Supporting Information

Metal-organic framework derived carbon supported Cu-In bimetallic nanoparticles for highly selective CO_2 electroreduction to CO

Xia Ma[a,b], Jianjian Tian[a,b], Min Wang[a,b], Xixiong Jin[a,b], Meng Shen[a,b], Lingxia Zhang*[a,b, c]

[a] State Key Laboratory of High Performance Ceramics and Superfine Microstructure, Shanghai Institute of Ceramics, Chinese Academy of Sciences, 1295 Ding-xi Road, Shanghai, 200050, P. R. China

[b] Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, No. 19A Yuquan Road, Beijing 100049, P. R. China

[c] School of Chemistry and Materials Science, Hangzhou Institute for Advanced Study, University of Chinese Academy of Sciences, 1 Sub-lane Xiangshan, Hangzhou 310024, P. R. China

*Corresponding author. E-mail: zhlingxia@mail.sic.ac.cn

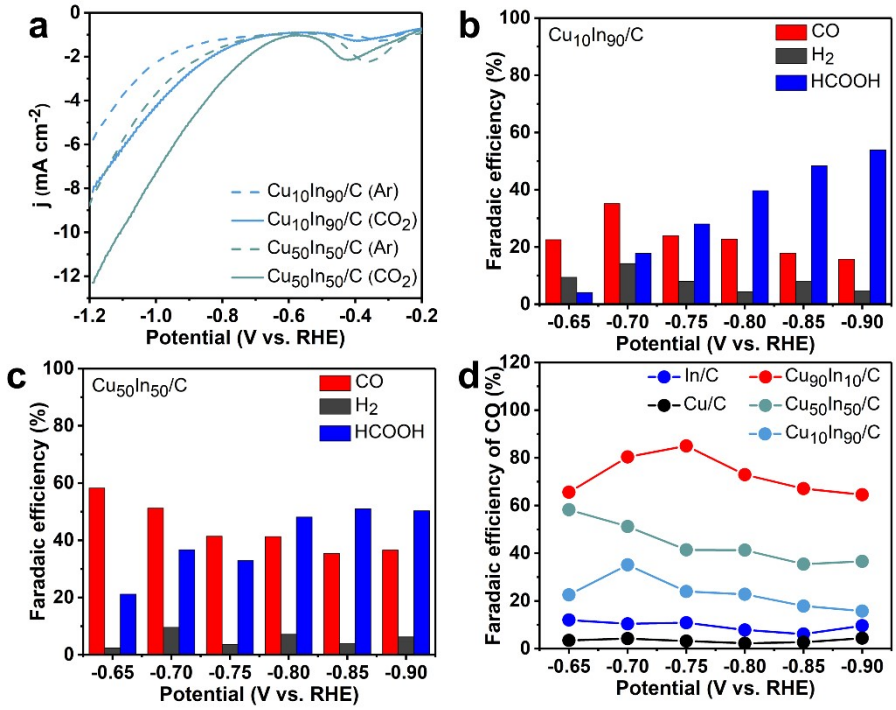

Fig. S1 LSV curves (a) and products selectivity on $Cu_{10}In_{90}$/C (b) and $Cu_{50}In_{50}$/C (c). Faradaic efficiency of CO on Cu_xIn_{100-x}/C (d).

