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APPENDICES

Appendix A Reforming of CO_2-Containing Natural Gas Using an AC Gliding Arc System: Effect of Gas Components in Natural Gas

Table A1 Effect of feed flow rate on CH_4 conversion and product yields of pure methane feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	CH_4 conversion (%)	Product yield (%)	
		H_2	C_2
25	18.10	9.08	10.37
50	11.34	4.83	7.16
75	6.80	2.88	4.65
100	5.34	2.39	4.01
125	4.77	2.03	3.70
150	4.13	1.60	3.54

Table A2 Effect of feed flow rate on concentrations of outlet gas of pure methane feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Concentration of outlet gas (%)						
	CH_4	H_2	C_2H_2	C_2H_4	C_2H_6	C_3H_8	C_4H_{10}
25	73.95	16.39	1.83	1.40	1.46	0.05	0.10
50	84.32	9.19	1.15	1.02	1.07	0.03	0.07
75	90.55	5.59	0.78	0.80	0.69	0.02	0.05
100	92.01	4.65	0.62	0.73	0.61	0.02	0.04
125	92.02	3.91	0.55	0.69	0.55	0.01	0.03
150	93.34	3.11	0.45	0.63	0.64	0.01	0.03

Table A3 Effect of feed flow rate on product selectivities of pure methane feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Product selectivity (%)						Product molar ratio		
	H_2	C_2H_2	C_2H_4	C_2H_6	C_3H_8	C_4H_{10}	H_2/C_2	C_2H_6/C_2H_4	C_2H_4/C_2H_2
25	50.17	50.17	22.34	22.34	17.11	17.85	3.50	1.04	0.77
50	42.59	42.59	21.40	21.40	22.40	19.32	2.83	1.05	0.89
75	42.31	42.31	23.51	23.51	24.10	20.85	2.47	0.87	1.03
100	44.79	44.79	23.73	23.73	27.95	23.41	2.39	0.84	1.18
125	42.49	42.49	23.97	23.97	29.78	23.97	2.19	0.80	1.24
150	38.75	38.75	22.54	22.54	31.29	31.94	1.81	1.02	1.39

Table A4 Effect of feed flow rate on CH_4 conversion and product yields of methane/helium feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	CH_4 conversion (%)	Product yield (%)	
		H_2	C_2
50	8.31	3.23	7.07
75	6.40	2.41	5.85
100	6.57	2.31	5.61
125	5.51	1.67	4.53
150	5.50	1.65	4.53

Table A5 Effect of feed flow rate on concentrations of outlet gas of methane/helium feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Concentration of outlet gas (%)						
	CH_4	H_2	C_2H_2	C_2H_4	C_2H_6	C_3H_8	C_4H_{10}
50	61.23	0.53	0.73	1.11	0.05	0.04	0.53
75	62.39	0.39	0.63	0.93	0.03	0.03	0.39
100	62.88	0.43	0.63	0.84	0.03	0.03	0.43
125	64.97	0.32	0.55	0.69	0.02	0.02	0.32
150	65.22	0.31	0.56	0.69	0.02	0.02	0.31

Table A6 Effect of feed flow rate on product selectivities of methane/helium feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Product selectivity (%)						Product molar ratio		
	H_2	C_2H_2	C_2H_4	C_2H_6	C_3H_8	C_4H_{10}	H_2/C_2	C_2H_6/C_2H_4	C_2H_4/C_2H_2
50	38.88	18.94	26.30	39.94	2.74	3.24	1.83	1.52	1.39
75	37.67	18.35	29.71	44.32	2.50	3.04	1.63	1.49	1.62
100	35.20	19.32	28.26	37.80	1.82	2.65	1.65	1.34	1.46
125	30.24	16.85	29.22	36.22	1.50	2.23	1.47	1.24	1.73
150	30.05	16.48	29.37	36.49	1.39	2.22	1.46	1.24	1.78

