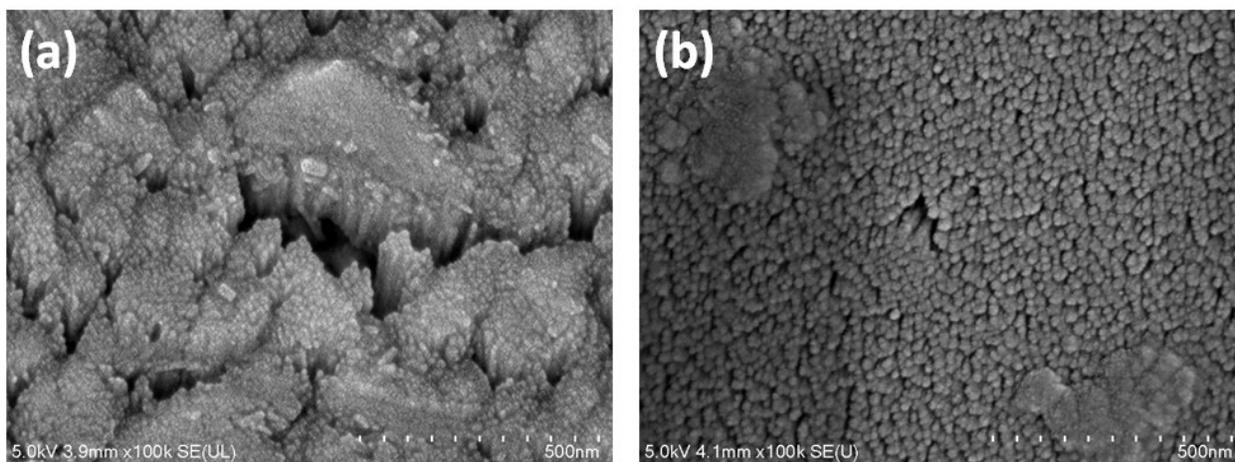
<sup>b</sup> Department of Smart and Green Technology Engineering, Pukyong National University, Busan 48513, Republic of Korea.

<sup>c</sup> McKetta Department of Chemical Engineering, Department of Chemistry, Texas Materials Institute, Center for Electrochemistry, University of Texas at Austin, Austin, Texas 78712, United States.