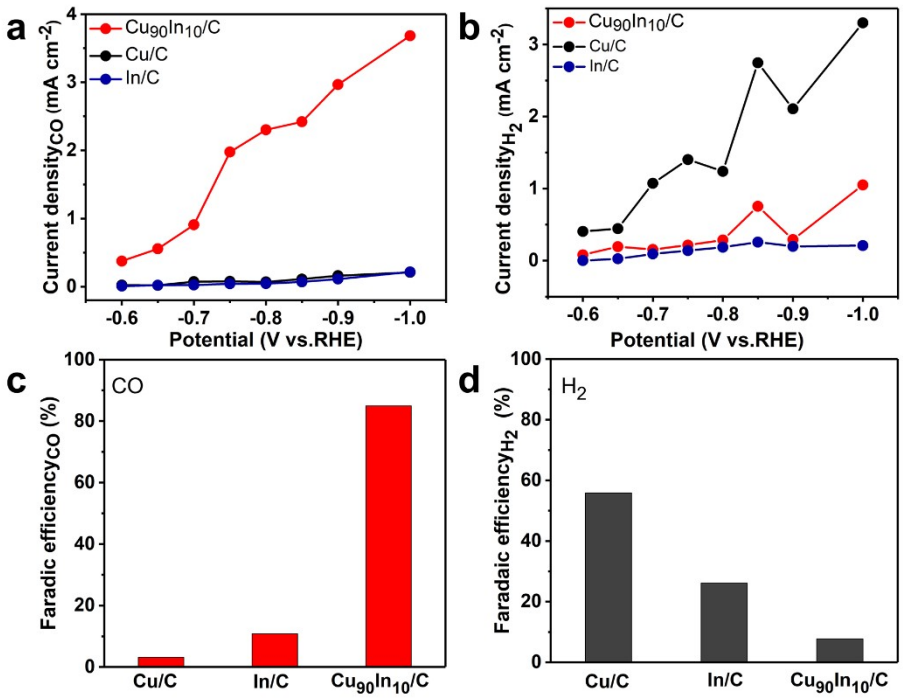

Fig. S2 Current density of CO (a) and H_2 (b) at -0.6 V ~ -1.0 V, and Faradaic efficiency of CO (c) and H_2 (d) at the potential of -0.75 V on Cu/C, In/C and $Cu_{90}In_{10}$/C catalysts.

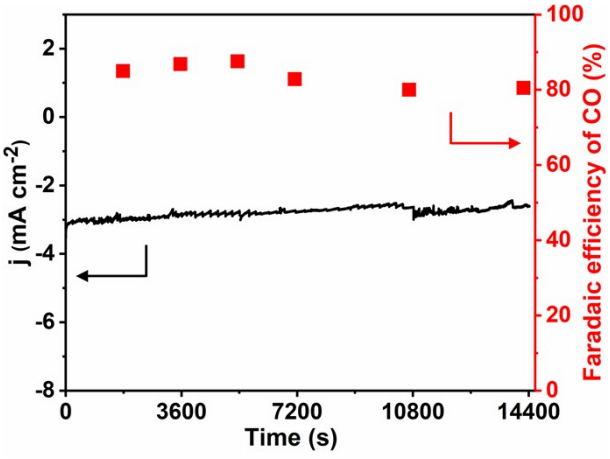

Fig. S3 The stability of $Cu_{90}In_{10}$/C at -0.75 V.

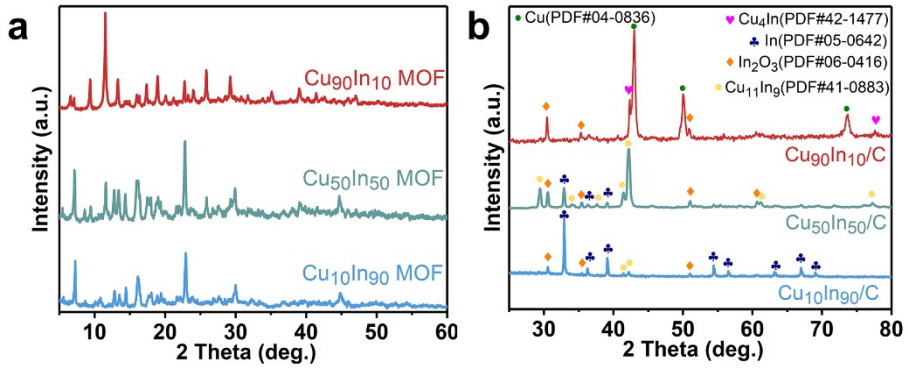

Fig. S4 XRD patterns of Cu_xIn_{100-x} MOFs (a) and Cu_xIn_{100-x}/C (b).