Table A7 Effect of feed flow rate on reactant conversions and product yields of methane/ethane/helium feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Reactant conversion (%)		Product yield (%)	
	CH_4	C_2H_6	H_2	C_2
50	9.43	20.28	13.07	16.85
75	7.46	19.62	10.08	13.76
100	5.72	18.02	8.67	12.73
125	5.08	13.11	6.26	11.40
150	4.24	7.30	4.28	7.63

Table A8 Effect of feed flow rate on concentrations of outlet gas of methane/ethane/helium feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Concentration of outlet gas (%)						
	CH_4	H_2	C_2H_2	C_2H_4	C_2H_6	C_3H_8	C_4H_{10}
50	58.49	6.60	0.99	1.27	3.70	0.09	0.08
75	60.80	4.70	0.70	1.03	3.86	0.07	0.06
100	62.76	3.72	0.57	0.91	3.91	0.06	0.05
125	63.47	3.07	0.49	0.84	4.01	0.05	0.04
150	63.66	2.43	0.39	0.74	3.88	0.04	0.03

Table A9 Effect of feed flow rate on product selectivities of methane/ethane/helium feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Product selectivity (%)					Product molar ratio		
	H_2	C_2H_2	C_2H_4	C_3H_8	C_4H_{10}	H_2/C_2H_4	H_2/C_2H_2	C_2H_4/C_2H_2
50	43.98	24.79	31.93	3.23	4.16	5.18	6.68	1.29
75	37.22	20.50	30.31	2.93	3.50	4.57	6.76	1.48
100	36.52	20.59	33.05	3.01	3.48	4.08	6.54	1.61
125	34.41	20.10	35.51	3.01	3.44	3.61	6.38	1.77
150	37.06	22.90	43.21	3.31	3.85	3.28	6.19	1.89

Table A10 Effect of feed flow rate on reactant conversions and product yields of methane/ethane/propane/helium feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Reactant conversion (%)			Product yield (%)	
	CH_4	C_2H_6	C_3H_8	H_2	C_2
75	9.23	21.90	41.54	16.92	24.98
100	7.61	17.05	34.97	14.42	22.18
125	6.64	10.91	30.43	11.50	19.27
150	5.26	8.18	24.59	9.52	16.74
175	4.38	7.83	21.39	8.01	14.76

Table A11 Effect of feed flow rate on concentrations of outlet gas of methane/ethane/propane/helium feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Concentration of outlet gas (%)						
	CH_4	H_2	C_2H_2	C_2H_4	C_2H_6	C_3H_8	C_4H_{10}
75	62.81	5.86	1.04	1.61	3.90	3.21	0.24
100	63.92	4.79	0.85	1.39	3.75	3.23	0.20
125	64.40	4.03	0.75	1.30	3.95	3.54	0.19
150	65.09	3.33	0.61	1.13	4.48	3.59	0.19
175	66.58	2.67	0.47	1.01	4.66	3.58	0.14

Table A12 Effect of feed flow rate on product selectivities of methane/ethane/propane/helium feed system at an applied voltage of 15.5 kV, a frequency of 200 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Product selectivity (%)				Product molar ratio		
	H_2	C_2H_2	C_2H_4	C_4H_{10}	H_2/C_2H_4	H_2/C_2H_2	C_2H_4/C_2H_2
50	23.29	13.50	20.88	6.34	3.64	5.63	1.55
75	24.18	14.14	23.06	6.78	3.45	5.63	1.63
100	23.96	14.77	25.40	7.44	3.11	5.35	1.72
125	25.04	15.15	27.74	9.24	2.96	5.43	1.83
150	23.85	13.98	29.96	8.30	2.63	5.64	2.14