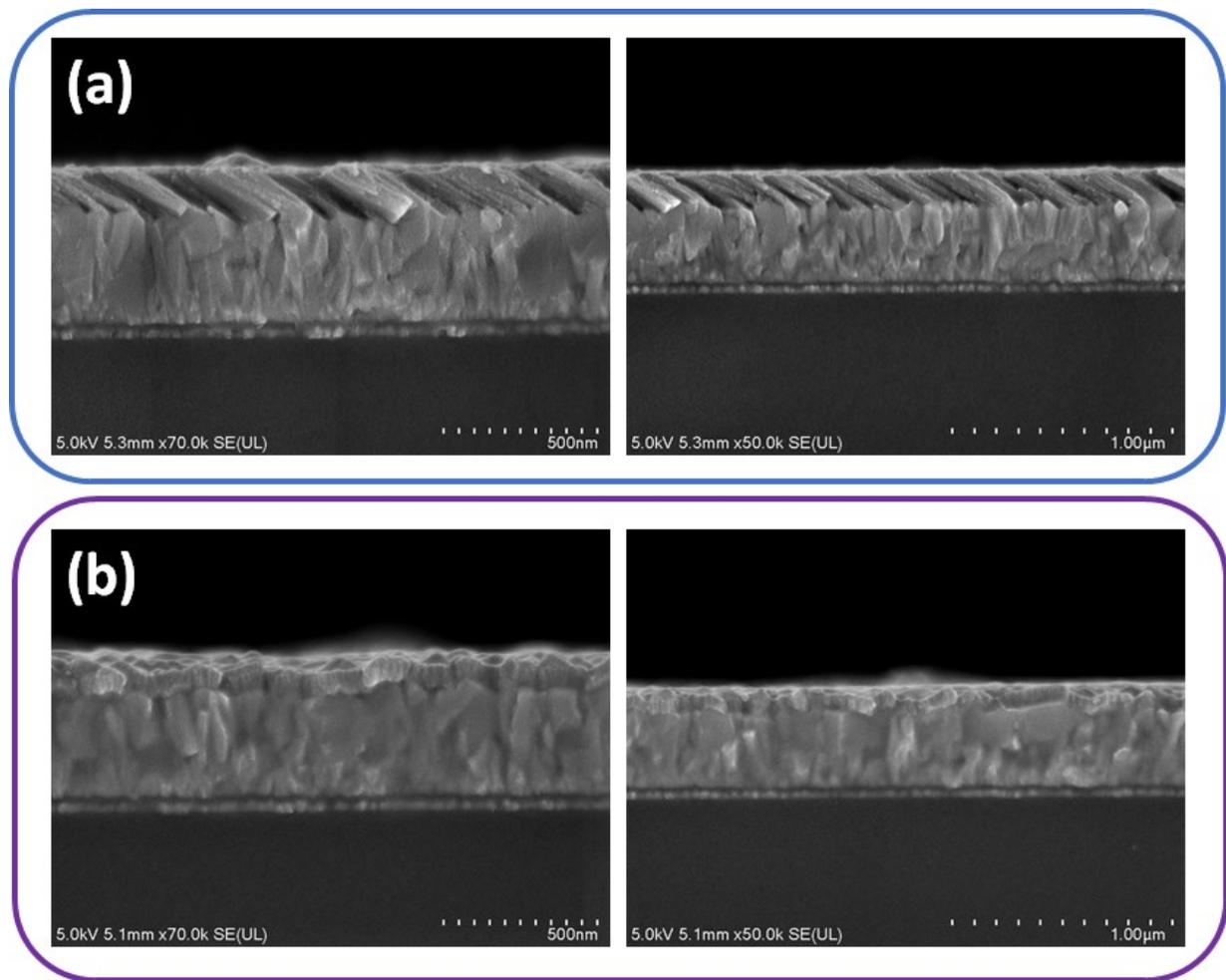
<sup>d</sup> Department of Chemical Engineering, Kangwon National University, Chuncheon, Gangwon-do 24341, Republic of Korea.

<sup>e</sup> Korea Technology Finance Corporation (KOTEC), Busan, 48400, Republic of Korea.

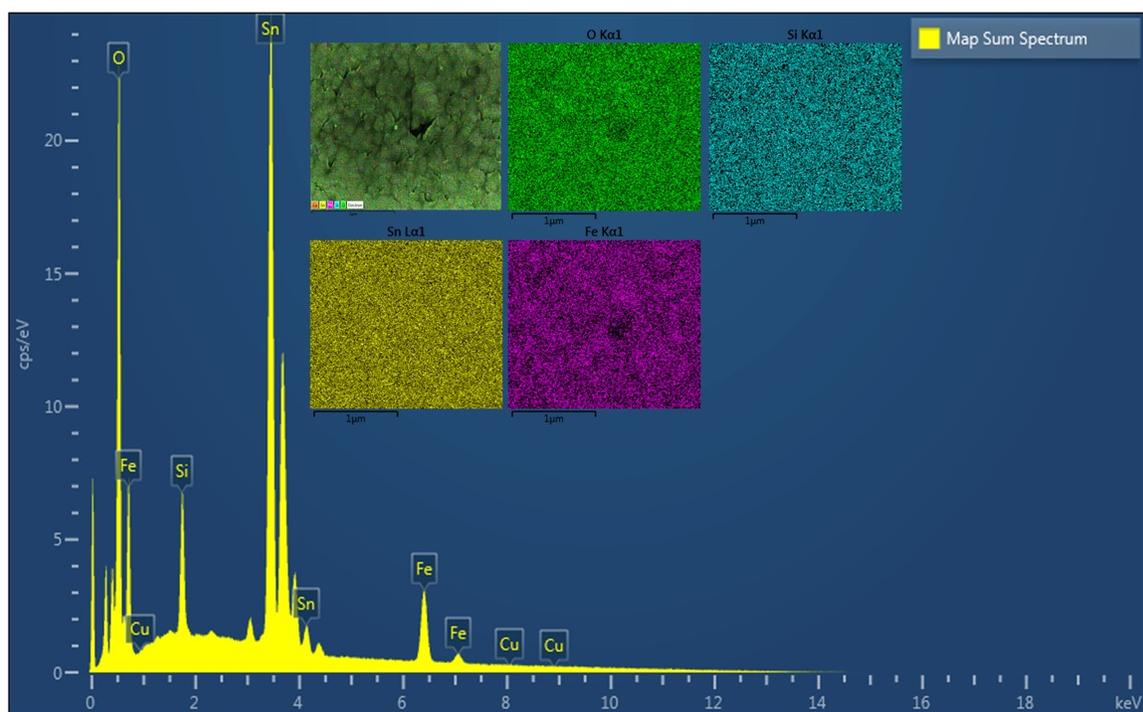
\*Corresponding author ([kimcw@pknu.ac.kr](mailto:kimcw@pknu.ac.kr))



