Table. S1 Summary of CO_2 reduction reaction using amines-based absorbent

Co-catalyst	Additive	Feed gas	Solvent + electrolyte	Electrode	Applied potential	FE of H_2 (%)	FE of CO (%)	FE of formate/formic acid (%)	Ref.
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	85.2	4.8	2.4	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	95.7	1.5	0.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	98.9	0.7	0.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	84.9	5.7	5.2	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	95.7	1.3	1.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	97.4	0.7	1.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	60.8	4.1	35.7	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	82.9	2.1	10.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	88.8	1.1	5.3	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	97.0	0.1	3.7	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	97.8	0.1	0.3	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	101.7	0.1	1.6	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Pd metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.1 V vs. RHE	87.8	-	1.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Pd metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.4 V vs. RHE	81.6	-	1.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Pd metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	80.0	-	0.7	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	85.8	12.4	1.3	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	93.0	6.1	1.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	94.2	2.3	1.2	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	90.2	0.5	0.8	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	93.4	-	0.6	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	94.2	-	0.7	1

-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	97.3	0.8	2.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	104.7	0.5	0.8	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Smooth Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	95.7	0.3	0.2	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	41.9	17.0	45.4	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	42.0	10.7	39.4	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	44.3	11.2	36.5	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	68.6	9.0	19.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	78.5	3.6	16.4	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	93.4	2.6	2.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	69.5	7.0	24.3	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	87.1	4.9	7.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	93.4	2.6	3.9	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	79.6	1.9	8.5	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	79.2	3.0	8.7	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	85.1	3.5	6.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Pd metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.1 V vs. RHE	91.6	-	4.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Pd metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.4 V vs. RHE	87.3	-	4.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Pd metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	96.0	-	0.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	62.8	33.4	2.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	84.7	15.9	2.8	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	89.5	9.2	1.7	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	79.7	1.7	19.1	1

-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	98.1	-	0.5	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	91.0	-	0.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	103.0	3.7	5.4	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	91.4	2.9	2.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Smooth Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	102.0	0.5	2.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	82.3	2.0	13.4	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	91.4	0.5	0.6	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	95.6	0.1	5.3	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	79.2	8.9	4.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	86.7	6.3	2.4	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Sn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	95.6	2.0	3.3	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	67.5	5.2	18.3	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	85.7	2.4	8.2	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Bi metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	84.6	1.9	7.7	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	92.5	0.9	2.2	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	101.8	0.4	4.5	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Pb metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	95.0	0.6	4.2	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Pd metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.5 V vs. RHE	75.9	0.1	2.5	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Pd metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	85.9	0.1	4.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	60.2	39.1	0.2	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	85.5	12.0	3.9	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Ag metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	91.0	5.0	2.1	1

-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	96.0	0.1	0.1	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Cu metal 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_2O	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_2O	WE : Porous Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	113.8	0.6	9.0	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.1 V vs. RHE	120.0	0.2	2.4	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	H_2O	WE : Porous Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	118.5	0.4	2.2	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Porous In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. RHE	14.3	22.8	54.5	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	WE : Porous In metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−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_2O	WE : Porous In metal 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_2O	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_2O	WE : Porous Sn metal 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_2O	WE : Porous Sn metal 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_2O	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_2O	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_2O	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_2O	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_2O	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_2O	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_2O	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_2O	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_2O	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_2O	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_2O	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_2O	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_2O	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_2O	WE : Porous Cu metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−1.3 V vs. RHE	98.0	-	0.8	1
-	30 wt % MEA	Saturated CO_2 (2.46 M)	0.1 wt % CTAB/H_2O	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_2O	WE : Porous Zn metal electrode CE : Pt plate RE : Ag/AgCl (3 M NaCl)	−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_2O	WE : Porous Zn metal 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 $TBAPF_6/CH_3CN$	WE : Graphite rod (type 1) 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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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][BF_4]	0.85 atm N_2	0.1 M $TBAPF_6/CH_3CN$	WE : Graphite rod (type 1) CE : Pt coil RE : Fc/Fc^+ (internal standard)	−2.20 V vs. Fc/Fc^+	111.0	-	-	3
1 mM (mesbpy)Mn$(CO)_3$Br	0.1 M Morpholine	0.85 atm CO_2	0.1 M $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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 $TBAPF_6/CH_3CN$	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

