Electrochemically derived nanoporous Bi from plasma-structured BiOCl for high-efficiency CO₂ electroreduction

Yaxin Xu[a], Zhongshuang Xu[a], Huanran Miao[a], Zhimao Yang[a], Chuncai Kong [a]†, Qikui Fan[a]†

a.MOE Key Laboratory for Non-Equilibrium Synthesis and Modulation of Condensed Matter, Key Laboratory for Advanced Materials and Mesoscopic Physics of Shaanxi Province, School of Physics, Xi'an Jiaotong University, Xi'an, 710049, China

† Address correspondence to Third C. Kong, kongcc@xjtu.edu.cn; Fourth Q. Fan, fanqikui@xjtu.edu.cn

Table S1. Comparison of CO_2RR performance to formate for P-BiOCl and other state-of-the-art catalysts.

Formula reference:

$$j_{HCOOH} = j_{total} \times FE_{HCOOH}$$

The unit for current density is uniformly defined as mA cm^{-2}.

Sample Name	j_{total}/ mA cm^{-2}	j_{HCOOH}/ mA cm^{-2}
P-Bi	50	41
	92	83
	200	186
	300	280
	400	365
	500	451
HT-Bi	50	30
	100	76
	200	161
	300	247
	400	290
	500	259

Table S2. Performance comparison of state-of-the-art Bi-based catalysts for CO_2 electroreduction to formate in flow cells.

Catalyst	Electrolyte	Current density (mA cm^{-2})	Potential (V vs. RHE)	FE_formate (%)	Stability (h) @ condition	Reference
P-Bi (nanoporous Bi, this work)	1.0 M KOH	**300**	0.90	**93.4**	**40**@ 100 mA cm^{-2} (4.73% FE loss)	This work
Bi NS-L (lattice-compressed Bi nanosheets)	1.0 M KOH	150	−1.0	94	15 @ 100 mA cm^{-2} (negligible decay)	Nano Lett.**2025**, 25, DOI: 10.1021/acs.nanolett.5c02163
BOC-NC-900 ℃ ($Bi_2O_2CO_3$/ N-doped carbon)	1.0 M KOH	91	-1.0	90.5	10 @ -1.0 V (FE >90%)	Nanoscale **2023**, 17, 9588-9598 DOI:10.1039/d4nr05343e
Bi-Cl derived (halide-guided)	1.0 M KOH	300	N/A	95	20 @ 200 mA cm^{-2} (FE decay <5%)	Nat. Catal. **2023**, 6, 796–806 DOI:10.1038/s41929-023-01008-0
Bi NSs（Bi nanosheets）	1.0 M KOH	300	-0.52	>90	10h@197 mA cm^{-2} (FE =90%)	Adv. Energy Mater. **2020,** 10, 2001709 DOI: 10.1002/aenm.202001709