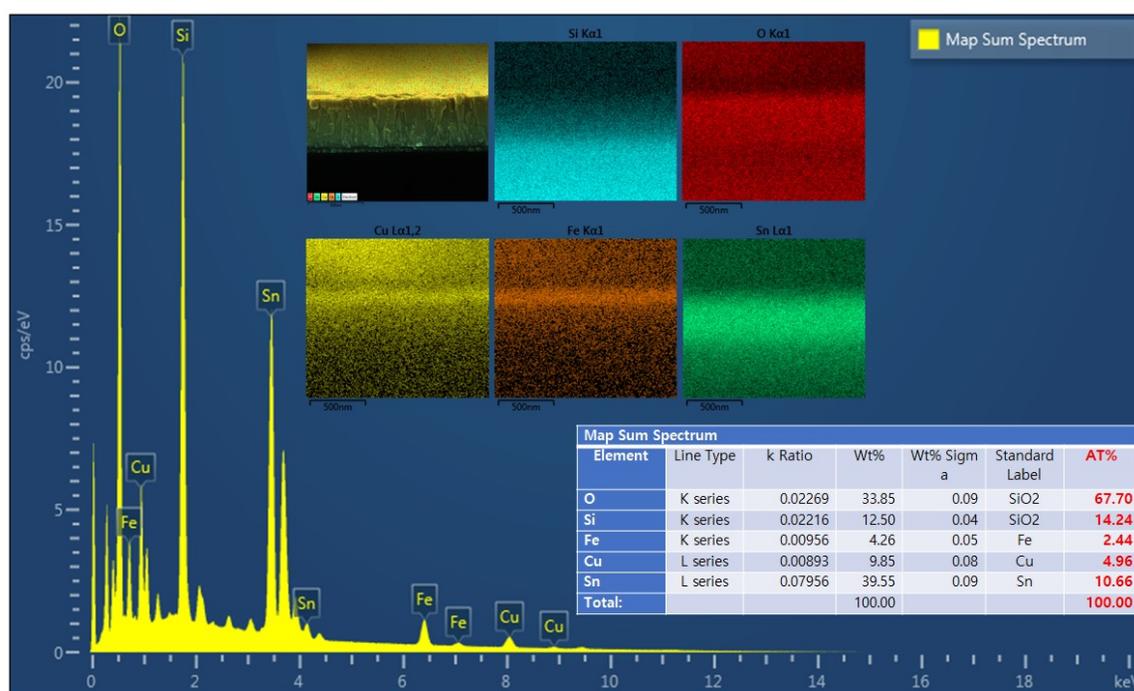
**Fig. S1** Magnified top-view SEM images of (a) Fe-O nanocolumns and (b) Cu-Fe-O nanocolumns in Fig. 2.



