$\textbf{Table. S1} \text{ Summary of } CO_2 \text{ reduction reaction using amines-based absorbent}$

Co-catalyst	Additive	Feed gas	Solvent + electrolyte	Electrode	Applied potential	FE of H2 (%)	FE of CO (%)	FE of formate/formic acid Ref. (%)
				WE : Smooth In metal				(70)
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth In metal	–0.8 V vs. RHE	85.2	4.8	2.4 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth In metal	–1.1 V vs. RHE	95.7	1.5	0.1 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Sn motel	-1.3 V vs. RHE	98.9	0.7	0.1 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	WE : Smooth Sh metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Sh matel	–0.8 V vs. RHE	84.9	5.7	5.2 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	WE : Smooth Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Sn metal	-1.1 V vs. RHE	95.7	1.3	1.0 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	wE : Smooth Sh metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Bi metal	-1.3 V vs. RHE	97.4	0.7	1.0 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Pi motel	–0.8 V vs. RHE	60.8	4.1	35.7 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Bi metal	–1.1 V vs. RHE	82.9	2.1	10.1 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Pb metal	–1.3 V vs. RHE	88.8	1.1	5.3 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Pb metal	–0.8 V vs. RHE	97.0	0.1	3.7 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Pb metal	–1.1 V vs. RHE	97.8	0.1	0.3 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Pd metal	-1.3 V vs. RHE	101.7	0.1	1.6 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Pd metal	–0.1 V vs. RHE	87.8	-	1.0 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Pd metal	–0.4 V vs. RHE	81.6	-	1.0 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Ag metal	–0.8 V vs. RHE	80.0	-	0.7 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Ag metal	–0.8 V vs. RHE	85.8	12.4	1.3 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WF : Smooth Ag metal	–1.1 V vs. RHE	93.0	6.1	1.0 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Cu metal	-1.3 V vs. RHE	94.2	2.3	1.2 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Cu metal	–0.8 V vs. RHE	90.2	0.5	0.8 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Smooth Cu motel	–1.1 V vs. RHE	93.4	-	0.6 1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	-1.3 V vs. RHE	94.2	-	0.7 1

				WE : Smooth Zn metal					
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–0.8 V vs. RHE	97.3	0.8	2.1	1
				WE : Smooth Zn metal					
	20 0/ MEA	Saturated CO2	ЦО	electrode	-1.1 V vs.	104.7	0.5	0.0	1
-	50 Wt % MEA	(2.46 M)	H_2O	CE : Pt plate	RHE	104.7	0.5	0.8	1
				RE : Ag/AgCl (3 M NaCl)					
				WE : Smooth Zn metal					
	20	Saturated CO ₂	цо	electrode	-1.3 V vs.	05.5	0.2	0.2	
-	30 wt % MEA	(2.46 M)	H ₂ O	CE : Pt plate	RHE	95.7	0.3	0.2	1
				RE : Ag/AgCl (3 M NaCl)					
				WE : Smooth In metal					
		Saturated CO ₂		electrode	-0.8 V vs.				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H ₂ O	CE : Pt plate	RHE	41.9	17.0	45.4	1
		(-)		RE : Ag/AgCl (3 M NaCl)					
				WE · Smooth In metal					
		Saturated CO ₂		electrode	-1.1 V vs.				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H ₂ O	CE : Pt plate	RHE	42.0	10.7	39.4	1
		. ,		RE : Ag/AgCl (3 M NaCl)					
				WE : Smooth In metal					
		Saturated CO ₂		electrode	-1.3 V vs.				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H ₂ O	CE : Pt plate	RHE	44.3	11.2	36.5	1
		. ,		RE : Ag/AgCl (3 M NaCl)					
				WE : Smooth Sn metal					
		Saturated CO ₂		electrode	-0.8 V vs.				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H ₂ O	CE : Pt plate	RHE	68.6	9.0	19.0	1
		. ,		RE : Ag/AgCl (3 M NaCl)					
				WE : Smooth Sn metal					
		Saturated CO ₂		electrode	-1.1 V vs.				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H ₂ O	CE · Pt plate	RHE	78.5	3.6	16.4	1
		(2.40 M)		$RE \cdot Ag/AgCl (3 M NaCl)$	Ruit				
				WE : Smooth Sn metal					
		Saturated CO.		electrode	1 2 V vc				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H2O	CE · Pt plate	-1.5 V VS. RHF	93.4	2.6	2.0	1
		(2.40 M)		$RE \cdot Ag/AgCl (3 M NaCl)$	KIIL				
				WE : Smooth Bi motal					
		Saturated CO		wE: Smooth Bi metai	0.8 1/ 1/2				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H2O	CE . Dt alata	-0.8 V VS.	69.5	7.0	24.3	1
		(2.40 MI)		CE: Ft plate $PE \cdot A \alpha / A \alpha Cl (2 M NaCl)$	КПЕ				
				WE Count Directol					
		Saturated CO		wE: Smooth Bi metai	1 1 17				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H ₂ O	CE . Dt alata	-1.1 V VS.	87.1	4.9	7.1	1
		(2.40 MI)		CE: Ft plate $PE + A \alpha / A \alpha Cl (2 M Na Cl)$	KHE				
				WE - Smooth Di motol					
		Saturated CO		wE: Smooth Bi metai	12 1/10				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H2O	CE : Pt plata	-1.5 V VS.	93.4	2.6	3.9	1
		(2.40 101)		$RE \cdot Ag/AgCl (3 M NaCl)$	KIIL				
				WE - Smooth Dh motol					
		Saturated CO		wE: Shlooti Fb metal	0.0 1/				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H2O	CE · Pt plate	-0.8 V VS.	79.6	1.9	8.5	1
		(2.40 101)		$RE \cdot Ag/AgCl (3 M NaCl)$	KIIL				
				WE - Ag/Ager (5 W Nacr)					
		S-t		WE : Smooth Pb metal	1 1 17				
-	30 wt % MEA	Saturated CO ₂	0.1 wt % CTAB/H ₂ O	CE . Dt alata	-1.1 V VS.	79.2	3.0	8.7	1
		(2.40 WI)		DE : A a/A aCl (2 M NaCl)	KIL				
				WE - Ag/Ager (5 W Nacr)					
		S-t		WE : Smooth Pb metal	1237				
-	30 wt % MEA	Saturated CO ₂	0.1 wt % CTAB/H2O	electrode	-1.5 V VS.	85.1	3.5	6.1	1
		(2.40 M)		CE : Pt plate	KHE				
				RE : Ag/AgCI (3 M NaCI)					
		S-t		WE : Smooth Pd metal	0.1.17				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H ₂ O	CE . Dt alata	-0.1 V Vs.	91.6	-	4.0	1
		(2.40 M)		CE : PL plate $RE \cdot \Lambda_{\alpha}/\Lambda_{\alpha}CL(2, M, N_{\alpha}CL)$	KHE				
				WE AGAGE (5 M NaUl)					
		S-t		WE : Smooth Pd metal	0.4.17				
-	30 wt % MEA	Saturated CO ₂	0.1 wt % CTAB/H2O	electrode	-0.4 V VS.	87.3	-	4.1	1
		(2.40 MI)		CE: Ft plate $PE + A \alpha / A \alpha Cl (2 M Na Cl)$	КПЕ				
				KE : Ag/AgCI (3 M NaCI)					
		S-t		WE : Smooth Pd metal	0.01/				
-	30 wt % MEA	Saturated CO_2	0.1 wt % CTAB/H ₂ O	electrode	-0.8 V vs.	96.0	-	0.1	1
		(2.40 M)		CE : Pt plate	KHE				
				WE . Constant					
		Comment 100		wE: Smooth Ag metal	0.9.17				
-	30 wt % MEA	Saturated CO ₂	0.1 wt % CTAB/H2O	electrode	-0.8 V VS.	62.8	33.4	2.0	1
		(2.40 M)		CE: Pt plate $RE \cdot A_{\alpha}/A_{\alpha}CL(2, M, M_{\alpha}CL)$	KHE				
				KE : Ag/AgCI (5 M NaCI)					
		0.1.1.00		WE : Smooth Ag metal					
-	30 wt % MEA	Saturated CO ₂	0.1 wt % CTAB/H2O	electrode	-1.1 V vs.	84.7	15.9	2.8	1
		(2.46 M)	2 -	CE : Pt plate	RHE				
				ке : Ag/AgCl (3 M NaCl)					
		a		WE : Smooth Ag metal	1				
-	30 wt % MEA	Saturated CO ₂	0.1 wt % CTAB/H2O	electrode	-1.3 V vs.	89.5	9.2	1.7	1
		(2.46 M)		CE : Pt plate	RHE				
				KE : Ag/AgCI (3 M NaCl)					
		0.4 . 100		WE : Smooth Cu metal	0.0.11				
-	30 wt % MEA	Saturated CO ₂	0.1 wt % CTAB/H2O	electrode	-0.8 V vs.	79.7	1.7	19.1	1
		(2.40 M)		CE: Pt plate	KHE				
				KE : Ag/AgCI (3 M NaCI)					