Table A13 Effect of feed flow rate on reactant conversions and product yields of methane/ethane/propane/carbon dioxide feed system at an applied voltage of 15.5 kV, a frequency of 300 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Reactant conversion (%)				Product yield (%)	
	CH_4	C_2H_6	C_3H_8	CO_2	H_2	C_2
75	10.04	17.72	41.00	5.52	16.75	27.99
100	8.72	12.91	32.54	5.11	13.28	23.19
125	7.90	12.04	29.80	4.34	12.17	20.46
150	6.79	12.10	25.76	4.53	10.59	19.84
175	6.99	10.74	24.90	3.28	9.75	18.66
200	6.21	6.21	22.30	3.04	8.22	16.30

Table A14 Effect of feed flow rate on concentrations of outlet gas of methane/ethane/propane/carbon dioxide feed system at an applied voltage of 15.5 kV, a frequency of 300 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Concentration of outlet gas (%)								
	CH_4	H_2	CO	CO_2	C_2H_2	C_2H_4	C_2H_6	C_3H_8	C_4H_{10}
75	61.34	6.02	0.47	17.54	1.16	1.65	4.14	3.00	0.22
100	62.48	5.11	0.39	17.71	1.02	1.42	4.59	3.56	0.18
125	64.66	4.51	0.34	17.76	0.88	1.27	4.62	3.60	0.15
150	65.36	3.92	0.30	17.90	0.81	1.17	4.66	3.65	0.14
175	65.11	3.76	0.29	18.25	0.83	1.15	4.69	3.73	0.14
200	65.44	3.40	0.25	18.33	0.71	1.14	4.80	4.14	0.14

Table A15 Effect of feed flow rate on product selectivities of methane/ethane/propane/carbon dioxide feed system at an applied voltage of 15.5 kV, a frequency of 300 Hz and an electrode gap distance of 6 mm

Feed flow rate (cm^3/min)	Product selectivity (%)					Product molar ratio			
	H_2	C_2H_2	C_2H_4	CO	C_4H_{10}	H_2/CO	H_2/C_2H_2	H_2/C_2H_4	C_2H_4/C_2H_2
75	24.36	15.57	22.11	2.97	5.83	12.75	5.19	3.66	3.66
100	24.52	16.35	22.76	2.90	5.90	13.12	5.01	3.60	3.60
125	24.47	16.11	23.37	2.90	5.59	13.26	5.14	3.54	3.54
150	23.72	16.49	23.85	2.84	5.59	12.90	4.83	3.34	3.34
175	22.88	17.03	23.62	2.80	5.73	12.96	4.54	3.27	3.27
200	23.66	16.54	26.63	2.74	6.47	13.64	4.82	2.99	2.99

Appendix B Reforming of CO_2-Containing Natural Gas Using an AC Gliding Arc System: Effects of Operational Parameters and Oxygen Addition in Feed

Table B1 Effect of applied voltage on reactant conversions and product yields of the simulated CO_2-containing natural gas reforming at a feed flow rate of 125 cm^3/min, a frequency of 300 Hz and an electrode gap distance of 6 mm

Applied voltage (kV)	Reactant conversion (%)				Product yield (%)	
	CH_4	C_2H_6	C_3H_8	CO_2	H_2	C_2
12.5	5.55	1.92	10.17	23.76	10.73	18.69
13.5	5.94	4.19	12.73	25.81	11.83	21.23
15.5	7.90	4.34	12.04	29.80	12.68	22.16
17.5	7.99	5.79	19.05	32.20	16.32	26.23
19.5	8.00	4.67	24.83	39.82	24.01	33.46
21.5	16.30	9.53	34.00	45.98	27.75	35.32

Table B2 Effect of applied voltage on concentrations of outlet gas of the simulated CO_2-containing natural gas reforming at a feed flow rate of 125 cm^3/min, a frequency of 300 Hz and an electrode gap distance of 6 mm

