Supplementary Information

Sn doped, strained CuAg film for electrochemical CO_2 reduction

Xiaoye Du, Yanyang Qin, Bo Gao, Jun Ho Jang, Chunhui Xiao, Yanhuai Li, Shujiang Ding, Zhongxiao Song, Yaqiong Su,* Ki Tae Nam**

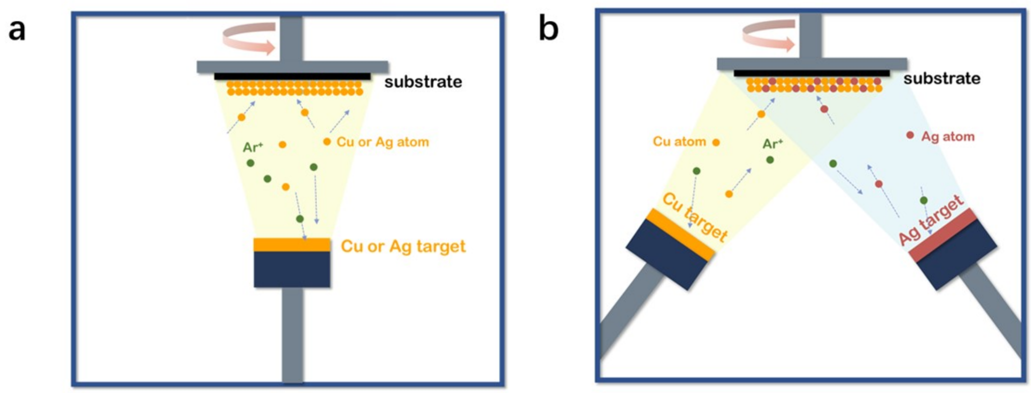

Figure S1. The schematic diagram of magnetron sputtering to prepare (a) the Cu or Ag film and (b) CuAg films with different atomic percentage of Cu to Ag.

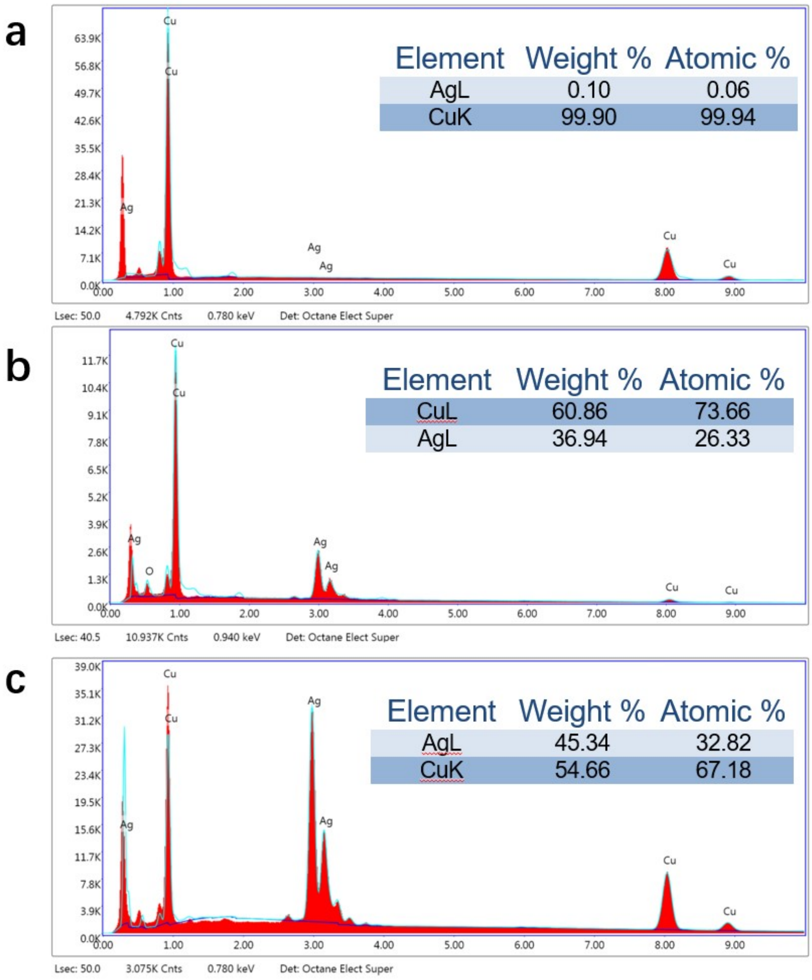

Figure S2. (a), (b) and (c) are the atomic percentage of Cu to Ag in CuAg-1, CuAg-2 and CuAg-3 from EDS respectively.