$ = 30 wt % MEA \\ Summar CD \\ (2.46 M) \\ Summar CD \\ (2.46 M) \\ Summar CD \\ (2.46 M) \\ $					WE : Smooth Cu metal					
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.1 V vs. RHE	98.1	-	0.5	1
$ = 30 wt % MEA \\ Subtradel CO2 0.1 wt % CTABEHO \\ (2.46 M) = 0$					WE : Smooth Cu metal					
$ \left \begin{array}{c c c c c c c c c c c c c c c c c c c $	-	30 wt % MEA	Saturated CO ₂	0.1 wt % CTAB/H ₂ O	CE : Pt plata	-1.3 V vs.	91.0	-	0.1	1
= 30 wt % MEA Statusted CO2 0.1 wt % CTAB H2 Statusted CO2 0.1 wt % CTAB H2 C (2.45 M) 0.1 wt % CTAB H2 (2.			(2.40 W)		RE : Ag/AgCl (3 M NaCl) WE : Smooth Zn metal	KIL				
		20 mit 9/ MEA	Saturated CO ₂	0.1 wt % CTAD/ILO	electrode	-0.8 V vs.	102.0	27	5.4	1
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	50 WI 70 MEA	(2.46 M)	0.1 Wt % CTAD/H ₂ O	CE : Pt plate	RHE	105.0	5.7	3.4	1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $					RE : Ag/AgCl (3 M NaCl)					
$ \begin{array}{c c c c c c } & 30 wt 50 MEA & Samarad CO & 0.1 wt 50 CTABFLO & EE make and the second s$			S-t1-CO		WE : Smooth Zn metal	1 1 17				
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H ₂ O	CE · Pt plate	-1.1 V VS. RHF	91.4	2.9	2.0	1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			(2.10 1.1)		RE : Ag/AgCl (3 M NaCl)	IGIL				
$ = 30 wt 50 MEA = Sama CO (2.46 M) = 0.1 wt 50 CAB H_O = CE : Pipelac RE: (3.4 MAC) RE: (4.4 M) = Re: (3.4 MAC) RE: (4.4 MAC) = RE: (3.4 MAC) RE: (4.4 MAC) = RE: (3.4 MAC) $					WE : Smooth Zn metal					
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		30 wt % MEA	Saturated CO2	0.1 wt % CTAB/H-O	electrode	-1.3 V vs.	102.0	0.5	2.0	1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		JU WI /0 WEA	(2.46 M)	0.1 wt /0 CTAD/1120	CE : Pt plate	RHE	102.0	0.5	2.0	1
$\begin{array}{c c c c c c c c c c c c c c c c c c c $					RE : Ag/AgCl (3 M NaCl)					
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			Saturated CO.		WE : Porous in metal	0.8 1/ 1/2				
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	30 wt % MEA	(2.46 M)	H_2O	CE : Pt plate	-0.8 V VS. RHE	82.3	2.0	13.4	1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			()		RE : Ag/AgCl (3 M NaCl)	iuit				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $					WE : Porous In metal					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	30 wt % MEA	Saturated CO ₂	H ₂ O	electrode	-1.1 V vs.	91.4	0.5	0.6	1
HE: $AgAgel (1 M Mel)$ WE: Provise in metal decroid dec		50 00 00 000000	(2.46 M)	1120	CE : Pt plate	RHE	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	0.0	010	
					RE : Ag/AgCl (3 M NaCl)					
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			Saturated CO.		WE : Porous in metal	1 2 V vo				
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	30 wt % MEA	(2 46 M)	H_2O	CE · Pt plate	RHE	95.6	0.1	5.3	1
$. \qquad 30 wt 56 MEA \qquad \begin{array}{c} \text{Samurald CO}_{1} \\ (2.46 M) \\ (2.46 M$			(2.10111)		RE : Ag/AgCl (3 M NaCl)	iuit				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $					WE : Porous Sn metal					
- 30 wt % MEA Saturated CO; (2.46 M) H ₂ O CE: Pip Plate RE: RE: AgA ACI (3M NACI) RHE 60.0 - 30 wt % MEA Saturated CO; (2.46 M) H ₂ O CE: Pip Plate RE: AgA ACI (3M NACI) RHE 86.7 6.3 - 30 wt % MEA Saturated CO; (2.46 M) H ₂ O CE: Pip Plate RE: AgA ACI (3M NACI) RHE 86.7 6.3 - 30 wt % MEA Saturated CO; (2.46 M) H ₂ O CE: Pip Plate RE: AgA ACI (3M NACI) RHE 95.6 2.0 - 30 wt % MEA Saturated CO; (2.46 M) H ₂ O CE: Pip Plate RE: AgA ACI (3M NACI) RHE 85.7 2.4 - 30 wt % MEA Saturated CO; (2.46 M) H ₂ O CE: Pip Plate RE: AgA ACI (3M NACI) RHE 85.7 2.4 - 30 wt % MEA Saturated CO; (2.46 M) H ₂ O CE: Pip Plate RE: AgA ACI (3M NACI) RHE 84.6 1.9 - 30 wt % MEA Saturated CO; (2.46 M) H ₂ O CE: Pip Plate RE: AgA ACI (3M NACI) RHE 81.6 1.9 - 30 wt % MEA Saturated CO; (2	-	30 wt % MEA	Saturated CO ₂	H ₂ O	electrode	-0.8 V vs.	79.2	89	41	1
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		50 WE /0 WEEK	(2.46 M)	1120	CE : Pt plate	RHE	19.2	0.7	4.1	1
. 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O $CE: Piplate MHE 86.7 6.3 . 30 \text{ wt \% MEA} Saturated CO2(2.46 M) H2O CE: Piplate MHE 86.7 6.3 . 30 \text{ wt \% MEA} Saturated CO2(2.46 M) H2O CE: Piplate MHE 86.7 6.3 . 30 \text{ wt \% MEA} Saturated CO2(2.46 M) H2O CE: Piplate MHE 86.7 6.3 . 30 \text{ wt \% MEA} Saturated CO2(2.46 M) H2O CE: Piplate MHE 86.7 5.2 . 30 \text{ wt \% MEA} Saturated CO2(2.46 M) H2O CE: Piplate MHE 81.7 2.4 . 30 \text{ wt \% MEA} Saturated CO2(2.46 M) H2O CE: Piplate MHE 81.8 9.5 2.0 . 30 \text{ wt \% MEA} Saturated CO2(2.46 M) H2O CE: Piplate MHE 84.6 1.9 . 30 \text{ wt \% MEA} Saturated CO2(2.46 M) H2O CE: Piplate MHE 84.6 1.9 . 30 \text{ wt \% MEA} Saturated CO2(2.46 M) H2O CE: Piplate MHE 84.6 1.9 84.6$					RE : Ag/AgCl (3 M NaCl)					
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			Saturated CO.		WE : Porous Sn metal	1.1 V vc				
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	30 wt % MEA	(2.46 M)	H_2O	CE : Pt plate	RHE	86.7	6.3	2.4	1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			(2.10 1.1)		RE : Ag/AgCl (3 M NaCl)	iuit				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$					WE : Porous Sn metal					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	30 wt % MEA	Saturated CO ₂	H ₂ O	electrode	-1.3 V vs.	95.6	2.0	33	1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		50 00 00 000000	(2.46 M)	1120	CE : Pt plate	RHE	2010	2.0	010	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $					RE : Ag/AgCl (3 M NaCl)					
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			Saturated CO.		WE : Porous Bi metal	0 8 V vo				
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	30 wt % MEA	(2.46 M)	H_2O	CE : Pt plate	RHE	67.5	5.2	18.3	1
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			()		RE : Ag/AgCl (3 M NaCl)					
$ - 30 \text{ wt \% MEA} \xrightarrow{\text{Saturated CO}_{2}}_{(2.46 \text{ M})} + \mu_{2}0 \qquad \begin{array}{c} \begin{array}{c} \text{electrode} & -1.1 \text{ V vs.} \\ \text{RE: Ag/AgCl (3 M NaCl)} \\ \text{WE: Porous B install} \\ \text{electrode} & -1.3 \text{ V vs.} \\ \text{RE: Ag/AgCl (3 M NaCl)} \\ \text{WE: Porous B install} \\ \text{electrode} & -0.8 \text{ V vs.} \\ \text{CE: Pt plate} & \text{RHE} & 84.6 \\ 1.9 \\ \text{RE: Ag/AgCl (3 M NaCl)} \\ \text{WE: Porous P b metall} \\ \text{electrode} & -0.8 \text{ V vs.} \\ \text{CE: Pt plate} & \text{RHE} & 82.5 \\ 0.9 \\ \text{CE: Pt plate} & \text{RHE} & 82.5 \\ 0.9 \\ \text{CE: Pt plate} & \text{RHE} & 82.5 \\ 0.9 \\ \text{CE: Pt plate} & \text{RHE} & 92.5 \\ 0.9 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 101.8 \\ 0.4 \\ \text{CE: Pt plate} & \text{RHE} & 55.0 \\ 0.6 \\ \text{CE: Pt plate} & \text{RHE} & 55.0 \\ 0.6 \\ \text{CE: Pt plate} & \text{RHE} & 55.9 \\ 0.1 \\ \text{RE: Ag/AgCl (3 M NaCl)} \\ \text{WE: Porous Pd metall} \\ \text{electrode} & -0.8 \text{ V vs.} \\ 0.5 \\ \text{CE: Pt plate} & \text{RHE} & 85.9 \\ 0.1 \\ \text{RE: Ag/AgCl (3 M NaCl)} \\ \text{WE: Porous Pd metall} \\ \text{electrode} & -0.8 \text{ V vs.} \\ 0.2 \\ \text{CE: Pt plate} & \text{RHE} & 10.2 \\ \text{RE: Ag/AgCl (3 M NaCl)} \\ \text{WE: Porous Ag metall} \\ \text{electrode} & -0.8 \text{ V vs.} \\ 0.2 \\ \text{CE: Pt plate} & \text{RHE} & 10.2 \\ \text{RE: Ag/AgCl (3 M NaCl)} \\ \text{WE: Porous Ag metall} \\ \text{electrode} & -0.8 \text{ V vs.} \\ 0.2 \\ \text{CE: Pt plate} & \text{RHE} & 10.2 \\ \text{RE: Ag/AgCl (3 M NaCl)} \\ \text{WE: Porous Ag metall} \\ \text{electrode} & -1.1 \text{ V vs.} \\ \text{RE: Ag/AgCl (3 M NaCl)} \\ \text{WE: Porous Ag metall} \\ \text{electrode} & -1.1 \text{ V vs.} \\ \text{RHE} & 85.5 \\ 12.0 \\ \text{RE: Ag/AgCl (3 M NaCl)} \\ WE: P$					WE : Porous Bi metal					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	30 wt % MEA	Saturated CO ₂	H ₂ O	electrode	-1.1 V vs.	85.7	24	82	1
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		50 00 00 000000	(2.46 M)	1120	CE : Pt plate	RHE	0017	2	0.2	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $					RE : Ag/AgCl (3 M NaCl)					
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			Saturated CO.		WE : Porous Bi metal	_1 3 V ve				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	-	30 wt % MEA	(2.46 M)	H_2O	CE : Pt plate	RHE	84.6	1.9	7.7	1
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			· /		RE : Ag/AgCl (3 M NaCl)					
$ - 30 \text{ wt \% MEA} \begin{array}{c} \text{Saturated CO}_{2} \\ (2.46 \text{ M}) \\ (2.$					WE : Porous Pb metal					
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	-	30 wt % MEA	Saturated CO2	H ₂ O	electrode	-0.8 V vs.	92.5	0.9	2.2	1
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			(2.46 M)		CE : Pt plate	RHE				
$ \begin{array}{c} & & & & & & & & & & $					WE : Ag/AgCI (5 M NaCI)					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			Saturated CO ₂		electrode	-1.1 V vs				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	-	30 wt % MEA	(2.46 M)	H_2O	CE : Pt plate	RHE	101.8	0.4	4.5	1
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$					RE : Ag/AgCl (3 M NaCl)					
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$					WE : Porous Pb metal					
$\left(\begin{array}{cccccccccccccccccccccccccccccccccccc$	-	30 wt % MEA	Saturated CO ₂	H ₂ O	electrode	-1.3 V vs.	95.0	0.6	4.2	1
$- 30 \text{ wt \% MEA} \xrightarrow{\text{Saturated CO}_2}_{(2.46 \text{ M})} H_2O \xrightarrow{\text{WE: Porous Pd metal}}_{(2.46 \text{ M})} \stackrel{\text{WE: Porous Pd metal}}{(2.46 \text{ M})} \stackrel{\text{WE: Porous Ag metal}$			(2.46 M)		CE : Pt plate PE : A g/A gCl (2 M NoCl)	KHE				
$- 30 \text{ wt \% MEA} \xrightarrow{\text{Saturated CO}_2}_{(2.46 \text{ M})} H_2O \xrightarrow{\text{H}_2O} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{H}_2O} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} H_2O \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{WE} : Porous Pd metal}_{(2.46 \text{ M})} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{WE} : Porous Ag metal}_{(2.46 \text{ M})} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{WE} : Porous Ag metal}_{(2.46 \text{ M})} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{WE} : Porous Ag metal}_{(2.46 \text{ M})} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{WE} : Porous Ag metal}_{(2.46 \text{ M})} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{WE} : Porous Ag metal}_{(2.46 \text{ M})} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{WE} : Porous Ag metal}_{(2.46 \text{ M})} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{WE} : Porous Ag metal}_{(2.46 \text{ M})} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{WE} : Porous Ag metal}_{(2.46 \text{ M})} \xrightarrow{\text{electrode}}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{RHE} : Ag/AgCl (3 M NaCl)}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{(2.46 \text{ M})} \xrightarrow{\text{CE} : Pt plate}_{($					WF : Porous Pd metal					
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		20	Saturated CO ₂		electrode	-0.5 V vs.				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	-	30 wt % MEA	(2.46 M)	H ₂ O	CE : Pt plate	RHE	75.9	0.1	2.5	1
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$					RE : Ag/AgCl (3 M NaCl)					
- 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O - (2.46 M) H ₂ O - $(2$					WE : Porous Pd metal					
$\left(\begin{array}{c} 2.46 \text{ M}\right) \\ \left(\begin{array}{c} C \\ E \\ P \\ P$	-	30 wt % MEA	Saturated CO ₂	H_2O	electrode	-0.8 V vs.	85.9	0.1	4.1	1
- $30 \text{ wt } \% \text{ MEA}$ $\begin{array}{c} \text{Saturated CO}_2 \\ (2.46 \text{ M}) \end{array} \qquad H_2O \end{array} \qquad \begin{array}{c} \text{WE: Procus Ag metal} \\ \text{electrode} & -0.8 \text{ V vs.} \\ \text{CE: Pt plate} \\ \text{RHE} \end{array} \qquad \begin{array}{c} 0.2 \text{ Saturated CO}_2 \\ \text{CE: Pt plate} \\ \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \begin{array}{c} \text{WE: Procus Ag metal} \\ \text{electrode} \\ \text{CE: Pt plate} \\ \text{RHE} \end{array} \qquad \begin{array}{c} 1.1 \text{ V vs.} \\ \text{CE: Pt plate} \\ \text{RHE} \end{array} \qquad \begin{array}{c} \text{RHE} \end{array} \qquad \begin{array}{c} 85.5 \\ \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \begin{array}{c} \text{WE: Procus Ag metal} \\ \text{electrode} \\ \text{CE: Pt plate} \\ \text{RHE} \end{array} \qquad \begin{array}{c} \text{RHE} \end{array} \qquad \begin{array}{c} 85.5 \\ \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \begin{array}{c} \text{WE: Procus Ag metal} \\ \text{electrode} \\ \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \begin{array}{c} \text{WE: Procus Ag metal} \end{array} \qquad \begin{array}{c} \text{electrode} \\ \text{CE: Pt plate} \\ \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \begin{array}{c} \text{WE: Procus Ag metal} \end{array} \qquad \begin{array}{c} \text{Saturated CO}_2 \\ \text{WE: Procus Ag metal} \end{array} \qquad \begin{array}{c} \text{RHE} \\ \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \begin{array}{c} \text{WE: Procus Ag metal} \end{array} \qquad \begin{array}{c} \text{RHE} \\ \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \begin{array}{c} \text{WE: Procus Ag metal} \end{array} \qquad \begin{array}{c} \text{RHE} \\ \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \begin{array}{c} \text{Saturated CO}_2 \\ \text{WE: Procus Ag metal} \end{array} \qquad \begin{array}{c} \text{RHE} \\ \text{RHE} \end{array} \qquad \begin{array}{c} \text{RHE} \end{array} \qquad \begin{array}{c} \text{Saturated CO}_2 \\ \text{CE: Pt plate} \\ \text{RHE} \end{array} \qquad \begin{array}{c} \text{RHE} \end{array} \qquad \begin{array}{c} \text{RHE} \end{array} \qquad \begin{array}{c} \text{Saturated CO}_2 \\ \text{CE: Pt plate} \\ \text{RHE} \end{array} \qquad \begin{array}{c} \text{RHE} \end{array} \qquad \begin{array}{c} \text{RHE} \end{array} \qquad \begin{array}{c} \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \begin{array}{c} \text{Saturated CO}_2 \end{array} \qquad \begin{array}{c} \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \begin{array}{c} \text{Saturated CO}_2 \end{array} \qquad \begin{array}{c} \text{RE: Ag/AgCl (3 M NaCl)} \end{array} \qquad \end{array}$ }			(2.40 M)		CE : Pt plate RE \cdot Ag/AgCl (3 M NgCl)	KHE				
- $30 \text{ wt } \% \text{ MEA}$ Saturated CO ₂ (2.46 M) H ₂ O - $30 \text{ wt } \% \text{ MEA}$ Saturated CO ₂ (2.46 M) H ₂ O - $30 \text{ wt } \% \text{ MEA}$ Saturated CO ₂ (2.46 M) H ₂ O - $30 \text{ wt } \% \text{ MEA}$ Saturated CO ₂ (2.46 M) H ₂ O - $30 \text{ wt } \% \text{ MEA}$ Saturated CO ₂ (2.46 M) H ₂ O - 1.1 V vs. (2.46 M) H ₂ O - 1.1 V vs. (2.46 M) H ₂ O - 1.3 V vs. 91.0 5.0 (2.46 M) H ₂ O - 1.3 V vs. 91.0 5.0 (2.46 M) H ₂ O - 1.3 V vs. 91.0 5.0 (2.46 M) H ₂ O - 1.3 V vs. 91.0 5.0 (2.46 M) H ₂ O - 1.3 V vs. 91.0 5.0					WE : Porous A o metal					
- $30 \text{ wt } \% \text{ MEA}$ (2.46 M) - H_2O CE : Pt plate RHE - $30 \text{ wt } \% \text{ MEA}$ (2.46 M) + H_2O CE : Pt plate RHE - $30 \text{ wt } \% \text{ MEA}$ Saturated CO ₂ (2.46 M) + H_2O (2.46 M) + H_2O CE : Pt plate RHE RE : Ag/AgCl (3 M NaCl) - $30 \text{ wt } \% \text{ MEA}$ Saturated CO ₂ (2.46 M) + H_2O CE : Pt plate RHE RE : Ag/AgCl (3 M NaCl) - $30 \text{ wt } \% \text{ MEA}$ Saturated CO ₂ (2.46 M) + H_2O CE : Pt plate RHE RE : Ag/AgCl (3 M NaCl) - $CE : Pt plate RHE$ 85.5 12.0 - $CE : Pt plate RHE$ 85.5 12.0 RE : Ag/AgCl (3 M NaCl) - $CE : Pt plate RHE$ 91.0 5.0 RE : Ag/AgCl (3 M NaCl)		20 .0/200	Saturated CO ₂	11.0	electrode	-0.8 V vs.	(0.2	20.1		
- 30 wt \% MEA Saturated CO ₂ (2.46 M) H ₂ O $\begin{array}{c} \text{RE : Ag/AgCl (3 M NaCl)} \\ \text{WE : Porous Ag metal} \\ \text{electrode} & -1.1 V vs. \\ \text{CE : Pt plate RHE} \\ \text{RE : Ag/AgCl (3 M NaCl)} \\ \text{WE : Porous Ag metal} \\ \text{electrode} & -1.3 V vs. \\ \text{(2.46 M)} \\ \text{H}_2O \\ \begin{array}{c} \text{CE : Pt plate RHE} \\ \text{electrode} & -1.3 V vs. \\ \text{CE : Pt plate RHE} \\ \text{RE : Ag/AgCl (3 M NaCl)} \\ \text{WE : Porous Ag metal} \\ \text{electrode} \\ \text{CE : Pt plate RHE} \\ \text{RHE} \\ \text{RHE} \\ \text{CE : Pt plate RHE} \\ \text{RHE} \\ \text{RHE} \\ \text{CE : Pt plate RHE} \\ \text{RHE} \\ \text{RE : Ag/AgCl (3 M NaCl)} \end{array}$	-	30 wt % MEA	(2.46 M)	H_2O	CE : Pt plate	RHE	60.2	39.1	0.2	1
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$					RE : Ag/AgCl (3 M NaCl)					
- 30 wt % MEA Saturated CO ₂ H ₂ O electrode -1.1 V vs. (2.46 M) H ₂ O CE : Pt plate RHE 85.5 12.0 RE : Ag/AgCl (3 M NaCl) WE : Porous Ag metal electrode -1.3 V vs. 91.0 5.0 CE : Pt plate RHE 91.0 5.0 RE : Ag/AgCl (3 M NaCl)					WE : Porous Ag metal					
(2.46 M) = CE : Pt plate RHE	-	30 wt % MEA	Saturated CO ₂	H ₂ O	electrode	-1.1 V vs.	85.5	12.0	3.9	1
- $30 \text{ wt }\% \text{ MEA}$ Saturated CO ₂ (2.46 M) H ₂ O $\begin{array}{c} \text{WE: Porous Ag metal} \\ \text{electrode} & -1.3 \text{ V vs.} \\ \text{CE: Pt plate} \\ \text{RHE} \\ \text{RE: Ag/AgCl (3 M NaCl)} \end{array}$			(2.46 M)	-	CE : Pt plate RE : $\Delta g/\Delta gC1$ (2 M NaCl)	RHE				
- $30 \text{ wt \% MEA} \xrightarrow{\text{Saturated CO}_2} H_2O \xrightarrow{\text{electrode}} -1.3 \text{ V vs.} 91.0 5.0$ (2.46 M) $H_2O \xrightarrow{\text{CE: Pt plate}} RHE RHE RHE RE: Ag/AgCl (3 M NaCl)$					WE : Porous Ag metal					
- 30 Wt % MEA (2.46 M) - H ₂ O CE : Pt plate RHE 91.0 5.0 RE : Ag/AgCl (3 M NaCl)		20 .0/200	Saturated CO ₂	11.0	electrode	-1.3 V vs.	01.0	5.0		
RE : Ag/AgCl (3 M NaCl)	-	50 Wt % MEA	(2.46 M)	H ₂ O	CE : Pt plate	RHE	91.0	5.0	2.1	1
					RE : Ag/AgCl (3 M NaCl)					