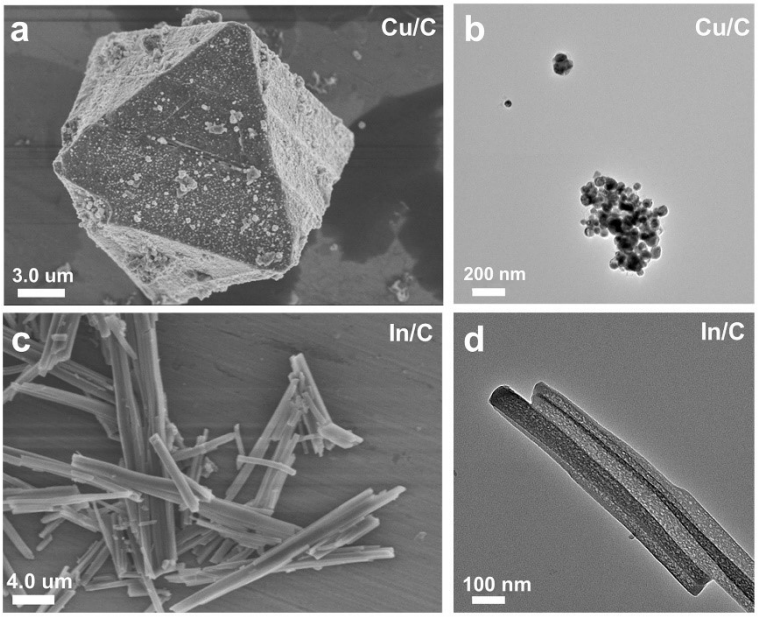

Fig. S5 SEM and TEM images of Cu/C (a, b) and In/C (c, d).

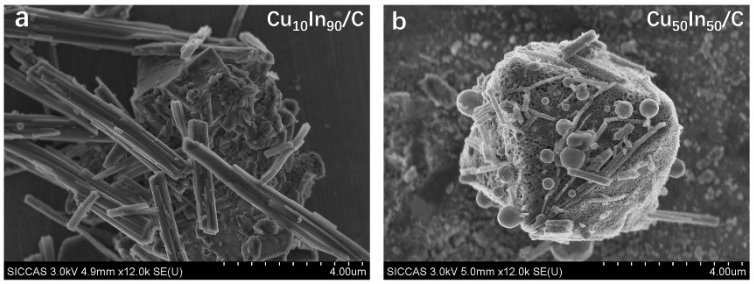

Fig. S6 SEM images of $Cu_{10}In_{90}$/C (a) and $Cu_{50}In_{50}$/C (b).

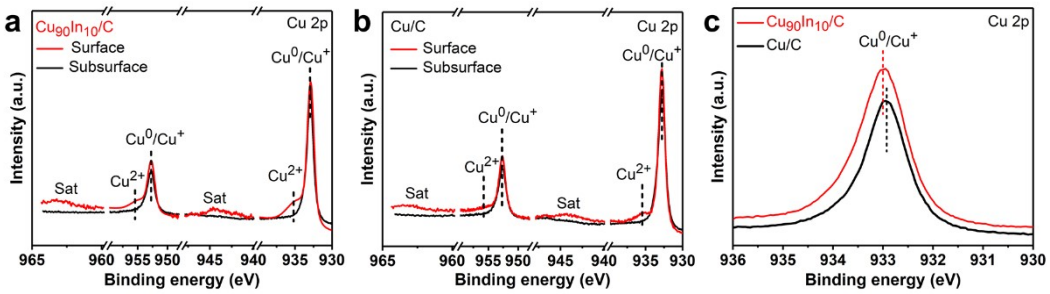

Fig. S7 The Cu 2p XPS spectra on the surface and subsurface of $Cu_{90}In_{10}/C$ (a) and Cu/C (b), the comparison of Cu $2p_{3/2}$ peaks of $Cu_{90}In_{10}/C$ and Cu/C.

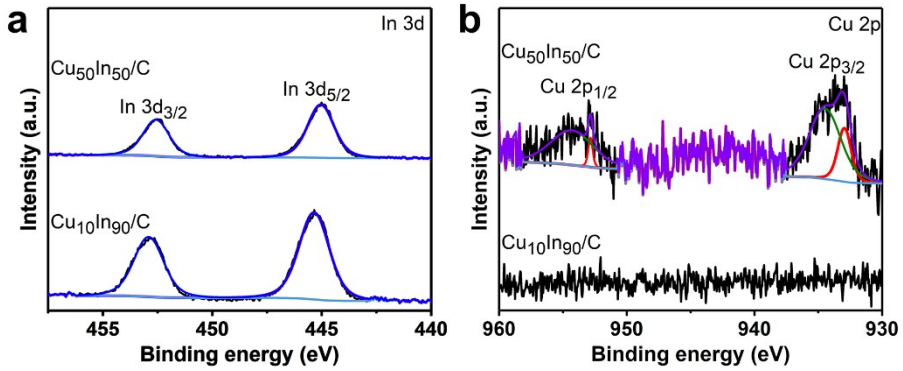

Fig. S8 In 3d (a) and Cu 2p (b) XPS spectra of $Cu_{10}In_{90}/C$ and $Cu_{50}In_{50}/C$.

