Electronic Supplementary Material (ESI) for Reaction Chemistry & Engineering.

Global opportunities and challenges on net-zero CO_2 emissions towards a sustainable future

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Supporting Information

Table S1. A summary of the performance of various materials/methods (SACs, Plasma, MOFs, COFs) for the CO_2 conversion

S. No	Catalyst	Method/ Reaction Condition	Efficiency/Performance	Reference
1	Ni-SAC	CO_2 electroreduction. *Potential range*: −0.53 V~−1.03 V	Faradaic efficiency: 92.0 %~98.0 %	S1
2	FePc@NiNC	*Potential range:* −0.5 V~−0.9 V	Faradaic efficiency: 72–86%	S2
3	PcCu-O8-Zn (MOF)	Hydrothermal method	Faradaic efficiency: 88% turnover frequency: 0.39 s^{-1}	S3
4	CoPc@Fe–N–C	*Potential range:* 0.71 V	>90%	S4
5	Ni/Fe–N–C	*Potential range:* −0.5 and −0.9 V	>90%	S5
6	Cu−CN-x x → up to 26.6 wt %	Carboxylation of terminal alkynes with CO_2	Cu−CN-8.0 → turnover frequency (TOF) of 9.7 h^{-1} Yield: 97%	S6
7	CuSAs/TCNFs	CO_2 reduction to methanol in liquid form	Faradaic efficiency: 44 %	S7
8	Pd-SAC	CO_2 reduction	Mass activity -373.0 mA mg^{-1}_{Pd} at	S8

		reaction	−0.8 V Faradaic efficiency: 55%	
9	DBD	CO_2 splitting. Outer electrode temperature <170°C	Energy efficiency: 7% CO_2 conversion rate 12.2 %	S9
10	DBD with ZrO_2 and CeO_2 as packing materials	CO_2 splitting. outer electrode temperature <170°C	Energy efficiency: 8.76 % CO_2 conversion rate: 64.38 %	S9
11	co-axial DBD reactor with 15 % of CuO/γ-Al_2O_3	Direct activation of undiluted CO_2	Energy efficiency:1.597 mmol/kJ CO_2 conversion rate:15.7 %	S10
12	DBD reactor with $BaTiO_3$-coated PU foam	CO_2 dissociation. Specific Energy Input: 60 kJ/L	CO_2 conversion rate: 27.4 %	S11
13	DBD reactor with Co and Fe solid catalysts	Direct conversion of CO_2 and CH_4	product selectivity 40 %	S12
14	CTU/TiO_2	Chemically immobilize (CuTCPP) into UiO-66 ($Zr_6O_4(OH)_4$), MOF structure (CTU)	CO evolution amount: 31.32 μmol g^{-1} h^{-1} (7 times higher than pure TiO_2)	S13
15	(Co/Ru)n-UiO-67(bpydc)	CO_2 reduction using a phosphorescent (H_2 : CO = 2 : 1)	Yield: 13,600 μmol·g^{-1}	S14

16	Core-shell HKUST-1 @TiO_2	Hydrothermal method; reduction of CO_2 to CH_4	high selectivity was acheived	S15
17	$CsPbBr_3$@ zinc/cobalt-based ZIF	Photocatalytic CO_2 reduction	higher moisture stability excellent charge separation efficiency	S16
18	Ni and Fe MOFs	Photoconversion of anthropogenic CO_2-to-syngas	Efficient element separation, low concentration of CO_2 to produce tuneable syngas	S17
19	Triazine-based aniline (1,3,5-tris-(4-amino phenyl) triazine and 1,3,5-tris-(4-amino phenoxy) benzene)	298 / 273 K	CO_2 uptake efficiency: 65.65 / 92.38 mg g^{-1}	S18
20	TPA-COFs & TPT-COFs	One-pot polycondensations of tris(4-aminophenyl) amine (TPA-$3NH_2$) & 2,4,6-tris(4-aminophenyl) triazine (TPT-3NH2)	CO_2 uptake efficiencies: up to 65.65 and 92.38 mg g^{-1} at 298 and 273 K, respectively.	S19
21	Fully bonded tetraphenylethane TPE-COF-I; frustrated bonding structure TPE-COF-II	Different solvent system with different polarities	CO_2 adsorption: 23.2 wt %, 118.8 cm^3 g^{-1} at 1 atm, 273 K	S20

22	Cz-COF Tz-COF	273 K/298 K	CO_2 uptake: 2.5/1.5 mmol g^{-1} selectivity: 36/28 CO_2 uptake: 3.5/2.3 selectivity: 20/12	S21
23	PA-TCIF(DMF), TPA-TCIF(DM), TPA-TCIF(BD)	Reflux and solvothermal conditions using different solvents; 273/298 K,	CO_2 capture capacity: 77.3/50.2 mg g^{-1} at 1 bar CO_2 selectivity: 51.6/61.8	S22

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