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APPENDICES

Appendix A Experimental Data of Gas Calibration of GC-8A

1. Methane

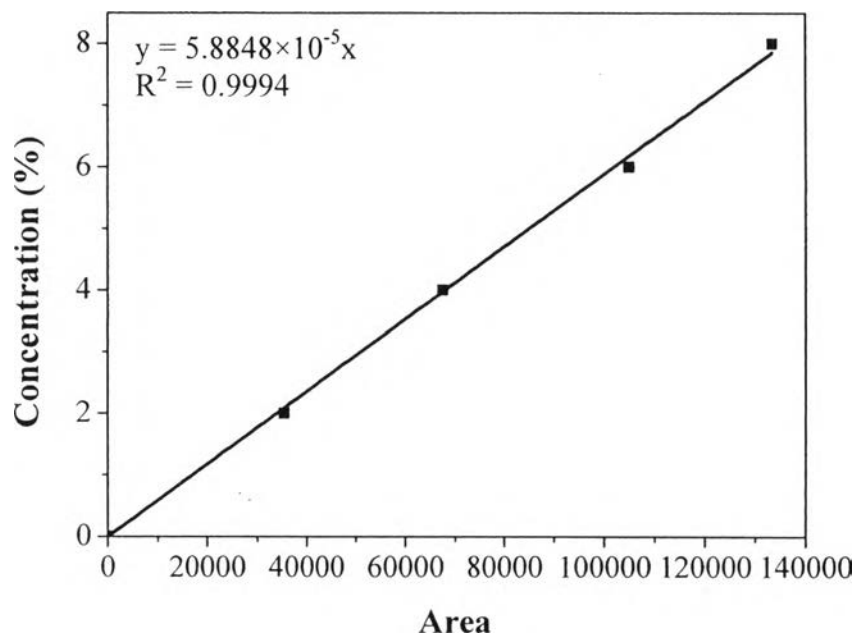


Figure A1 Relationship between area and concentration of methane.

2. Oxygen

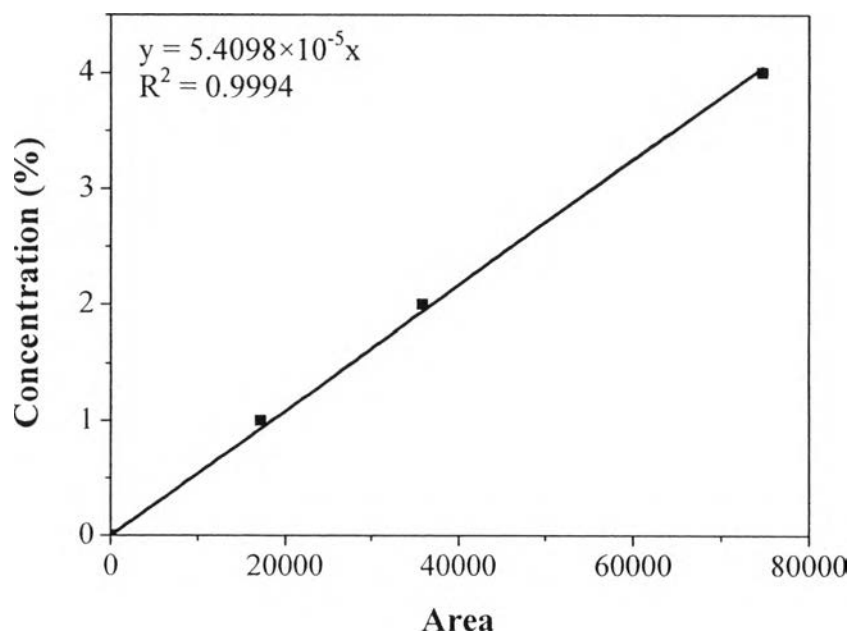


Figure A2 Relationship between area and concentration of oxygen.

