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Supplementary Materials

Ni, Co and Ni-Co-Modified Tungsten Carbides Obtained by an Electric Arc Method as Dry Reforming Catalysts

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Figure S1. XRD patterns of support and catalysts: (**1**) – WC; (**2**) - 20%Ni/WC_IWI; (**3**) - 20%Ni/WC_DP; (**4**) - 19%Ni_1%Co/WC_IWI; (**5**) - 19%Ni_1%Co/WC_DP; (**6**) - 15%Ni_5%Co/WC_IWI; (**7**) - 15%Ni_5%Co/WC_DP; (**8**) - 10%Ni_10%Co/WC_IWI; (**9**) - 10%Ni_10%Co/WC_DP; (**10**) - 5%Ni_15%Co/WC_IWI; (**11**) - 5%Ni_15%Co/WC_DP; (**12**) - 1%Ni_19%Co/WC_IWI; (**13**) - 1%Ni_19%Co/WC_DP; (**14**) - 20%Co/WC_IWI and (**15**) - 20%Co/WC_DP.

Figure S2. XRD patterns of spent (used) support and catalysts: (**16**) – WC; (**17**) - 20%Ni/WC_IWI; (**18**) - 20%Ni/WC_DP; (**19**) - 10%Ni_10%Co/WC_IWI; (**20**) - 10%Ni_10%Co/WC_DP; (**21**) - 20%Co/WC_IWI and (**22**) - 20%Co/WC_DP.

Figure S3. Ni2p and Co2p XPS spectra: (**4**) - 19%Ni_1%Co/WC_IWI; (**5**) - 19%Ni_1%Co/WC_DP; (**6**) - 15%Ni_5%Co/WC_IWI; (**7**) - 15%Ni_5%Co/WC_DP; (**10**) - 5%Ni_15%Co/WC_IWI; (**11**) - 5%Ni_15%Co/WC_DP; (**12**) - 1%Ni_19%Co/WC_IWI and (**13**) - 1%Ni_19%Co/WC_DP.

One table:

Table S1. Catalytic behavior of studied materials in methane dry reforming.

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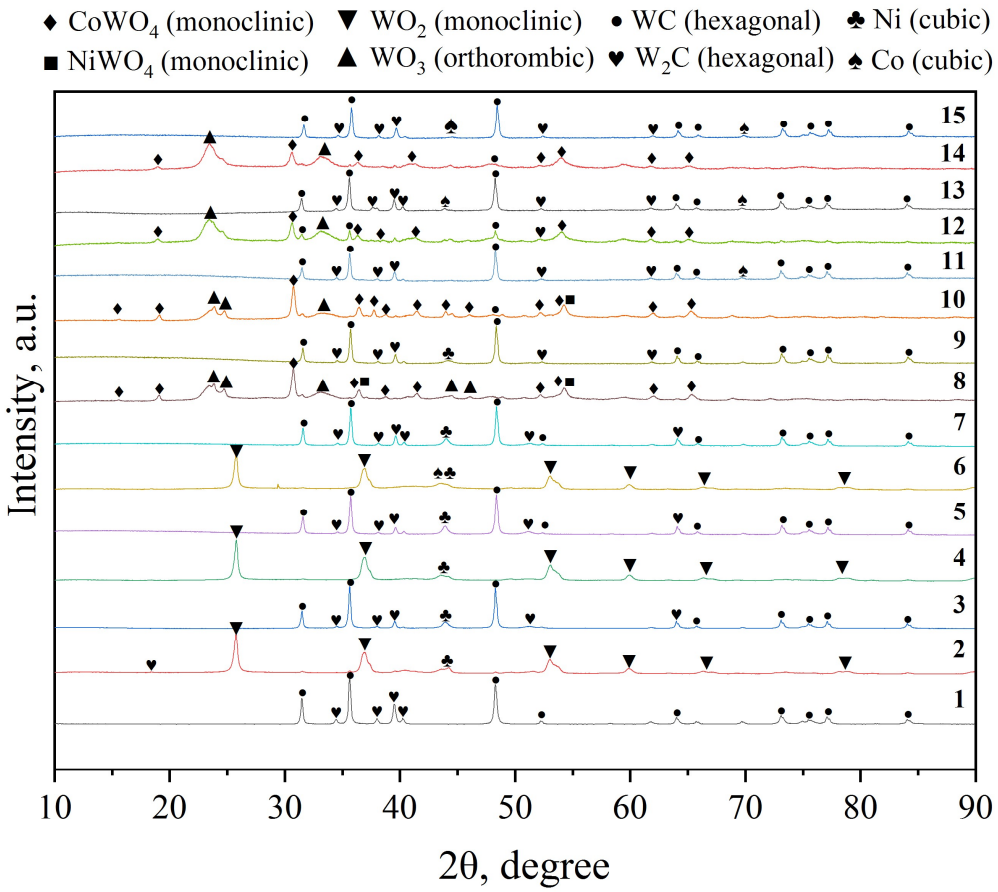