		Saturated CO ₂		WE : Porous Cu metal electrode	-0.8 V vs				
-	30 wt % MEA	(2.46 M)	H ₂ O	CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Porous Cu metal	RHE	96.0	0.1	0.1	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.1 V vs. RHE	98.5	0.1	1.7	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	WE : Porous Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	-1.3 V vs. RHE	101.9	-	0.7	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	WE : Porous Zn metal electrode CE : Pt plate	–0.8 V vs. RHE	113.8	0.6	9.0	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	H ₂ O	RE : Ag/AgCl (3 M NaCl) WE : Porous Zn metal electrode CE : Pt plate	–1.1 V vs. RHE	120.0	0.2	2.4	1
-	30 wt % MEA	Saturated CO ₂	H ₂ O	RE : Ag/AgCl (3 M NaCl) WE : Porous Zn metal electrode	-1.3 V vs.	118.5	0.4	2.2	1
		(2.46 M) Saturated CO ₂		CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Porous In metal electrode	-0.8 V vs				
-	30 wt % MEA	(2.46 M)	0.1 wt % CTAB/H ₂ O	CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Porous In metal	RHE	14.3	22.8	54.5	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Porous In metal	–1.1 V vs. RHE	53.3	7.6	30.0	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.3 V vs. RHE	74.2	3.9	19.6	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–0.8 V vs. RHE	66.1	16.6	11.6	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.1 V vs. RHE	81.7	9.0	4.8	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.3 V vs. RHE	90.2	5.0	4.4	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–0.8 V vs. RHE	58.5	4.9	36.0	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.1 V vs. RHE	79.5	3.4	13.0	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.3 V vs. RHE	86.3	0.5	5.3	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–0.8 V vs. RHE	36.7	2.9	60.8	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.1 V vs. RHE	66.4	3.1	21.5	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.3 V vs. RHE	79.7	2.8	14.7	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Pd metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–0.5 V vs. RHE	69.4	0.2	1.0	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Pd metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–0.8 V vs. RHE	75.3	-	1.1	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–0.8 V vs. RHE	56.0	38.2	2.4	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.1 V vs. RHE	62.8	34.3	1.6	1