3. Hydrogen

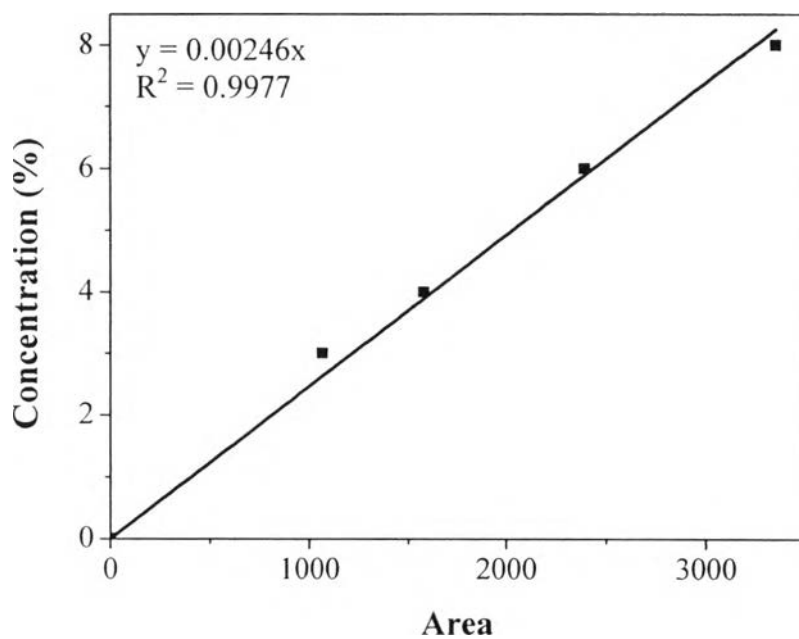


Figure A3 Relationship between area and concentration of hydrogen.

4. Carbon monoxide

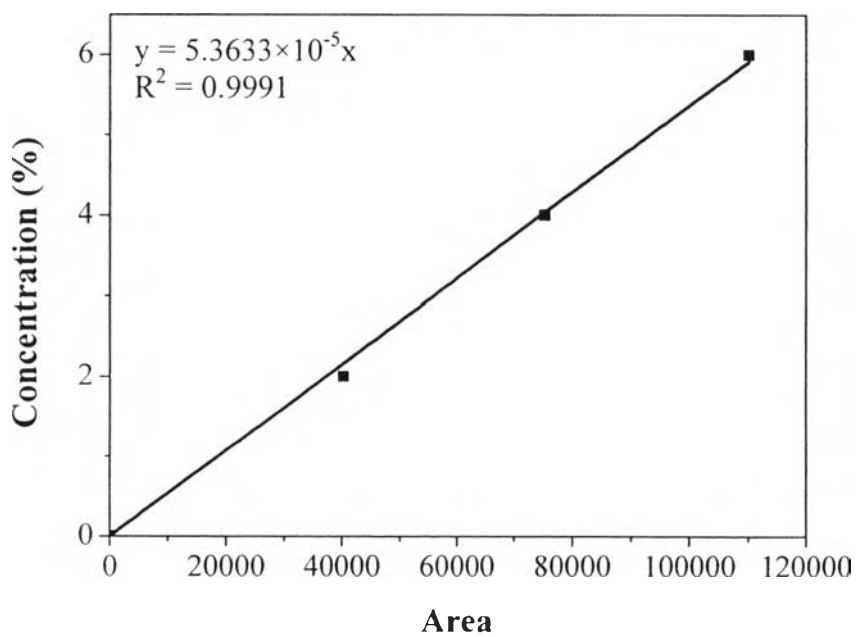


Figure A4 Relationship between area and concentration of carbon monoxide.

5. Carbon dioxide

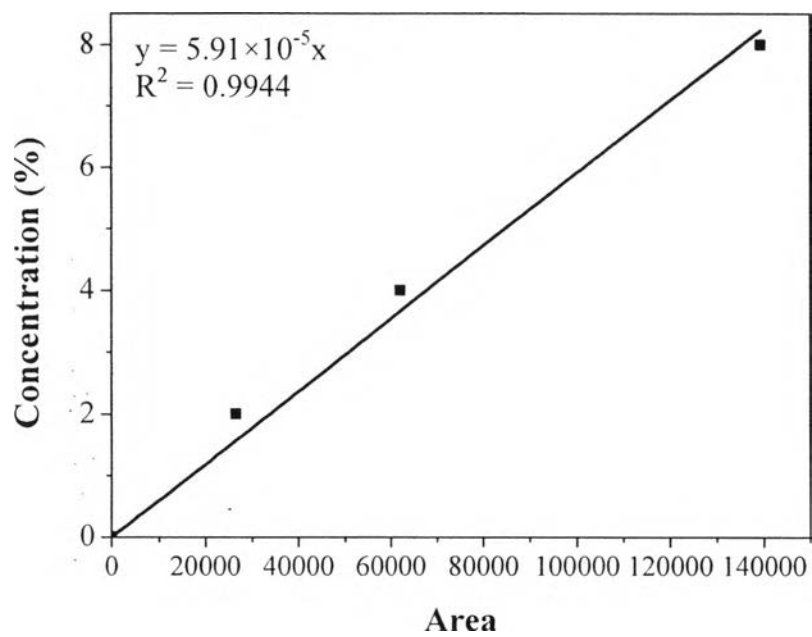


Figure A5 Relationship between area and concentration of carbon dioxide.