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

Catalysts	Additive	Feed gas	Solvent + electrolyte	Electrode	Applied potential	FE of H_2 (%)	FE of CO (%)	FE of formate/formic acid (%)	Ref.
-	-	-	0.1 M $KHCO_3/H_2O$	WE : Sn foil CE : Pt foil RE : Ag/AgCl (3M KCl)	–1.6 V vs. Ag/AgCl	-	-	-	5
-	-	-	0.5 M $KHCO_3/H_2O$	WE : Sn foil CE : Pt foil RE : Ag/AgCl (3M KCl)	–1.6 V vs. Ag/AgCl	-	-	8.0	5
-	-	-	1.5 M $KHCO_3/H_2O$	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 $KHCO_3/H_2O$	WE : Sn foil CE : Pt foil RE : Ag/AgCl (3M KCl)	–1.6 V vs. Ag/AgCl	-	-	47.0	5
-	-	-	2.0 M $KHCO_3/H_2O$	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 $KHCO_3/H_2O$	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 $KHCO_3/H_2O$	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 $KHCO_3/H_2O$	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	30.0	-	70.0	6
-	-	-	0.5 M $KHCO_3/H_2O$	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 $KHCO_3/H_2O$	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	81.0	-	19.0	6
-	-	-	1.0 M $KHCO_3/H_2O$	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 $KHCO_3/H_2O$	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 $KHCO_3/H_2O$	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 $KHCO_3/H_2O$	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 $KHCO_3/H_2O$	WE : Sn wire CE : Pt mesh RE : Ag/AgCl 3 M	–0.9 V vs. RHE	66.0	-	34.0	6
-	-	-	0.5 M $NaHCO_3/H_2O$	WE : Sn/CNT (10/90) CE : stainless steel	–0.4021 V vs. Ag/AgCl	-	-	58.0	7
-	-	-	0.5 M $NaHCO_3/H_2O$	WE : Sn/CNT/ND (10/90/100) CE : stainless steel	–0.3292 V vs. Ag/AgCl	-	-	67.0	7
-	-	-	0.5 M $NaHCO_3/H_2O$	WE : Sn/ND (10/100) CE : stainless steel	–0.4368 V vs. Ag/AgCl	-	-	43.0	7
-	-	CO_2	0.1858 M H_3PO_4 + 0.01402 M KH_2PO_4/H_2O (pH 1.46)	WE : Cu/GDL CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	0.1[a]	8
-	-	CO_2	0.1858 M H_3PO_4 + 0.01402 M KH_2PO_4/H_2O (pH 1.46)	WE : Cu/GDL (0.82 mg/cm^2 P4VP) CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	0.1[a]	8
-	-	CO_2	0.0026 M H_3PO_4 + 0.1974 M KH_2PO_4/H_2O (pH 3.87)	WE : Cu/GDL CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	0.8[a]	8
-	-	CO_2	0.0026 M H_3PO_4 + 0.1974 M KH_2PO_4/H_2O (pH 3.87)	WE : Cu/GDL (0.82 mg/cm^2 P4VP) CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	6.0[a]	8
-	-	CO_2	0.1 M KH_2PO_4 + 0.1 M K_2HPO_4/H_2O (pH 6.7)	WE : Cu/GDL CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	7.0[a]	8
-	-	CO_2	0.1 M KH_2PO_4 + 0.1 M K_2HPO_4/H_2O (pH 6.7)	WE : Cu/GDL (0.82 mg/cm^2 P4VP) CE : Au coil RE : RHE	–0.65 V vs. RHE	-	-	11.5[a]	8
-	-	CO_2	0.1858 M H_3PO_4 + 0.01402 M KH_2PO_4/H_2O (pH 1.46)	WE : Cu/GDL CE : Au coil RE : RHE	–1.1 V vs. RHE	-	-	-[a]	8
-	-	CO_2	0.1858 M H_3PO_4 + 0.01402 M KH_2PO_4/H_2O (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_3PO_4 + 0.1974 M KH_2PO_4/H_2O (pH 3.87)	WE : Cu/GDL CE : Au coil RE : RHE	–1.1 V vs. RHE	-	-	3.0[a]	8