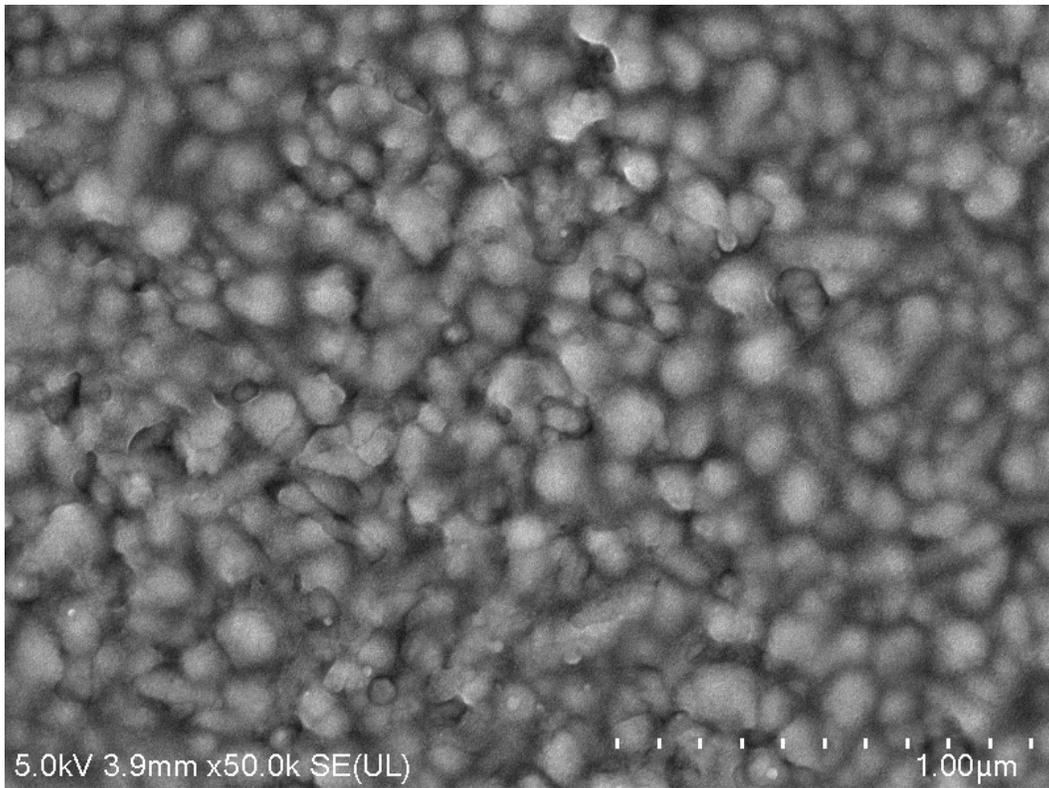
**Fig. S2** Magnified cross-sectional SEM images of (a) Fe-O nanocolumns and (b) Cu-Fe-O nanocolumns shown in Fig. 2.



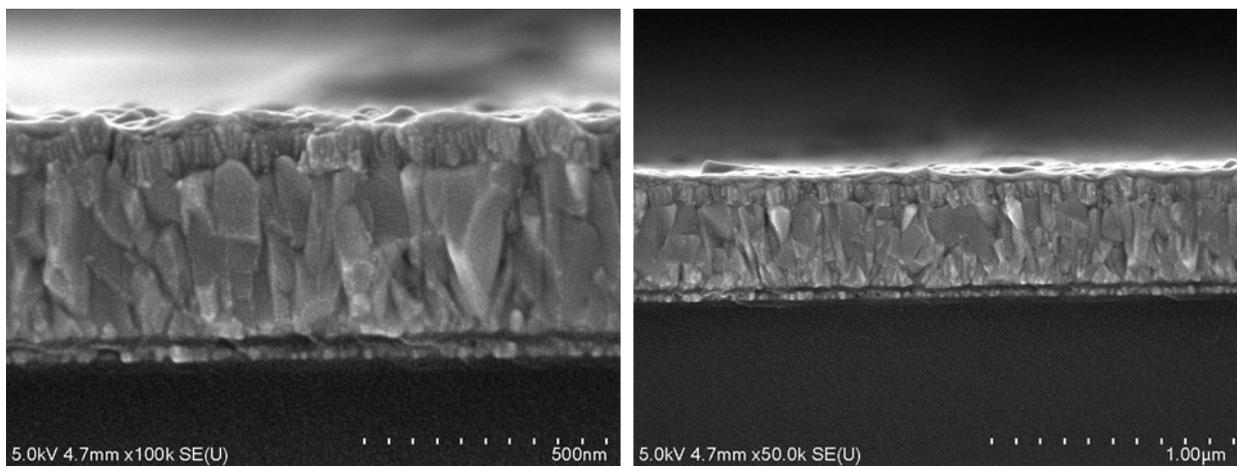
**Fig. S3** Top-view EDS elemental mapping images and corresponding EDS spectrum of Fe-O nanocolumns in Fig. 2, which shows the uniform distribution of Fe and O on FTO.