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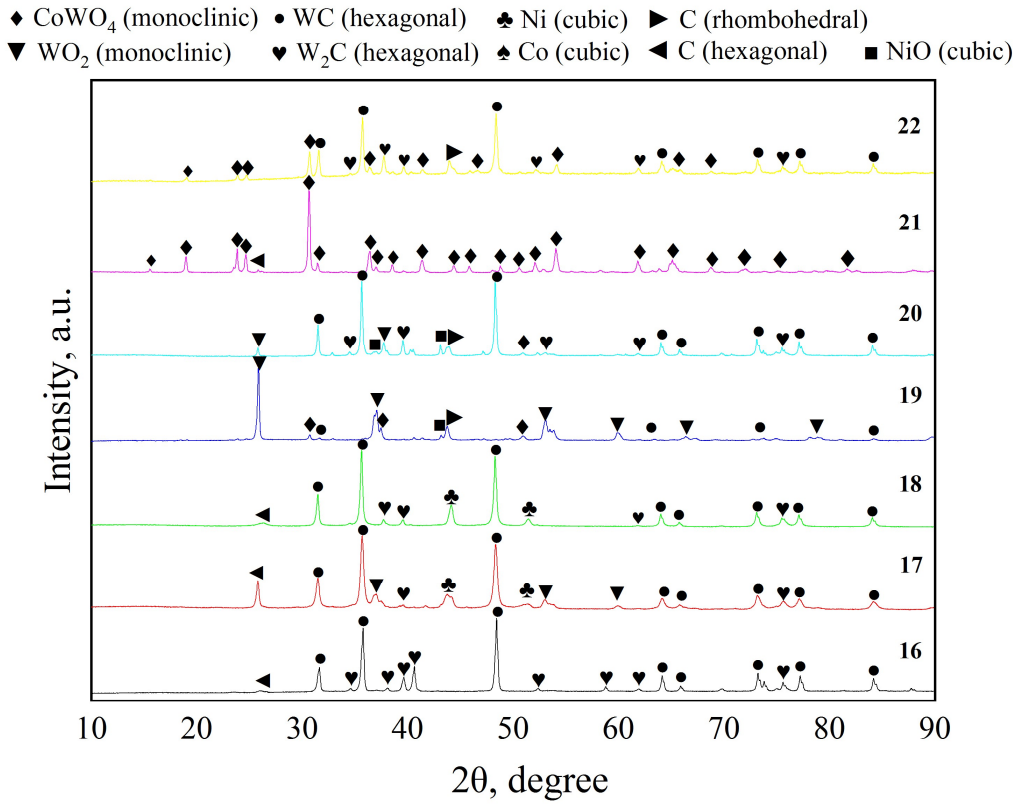