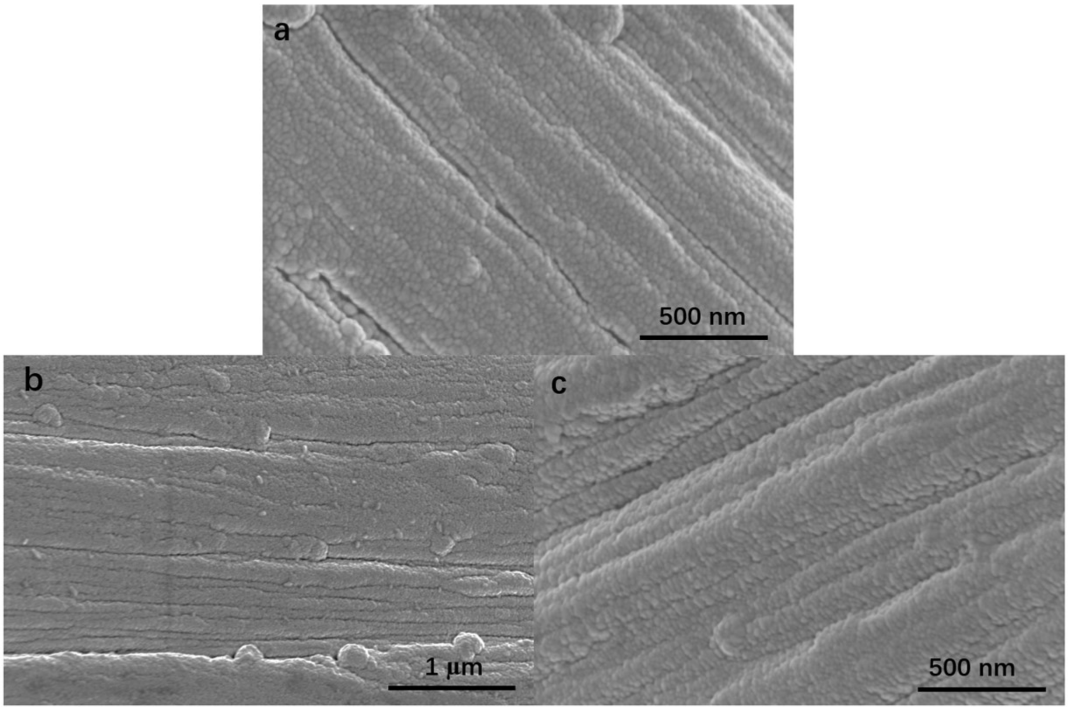

Figure S3. SEM images of CuAg-1, CuAAg-2 and CuAg-3, the surface morphology of three samples has little difference.