-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	-1.3 V vs. RHE	79.7	20.0	1.3	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–0.8 V vs. RHE	98.6	0.1	1.1	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	wE : Porous Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–1.1 V vs. RHE	103.0	0.1	0.8	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Porous 7n metal	–1.3 V vs. RHE	98.0	-	0.8	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	–0.8 V vs. RHE	99.2	1.4	7.3	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	WE : Porous Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl) WE : Porous Zn metal	–1.1 V vs. RHE	115.3	2.4	3.3	1
-	30 wt % MEA	Saturated CO ₂ (2.46 M)	0.1 wt % CTAB/H ₂ O	electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	-1.3 V vs. RHE	110.8	1.9	3.1	1
-	0.1 M TMG	0.85 atm CO_2	0.1 M TBAPF ₆ /CH ₃ CN	CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.40 V vs. Fc/Fc ⁺	-	-	10.69	2
-	0.1 M Aniline	0.85 atm CO ₂	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.45 V vs. Fc/Fc ⁺	-	-	6.56	2
-	0.1 M Aniline + TMG	0.85 atm CO ₂	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.40 V vs. Fc/Fc ⁺	-	-	15.76	2
-	0.1 M TEOA	0.85 atm CO_2	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.45 V vs. Fc/Fc ⁺	-	-	7.09	2
-	0.1 M TEOA + TMG	0.85 atm CO_2	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.40 V vs. Fc/Fc ⁺	-	-	7.52	2
-	0.1 M Morpholine	0.85 atm CO_2	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.45 V vs. Fc/Fc ⁺	-	-	5.86	2
-	0.1 M Morpholine + TMG	0.85 atm CO_2	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.40 V vs. Fc/Fc ⁺	-	-	50.94	2
-	0.1 M TEA	0.85 atm CO_2	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.50 V vs. Fc/Fc ⁺	-	-	3.51	2
-	0.1 M DEA	0.85 atm CO ₂	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.40 V vs. Fc/Fc ⁺	-	-	2.38	2
-	0.1 M [DMAH][DMC]	0.85 atm CO ₂	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.20 V vs. Fc/Fc ⁺	-	-	3.80	2
1 mM (bpy)Mn(CO) ₃ CN	0.1 M Morpholine	0.85 atm CO ₂	0.1 M TBAPF6/CH3CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.20 V vs. Fc/Fc ⁺	57.0 (±2.0)	9.0 (±1)	29.0 (±1.0)	3
1 mM (bpy)Mn(CO) ₃ CN	0.5 M PhOH	0.85 atm CO ₂	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.20 V vs. Fc/Fc ⁺	4.0	100.0	-	3
1 mM (bpy)Mn(CO) ₃ CN	0.1 M Morpholine + 0.5 M PhOH	0.85 atm CO ₂	0.1 M TBAPF6/CH3CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.20 V vs. Fc/Fc ⁺	124.0 (±1.0)	4.0 (±1.0)	-	3
1 mM (bpy)Mn(CO) ₃ CN	0.1 M [morph-H][BF4]	$0.85 atm N_2$	0.1 M TBAPF6/CH3CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.20 V vs. Fc/Fc ⁺	111.0	-	-	3
l mM (mesbpy)Mn(CO) ₃ Br	0.1 M Morpholine	0.85 atm CO ₂	0.1 M TBAPF6/CH3CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.20 V vs. Fc/Fc ⁺	16.0 (±1.0)	65.0 (±1.0)	35.0 (±1.0)	3