-	-	CO_2	0.0026 M H_3PO_4 + 0.1974 M KH_2PO_4/H_2O (pH 3.87)	WE : Cu/GDL (0.82 mg/cm^2 P4VP) CE : Au coil RE : RHE	−1.1 V vs. RHE	-	-	15.0[a]	8
-	-	CO_2	0.1 M KH_2PO_4 + 0.1 M K_2HPO_4/H_2O (pH 6.7)	WE : Cu/GDL CE : Au coil RE : RHE	−1.1 V vs. RHE	-	-	8.5[a]	8
-	-	CO_2	0.1 M KH_2PO_4 + 0.1 M K_2HPO_4/H_2O (pH 6.7)	WE : Cu/GDL (0.82 mg/cm^2 P4VP) CE : Au coil RE : RHE	−1.1 V vs. RHE	-	-	6.0[a]	8
-	-	CO_2	0.5 M $NaHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.05 V vs. RHE	-	-	89.0[a]	9
-	-	CO_2	0.5 M $NaHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.15 V vs. RHE	-	-	96.0[a]	9
-	-	CO_2	0.5 M $NaHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.25 V vs. RHE	-	-	94.0[a]	9
-	-	CO_2	0.5 M $NaHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.35 V vs. RHE	-	-	85.0[a]	9
-	-	CO_2	2.8 M $KHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.05 V vs. RHE	-	-	99.0[a]	9
-	-	CO_2	2.8 M $KHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.15 V vs. RHE	-	-	99.0[a]	9
-	-	CO_2	2.8 M $KHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.25 V vs. RHE	-	-	99.0[a]	9
-	-	CO_2	2.8 M $KHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.35 V vs. RHE	-	-	99.0[a]	9
-	-	N_2	2.8 M $KHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.05 V vs. RHE	-	-	97.0[a]	9
-	-	N_2	2.8 M $KHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.15 V vs. RHE	-	-	88.0[a]	9
-	-	N_2	2.8 M $KHCO_3/H_2O$	WE : Pd/C CE : Pt foil or gauze RE : Ag/AgCl (3 M NaCl)	−0.25 V vs. RHE	-	-	52.0[a]	9
-	-	Anolyte : Humid H_2	Catholyte : 3.0 M $KHCO_3/H_2O$	Cathode : Ag foam 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[c]
-	-	Anolyte : Humid H_2	Catholyte : 3.0 M $KHCO_3/H_2O$	Cathode : Ag foam Anode : Pt/C RE : Ag/AgCl (3 M NaCl) Thickness of Nafion : 25 μm	100 mA/cm^2, 1.7 V [b]	-	43.0	-	10[c]
-	-	Anolyte : Humid H_2	Catholyte : 3.0 M $KHCO_3/H_2O$	Cathode : Ag foam Anode : Pt/C RE : Ag/AgCl (3 M NaCl) Thickness of Nafion : 50 μm	100 mA/cm^2, 2.5 V [b]	-	47.0	-	10[c]
-	500 μm PTFE gasket between the Nafion membrane and the cathode	Anolyte : Humid H_2	Catholyte : 3.0 M $KHCO_3/H_2O$	Cathode : Ag foam Anode : Pt/C RE : Ag/AgCl (3 M NaCl) Thickness of Nafion : 50 μm	100 mA/cm^2, 2.5 V [b]	-	71.0	-	10[c]
-	95% Ag coverage on Ag GDE obtained by spray-coat deposition and physical vapor deposition	N_2	Catholyte : 3.0 M $KHCO_3/H_2O$ (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[c]
-	95% Ag coverage on Ag GDE obtained by spray-coat deposition and physical vapor deposition	N_2	Catholyte : 3.0 M $KHCO_3/H_2O$ (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[c]

-	-	CO_2	0.1 M KH_2PO_4, K_2HPO_4 Phosphate buffer solutions/H_2O	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_2O	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_2O	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

[a]FE 2 h after electrolysis. [b]The applied current density and the full cell voltage. [c]Full cell reaction (electrolyzer)

Table. S3 Summary of CO_2 reduction reaction using ILs-based absorbent.

