Electronic supplementary information (ESI)

Continuous CO_2 capture and methanation over Ni-Ca/Al_2O_3 dual functional materials

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Figures

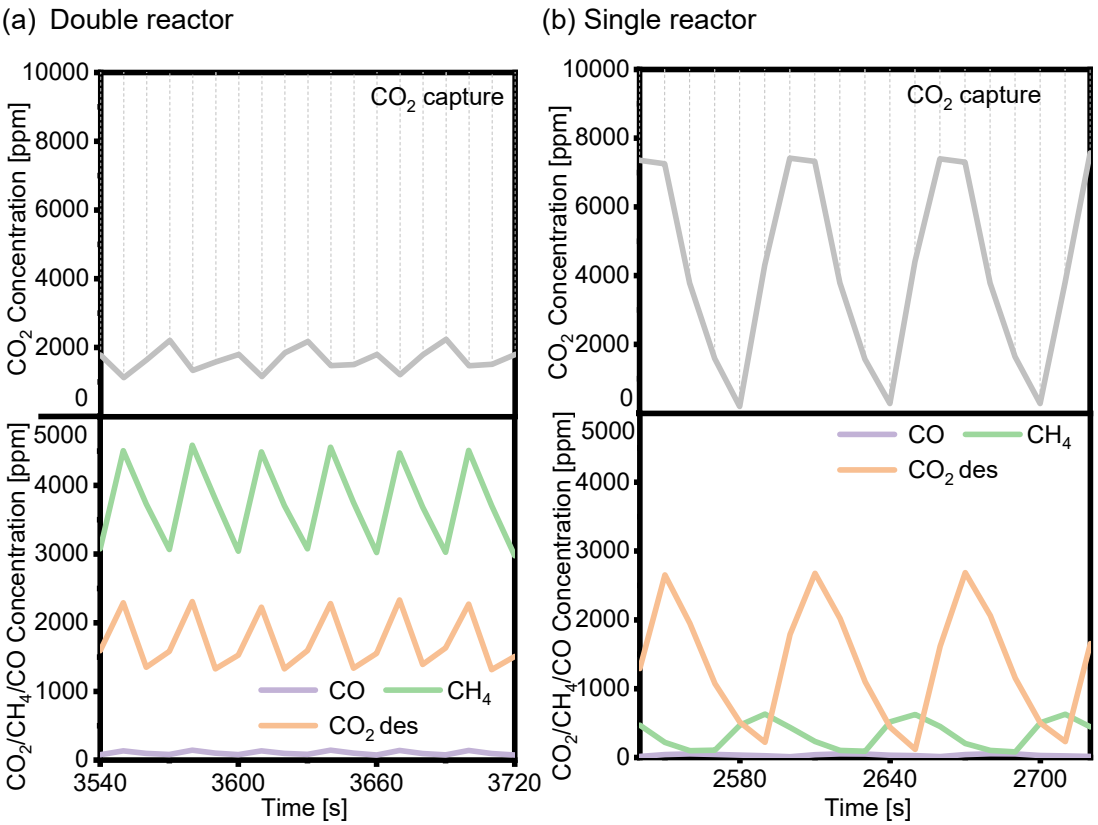

Figure S1. Effluent gas compositions for CCR over Ni(10)–Ca(30)/Al_2O_3 in (a) double reactor and (b) single reactor systems. Conditions: 100 mg of catalyst, 450 °C, 100 mL min^{-1} of 1% CO_2/10% O_2/N_2 for 30 s, switched to 100 mL min^{-1} of H_2 for 30 s.

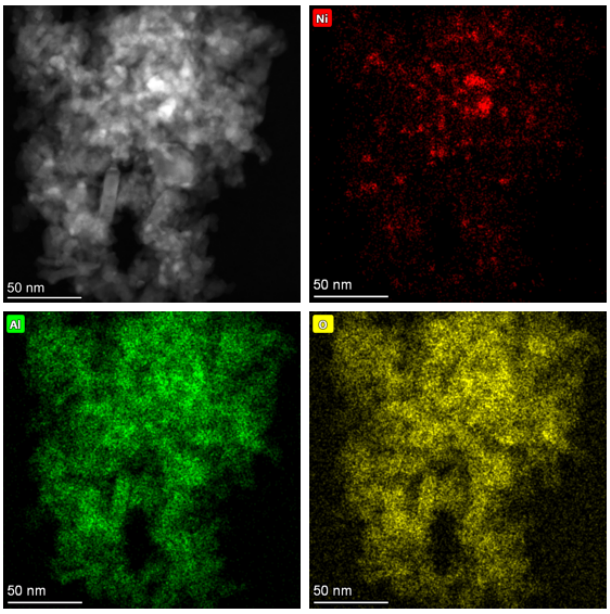

Figure S2. STEM images and EDS mapping of Ni(10)/Al_2O_3.