Appendix B Experimental Data of Flow Meter Gas Calibration of Brooks 5850E
Mass Flow Controllers

1. Methane

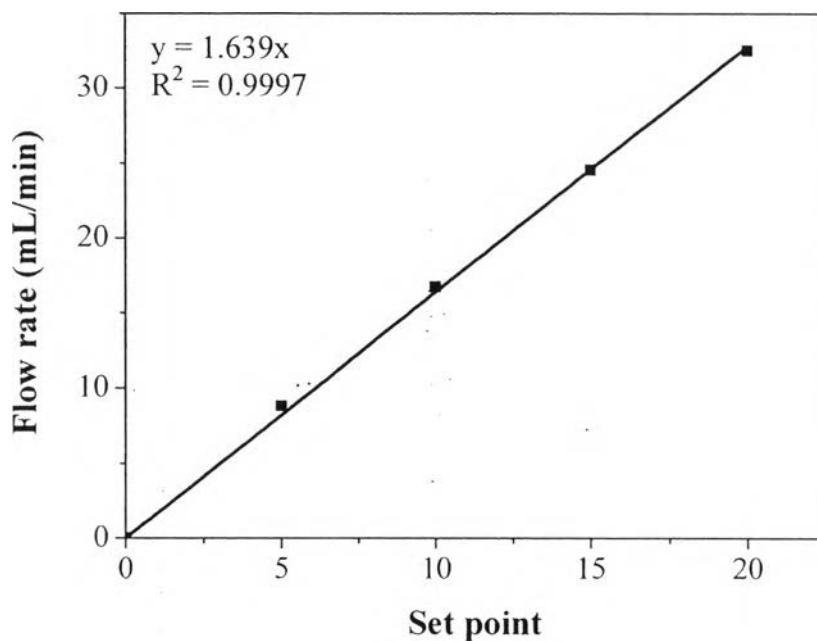


Figure B1 Relationship between set point and flow rate of methane.

2. Air

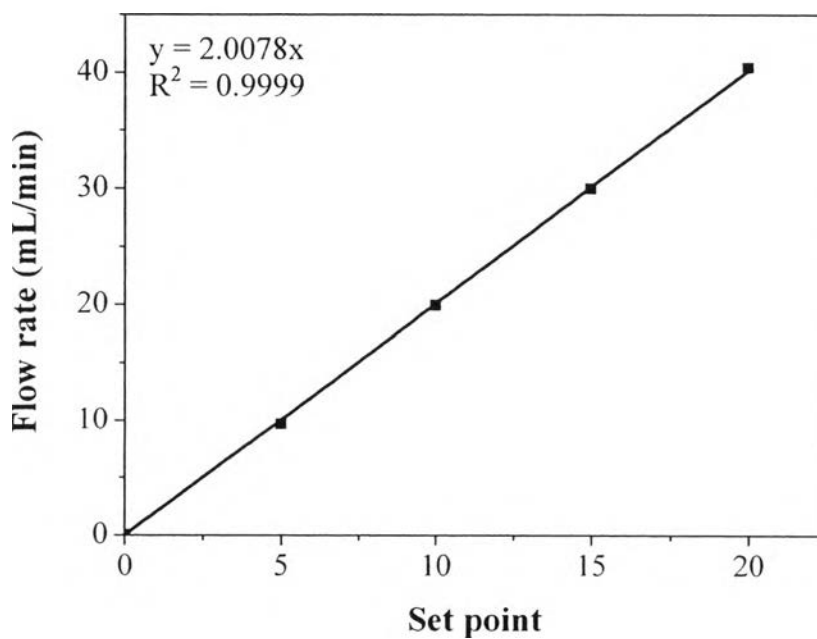


Figure B2 Relationship between set point and flow rate of air.