Applied voltage (kV)	Concentration of outlet gas (%)								
	CH_4	H_2	CO	CO_2	C_2H_2	C_2H_4	C_2H_6	C_3H_8	C_4H_{10}
12.5	66.06	3.77	0.37	18.28	0.76	1.12	4.22	3.76	0.14
13.5	66.01	4.07	0.37	18.27	0.86	1.16	4.15	3.70	0.14
15.5	64.97	4.39	0.33	17.68	0.85	1.25	4.11	3.28	0.15
17.5	64.72	5.60	0.38	17.99	1.16	1.31	3.85	3.35	0.15
19.5	63.29	7.36	0.42	17.75	1.43	1.53	3.50	2.94	0.18
21.5	58.72	10.63	0.49	17.31	2.02	1.57	3.13	2.70	0.15

Table B3 Effect of applied voltage on product selectivities and product molar ratios of the simulated CO_2-containing natural gas reforming at a feed flow rate of 125 cm^3/min, a frequency of 300 Hz and an electrode gap distance of 6 mm

Applied voltage (kV)	Product selectivity (%)					Product molar ratio			
	H_2	C_2H_2	C_2H_4	CO	C_4H_{10}	H_2/CO	H_2/C_2H_2	H_2/C_2H_4	C_2H_4/C_2H_2
12.5	27.18	18.29	26.85	4.28	6.83	10.12	4.94	3.37	1.47
13.5	26.58	18.56	25.04	3.73	6.23	10.87	4.74	3.52	1.35
15.5	23.98	15.56	22.87	2.82	5.45	13.26	5.14	3.54	1.45
17.5	27.55	18.93	21.39	2.84	4.78	14.83	4.85	4.29	1.13
19.5	33.06	20.93	22.35	2.87	5.13	17.66	5.15	4.82	1.07
21.5	28.82	18.79	14.60	2.09	2.83	21.72	5.25	6.76	0.78

Table B4 Effect of applied voltage on specific energy consumption and current of the simulated CO_2-containing natural gas reforming at a feed flow rate of 125 cm^3/min, a frequency of 300 Hz and an electrode gap distance of 6 mm

Applied voltage (kV)	Energy consumption ($x10^{18}$ Ws per H_2 molecule produced)	Energy consumption ($x10^{18}$ Ws per reactant molecule converted)	Current (mA)
12.5	5.30	3.40	1.2308
13.5	5.42	3.22	1.3077
15.5	6.34	3.36	1.5385
17.5	5.13	3.11	2.0000
19.5	3.57	2.78	2.0000
21.5	2.34	1.45	1.8462

Table B5 Effect of input frequency on reactant conversions and product yields of the simulated CO_2-containing natural gas reforming at a feed flow rate of 125 cm^3/min, an applied voltage of 17.5 kV and an electrode gap distance of 6 mm

Input frequency (Hz)	Reactant conversion (%)				Product yield (%)	
	CH_4	C_2H_6	C_3H_8	CO_2	H_2	C_2
250	9.16	24.96	37.35	4.51	25.21	33.67
300	7.99	19.05	32.20	5.79	16.32	26.23
400	6.87	13.17	26.01	4.14	11.92	20.91
500	5.92	10.33	23.01	2.90	9.30	18.09
600	4.51	7.24	18.25	3.06	8.05	15.76
700	2.85	2.79	13.08	1.19	5.48	11.34

Table B6 Effect of input frequency on concentrations of outlet gas of the simulated CO_2-containing natural gas reforming at a feed flow rate of 125 cm^3/min, an applied voltage of 17.5 kV and an electrode gap distance of 6 mm

Input frequency (Hz)	Concentration of outlet gas (%)								
	CH_4	H_2	CO	CO_2	C_2H_2	C_2H_4	C_2H_6	C_3H_8	C_4H_{10}
250	61.95	8.13	0.44	17.63	1.61	1.47	3.45	2.97	0.16
300	64.72	5.60	0.38	17.99	1.16	1.31	3.85	3.35	0.15
400	65.18	4.31	0.38	18.24	0.92	1.15	4.10	3.68	0.14
500	66.09	3.40	0.38	18.46	0.77	1.07	4.25	3.83	0.13
600	66.97	2.95	0.40	18.55	0.65	0.92	4.41	4.09	0.11
700	67.60	2.03	0.36	18.76	0.42	0.77	4.57	4.30	0.10