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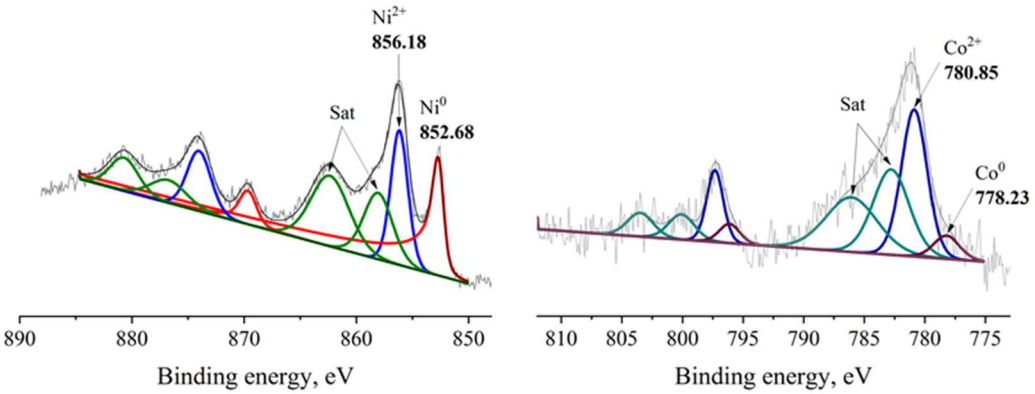
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Sat
Ni0
852.68
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Binding energy, eV
Co2p
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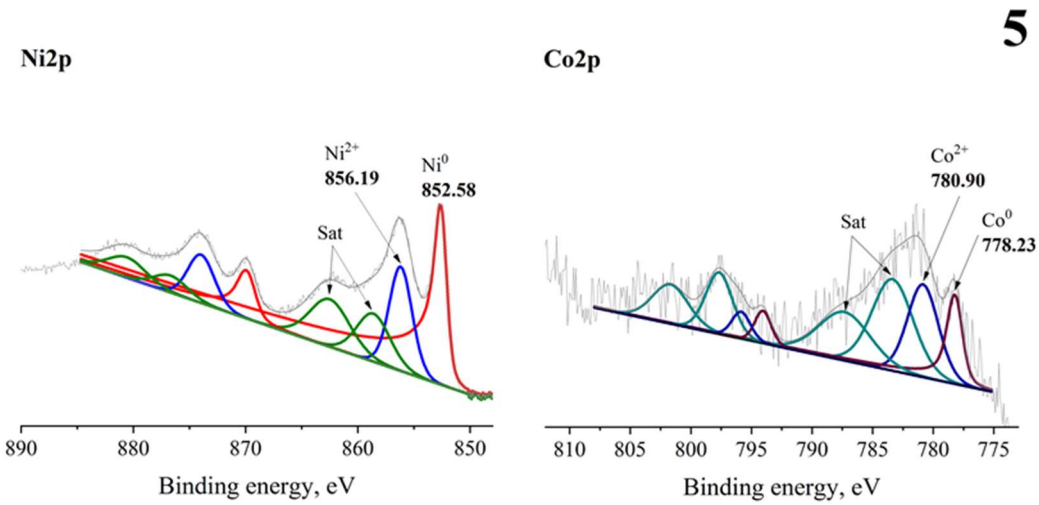
Binding energy, eV

