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The catalytic properties of the graphene oxide / palladium composites as the function of the fabrication method

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Table S1. The contaminants in the used reagents:

Sulfuric acid (98%)	hydrochloric acid (35%)	potassium permanganate	hydrazine sulfate	Graphite flakes
Mass fraction of chlorides (Cl),%, no more than 0.00002	Mass fraction of sulfites (SO3),%, no more than 0,0002	Mass fraction of manganese oxide (MnO2) no more than 0.2%	Chlorides (Cl),%, no more than 0,0005	Ash content, not more than 13%
Mass fraction of nitrates (NO3),%, no more than 0.00002	Mass fraction of sulfates (SO4),%, no more than 0,0002	Mass fraction of sulfates no more than 0,01%	Iron (Fe),%, no more than 0,0005	SiO_2 5 – 13 %
Mass fraction of ammonium salts (NH4),%, no more than 0,0001	Mass fraction of free chlorine (Cl),%, no more than 0,00005	Mass fraction of chlorides and chlorates no more than 0,01%	Heavy metals (Pb),%, no more than 0,0005	
Mass fraction of iron (Fe),%, no more than 0,00002	Mass fraction of ammonium salts (NH4),%, not less than 0,0003			
Mass fraction of arsenic (As),%, no more than 0,000001	Mass fraction of heavy metals (Pb),%, no more than 0,00005			
Mass fraction of substances reducing $KMnO_4$ (in terms of SO2),%, not more than 0,0002	Mass fraction of arsenic (As),%, no more than 0.000005			

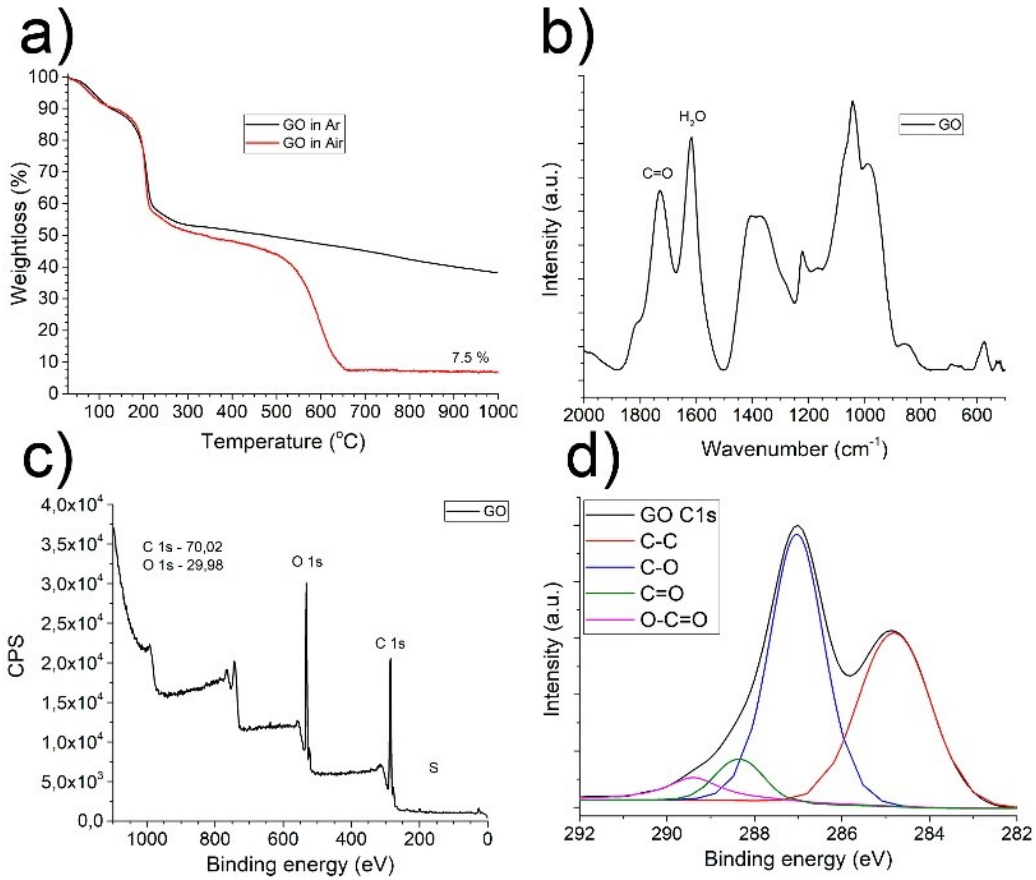

Fig. S1. a) TG analysis in argon and synthetic air of GO; b) FT-IR spectra of GO ; c) XPS survey spectra of GO ; d) C 1s XPS spectra of GO.