Co-catalysts	Additive	Feed gas	Solvent + electrolyte	Electrode	Applied potential	FE of H_2 (%)	FE of CO (%)	FE of formate/formic acid (%)	Ref.
-	-	CO_2	Catholyte : 18 mol% [emim][BF_4]/H_2O Anolyte : 100 mM sulfuric acid/H_2O	Cathode : Ag GDL Anode : Pt GDL RE : Ag/AgCl	1.5 V [b]	< 3.0	> 96.0	-	13[c]
-	-	CO_2	Catholyte : 18 mol% [emim][BF_4]/H_2O Anolyte : 100 mM sulfuric acid/H_2O	Cathode : Ag GDL Anode : Pt GDL RE : Ag/AgCl	2.0 V [b]	< 3.0	> 96.0	-	13[c]
-	-	CO_2	Catholyte : 18 mol% [emim][BF_4]/H_2O Anolyte : 100 mM sulfuric acid/H_2O	Cathode : Ag GDL Anode : Pt GDL RE : Ag/AgCl	2.5 V [b]	< 3.0	> 96.0	-	13[c]
-	-	CO_2	0.1 M TEAP/CH_3CN	WE : Pb sheet CE : Pt gauze RE : Ag/$AgNO_3$ (calibrated against Fc/Fc^+)	−2.4 V vs. Ag/$AgNO_3$	-	9.0	-	14
-	-	CO_2	0.1 M [emim][Tf_2N]/CH_3CN	WE : Pb sheet 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 $TBAPF_6$/CH_3CN 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[c]
-	50 mM [bmim][BF_4] in catholyte	CO_2	Catholyte : 0.1 M $TBAPF_6$/CH_3CN 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[c]
-	50 mM [bmim][BF_4] in catholyte	CO_2	Catholyte : 0.1 M $TBAPF_6$/CH_3CN 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[c]
-	50 mM [bmim][BF_4] in catholyte	CO_2	Catholyte : 0.1 M $TBAPF_6$/CH_3CN and H_2O (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[c]
-	-	CO_2	0.5 M [Emim][$N(CN)_2$]/H_2O	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_2O	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_2O	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_2O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl)	−1.0 V vs. NHE	-	-	74.0	16
-	-	CO_2	0.5 M [Emim][$N(CN)_2$]/H_2O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl)	−0.8 V vs. NHE	-	-	22.0	16
-	-	CO_2	0.5 M [Emim][$N(CN)_2$]/H_2O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl)	−0.6 V vs. NHE	-	-	13.0	16
-	-	CO_2	0.05 M [Emim][$N(CN)_2$]/H_2O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl)	−1.2 V vs. NHE	-	-	15.0	16
-	-	CO_2	0.3 M [Emim][$N(CN)_2$]/H_2O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl)	−1.2 V vs. NHE	-	-	65.0	16
-	-	CO_2	0.7 M [Emim][$N(CN)_2$]/H_2O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl)	−1.2 V vs. NHE	-	-	77.0	16
-	-	CO_2	0.9 M [Emim][$N(CN)_2$]/H_2O	WE : Sn CE : Pt RE : Ag/AgCl (3 M NaCl)	−1.2 V vs. NHE	-	-	72.0	16
-	-	CO_2	0.1 M [P_{66614}][124Triz], 0.7 M H_2O/CH_3CN	WE : Au foil CE : Pt coil RE : Ag/$AgNO_3$ (dissoved in [C_4mim][NO_3]	−0.9 V vs. Ag/Ag^+	-	4.3	49.7	17
-	-	CO_2	0.1 M [P_{66614}][124Triz], 0.7 M H_2O/CH_3CN	WE : Pt wire CE : Pt coil RE : Ag/$AgNO_3$ (dissoved in [C_4mim][NO_3]	−0.9 V vs. Ag/Ag^+	-	1.6	52.0	17
-	-	CO_2	0.1 M [P_{66614}][124Triz], 0.7 M H_2O/CH_3CN	WE : Ag CE : Pt coil RE : Ag/$AgNO_3$ (dissoved in [C_4mim][NO_3]	−0.9 V vs. Ag/Ag^+	-	5.6	10.1	17
-	-	CO_2	0.1 M [P_{66614}][124Triz], 0.7 M H_2O/CH_3CN	WE : Au foil CE : Pt coil RE : Ag/$AgNO_3$ (dissoved in [C_4mim][NO_3]	−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_2O/CH_3CN	WE : Pt wire CE : Pt coil RE : Ag/$AgNO_3$ (dissoved in [C_4mim][NO_3]	−1.9 V vs. Ag/Ag^+	15.6	0.8	16.3	17