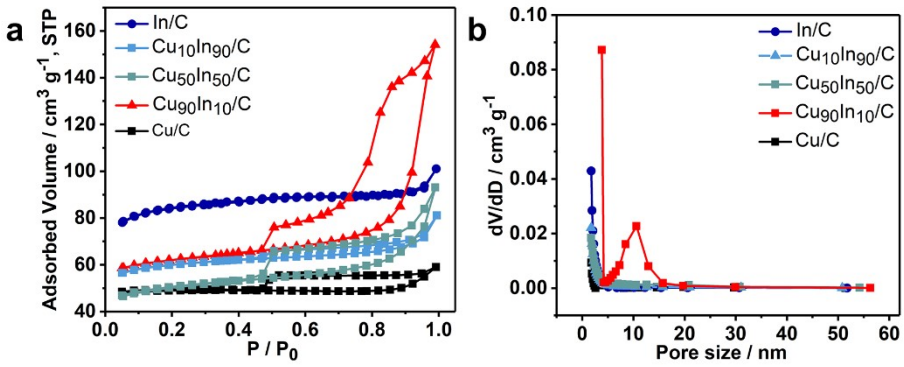

Fig. S9 N_2 adsorption isotherms (a) and pore size distributions (b) of Cu_xIn_{100-x}/C.

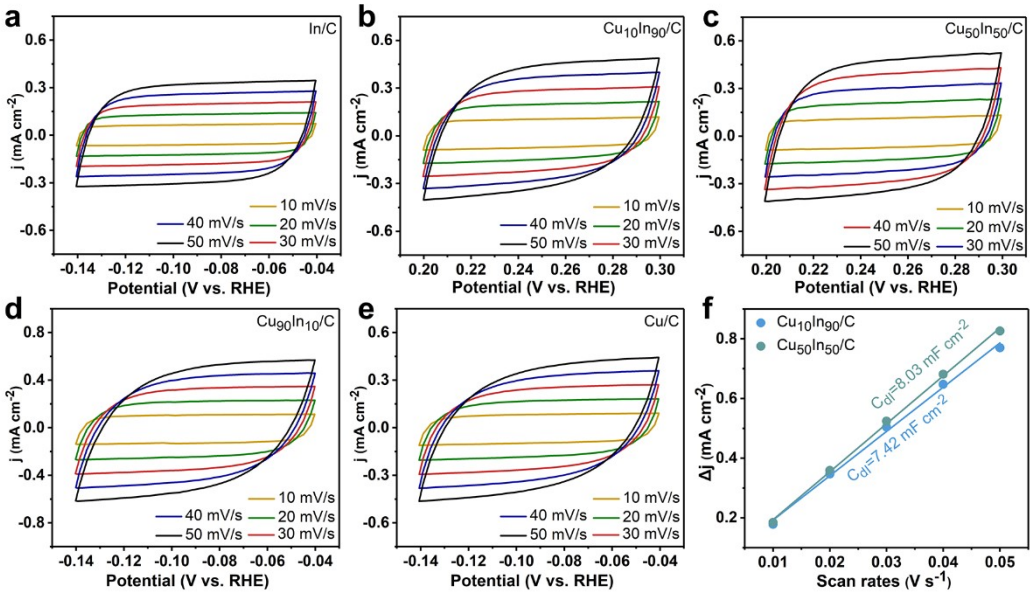

Fig. S10 CV curves of Cu_xIn_{100-x}/C obtained at various scan rates (a-e), charging current density differences plotted against scan rates of $Cu_{10}In_{90}$/C and $Cu_{50}In_{50}$/C (f).

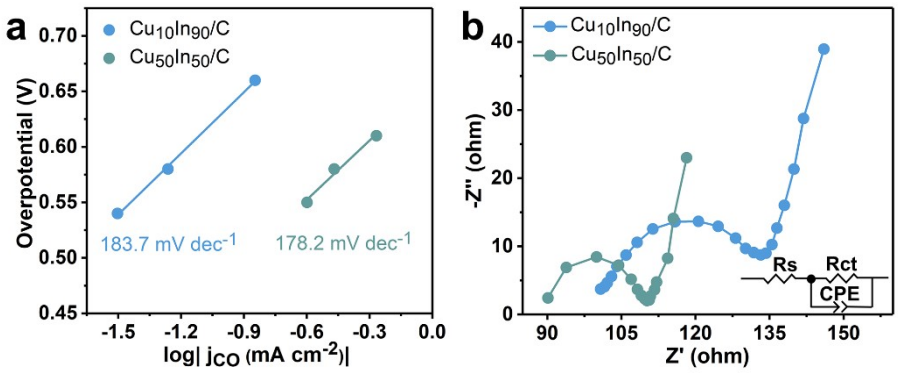

Fig. S11 Tafel plots for CO (a), and Nyquist plots (b) of $Cu_{10}In_{90}$/C and $Cu_{50}In_{50}$/C.