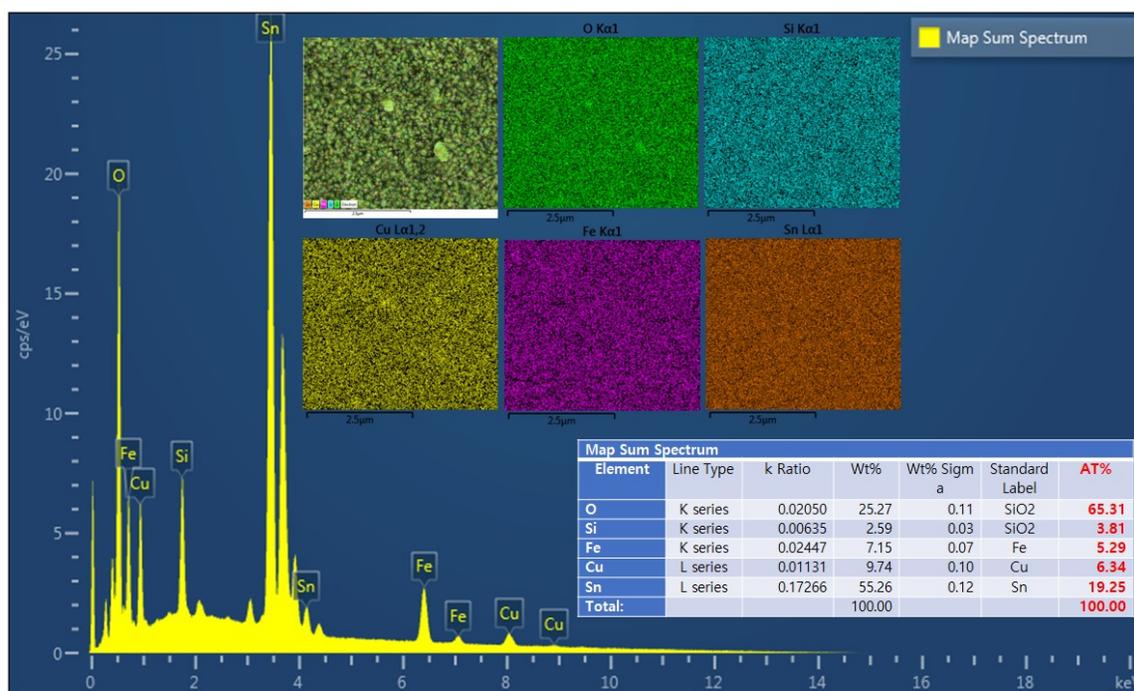
**Fig. S4** Cross-sectional EDS elemental mapping images and corresponding EDS spectrum of Cu-Fe-O nanocolumns in Fig. 2, which shows the uniform distribution of Cu, Fe, and O on FTO.