1 mM (mesbpy)Mn(CO) ₃ Br	0.5 M PhOH	0.85 atm CO_2	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.20 V vs. Fc/Fc ⁺	-	120.0	-	3
1 mM (mesbpy)Mn(CO) ₃ Br	0.1 M Morpholine + 0.5 M PhOH	0.85 atm CO ₂	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.20 V vs. Fc/Fc ⁺	29.0 (±2.0)	4.0 (±1.0)	57.0 (±3.0)	3
1 mM (mesbpy)Mn(CO) ₃ Br	0.1 M [morph-H][BF ₄]	$0.85 \ atm \ N_2$	0.1 M TBAPF6/CH3CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.20 V vs. Fc/Fc ⁺	81.0	-	-	3
1 mM (mesbpy)Mn(CO) ₃ Br	0.1 M TEOA	0.85 atm CO ₂	0.1 M TBAPF ₆ /CH ₃ CN	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc ⁺ (internal standard)	-2.20 V vs. Fc/Fc ⁺	-	112.0	-	3
250 μM FeTPP	40 mM PrOH	15 mL/min CO ₂	0.05 M TMABF ₄ or TBAPF ₆ /DMF	WE : Glassy carbon CE : Pt mesh RE : SCE electrode, Fc/Fc ⁺ (internal standard)	-2.40 V vs. Fc/Fc ⁺	-	29.0	-	4
250 μM FeTPP	40 mM PrOH + 40 mM Quinuclidine	15 mL/min CO ₂	0.05 M TMABF ₄ or TBAPF ₆ /DMF	WE : Glassy carbon CE : Pt mesh RE : SCE electrode, Fc/Fc ⁺ (internal standard)	-2.40 V vs. Fc/Fc ⁺	15.0	1.9	68.0	4
250 μM FeTPP	40 mM PrOH + 40 mM TEA	15 mL/min CO ₂	0.05 M TMABF ₄ or TBAPF ₆ /DMF	WE : Glassy carbon CE : Pt mesh RE : SCE electrode, Fc/Fc ⁺ (internal standard)	-2.40 V vs. Fc/Fc ⁺	-	2.1	72.0	4
250 μM FeTPP	40 mM PrOH + 40 mM Hűnig's base	15 mL/min CO ₂	0.05 M TMABF ₄ or TBAPF ₆ /DMF	WE : Glassy carbon CE : Pt mesh RE : SCE electrode, Fc/Fc ⁺ (internal standard)	-2.40 V vs. Fc/Fc ⁺	-	0.9	21.0	4