Table S1. The atom ratio of $Cu_{90}In_{10}$/C measured by ICP-OES.

Elements	At (%)
Cu	1.03
In	0.093
Cu/In	**11.07**

Table S2. Comparison of FE_{CO} on $Cu_{90}In_{10}$/C with other reported Cu-based MOFs catalysts.

Catalyst	Electrolyte	Maximum FE_{CO} (%)	Potential (V vs. RHE)/ J (mA cm^{-2})
$Cu_{90}In_{10}$/C (this work)	0.1 M $KHCO_3$	95	-0.75/-2.3
C-$Cu(OH)_2$@ZIF-8-10%-1000[1]	0.5 M $KHCO_3$	90	-0.5/~ -5
CoPc-Cu-O[2]	0.1 M $KHCO_3$	85	-0.74/-13.2
Cu-NC400[3]	0.1 M $KHCO_3$	~ 23	-0.7/~ -2
Cu-MOF-74 derived Cu NPs[4]	0.1 M $KHCO_3$	~ 5	-1.1/~ -3
$Fe_{0.07}Cu–N–C_{800}$[5]	--	47.8	-1.2 (V vs. Ag/AgCl) /~ -18
$Cu–N–C_{1100}$[6]	0.1 M $KHCO_3$	40.8	-0.6/~ -0.4
Cu_2O@Cu-MOF[7]	0.1 M $KHCO_3$	23.1	-0.91/~ -2.5
MOFs-drived Cu/Cu_2O[8]	0.5 M $KHCO_3$	43.8	-0.76/~ -22.5
Cu-N-C[9]	0.5 M $KHCO_3$	~ 23	-0.55/~ -2
MOFs-derived Cu_xO/C[10]	0.1 M $KHCO_3$	~ 22.2	-0.78/--

References

1. X. Chen, L. Ma, W. Su, L. Ding, H. Zhu and H. Yang, *Electrochim. Acta*, 2020, **331**, 135273.
2. Z. Meng, J. Luo, W. Li and K. A. Mirica, *J. Am. Chem. Soc.*, 2020, **142**, 21656-21669.
3. Y. Cheng, X. Chu, M. Ling, N. Li, K. Wu, F. Wu, H. Li, G. Yuan and X. Wei, *Catal. Sci. Technol.*, 2019, **9**, 5668-5675.
4. M. K. Kim, H. J. Kim, H. Lim, Y. Kwon and H. M. Jeong, *Electrochim. Acta*, 2019, **306**, 28-34.
5. S. Cao, H. Chen, M. Liu, B. Feng, B. Dong, Q. Zheng, W. Liu and Y. Teng, *J. CO_2 Util.*, 2021, **44**, 101418.
6. S. Cao, H. Chen, B. Dong, Q. Zheng, Y. Ding, M. Liu, S. Qian, Y. Teng, Z. Li and W. Liu, *J. Energy Chem.*, 2021, **54**, 555-563.
7. X. Tan, C. Yu, C. Zhao, H. Huang, X. Yao, X. Han, W. Guo, S. Cui, H. Huang and J. Qiu, *ACS Appl. Mater. Interfaces*, 2019, **11**, 9904-9910.
8. J. Liu, L. Peng, Y. Zhou, L. Lv, J. Fu, J. Lin, D. Guay and J. L. Qiao, *ACS Sustain. Chem. Eng.*, 2019, **7**, 15739-15746.
9. L. Jiao, W. J. Yang, G. Wan, R. Zhang, X. S. Zheng, H. Zhou, S. H. Yu and H. L. Jiang, *Angew. Chem., Int. Ed.*, 2020, **59**, 20589-20595.
10. K. Yao, Y. Xia, J. Li, N. Wang, J. Han, C. Gao, M. Han, G. Shen, Y. Liu, A. Seifitokaldani, X. Sun and H. Liang, *J. Mater. Chem. A*, 2020, **8**, 11117-11123.