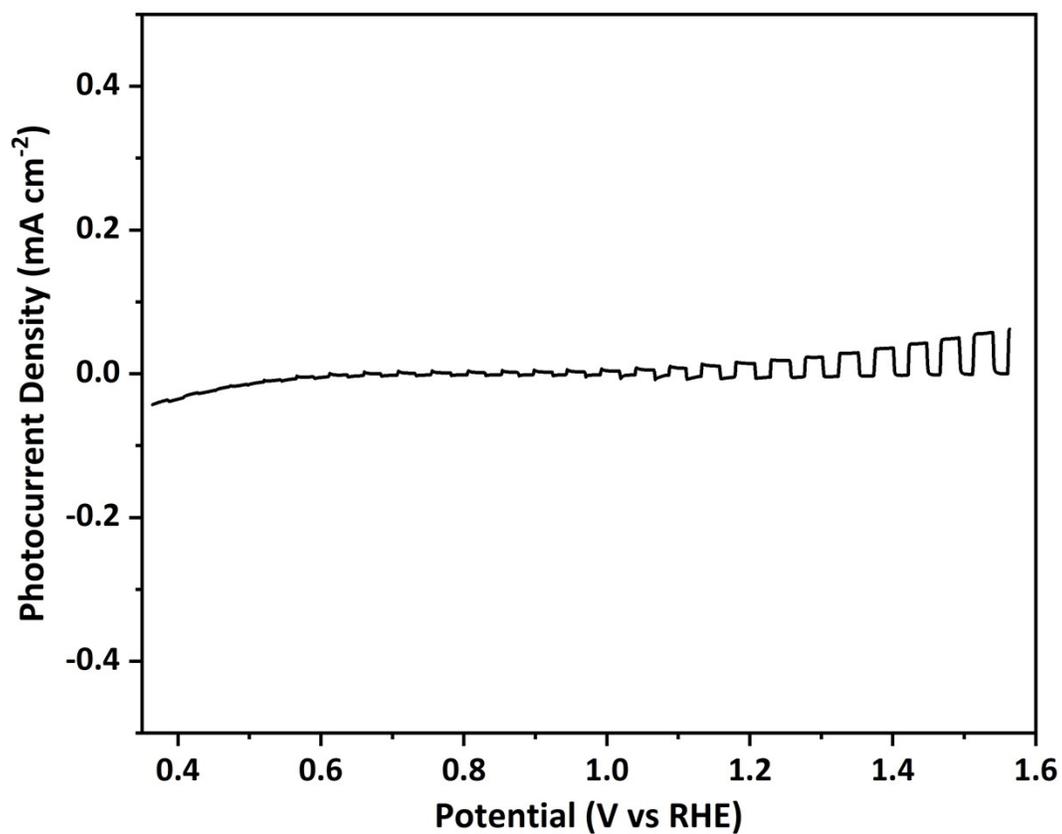
**Fig. S5** Magnified top-view FESEM image of heat-treated Cu-Fe-O nanocolumns shown in Fig. 4(a).



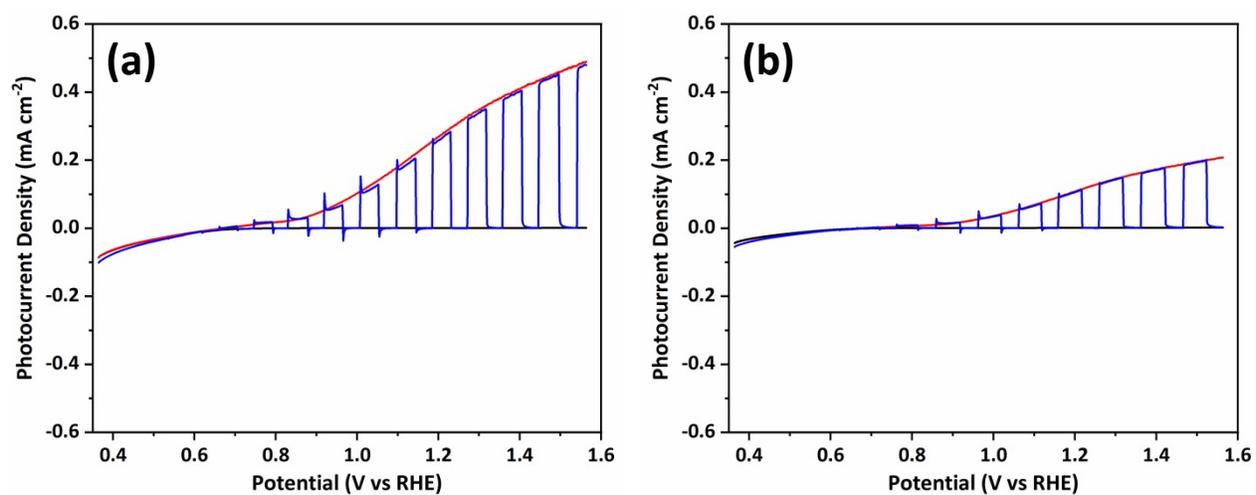
**Fig. S6** Magnified cross-sectional FESEM images of heat-treated Cu-Fe-O nanocolumns shown in Fig. 4(b).