-	-	CO_2	0.1 M [P_{66614}][124Triz], 0.7 M H_2O/CH_3CN	WE : Ag CE : Pt coil RE : Ag/$AgNO_3$ (dissoved in [C_4mim][NO_3]	−1.9 V vs. Ag/Ag^+	41.1	6.4	3.2	17
-	-	CO_2	4 mol % [emim][BF_4]/H_2O	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_2O	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_2O	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][BF_4]/H_2O Anolyte : 100 mM sulfuric acid/H_2O	Cathode : Ag GDL Anode : Pt GDL RE : Ag/AgCl	2.5 V [b]	-	100.0	-	18[c]
-	-	CO_2	80 wt % [bmim][Cl]/H_2O	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][BF_4]/H_2O Anolyte : 0.5 M H_2SO_4/H_2O	Cathode : Ag/Al foam Anode : Pt gauze RE : Pt wire	−1.8 V vs. Pt	-	75.0	-	18

[a]FE 2 h after electrolysis. [b]The applied current density the full cell voltage. [c]Full cell reaction (electrolyzer)

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

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_2H_4 (%)	Ref.
-	-	CO_2	1 M KOH/H_2O	Cathode : Cu dimer distorted HKUST-1 GDL Anode : Pt foil RE : Ag/AgCl	−1.07 V vs. RHE	7.0	24.0	-	0.4	45.0	19
-	-	CO_2	0.5 M $KHCO_3$/H_2O	WE : NiNPIC on carbon paper CE : Pt plate RE : Ag/AgCl	−0.65 V vs. RHE	-	95.1	-	-	-	20
-	-	CO_2	0.1 M $KHCO_3$/H_2O	WE : Zn-MOF74 on glassy carbon CE : Pt mesh RE : SCE	−1.25 V vs. RHE	55.0	45.0	-	-	-	21
-	-	CO_2	0.1 M $KHCO_3$/H_2O	WE : ZnCa-MOF74 on glassy carbon CE : Pt mesh RE : SCE	−1.25 V vs. RHE	7.0	93.0	-	-	-	21
-	-	5% N_2/CO_2	0.25 M K_2SO_4/H_2O	WE : ZIF-8 CE : Pt wire RE : Ag/AgCl	−1.1 V vs. RHE	-	81.0	-	-	-	22
-	-	5% N_2/CO_2	0.25 M K_2SO_4/H_2O	WE : ZIF-7 CE : Pt wire RE : Ag/AgCl	−1.1 V vs. RHE	-	23.8	-	-	-	22
-	-	5% N_2/CO_2	0.25 M K_2SO_4/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_2SO_4/H_2O	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_2O	WE : $Fe_{0.07}$Cu-N-C_{800} CE : Pt wire RE : Ag/AgCl	−1.2 V vs. Ag/AgCl	-	48.0	-	-	-	23
-	-	CO_2	0.1 M $KHCO_3$/H_2O	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_2O	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_2O	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_2O	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_2O	WE : Co(TAP) CE : graphite RE : Ag/AgCl	−0.67 V vs. RHE	-	80.0	-	-	-	25
-	-	CO_2	0.5 M $KHCO_3$/H_2O	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_2O	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_2O	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_2O	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_2O	WE : COF-366-Co thin films on glassy carbon CE : graphite RE : Ag/AgCl	−0.67 V vs. RHE	-	86.0	-	-	-	25
-	-	CO_2	0.1 M $KHCO_3$/H_2O	WE : COF-300-AR/Ag foil CE : carbon paper RE : SCE	−0.85 V vs. RHE	10.0	80.0[a]	-	-	-	26
-	-	CO_2	0.5 M $KHCO_3$/H_2O	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_2O	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_2O	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

[a]FE 2 h after electrolysis.

	CO			HCOOH			HCHO		
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 electricity	Wind	Biofuels	Solar electricity	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

	CH_3OH			CH_4			C_2H_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 CO_2 reduction products according to renewable sources

[a]Ideal 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 m^2/W, respectively.[29]

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