5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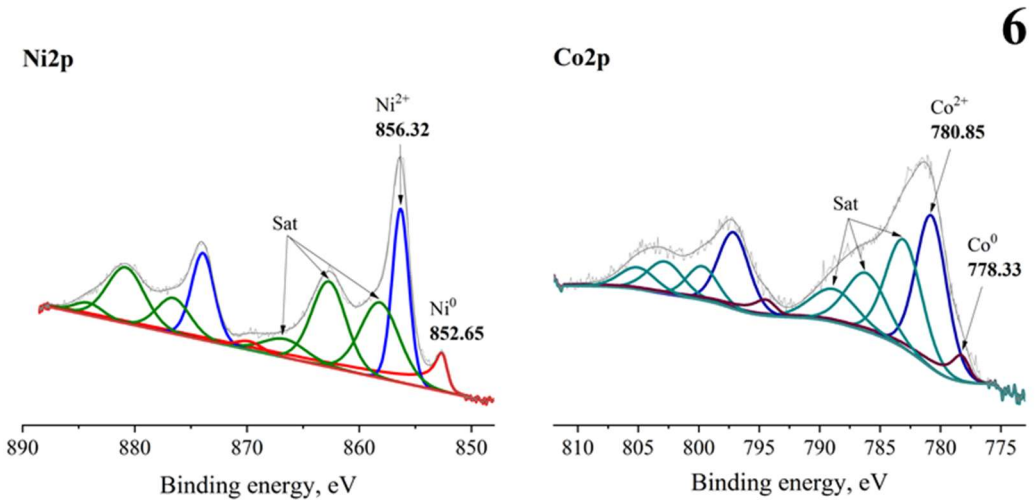
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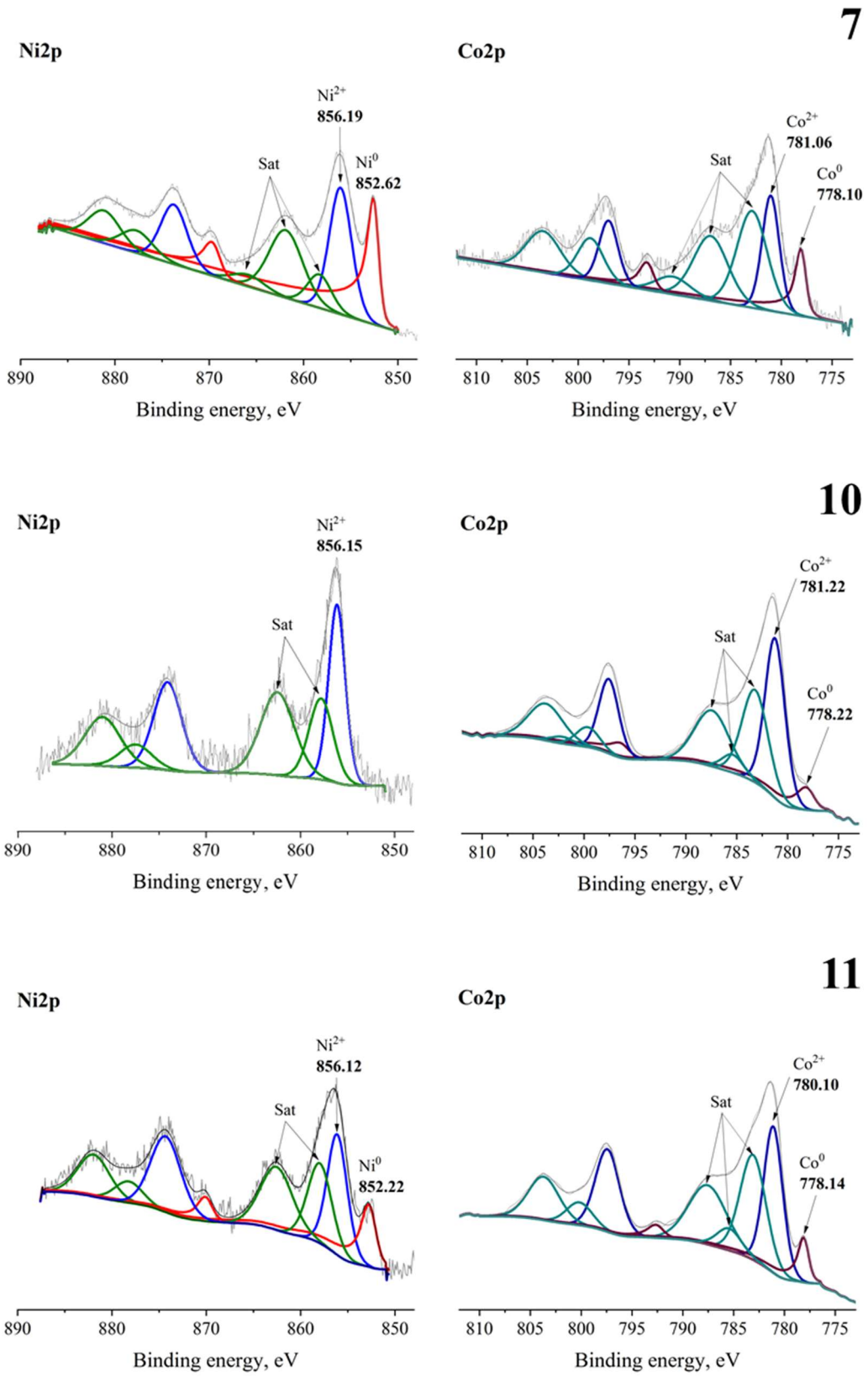
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Binding energy, eV
10
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856.15