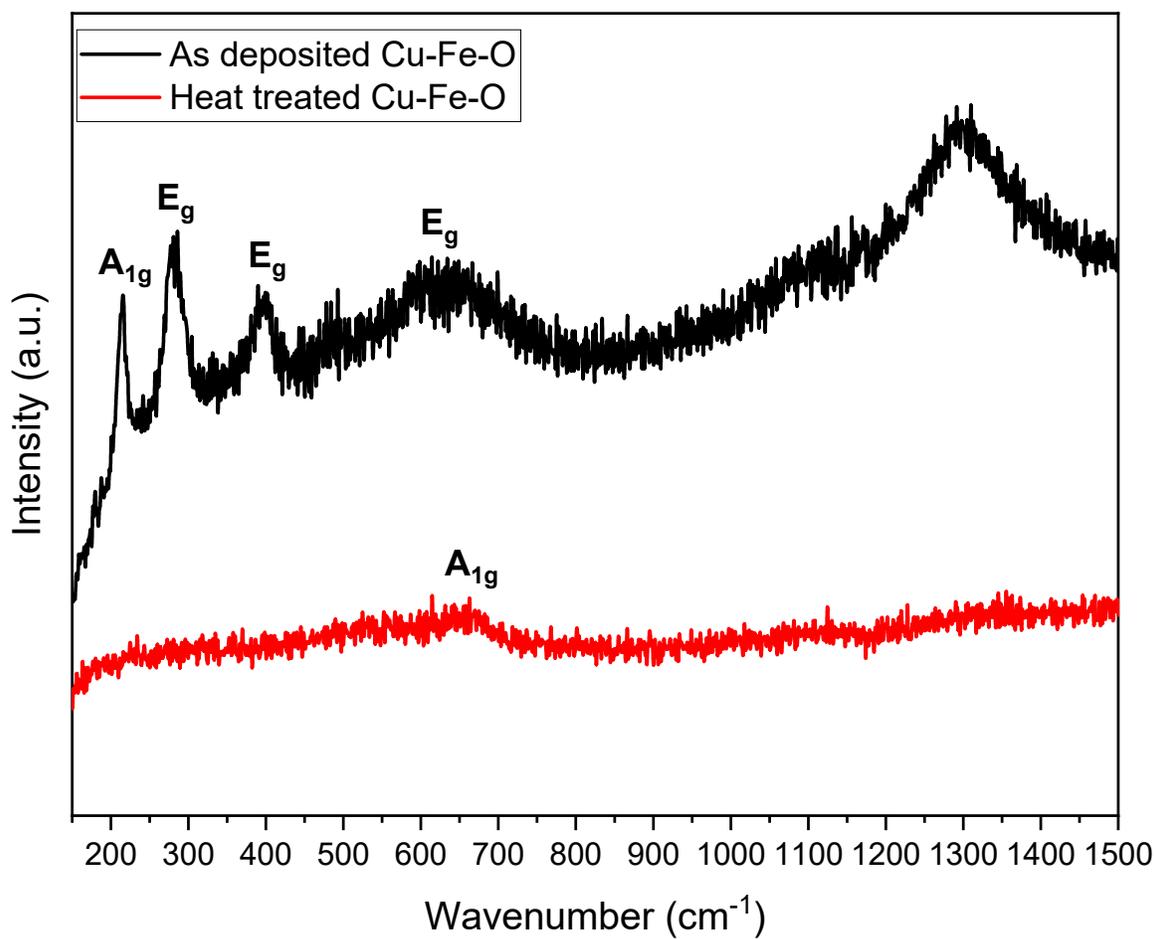
**Fig. S7** Top-view EDS elemental mapping images and corresponding EDS spectrum of heat-treated Cu-Fe-O nanocolumns on FTO, which shows the presence of Cu, Fe, Si, Sn, and O elements in Fig. 4(c).



**Fig. S8** Chopped linear sweep voltammograms of Cu-Fe-O nanowire arrays heat-treated at 450 °C for 1 h under Ar flow.



**Fig. S9** Linear sweep voltammograms (red line) and chopped linear sweep voltammograms (blue line) of (a) Fe-O and (b) Cu-Fe-O nanocolumnar arrays heat-treated at 650 °C for 2 h in air. LSV curve of each electrode under a dark condition is drawn by a black line.



**Fig. S10** Raman spectra of as-deposited and heat-treated Cu-Fe-O nanocolumnar arrays.