Table B7 Effect of input frequency on product selectivities and product molar ratios, of the simulated CO_2-containing natural gas reforming at a feed flow rate of 125 cm^3/min, an applied voltage of 17.5 kV and an electrode gap distance of 6 mm

Input frequency (Hz)	Product selectivity (%)					Product molar ratio			
	H_2	C_2H_2	C_2H_4	CO	C_4H_{10}	H_2/CO	H_2/C_2H_2	H_2/C_2H_4	C_2H_4/C_2H_2
250	35.28	23.17	21.15	2.97	4.52	18.63	5.06	5.54	0.91
300	27.55	18.93	21.39	2.84	4.78	14.83	4.85	4.29	1.13
400	25.88	18.54	23.13	3.51	5.44	11.47	4.68	3.75	1.25
500	23.68	17.86	25.04	4.20	6.21	8.87	4.44	3.17	1.40
600	26.84	19.71	27.96	5.61	6.85	7.34	4.55	3.21	1.42
700	29.29	19.95	37.02	8.07	9.81	5.71	4.87	2.63	1.86

Table B8 Effect of input frequency on specific energy consumption and current of the simulated CO_2-containing natural gas reforming at a feed flow rate of 125 cm^3/min, an applied voltage of 17.5 kV and an electrode gap distance of 6 mm

Input frequency (Hz)	Energy consumption ($x10^{18}$ Ws per H_2 molecule produced)	Energy consumption ($x10^{18}$ Ws per reactant molecule converted)	Current (mA)
250	3.24	2.63	2.0769
300	5.13	3.11	2.0000
400	6.22	3.57	1.3077
500	5.90	3.16	1.2308
600	5.82	3.44	1.0769
700	8.95	6.10	0.9231

Table B9 Effect of HCs/O_2 feed molar ratio on reactant conversions and product yields of the simulated CO_2-containing natural gas reforming using feeds with pure oxygen added, and feed in the absence of oxygen at a feed flow rate of 125 cm^3/min, an applied voltage of 17.5 kV, frequency of 300 Hz and an electrode gap distance of 6 mm

HCs/O_2 feed molar ratio	Reactant conversion (%)					Product yield (%)		
	CH_4	C_2H_6	C_3H_8	CO_2	O_2	H_2	C_2	CO
1/0	7.99	19.05	32.20	5.79	-	16.32	23.89	3.11
2/1	23.20	35.85	45.66	-2.67	36.89	48.21	35.06	57.45
3/1	21.57	29.73	45.24	5.12	37.50	37.50	35.11	29.48
4/1	17.32	24.52	40.63	2.34	31.25	32.04	29.99	24.59
5/1	14.78	29.17	40.91	4.81	31.45	31.94	30.57	21.25
7/1	13.20	27.42	39.62	5.95	33.91	26.72	28.40	15.13
10/1	8.02	21.22	34.43	2.55	28.63	22.87	27.13	9.75
15/1	7.43	20.07	34.70	3.49	28.54	19.30	25.25	8.02
20/1	6.20	14.91	29.78	1.93	23.19	14.86	20.96	3.36

Table B10 Effect of HCs/O_2 feed molar ratio on reactant conversions and product yields of the simulated CO_2-containing natural gas reforming using feeds with air added, and feed in the absence of oxygen at a feed flow rate of 125 cm^3/min, an applied voltage of 17.5 kV, frequency of 300 Hz and an electrode gap distance of 6 mm