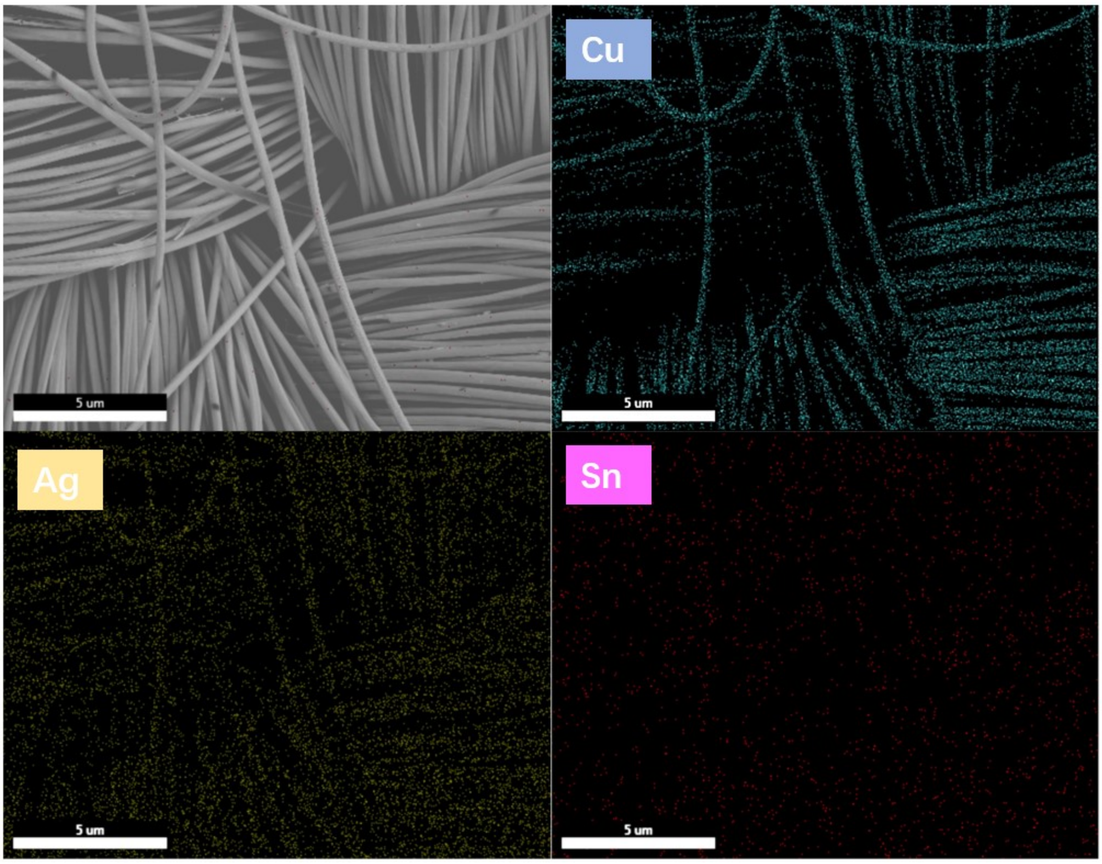

Figure S4. EDS analysis shows that element distribution on the surface of CuAgSn is uniform by SEM.

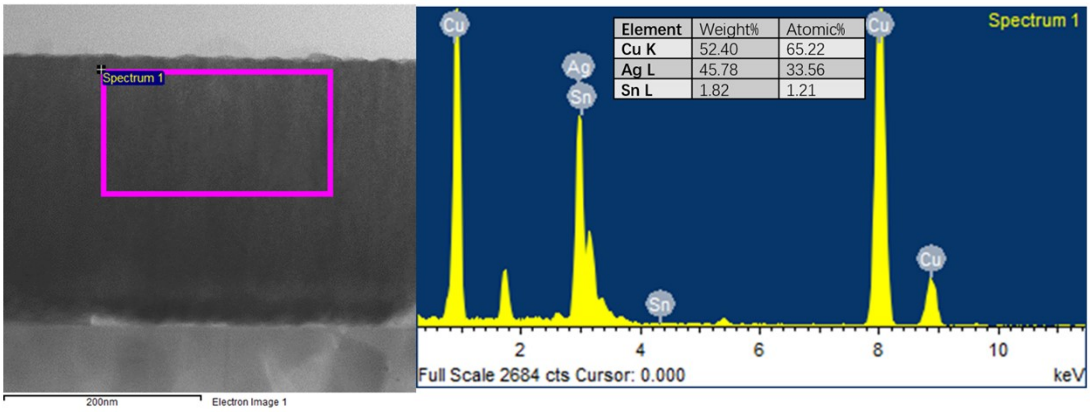

Figure S5. The longitudinal section of CuAgSn is analyzed by energy spectrum using TEM, and the atomic ratio of Sn is only 1.21%.