Catalysts	Additive	Feed gas	Solvent + electrolyte	Electrode	Applied potential	FE of H ₂ (%)	FE of CO (%)	FE of formate/formic a (%)	ncid Ref.
-	-	-	0.1 M KHCO ₃ /H ₂ O	WE : Sn foil CE : Pt foil RE : Ag/AgCl (3M KCl)	–1.6 V vs. Ag/AgCl	-	-	-	5
-	-	-	0.5 M KHCO ₃ /H ₂ O	WE : Sn foil CE : Pt foil RE : Ag/AgCl (3M KCl)	–1.6 V vs. Ag/AgCl	-	-	8.0	5
-		-	1.5 M KHCO ₃ /H ₂ O	WE : Sn foil CE : Pt foil RE : Ag/AgCl (3M KCl)	-1.6 V vs. Ag/AgCl	-		18.0	5
-	-	CO ₂	1.5 M KHCO ₃ /H ₂ O	WE : Sn foil CE : Pt foil RE : Ag/AgCl (3M KCl)	–1.6 V vs. Ag/AgCl	-	-	47.0	5
-	-	-	2.0 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	88.0	-	12.0	6
-	1 mM CKC	-	2.0 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	34.0	-	66.0	6
-	5 mM CKC	-	2.0 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	34.0	-	66.0	6
-	0.5 mM CKC	-	2.0 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	30.0	-	70.0	6
-	-	-	0.5 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	87.0	-	13.0	6
-	1 mM CKC	-	0.5 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	81.0	-	19.0	6
-	-	-	1.0 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	92.0	-	8.0	6
-	1 mM CKC	-	1.0 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	29.0	-	71.0	6
-	1 mM CTAB	-	2.0 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	49.0	-	51.0	6
-	1 mM CTAB	-	0.5 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	74.0	-	26.0	6
-	1 mM CTAB	-	1.0 M KHCO ₃ /H ₂ O	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	66.0	-	34.0	6
-	-	-	0.5 M NaHCO ₃ /H ₂ O	WE : Sn/CNT (10/90) CE : stainless steel WE : Sn/CNT/ND	-0.4021 V vs. Ag/AgCl	-	-	58.0	7
-	-	-	0.5 M NaHCO ₃ /H ₂ O	(10/90/100) CE : stainless steel WE : Sp/ND (10/100)	-0.3292 V vs. Ag/AgCl	-	-	67.0	7
-	-	-	0.5 M NaHCO ₃ /H ₂ O 0.1858 M H ₃ PO ₄ + 0.01402 M	CE : stainless steel WE : Cu/GDL	-0.4508 V Vs. Ag/AgCl -0.65 V vs.	-	-	43.0	7
-	-	CO ₂	KH ₂ PO ₄ /H ₂ O (pH 1.46) 0.1858 M H ₂ PO ₂ + 0.01402 M	CE : Au coil RE : RHE WE : Cu/GDL (0.82	RHE	-	-	0.1ª	8
-	-	CO ₂	KH ₂ PO ₄ /H ₂ O (pH 1.46)	mg/cm ² P4VP) CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	0.1ª	8
-	-	CO ₂	0.0026 M H ₃ PO ₄ + 0.1974 M KH ₂ PO ₄ /H ₂ O (pH 3.87)	WE : Cu/GDL CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	0.8ª	8
-	-	CO ₂	$\begin{array}{c} 0.0026 \ M \ H_{3}PO_{4} + 0.1974 \ M \\ KH_{2}PO_{4}/H_{2}O \\ (pH \ 3.87) \end{array}$	WE : Cu/GDL (0.82 mg/cm ² P4VP) CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	6.0ª	8
-		CO ₂	0.1 M KH ₂ PO ₄ + 0.1 M K ₂ HPO ₄ /H ₂ O (pH 6.7)	WE : Cu/GDL CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	7.0ª	8
-	-	CO ₂	$\begin{array}{c} 0.1 \text{ M KH}_2\text{PO}_4 + 0.1 \text{ M} \\ \text{K}_2\text{HPO}_4/\text{H}_2\text{O} \\ \text{(pH 6.7)} \end{array}$	WE : Cu/GDL (0.82 mg/cm ² P4VP) CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	11.5ª	8
-	-	CO ₂	0.1858 M H ₃ PO ₄ + 0.01402 M KH ₂ PO ₄ /H ₂ O (pH 1.46)	WE : Cu/GDL CE : Au coil RE : RHE	–1.1 V vs. RHE	-	-	_a	8
-	-	CO ₂	0.1858 M H ₃ PO ₄ + 0.01402 M KH ₂ PO ₄ /H ₂ O (pH 1.46)	WE : Cu/GDL (0.82 mg/cm ² P4VP) CE : Au coil RE : RHE	–1.1 V vs. RHE	-	-	_a	8
-	-	CO ₂	0.0026 M H ₃ PO ₄ + 0.1974 M KH ₂ PO ₄ /H ₂ O (pH 3.87)	WE : Cu/GDL CE : Au coil RE : RHE	–1.1 V vs. RHE	-	-	3.0ª	8

Table. S2 Summary of CO_2 reduction reaction using bicarbonates-based absorbent

			0.0026 M H-PO. + 0.1974 M	WE : Cu/GDL (0.82					
-	-	CO ₂	KH ₂ PO ₄ /H ₂ O (pH 3.87)	mg/cm ² P4VP) CE : Au coil RE : RHE	-1.1 V vs. RHE	-	-	15.0ª	8
-	-	CO ₂	$\begin{array}{c} 0.1 \ \mathrm{M} \ \mathrm{KH_2PO_4} + 0.1 \ \mathrm{M} \\ \mathrm{K_2HPO_4/H_2O} \\ \mathrm{(pH \ 6.7)} \end{array}$	WE : Cu/GDL CE : Au coil RE : RHE	–1.1 V vs. RHE	-	-	8.5ª	8
-	-	CO ₂	0.1 M KH ₂ PO ₄ + 0.1 M K ₂ HPO ₄ /H ₂ O (pH 6.7)	WE : Cu/GDL (0.82 mg/cm ² P4VP) CE : Au coil RE : RHE	–1.1 V vs. RHE	-	-	6.0ª	8
-	-	CO ₂	0.5 M NaHCO ₃ /H ₂ O	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	–0.05 V vs. RHE	-	-	89.0ª	9
-		CO ₂	0.5 M NaHCO ₃ /H ₂ O	CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl) WE : Pd/C	–0.15 V vs. RHE	-	-	96.0ª	9
-	-	CO ₂	$0.5 \text{ M NaHCO}_3/\text{H}_2\text{O}$	CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl) WE : Pd/C	-0.25 V vs. RHE	-	-	94.0ª	9
-	-	CO ₂	0.5 M NaHCO ₃ /H ₂ O	CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl) WE : Pd/C	–0.35 V vs. RHE	-	-	85.0ª	9
-		CO ₂	2.8 M KHCO ₃ /H ₂ O	CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl) WE : Pd/C	–0.05 V vs. RHE	-	-	99.0ª	9
-		CO ₂	2.8 M KHCO ₃ /H ₂ O	CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl) WE : Pd/C	-0.15 V vs. RHE	-	-	99.0ª	9
-	-	CO ₂	2.8 M KHCO ₃ /H ₂ O	CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl) WE : Pd/C	-0.25 V vs. RHE	-	-	99.0ª	9
-	-	CO ₂	2.8 M KHCO ₃ /H ₂ O	RE : Ag/AgCl (3 M NaCl) WE : Pd/C	-0.35 V vs. RHE	-	-	99.0ª	9
-	-	N ₂	2.8 M KHCO ₃ /H ₂ O	CE : Pt foil of gauze RE : Ag/AgCl (3 M NaCl) WE : Pd/C	-0.05 V vs. RHE	-	-	97.0ª	9
-	-	N ₂	2.8 M KHCO ₃ /H ₂ O	CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl) WE : Pd/C	-0.15 V vs. RHE	-	-	88.0ª	9
-	-	N ₂	2.8 M KHCO ₃ /H ₂ O	CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl) Cathode : Ag foam	–0.25 V vs. RHE	-	-	52.0ª	9
-		Anolyte : Humid H ₂	Catholyte : 3.0 M KHCO ₃ /H ₂ O	Anode : Pt/C RE : Ag/AgCl (3 M NaCl) Thickness of Nafion : 25 μm	500 mA/cm ² , 2.2 V ^b	-	15.0	-	10°
-		Anolyte : Humid H ₂	Catholyte : 3.0 M KHCO ₃ /H ₂ O	Anode : Ag toam Anode : Pt/C RE : Ag/AgCl (3 M NaCl) Thickness of Nafion : 25 µm	100 mA/cm², 1.7 V ^b	-	43.0	-	10°
-	-	Anolyte : Humid H ₂	Catholyte : 3.0 M KHCO ₃ /H ₂ O	Cathode : Ag foam Anode : Pt/C RE : Ag/AgCl (3 M NaCl) Thickness of Nafion : 50	100 mA/cm ² , 2.5 V ^b	-	47.0	-	10°
-	500 µm PTFE gasket between the Nafion membrane and the cathode	Anolyte : Humid H ₂	Catholyte : 3.0 M KHCO ₃ /H ₂ O	Land Cathode : Ag foam Anode : Pt/C RE : Ag/AgCl (3 M NaCl) Thickness of Nafion : 50	100 mA/cm², 2.5 V ^b	-	71.0	-	10°
-	95% Ag coverage on Ag GDE obtained by spray- coat deposition and physical vapor deposition	N ₂	Catholyte : 3.0 M KHCO ₃ /H ₂ O (0.02 M EDTA for preventing impurities) Anolyte : 1.0 M KOH	Cathode : Ag GDE Anode : Ni foam Membrane : BPM	100 mA/cm ^{2 b}	-	82.0	-	11°
-	95% Ag coverage on Ag GDE obtained by spray- coat deposition and physical vapor deposition	N ₂	Catholyte : 3.0 M KHCO ₃ /H ₂ O (0.02 M EDTA for preventing impurities) Anolyte : 1.0 M KOH	Cathode : Ag GDE Anode : Ni foam Membrane : BPM	200 mA/cm ^{2 b}	-	62.0	-	11°

-	-	CO ₂	0.1 M KH ₂ PO ₄ , K ₂ HPO ₄ Phosphate buffer solutions/H ₂ O	WE : HPG-Ppy coated on a glassy carbon CE : Pt foil RE : Ag/AgCl (3 M NaCL)	–0.61 V vs. RHE	80.0	7.3	-	12
-	-	Ar	0.13 M KHCO ₃ /H ₂ O	WE : HPG-Ppy coated on a glassy carbon CE : Pt foil RE : Ag/AgCl (3 M NaCL)	–0.61 V vs. RHE	85.0	3.4	-	12
-	-	CO ₂	0.1 M KHCO ₃ /H ₂ O	WE : HPG-Ppy coated on a glassy carbon CE : Pt foil RE : Ag/AgCl (3 M NaCL)	–0.61 V vs. RHE	45.0	31.6	-	12