HCs/O_2 feed molar ratio	Reactant conversion (%)					Product yield (%)		
	CH_4	C_2H_6	C_3H_8	CO_2	O_2	H_2	C_2	CO
1/0	7.99	19.05	32.20	5.79	-	16.32	23.89	3.11
2/1	31.78	42.48	50.79	4.31	43.35	58.07	49.75	61.58
5/1	18.39	31.03	42.37	5.82	31.28	37.18	37.86	21.37
10/1	13.44	29.25	42.45	3.37	30.71	34.70	37.63	14.31
15/1	10.85	26.77	40.06	4.68	29.21	27.25	32.50	9.25
20/1	10.81	26.74	40.04	3.69	29.00	26.74	32.55	8.74

Table B11 Effect of HCs/O_2 feed molar ratio on product selectivities and product molar ratio of the simulated CO_2-containing natural gas reforming using feeds with pure oxygen added, and feed in the absence of oxygen at a feed flow rate of 125 cm^3/min, an applied voltage of 17.5 kV, frequency of 300 Hz and an electrode gap distance of 6 mm

HCs/O_2 feed molar ratio	Product selectivity (%)					Product molar ratio			
	H_2	C_2H_2	C_2H_4	CO	C_4H_{10}	H_2/CO	H_2/C_2H_2	H_2/C_2H_4	C_2H_4/C_2H_2
1/0	27.55	18.93	21.39	2.84	4.78	14.83	4.29	4.85	1.13
2/1	46.04	20.71	12.77	56.30	1.88	1.46	12.63	7.79	0.62
3/1	38.85	20.83	15.53	29.00	2.67	2.06	10.86	7.14	0.66
4/1	38.85	20.83	15.53	29.00	2.67	2.29	8.72	6.50	0.75
5/1	37.64	19.73	16.29	23.70	2.99	2.60	7.92	6.54	0.83
7/1	33.30	18.16	17.23	17.55	3.37	3.04	6.58	6.25	0.95
10/1	35.93	19.43	23.18	14.73	4.91	3.88	5.12	6.11	1.19
15/1	31.02	16.37	24.22	12.21	5.43	3.95	4.20	6.21	1.48
20/1	29.20	14.84	26.35	9.93	6.36	4.66	3.64	6.45	1.78

Table B12 Effect of HCs/O_2 feed molar ratio on product selectivities and product molar ratio of the simulated CO_2-containing natural gas reforming using feeds with air added, and feed in the absence of oxygen at a feed flow rate of 125 cm^3/min, an applied voltage of 17.5 kV, frequency of 300 Hz and an electrode gap distance of 6 mm

HCs/O_2 feed molar ratio	Product selectivity (%)					Product molar ratio			
	H_2	C_2H_2	C_2H_4	CO	C_4H_{10}	H_2/CO	H_2/C_2H_2	H_2/C_2H_4	C_2H_4/C_2H_2
1/0	46.44	27.98	11.81	1.34	47.60	1.70	14.02	5.92	0.42
2/1	40.51	25.35	15.89	2.28	21.90	3.06	8.85	5.55	0.63
5/1	40.76	25.00	19.20	3.27	16.17	4.12	7.19	5.52	0.77
10/1	35.07	21.16	20.68	3.95	11.24	4.95	5.67	5.54	0.98
15/1	34.46	21.21	20.74	3.96	10.76	5.13	5.55	5.43	0.98
20/1	46.44	27.98	11.81	1.34	47.60	1.70	14.02	5.92	0.42

Table B13 Effect of HCs/O_2 feed molar ratio on energy consumption of the simulated CO_2-containing natural gas reforming using feeds with pure oxygen added , and feed in the absence of oxygen at a feed flow rate of 125 cm^3/min, an applied voltage of 17.5 kV, frequency of 300 Hz and an electrode gap distance of 6 mm

HCs/O_2 feed molar ratio	Energy consumption ($x10^{18}$ Ws per H_2 molecule produced)	Energy consumption ($x10^{18}$ Ws per reactant molecule converted)
1/0	5.13	3.11
2/1	1.89	2.08
3/1	2.49	2.28
4/1	2.27	2.01
5/1	2.23	1.89
7/1	2.94	2.17
10/1	3.84	3.30
15/1	4.44	3.26
20/1	6.04	4.28