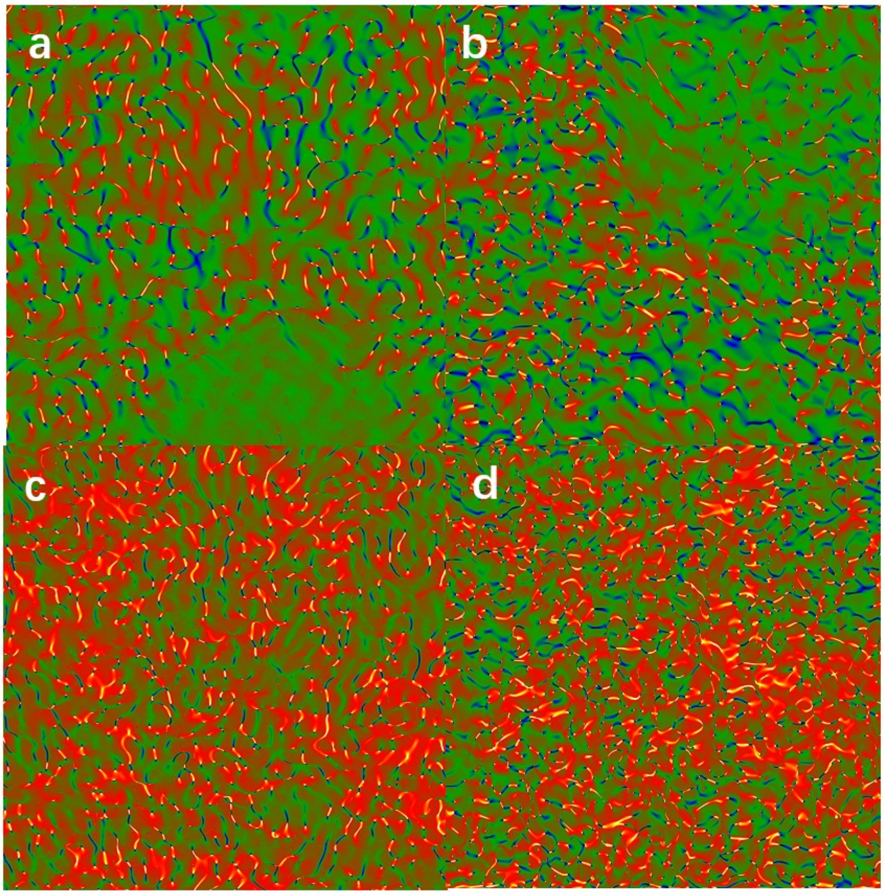

Figure S6. (a) Symmetric strain distribution maps ε_{xx} of CuAg using GPA. (b) Symmetric strain distribution maps ε_{yy} of CuAg using GPA. (c) Symmetric strain distribution maps ε_{xx} of CuAgSn using GPA. (d) Symmetric strain distribution maps ε_{yy} of CuAgSn using GPA.

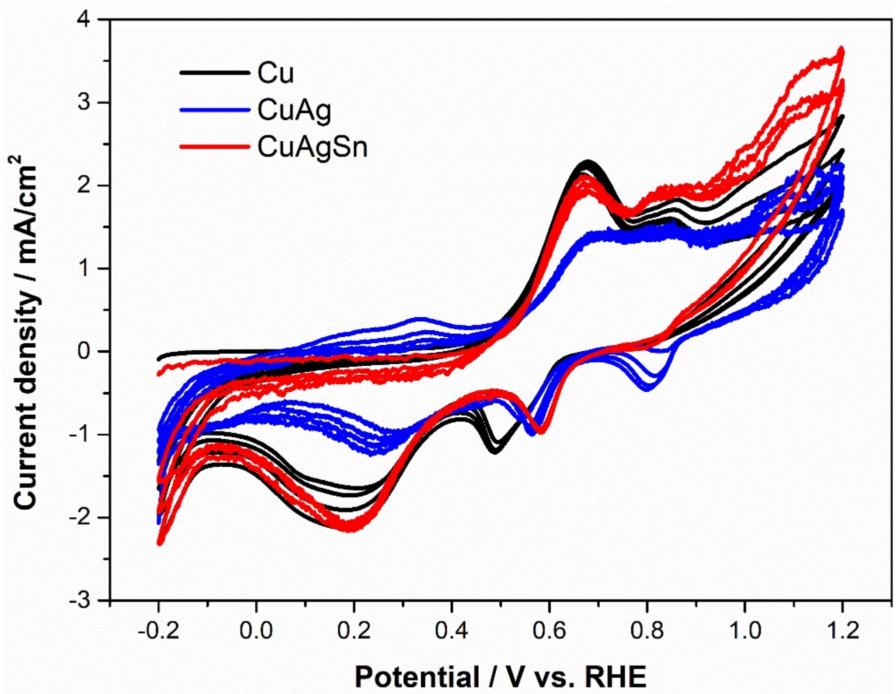

Figure S7. Cyclic voltammograms conducted to determine the redox properties over the Cu, CuAg and CuAgSn electrodes.