3. Helium

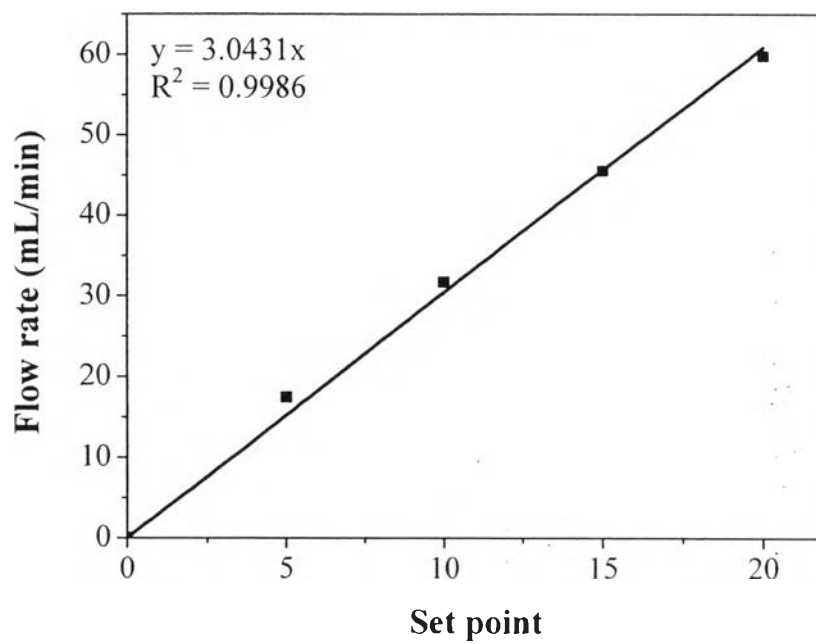


Figure B3 Relationship between set point and flow rate of helium.

Appendix C Experimental Data of Catalytic Activity Tests for MPO

Table C1 Catalytic activity test of 15Ni/CZO catalyst

Temperature (°C)	X _{CH₄} (%)	X _{O₂} (%)	S _{H₂} (%)	S _{CO} (%)
400	7.05	22.73	0.00	0.00
450	14.67	84.56	0.00	0.00
500	22.92	97.94	0.00	0.00
550	24.77	99.58	0.00	0.00
600	87.88	99.59	87.79	86.5
650	92.82	99.56	91.83	94.06
700	96.51	93.58	93.82	97.36
750	99.37	95.55	95.70	98.70
800	99.40	95.58	95.43	99.33

Table C2 Catalytic activity test of 15Ni5Mg/CZO (C) catalyst

Temperature (°C)	X _{CH₄} (%)	X _{O₂} (%)	S _{H₂} (%)	S _{CO} (%)
400	4.52	9.80	0.00	0.00
450	12.38	21.37	0.00	0.00
500	20.46	57.31	0.00	0.00
550	21.83	81.49	0.00	0.00
600	23.60	93.53	0.00	0.00
650	92.07	99.03	89.14	97.52
700	96.14	99.34	91.92	98.82
750	96.85	99.35	93.89	99.57
800	97.42	99.34	94.63	99.91

Table C3 Catalytic activity test of 15Ni5Mg/CZO (S) catalyst

Temperature (°C)	X _{CH₄} (%)	X _{O₂} (%)	S _{H₂} (%)	S _{CO} (%)
400	5.23	8.48	0.00	0.00
450	13.56	27.17	0.00	0.00
500	21.47	90.79	0.00	0.00
550	24.63	98.40	0.00	0.00
600	24.56	99.06	0.00	0.00
650	92.48	99.54	90.62	97.98
700	97.42	99.72	94.13	98.28
750	97.46	99.23	95.00	98.48
800	97.61	99.53	95.44	98.97

Table C4 Catalytic activity test of 15Ni10Mg/CZO (C) catalyst

Temperature (°C)	X _{CH₄} (%)	X _{O₂} (%)	S _{H₂} (%)	S _{CO} (%)
400	2.57	11.20	0.00	0.00
450	7.91	29.02	0.00	0.00
500	18.21	73.01	0.00	0.00
550	23.64	94.34	0.00	0.00
600	24.32	99.37	0.00	0.00
650	25.01	99.58	0.00	0.00
700	24.96	99.61	0.00	0.00
750	97.44	99.60	92.11	98.65
800	97.16	99.59	92.67	99.37

Table C5 Catalytic activity test of 15Ni10Mg/CZO (S) catalyst

Temperature (°C)	X _{CH₄} (%)	X _{O₂} (%)	S _{H₂} (%)	S _{CO} (%)
400	2.79	8.08	0.00	0.00
450	9.09	26.70	0.00	0.00
500	19.34	79.60	0.00	0.00
550	23.34	98.31	0.00	0.00
600	24.61	99.35	0.00	0.00
650	22.99	99.21	0.00	0.00
700	24.46	99.43	0.00	0.00
750	97.33	99.20	95.24	98.66
800	98.33	99.42	95.17	99.00