Appendix C Non-Oxidative Methane Reforming in an AC Gliding Arc Microreactor: Effects of Operational Parameters and the Presence of Catalyst

Table C1 Effect of input power on methane conversion and product yields of the non-oxidative methane reforming at a feed flow rate of 200 cm^3/min, an electrode gap distance of 4 mm and a reactor width of 1.25 mm

Input power (W)	CH_4 conversion (%)	Product yield (%)	
		H_2	C_2
4	24.42	17.94	19.25
6	29.61	21.87	24.82
8	30.69	22.88	26.40
10	30.44	22.90	26.18
12	31.98	23.74	28.92

Table C2 Effect of input power on product selectivities of the non-oxidative methane reforming at a feed flow rate of 200 cm^3/min, an electrode gap distance of 4 mm and a reactor width of 1.25 mm

Input power (W)	Product selectivity (%)					
	H_2	C_2H_2	C_2H_4	C_2H_6	C_4H_6	carbon
4	73.48	68.42	7.29	3.14	9.11	12.04
6	73.86	77.36	4.70	1.78	8.31	7.85
8	74.56	80.83	3.95	1.24	6.22	7.76
10	75.25	81.26	3.71	1.04	4.82	9.17
12	74.26	85.74	3.78	0.94	4.58	4.97

Table C3 Effect of electrode gap distance on methane conversion and product yields of the non-oxidative methane reforming at a feed flow rate of 200 cm^3/min, an input power of 6 W and a reactor width of 1.25 mm

Electrode gap distance (mm)	CH_4 conversion (%)	Product yield (%)	
		H_2	C_2
2	18.77	14.07	15.57
3	26.54	19.73	22.26
4	29.61	21.87	24.82
5	31.57	23.25	26.44

Table C4 Effect of electrode gap distance on product selectivities of the non-oxidative methane reforming at a feed flow rate of 200 cm^3/min, an input power of 6 W and a reactor width of 1.25 mm

Electrode gap distance (mm)	Product selectivity (%)					
	H_2	C_2H_2	C_2H_4	C_2H_6	C_4H_6	carbon
2	74.95	76.51	4.55	1.90	5.92	11.12
3	74.32	77.79	4.47	1.62	7.40	8.71
4	73.86	77.36	4.70	1.78	8.31	7.85
5	73.67	76.86	5.06	1.84	8.55	7.69

Table C5 Effect of reactor width on methane conversion and product yields of the non-oxidative methane reforming at a feed flow rate of 200 cm^3/min, an input power of 6 W and a electrode gap distance of 4 mm

Reactor width (mm)	CH_4 conversion (%)	Product yield (%)	
		H_2	C_2
0.65	25.84	19.06	21.36
1.25	29.61	21.87	24.82
2.25	33.13	24.55	27.58
3.25	39.94	29.62	32.47
4.25	42.69	31.68	34.16

Table C6 Effect of reactor width on product selectivities of the non-oxidative methane reforming at a feed flow rate of 200 cm^3/min, an input power of 6 W and an electrode gap distance of 4 mm

Reactor width (mm)	Product selectivity (%)					
	H_2	C_2H_2	C_2H_4	C_2H_6	C_4H_6	carbon
0.65	73.77	74.62	5.63	2.40	7.90	9.45
1.25	73.86	77.36	4.70	1.78	8.31	7.85
2.25	74.09	76.94	4.73	1.58	8.34	8.41
3.25	74.16	74.20	5.25	1.87	8.72	9.98
4.25	74.20	72.66	5.41	1.94	9.25	10.74

Table C7 Effect of the presence of catalyst on methane conversion of the combined catalytic-plasma non-oxidative methane reforming at an electrode gap distance of 4 mm and an input power of 6 W