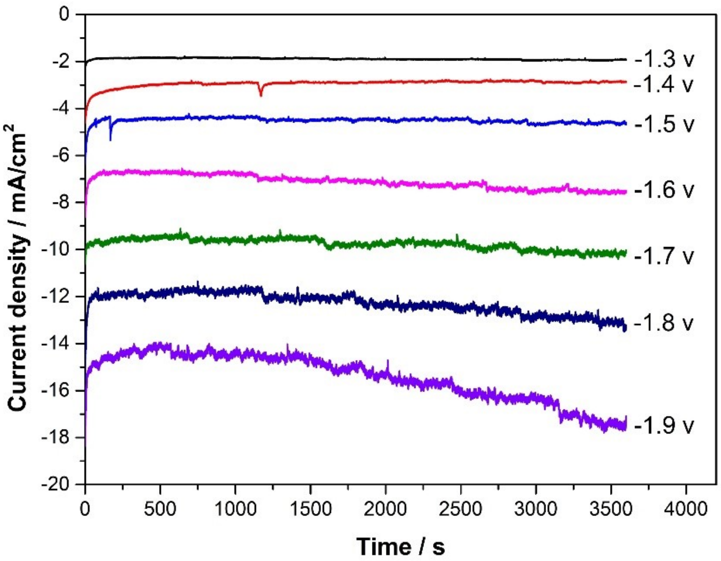

Figure S8. The potentiostatic picture of CuAgSn in CO_2-saturated 0.1M $KHCO_3$ at different potentials for 1 h.

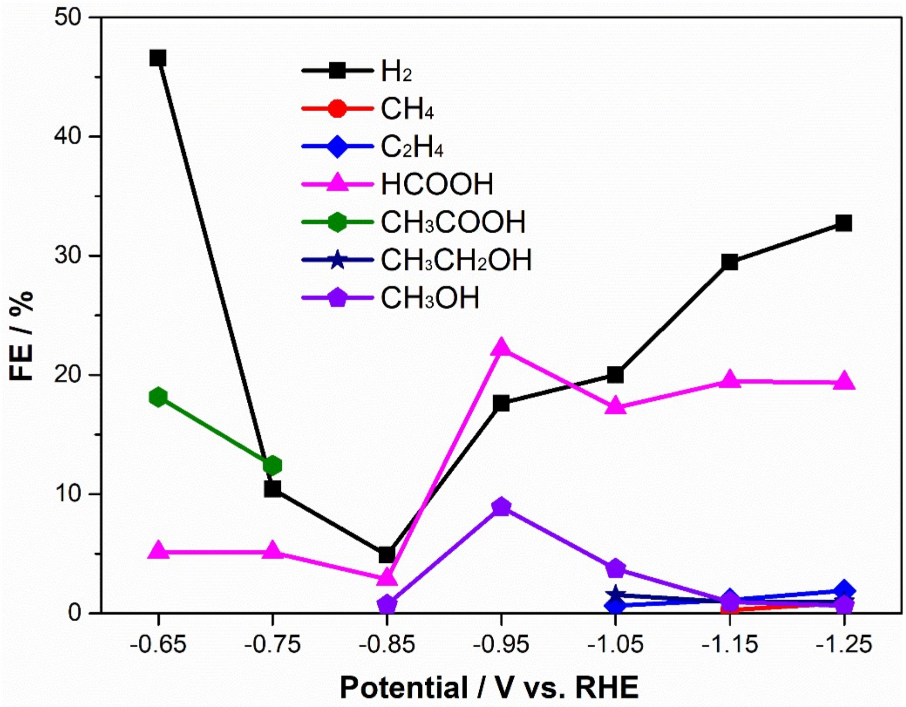

Figure S9. FEs for other products on CuAgSn film fabricated by magnetron sputtering in CO_2-saturated 0.1 M $KHCO_3$ electrolyte at selected potential.