Table C6 Catalytic activity test of 15Ni15Mg/CZO (C) catalyst

Temperature (°C)	X _{CH₄} (%)	X _{O₂} (%)	S _{H₂} (%)	S _{CO} (%)
400	0.14	6.87	0.00	0.00
450	3.02	21.58	0.00	0.00
500	9.55	56.66	0.00	0.00
550	19.41	87.14	0.00	0.00
600	20.53	96.63	0.00	0.00
650	21.42	99.11	0.00	0.00
700	21.92	99.42	0.00	0.00
750	92.35	99.42	89.01	99.55
800	92.56	99.42	90.78	99.60

Table C7 Catalytic activity test of 15Ni15Mg/CZO (S) catalyst

Temperature (°C)	X _{CH₄} (%)	X _{O₂} (%)	S _{H₂} (%)	S _{CO} (%)
400	0.75	6.75	0.00	0.00
450	3.63	17.32	0.00	0.00
500	12.01	52.08	0.00	0.00
550	23.07	98.87	0.00	0.00
600	23.18	99.36	0.00	0.00
650	23.76	99.45	0.00	0.00
700	24.47	99.42	0.00	0.00
750	93.08	99.42	90.64	99.00
800	94.33	99.59	93.43	99.20

Appendix D Experimental Data of Stability Tests for MPO

Table D1 Stability test of 15Ni/CZO catalyst

Time (hr)	X _{CH₄} (%)	X _{O₂} (%)	S _{H₂} (%)	S _{CO} (%)
1	97.28	99.55	94.04	98.93
2	97.52	99.60	93.95	98.96
3	97.44	99.60	93.67	98.94
4	97.12	99.62	93.91	98.91
5	97.62	99.61	93.15	98.84
6	97.52	99.58	92.94	98.80
7	97.23	99.60	93.13	98.81
8	97.20	99.61	93.07	98.76
9	97.43	99.61	92.46	98.60
10	97.60	99.56	92.73	98.67
11	97.40	99.57	92.50	98.60
12	97.19	99.50	93.06	98.61
13	97.28	99.53	93.14	98.54
14	97.22	99.58	92.92	98.39
15	97.29	99.58	93.30	98.42
16	97.34	99.58	93.30	98.42
17	97.33	99.47	92.67	98.38
18	97.51	99.59	92.80	98.33

Table D2 Stability test of 15Ni5Mg/CZO (C) catalyst

Time (hr)	X _{CH₄} (%)	X _{O₂} (%)	S _{H₂} (%)	S _{CO} (%)
1	98.09	99.57	95.97	98.78
2	97.88	99.52	95.83	98.88
3	97.94	99.57	95.41	98.85
4	97.82	99.43	95.32	98.76
5	97.49	99.55	95.78	98.82
6	97.78	99.55	95.76	98.82
7	97.74	99.59	95.19	98.81
8	97.75	99.55	94.85	98.80
9	97.54	99.58	94.55	98.79
10	97.48	99.55	94.26	98.63
11	97.22	99.49	94.08	98.74
12	97.33	99.52	94.43	98.74
13	97.54	99.56	93.92	98.69
14	97.59	99.51	93.47	98.55
15	97.44	99.48	93.32	98.64
16	97.43	99.55	93.63	98.59
17	97.50	99.48	93.75	98.45
18	97.79	99.56	93.10	98.55

Table D3 Stability test of 15Ni5Mg/CZO (S) catalyst

Time (hr)	X _{CH₄} (%)	X _{O₂} (%)	S _{H₂} (%)	S _{CO} (%)
1	98.17	99.59	95.05	98.82
2	98.15	99.56	96.23	98.76
3	97.93	99.53	96.00	98.82
4	97.76	99.56	96.31	99.01
5	97.56	99.57	95.61	99.01
6	97.42	99.57	96.56	98.92
7	97.35	99.58	95.68	99.02
8	97.57	99.59	95.78	99.04
9	97.43	99.62	96.39	99.06
10	97.51	99.50	95.80	99.03
11	97.46	99.51	95.73	99.05
12	97.13	99.57	95.21	99.10
13	97.62	99.58	95.99	99.04
14	97.67	99.50	94.67	98.99
15	97.59	99.52	96.09	99.03
16	97.38	99.52	95.38	99.04
17	97.51	99.48	95.64	98.98
18	97.74	99.57	96.38	98.99

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Proceedings:

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