Catalyst distance (mm)	System	Feed flow rate (cm^3/min)	Residence time (s)	CH_4 conversion (%)	Product yield (%)	
					H_2	C_2
0.2	plasma alone	75	0.0836	40.54	30.81	34.59
		100	0.0627	34.07	26.01	28.13
		200	0.0314	25.78	19.05	21.83
	plasma+unloaded cat.	75	0.0836	49.96	38.33	40.98
		100	0.0627	45.39	34.47	37.64
		200	0.0314	31.97	23.51	26.49
	plasma+Ni-loaded cat.	75	0.0836	53.41	40.90	43.92
		100	0.0627	48.75	37.17	39.81
		200	0.0314	32.92	24.16	27.31
0.5	plasma alone	75	0.1100	44.52	34.31	36.24
		100	0.0825	41.02	31.35	33.57
		200	0.0413	29.50	21.78	24.74
	plasma+unloaded cat.	75	0.1100	50.29	38.33	42.57
		100	0.0825	44.38	33.84	36.49
		200	0.0413	30.66	22.72	25.43
	plasma+Ni-loaded cat.	75	0.1100	53.54	41.17	44.01
		100	0.0825	46.88	36.13	37.03
		200	0.0413	31.89	23.56	26.49

Table C8 Effect of the presence of catalyst on product selectivities of the combined catalytic-plasma non-oxidative methane reforming at an electrode gap distance of 4 mm and an input power of 6 W

Catalyst distance (mm)	System	Residence time (s)	Product selectivity (%)					
			H_2	C_2H_2	C_2H_4	C_2H_6	C_4H_6	carbon
0.2	plasma alone	0.0836	76.01	80.53	3.81	0.98	3.24	11.43
		0.0627	76.35	77.64	3.78	1.14	3.98	13.45
		0.0314	73.87	78.24	4.67	1.77	7.73	7.58
	plasma+unloaded cat.	0.0836	76.73	76.92	3.99	1.12	3.23	14.74
		0.0627	75.93	77.62	4.06	1.24	4.53	12.55
		0.0314	73.55	75.57	5.20	2.10	9.03	8.10
	plasma+Ni-loaded cat.	0.0836	76.58	77.21	3.99	1.04	3.58	14.18
		0.0627	76.24	76.16	4.18	1.32	4.37	13.96
		0.0314	73.38	75.52	5.32	2.12	9.28	7.75
0.5	plasma alone	0.1100	77.07	76.96	3.59	0.87	3.31	15.27
		0.0825	76.43	76.95	3.79	1.09	4.31	13.86
		0.0413	73.84	77.42	4.72	1.75	8.35	7.76
	plasma+unloaded cat.	0.1100	76.22	79.64	4.02	1.00	2.95	12.39
		0.0825	76.25	77.27	3.83	1.11	4.51	13.29
		0.0413	74.11	76.55	4.66	1.74	8.32	8.73
	plasma+Ni-loaded cat.	0.1100	76.89	77.34	3.91	0.96	2.94	14.86
		0.0825	77.06	73.99	3.83	1.16	4.43	16.59
		0.0413	73.88	76.67	4.65	1.75	8.82	8.10

CURRICULUM VITAE

Name: Ms. Nongnuch Rueangjitt

Date of Birth: April 12, 1977

Nationality: Thai

University Education:

1994-1998 Bachelor Degree of Chemical Engineering, Faculty of Engineering, Srinakharinwirot University, Bangkok, Thailand

2001-2003 Master Degree of Chemical Engineering, Faculty of Engineering, Kasetsart University, Bangkok, Thailand

Working Experience:

1999-2000 Process Engineer at Hoya Glass Disk (Thailand) Ltd.

Publications:

1. Rueangjitt, N., Akarawitoo, C., Sreethawong, T. and Chavadej, S. (2007) Reforming of CO_2-containing natural gas using an AC gliding arc system: Effects of gas components. Plasma Chemistry and Plasma Processing, 27(5), 559-576.
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