^aFE 2 h after electrolysis. ^bThe applied current density and the full cell voltage. ^cFull cell reaction (electrolyzer)

Co-catalysts	Additive	Feed gas	Solvent + electrolyte	Electrode	Applied potential	FE of H ₂ (%)	FE of CO (%)	FE of formate/formic ac (%)	cid Ref.
-	-	CO ₂	Catholyte : 18 mol% [emim][BF4]/H2O Anolyte : 100 mM sulfuric acid/H2O	Cathode : Ag GDL Anode : Pt GDL RE : Ag/AgCl	1.5 V ^b	< 3.0	> 96.0	-	13°
-	-	CO ₂	$\label{eq:catholyte:18mol%} \begin{array}{l} Catholyte:18mol\% \ [emim] [BF_4]/H_2O \\ Anolyte:100 \ mM \ sulfuric \ acid/H_2O \end{array}$	Cathode : Ag GDL Anode : Pt GDL RE : Ag/AgCl	2.0 V ^b	< 3.0	> 96.0	-	13°
-	-	CO ₂	Catholyte : 18 mol% [emim][BF ₄]/H ₂ O Anolyte : 100 mM sulfuric acid/H ₂ O	Cathode : Ag GDL Anode : Pt GDL RE : Ag/AgCl	2.5 V ^b	< 3.0	> 96.0	-	13°
-	-	CO ₂	0.1 M TEAP/CH ₃ CN	WE : Pb sheet CE : Pt gauze RE : Ag/AgNO ₃ (calibrated against Fc/Fc ⁺) WE : Pb sheet	-2.4 V vs. Ag/AgNO ₃	-	9.0	-	14
-	-	CO ₂	0.1 M [emim][Tf ₂ N]/CH ₃ CN	CE : Pt gauze RE : Ag/AgNO ₃ (calibrated against Fc/Fc ⁺)	-2.25 V vs. Ag/AgNO ₃	-	44.0	-	14
-	50 mM [bmim][BF ₄] in catholyte	Ar	Catholyte : 0.1 M TBAPF ₀ /CH ₃ CN Anolyte : 0.5 M sodium phosphate buffer containing 0.5 mM cobaltous nitrate	Cathode : Sn Anode : Pt foil RE : Ag/AgCl	–1.952 V vs. NHE	97.0	-	-	15°
-	50 mM [bmim][BF ₄] in catholyte	CO ₂	Catholyte : 0.1 M TBAPF ₆ /CH ₃ CN Anolyte : 0.5 M sodium phosphate buffer containing 0.5 mM cobaltous nitrate	Cathode : Sn Anode : Pt foil RE : Ag/AgCl	–1.952 V vs. NHE	5.1	79.9	-	15°
-	50 mM [bmim][BF ₄] in catholyte	CO_2	Catholyte : 0.1 M TBAPF ₆ /CH ₃ CN Anolyte : 0.5 M sodium phosphate buffer containing 0.5 mM cobaltous nitrate	Cathode : Sn Anode : Pt foil RE : Ag/AgCl	–1.952 V vs. NHE	3.8	91.2	-	15°
-	50 mM [bmim][BF ₄] in catholyte	CO ₂	Catholyte : 0.1 M TBAPF ₆ /CH ₃ CN and H ₂ O (90/10 v/v) Anolyte : 0.5 M sodium phosphate buffer containing 0.5 mM cobaltous nitrate	Cathode : Sn Anode : Pt foil RE : Ag/AgCl	–1.952 V vs. NHE	6.67	76.63	-	15°
-	-	CO ₂	0.5 M [Emim][N(CN) ₂]/H ₂ O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl)	-1.6 V vs. NHE	-	-	45.0	16
-	-	CO_2	0.5 M [Emim][N(CN) ₂]/H ₂ O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl)	-1.4 V vs. NHE	-	-	70.0	16
-	-	CO ₂	0.5 M [Emim][N(CN) ₂]/H ₂ O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl)	-1.2 V vs. NHE	-	-	81.9	16
-	-	CO_2	0.5 M [Emim][N(CN) ₂]/H ₂ O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl) WE : Sn	–1.0 V vs. NHE	-	-	74.0	16
-	-	CO ₂	0.5 M [Emim][N(CN) ₂]/H ₂ O	CE : Pt RE : Ag/AgCl (3 M NaCl) WE : Sn	–0.8 V vs. NHE	-	-	22.0	16
-	-	CO ₂	0.5 M [Emim][N(CN) ₂]/H ₂ O	CE : Pt RE : Ag/AgCl (3 M NaCl) WE : Sn	–0.6 V vs. NHE	-	-	13.0	16
-	-	CO ₂	0.05 M [Emim][N(CN) ₂]/H ₂ O	CE : Pt RE : Ag/AgCl (3 M NaCl) WE : Sn	-1.2 V vs. NHE	-	-	15.0	16
-	-	CO ₂	0.3 M [Emim][N(CN) ₂]/H ₂ O	CE : Pt RE : Ag/AgCl (3 M NaCl) WE : Sn	–1.2 V vs. NHE	-	-	65.0	16
-	-	CO ₂	0.7 M [Emim][N(CN) ₂]/H ₂ O	CE : Pt RE : Ag/AgCl (3 M NaCl) WE : Sn	–1.2 V vs. NHE	-	-	77.0	16
-	-	CO ₂	0.9 M [Emim][N(CN) ₂]/H ₂ O	CE : Pt RE : Ag/AgCl (3 M NaCl) WE : Au foil	-1.2 V vs. NHE	-	-	72.0	16
-	-	CO ₂	0.1 M [P ₆₆₆₁₄][124Triz], 0.7 M H ₂ O/CH ₃ CN	CE : Pt coil RE : Ag/AgNO ₃ (dissoved in [C ₄ mim][NO ₃] WE : Pt wire	-0.9 V vs. Ag/Ag ⁺	-	4.3	49.7	17
-	-	CO ₂	0.1 M [P ₆₆₆₁₄][124Triz], 0.7 M H ₂ O/CH ₃ CN	$CE : Pt coil$ $RE : Ag/AgNO_3 (dissoved in [C4mim][NO_3]$ $WE : A \alpha$	-0.9 V vs. Ag/Ag+	-	1.6	52.0	17
-	-	CO ₂	0.1 M [P ₆₆₆₁₄][124Triz], 0.7 M H ₂ O/CH ₃ CN	CE : Pt coil RE : Ag/AgNO ₃ (dissoved in [C4mim][NO ₃] WE : Au foil	-0.9 V vs. Ag/Ag+	-	5.6	10.1	17
-	-	CO ₂	0.1 M [P ₆₆₆₁₄][124Triz], 0.7 M H ₂ O/CH ₃ CN	CE : Pt coil RE : Ag/AgNO ₃ (dissoved in [C4mim][NO ₃] WE : Pt wire	-1.9 V vs. Ag/Ag+	4.3	5.1	16.1	17
-	-	CO_2	0.1 M [P ₆₆₆₁₄][124Triz], 0.7 M H ₂ O/CH ₃ CN	CE : Pt coil RE : Ag/AgNO ₃ (dissoved in [C ₄ mim][NO ₃]	-1.9 V vs. Ag/Ag+	15.6	0.8	16.3	17

$\label{eq:constraint} \textbf{Table. S3} \ \text{Summary of CO}_2 \ \text{reduction reaction using ILs-based absorbent}.$