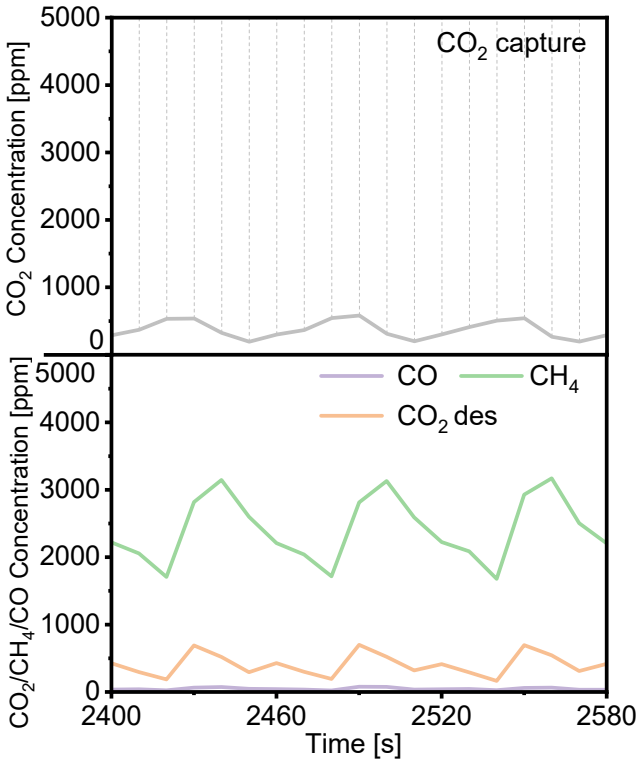

Figure S3 Effluent gas composition for continuous operated CCR over Ni(10)/$Ca_{12}Al_{14}O_{33}$. Conditions: 100 mg of catalyst, 450 °C, 100 mL min^{-1} of 0.5% CO_2/10% O_2/N_2 for 30 s, switched to 100 mL min^{-1} of H_2 for the other 30 s.

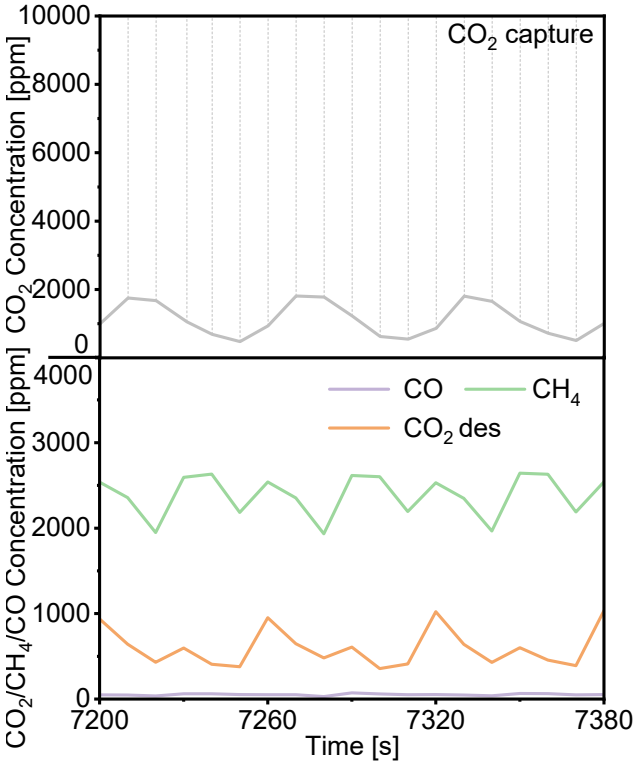

Figure S4 Continuous CCR operation with flowing steam over Ni(10)-Ca(30)/Al_2O_3. Conditions: 100 mg of catalyst for each reactor, 450 °C, 100 mL min^{-1} of 1% CO_2/10% O_2/N_2 with 20% water vapor for 30 s, switched to 100 mL min^{-1} of H_2 for the other 30 s.

Table S1. Comparison of CCR performance among the reported Ni-Ca based DFMs.

Ni-Ca DFM	Reaction Temperature [°C]	CO_2 capture [μmol g^{-1}]	CO_2 conversion (%)	CH_4 formation [μmol g^{-1}]	CH_4 selectivity (%)	Ref.
10% Ni-30% Ca/Al_2O_3	450	340	46	153	97	This work
1% Ni-CaO	550	9200	38	2000	58	Fuel **2021**, 286, 119308
10% Ni-CaO	550	8100	45	2500	69	Fuel **2021**, 286, 119308
10% Ni-15% Ca-Al_2O_3	450	73	82	58	97	*ACS Sustainable Chem. Eng.* **2021**, *9*, 3452–3463
5% Ni/15%Ca-Al_2O_3	520	----	----	223	----	*J. CO_2 Util.* **2019**, *34*, 576-587
10% Ni/15%Ca-Al_2O_3	520	----	----	225	----	*J. CO_2 Util.* **2019**, *34*, 576-587
15% Ni/20%Ca-Al_2O_3	450	----	66.6	----	63.2	*J. CO_2 Util.* **2019**, *31*, 143-151