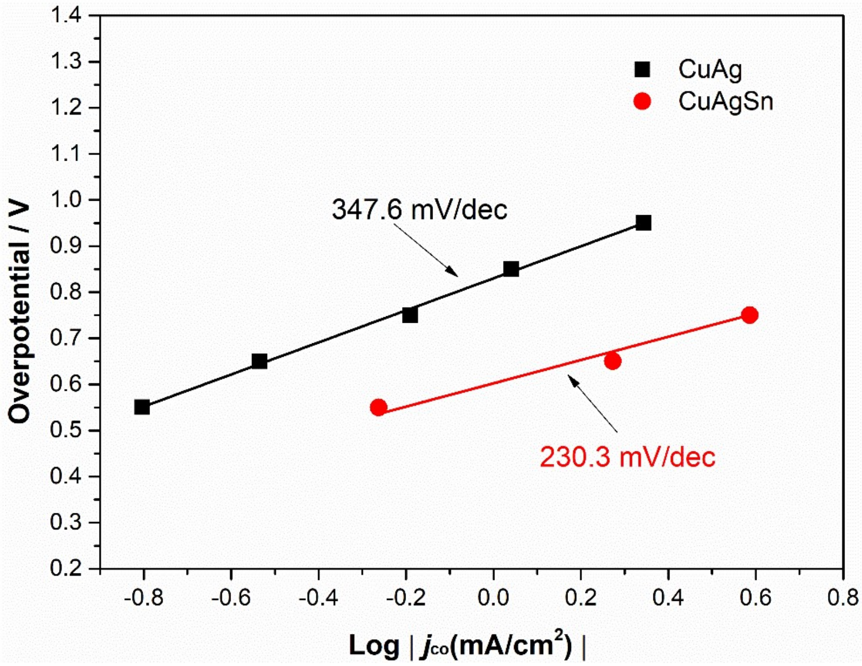

Figure S10. Tafel slopes of CuAg and CuAgSn electrodes.

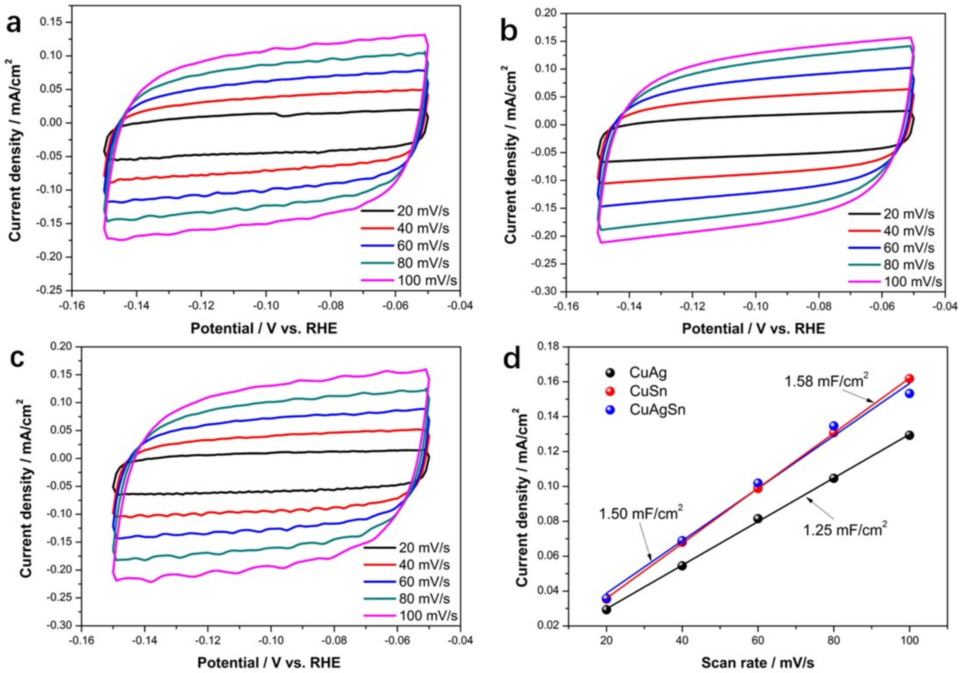

Figure S11. The electrochemical active area (ECSA) of CuAg, CuAgSn and CuSn by the electrochemical double layer capacitance.