-	-	CO ₂	0.1 M [P ₆₆₆₁₄][124Triz], 0.7 M H ₂ O/CH ₃ CN	WE : Ag CE : Pt coil RE : Ag/AgNO ₃ (dissoved in [C ₄ mim][NO ₃]	-1.9 V vs. Ag/Ag+	41.1	6.4	3.2	17
-	-	CO ₂	4 mol % [emim][BF ₄]/H ₂ O	WE : MoS ₂ CE : Pt gauze RE : Ag wire	–0.764 V vs. RHE	-	98.0	-	18
-	-	CO ₂	50 vol % [emim][BF ₄]/H ₂ O	WE : WSe ₂ nanoflakes CE : Pt gauze RE : Ag/AgCl	–0.164 V vs. RHE	-	24.0	-	18
-	-	CO ₂	25 mol % [emim][BF ₄]/H ₂ O	WE : Metal free carbon nanofibers CE : Pt gauze RE : Ag wire	–0.573 V vs. SHE	-	98.0	-	18
-	-	CO_2	Catholyte : 10.5 mol % [emim][BF4]/H2O Anolyte : 100 mM sulfuric acid/H2O	Cathode : Ag GDL Anode : Pt GDL RE : Ag/AgCl	2.5 V ^b	-	100.0	-	18°
-	-	CO ₂	80 wt % [bmim][Cl]/H ₂ O	WE : Ag CE : Pt wire RE : SCE	-1.5 V vs. SCE	-	> 99	-	18
Poly-CoTAPP on ITO	-	CO ₂	[bmim][BF ₄]	WE : ITO CE : Pt wire RE : Ag/AgCl	-0.8 V vs. Ag/AgCl	-	64.9	-	18
-	-	CO ₂	Catholyte : 92 vol % [emim][BF4]/H2O Anolyte : 0.5 M H2SO4/H2O	Cathode : Ag/Al foam Anode : Pt gauze RE : Pt wire	-1.8 V vs. Pt	-	75.0	-	18

^aFE 2 h after electrolysis. ^bThe applied current density the full cell voltage. ^cFull cell reaction (electrolyzer)

Co- catalysts	Additive	Feed gas	Solvent + electrolyte	Electrode	Applied potential	FE of H ₂ (%)	FE of CO (%)	FE of formate/formic acid (%)	FE of CH ₄ (%)	FE of C ₂ H ₄ (%)	Ref.
				Cathode : Cu dimer distorted HKUST-1			. /	× /	. /		
-	-	CO_2	1 M KOH/H ₂ O	GDL Anode : Pt foil	-1.07 V vs. RHE	7.0	24.0	-	0.4	45.0	19
-	-	CO ₂	0.5 M KHCO3/H2O	RE : Ag/AgCl WE : NiNPIC on carbon paper CE : Pt plate	–0.65 V vs. RHE	-	95.1	-	-	-	20
				RE : Ag/AgCl WE : Zn-MOF74 on glassy carbon							
-	-	CO ₂	0.1 M KHCO ₃ /H ₂ O	CE : Pt mesh RE : SCE WE : ZnCa-MOF74 on glassy carbon	–1.25 V vs. RHE	55.0	45.0	-	-	-	21
-	-	CO ₂	0.1 M KHCO ₃ /H ₂ O	CE : Pt mesh RE : SCE WE : 71E 8	-1.25 V vs. RHE	7.0	93.0	-	-	-	21
-	-	5% N ₂ /CO ₂	$0.25 \; M \; K_2 SO_4 / H_2 O$	CE : Pt wire RE : Ag/AgCl	-1.1 V vs. RHE	-	81.0	-	-	-	22
-	-	5% N ₂ /CO ₂	$0.25 \; M \; K_2 SO_4 \!/ \mathrm{H_2O}$	CE : Pt wire RE : Ag/AgCl	-1.1 V vs. RHE	-	23.8	-	-	-	22
-	-	5% N ₂ /CO ₂	$0.25 \; M \; K_2 SO_4 \!/ \mathrm{H_2O}$	WE : ZIF-108 CE : Pt wire RE : Ag/AgCl	-1.1 V vs. RHE	-	63.5	-	-	-	22
-	-	5% N ₂ /CO ₂	0.25 M K ₂ SO ₄ /H ₂ O	WE : SIM-1 CE : Pt wire RE : Ag/AgCl	-1.1 V vs. RHE	-	66.6	-	-	-	22
-	-	CO ₂	0.1 M KHCO ₃ /H ₂ O	$\label{eq:WE} \begin{array}{l} WE: Fe_{0.07}Cu-N-C_{800}\\ CE: Pt wire\\ RE: Ag/AgCl \end{array}$	-1.2 V vs. Ag/AgCl	-	48.0	-	-	-	23
-	-	CO_2	0.1 M KHCO ₃ /H ₂ O	WE : PcCu-O ₈ -Zn/CNT CE : Pt mesh RE : Ag/AgCl	–0.7 V vs. RHE	12.0	88.0	-	-	-	24
-	-	CO ₂	0.1 M KHCO ₃ /H ₂ O	WE : PcZn-O ₈ -Zn/CNT CE : Pt mesh RE : Ag/AgCl	–0.7 V vs. RHE	37.0	63.0	-	-	-	24
-	-	CO_2	0.1 M KHCO ₃ /H ₂ O	WE : PcZn-O ₈ -Cu/CNT CE : Pt mesh RE : Ag/AgCl	–0.7 V vs. RHE	94.0	6.0	-	-	-	24
-	-	CO ₂	0.1 M KHCO ₃ /H ₂ O	WE : PcCu-O ₈ -Cu/CNT CE : Pt mesh RE : Ag/AgCl	–0.7 V vs. RHE	90.0	10.0	-	-	-	24
-	-	CO ₂	0.5 M KHCO ₃ /H ₂ O	WE : Co(TAP) CE : graphite RE : Ag/AgCl	-0.67 V vs. RHE	-	80.0	-	-	-	25
-	-	CO ₂	0.5 M KHCO ₃ /H ₂ O	WE : COF-366-Co CE : graphite RE : Ag/AgCl	-0.67 V vs. RHE	-	90.0	-	-	-	25
-	-	CO ₂	0.5 M KHCO ₃ /H ₂ O	WE : COF-367-Co CE : graphite RE : Ag/AgCl	-0.67 V vs. RHE	-	91.0	-	-	-	25
-	-	CO_2	0.5 M KHCO ₃ /H ₂ O	WE : COF-367-Co(10%) CE : graphite RE : Ag/AgCl	-0.67 V vs. RHE	-	70.0	-	-	-	25
-	-	CO ₂	0.5 M KHCO ₃ /H ₂ O	WE : COF-367-Co(1%) CE : graphite RE : Ag/AgCl	–0.67 V vs. RHE	-	40.0	-	-	-	25
-	-	CO_2	0.5 M KHCO ₃ /H ₂ O	Carbon CE : graphite RE : Ag/AgCl	–0.67 V vs. RHE	-	86.0	-	-	-	25
-	-	CO ₂	0.1 M KHCO ₃ /H ₂ O	WE : COF-300-AR/Ag foil CE : carbon paper RE : SCE	-0.85 V vs. RHE	10.0	80.0ª	-	-	-	26
-	-	CO ₂	0.5 M KHCO ₃ /H ₂ O	WE : COF-Re on carbon fabric CE : carbon fabric RE : Ag/AgCl (saturated KCl)	–1.1 V vs. SHE	11.0	-	-	-	-	27
-	-	CO_2	0.5 M KHCO ₃ /H ₂ O	WE : COF-Re_Co on carbon fabric CE : carbon fabric RE : Ag/AgCl (saturated KCl)	–1.1 V vs. SHE	55.0	18.0	-	-	-	27
-	-	CO ₂	0.5 M KHCO ₃ /H ₂ O	WE : COF-Re_Fe on carbon fabric CE : carbon fabric RE : Ag/AgCl (saturated KCl)	–1.1 V vs. SHE	65.0	< 2.0	-	-	-	27

Table. S4 Summary of CO_2 reduction reaction using MOFs/COFs-based absorbent

^aFE 2 h after electrolysis.

		со			нсоон			нсно		
TWh/1 Gt CO ₂ ª		1628			1803			3167		
TWy/1 Gt CO ₂		0.186			0.206			0.361		
Renewable sources ^b	Biofuels	Solar electrici	ty Wind	Biofuels	Solar electricit	y Wind	Biofuels	Solar electricity	/ Wind	
Land requirement (km ²) 1,246,200	39,060	372,000	1,380,200	43,260	412,000	2,418,700) 75,810	720,000	
		CH₃OH		CH ₄			C ₂ H ₄			
TWh/1 Gt CO ₂ ª		4437			5170			8523		
TWy/1 Gt CO ₂		0.506			0.590			0.973		
Renewable sources ^b	Biofuels	Solar electricity	Wind	Biofuels	Solar electricity	Wind	Biofuels	Solar electricity	Wind	
Land requirement (km ²)	3,390,200	106,260	1,000,000	3,953,000	123,900	1,180,000	6,519,100	204,330	1,946,000	

Table. S5 Ideal energy and the corresponding land requirements of CO₂ reduction products according to renewable sources

^aldeal energy requirements for converting CO_2 into various products at zero overpotential and 100% Faradaic efficiency (FE).^{28 b}Land requirements for biofuels, solar electricity, and wind used in the estimation are 6.7, 0.21, 2 m²/W, respectively.²⁹

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