Sat
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Binding energy, eV
Co2p
Co2+
781.22
Sat
Co0
778.22
810 805 800 795 790 785 780 775
Binding energy, eV
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Ni0
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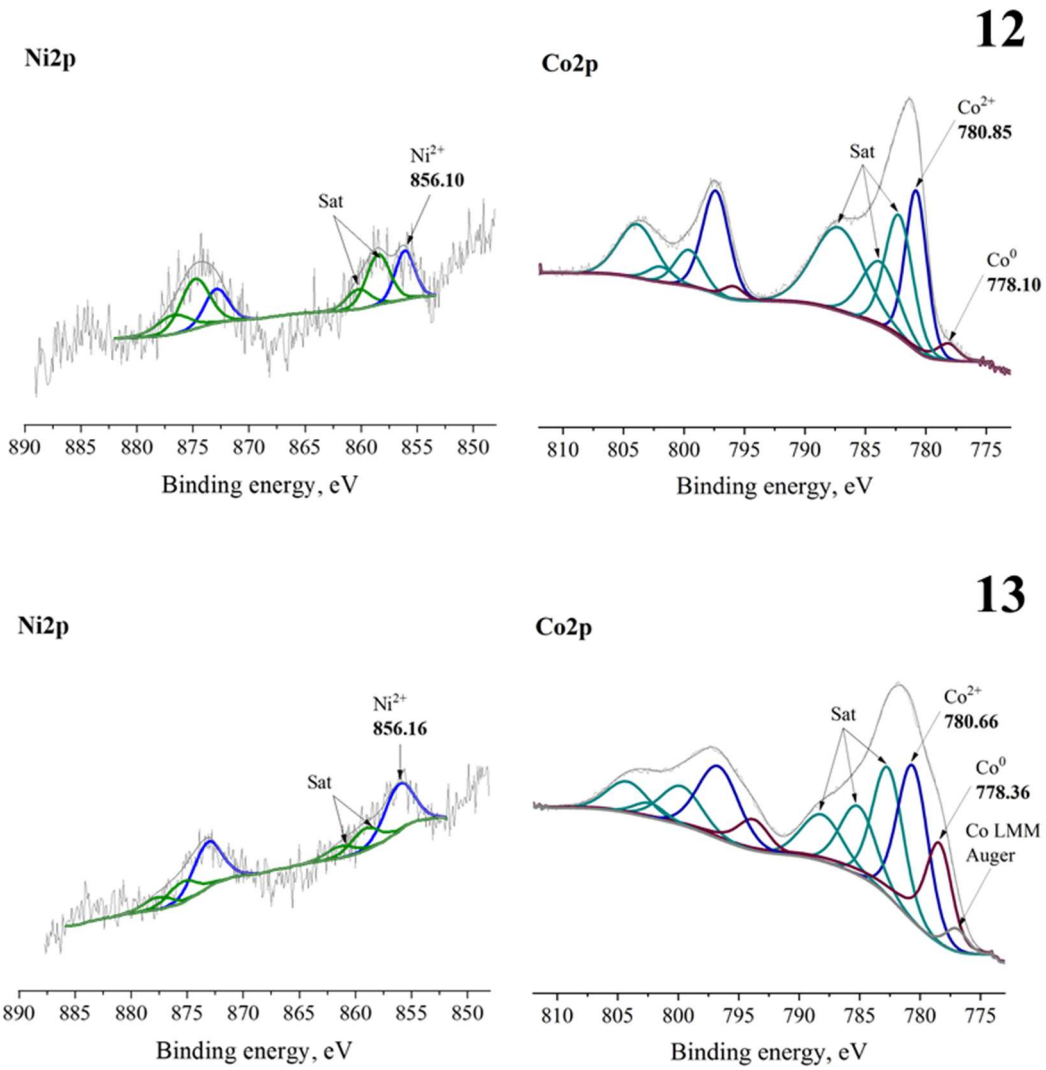