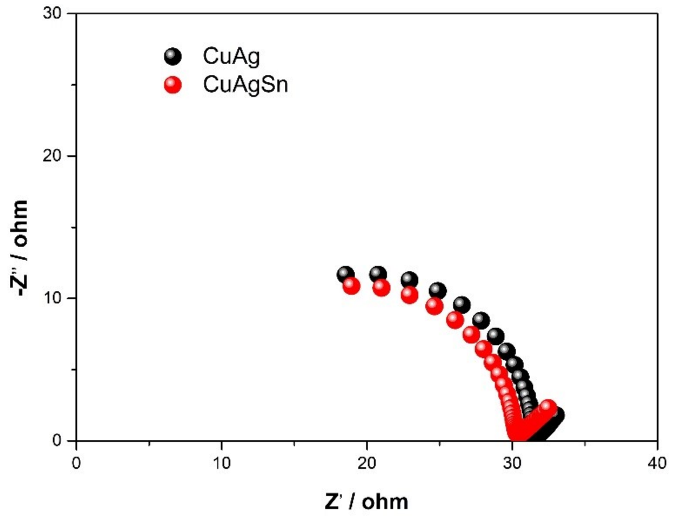

Figure S12. The electrochemical impedance spectroscopy (EIS) of CuAg and CuAgSn electrodes.

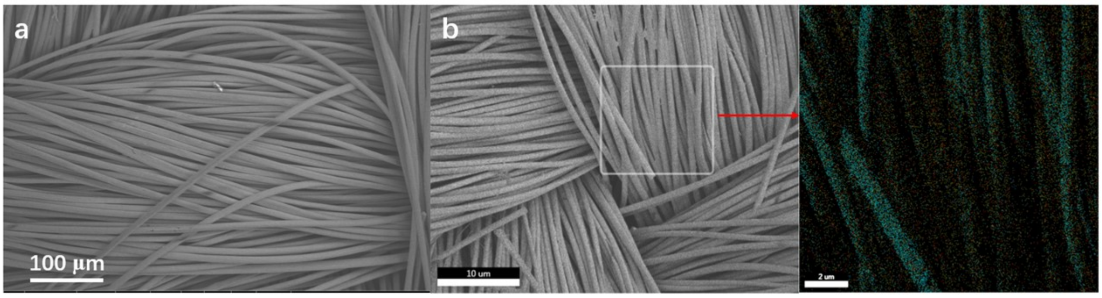

Figure S13. SEM and EDS image of CuAgSn electrode after stability test for 6h. The CuAgSn film and the substrate are well combined, and there is no difference before and after the stability test, which indicates that CuAgSn electrode fabricated by magnetron sputtering has a good stability in the process of CO_2RR.

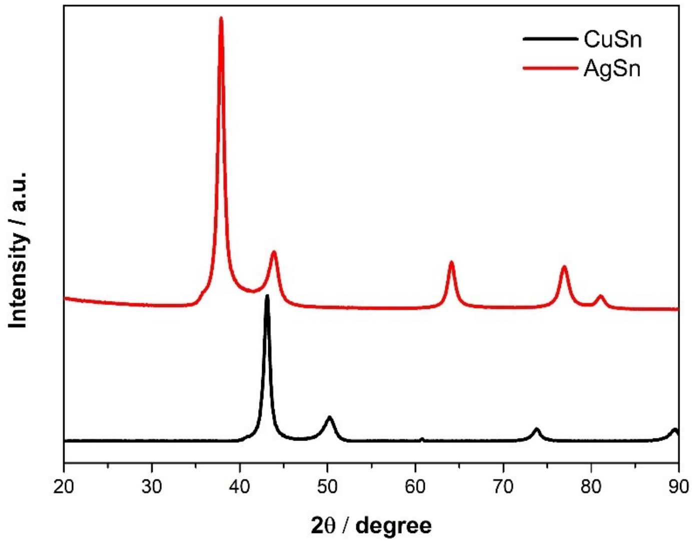

Figure S14. XRD of CuSn film and AgSn film fabricating by magnetron sputtering using the same deposition parameters. There is no new phase in the Cu and Ag added with a small amount of Sn.

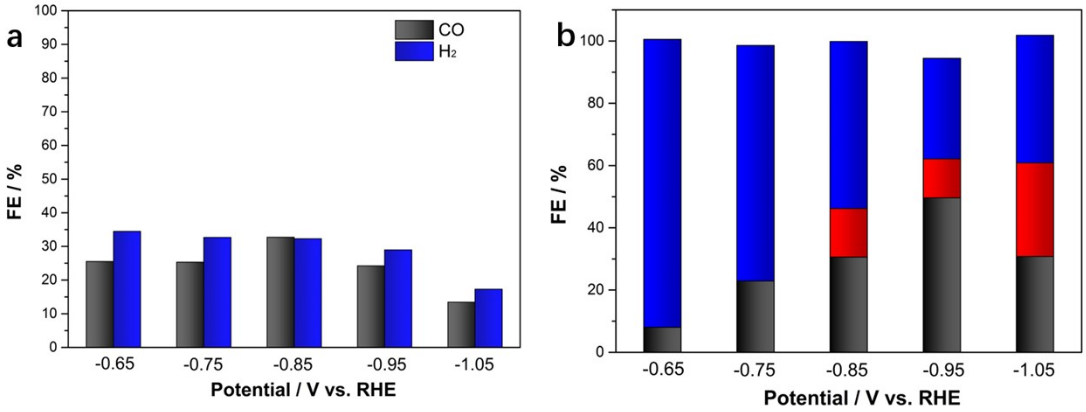

Figure S15. (a) FEs for gas products on AgSn film fabricated by magnetron sputtering in CO_2-saturated 0.1 M $KHCO_3$ electrolyte. (b) FEs for all products on CuSn film fabricated by magnetron sputtering in CO_2-saturated 0.1 M $KHCO_3$ electrolyte, red represents HCOOH.

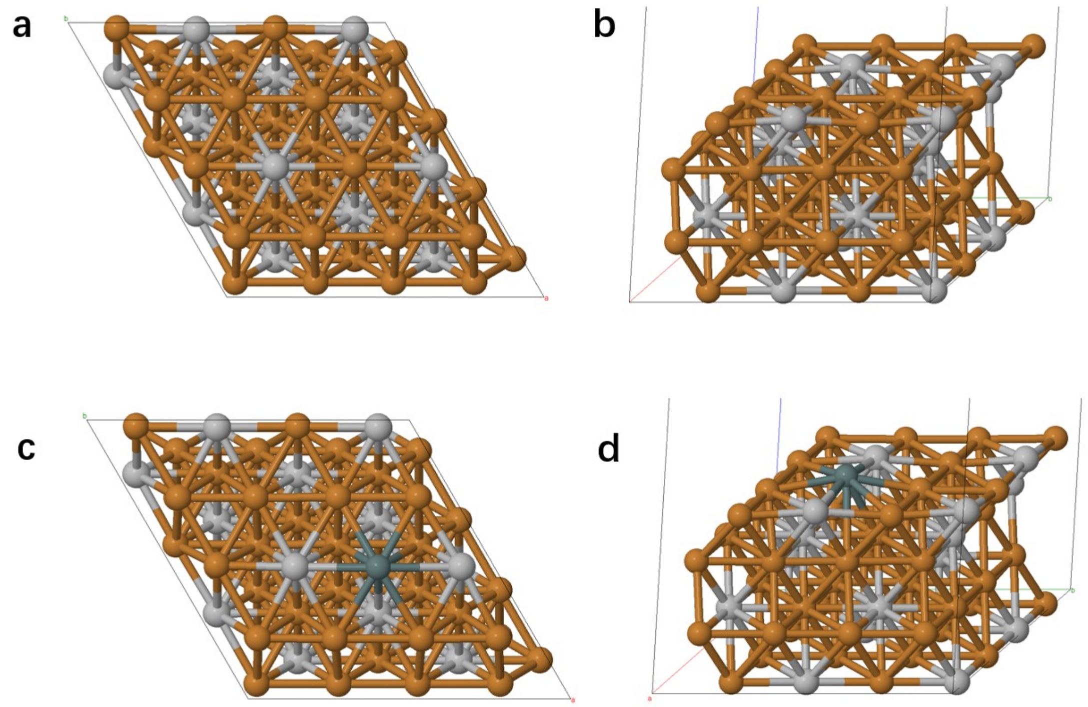

Figure S16. (a) and (b) The structures of CuAg (111) surface from different perspectives. (c) and (d) The structures of CuAgSn (111) surface from different perspectives.