Figure S3. Ni2p and Co2p XPS spectra of: (**4**) - 19%Ni_1%Co/WC_IWI; (**5**) - 19%Ni_1%Co/WC_DP; (**6**) - 15%Ni_5%Co/WC_IWI; (**7**) - 15%Ni_5%Co/WC_DP; (**10**) - 5%Ni_15%Co/WC_IWI; (**11**) - 5%Ni_15%Co/WC_DP; (**12**) - 1%Ni_19%Co/WC_IWI and (**13**) - 1%Ni_19%Co/WC_DP.

Table S1. Catalytic behavior of the studied materials in methane dry reforming.

Sample		Temperature, °C								
		600			700			800		
		1	2	3	1	2	3	1	2	3
20%Ni/WC_IWI	Conv. of CO_2, %	34	36	28	52	46	40	64	66	52
	Conv. of CH_4, %	38	32	24	52	42	32	64	60	44
	H_2/CO ratio	0.44	0.43	0.39	0.47	0.43	0.42	0.54	0.55	0.39
20%Ni/WC_DP	Conv. of CO_2, %	50	50	40	74	72	58	94	92	88
	Conv. of CH_4, %	54	50	40	86	76	54	96	88	80
	H_2/CO ratio	0.59	0.63	0.56	0.97	0.82	0.66	1.00	0.87	0.79
19%Ni_1%Co/WC_IWI	Conv. of CO_2, %	38	32	24	58	48	38	66	64	54
	Conv. of CH_4, %	28	26	22	44	36	30	56	54	44
	H_2/CO ratio	0.45	0.42	0.46	0.48	0.43	0.41	0.56	0.50	0.41
19%Ni_1%Co/WC_DP	Conv. of CO_2, %	30	26	22	72	76	50	92	88	86
	Conv. of CH_4, %	26	24	20	76	74	46	94	86	76
	H_2/CO ratio	0.35	0.33	0.33	0.79	0.80	0.47	1.00	0.83	0.75
15%Ni_5%Co/WC_IWI	Conv. of CO_2, %	34	30	18	50	38	34	60	62	48
	Conv. of CH_4, %	28	24	20	44	36	30	54	54	42
	H_2/CO ratio	0.41	0.39	0.36	0.45	0.43	0.39	0.53	0.49	0.39
15%Ni_5%Co/WC_DP	Conv. of CO_2, %	32	28	24	62	60	36	88	82	68
	Conv. of CH_4, %	30	24	20	58	54	32	92	82	62
	H_2/CO ratio	0.43	0.39	0.43	0.61	0.59	0.42	0.83	0.80	0.63
10%Ni_10%Co/WC_IWI	Conv. of CO_2, %	30	24	18	36	34	26	56	52	44
	Conv. of CH_4, %	26	20	18	32	28	24	52	42	36
	H_2/CO ratio	0.40	0.36	0.44	0.39	0.38	0.35	0.47	0.41	0.39
10%Ni_10%Co/WC_DP	Conv. of CO_2, %	32	28	22	40	34	24	46	44	26
	Conv. of CH_4, %	26	22	20	30	24	20	36	34	20
	H_2/CO ratio	0.39	0.40	0.36	0.38	0.37	0.38	0.41	0.42	0.36
5%Ni_15%Co/WC_IWI	Conv. of CO_2, %	32	28	20	28	20	14	40	32	28
	Conv. of CH_4, %	26	18	18	24	18	14	34	28	24
	H_2/CO ratio	0.40	0.33	0.36	0.33	0.40	0.33	0.40	0.36	0.38
5%Ni_15%Co/WC_DP	Conv. of CO_2, %	30	28	22	40	32	24	48	46	24
	Conv. of CH_4, %	26	22	20	30	24	20	36	34	20
	H_2/CO ratio	0.39	0.40	0.36	0.39	0.37	0.38	0.43	0.42	0.36
1%Ni_19%Co/WC_IWI	Conv. of CO_2, %	32	22	14	18	2	2	16	12	10
	Conv. of CH_4, %	26	18	14	16	2	2	14	12	10
	H_2/CO ratio	0.33	0.36	0.29	0.20	1.00	1.00	0.39	0.33	0.5
1%Ni_19%Co/WC_DP	Conv. of CO_2, %	28	32	24	50	46	40	56	54	48
	Conv. of CH_4, %	30	26	20	40	36	32	44	40	38
	H_2/CO ratio	0.44	0.37	0.33	0.40	0.39	0.40	0.39	0.39	0.37

20%Co/WC_IWI	Conv. of CO_2, %	32	22	14	20	2	2	14	10	2
	Conv. of CH_4, %	28	16	12	14	2	2	12	10	2
	H_2/CO ratio	0.37	0.31	0.29	0.20	1.00	1.00	0.40	0.33	1.00
20%Co/WC_DP	Conv. of CO_2, %	34	34	24	52	46	38	56	54	46
	Conv. of CH_4, %	28	22	22	38	34	28	42	36	32
	H_2/CO ratio	0.42	0.37	0.29	0.40	0.36	0.33	0.39	0.39	0.35

Conv.—Conversion.