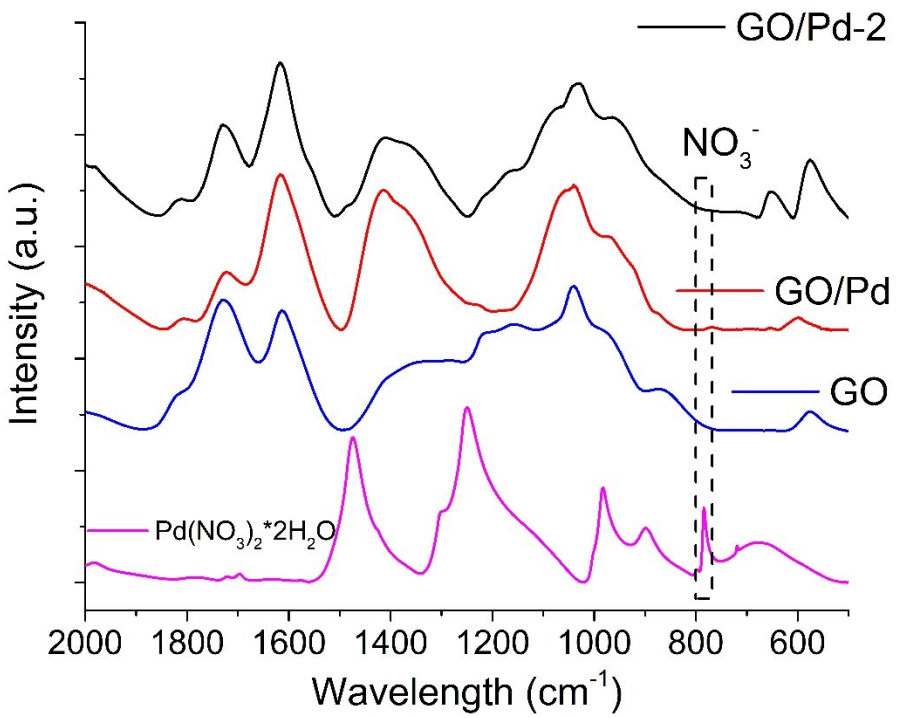

Fig. S2. The FTIR spectra of Initial GO, composites GO/Pd and GO/Pd-2, and palladium (II) nitrate for comparison purposes.

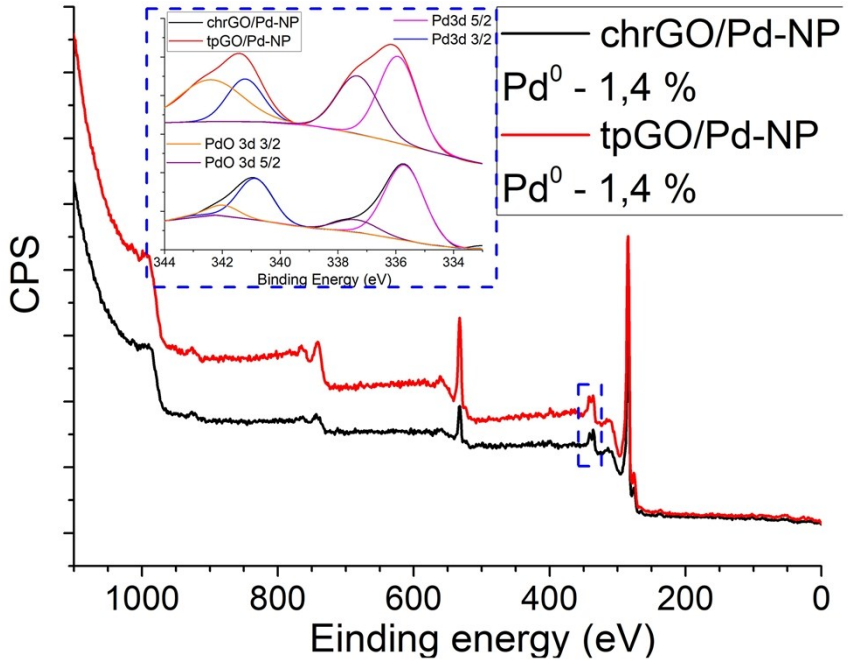

Fig S3. XPS survey spectra of chrGO/Pd-NP and tpGO/Pd-Np with palladium content

The analyzed gas chromatography method and products: methane, ethane, ethylene, acetylene, t-2-butene, 1-butene, c-2-butene, isopentane, 1,3-butadiene.

Table S2. The TOF values for all the tested samples.

Temperature	TOF ; h^{-1}				
	chrGO/Pd-NP	tpGO/Pd-NP	chrGO/Pd-NP-2		
			day-1 (400 ml)	day-2 (800 ml)	day-3 (400 ml)
30	239,11	5,27	336,93	495,93	174,71
35	241,31	0,00	336,93	425,89	
40	252,28	8,42	336,93	433,46	219,57

50	274,21	12,21		424,00	213,89
60	302,73	22,02		429,68	217,68
70	364,16	29,50		581,11	314,21
80	342,22	45,43		611,39	
90	350,99	65,93		495,93	174,71

Table S3. Study of tpGO/Pd-NP catalyst at a temperature of 30 °C. Ethylene-based feed mixture flow rate 400 ml

Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,08	10,19	10,11	10,19	10,18	10,16	10,16
ethane	2,14	28,80	31,09	32,80	32,35	33,08	33,73	32,61
ethylene	2,18	47997,83	48492,31	48029,87	48503,68	48505,53	48407,54	48387,79
acetylene	3,31	403,01	399,17	398,54	399,83	399,41	398,47	399,08
t-2-butene	4,36	0,16	0,35	0,37	0,39	0,40	0,42	0,38
1-butene	4,52	0,34	0,82	0,88	0,93	0,96	1.00	0,89
c-2-butene	4,92	0,14	0,14	0,15	0,14	0,14	0,14	0,14
isopentane	5,17	0,13	0,28	0,30	0,31	0,32	0,33	0,30
1,3-butadiene	8,22	0,548	0,728	0,742	0,763	0,766	0,78	0,75
The sum of the areas		48320,05	48935,11	48473,78	48948,62	48950,83	48852,59	48832,19
Conversion			0,95	1,11	0,79	0,89	1,13	0,97
Ethylene Growth			0,44	-0,66	-1,70	-2,06	-1,81	-1,15
Selectivity			11,58	-14,82	-53,37	-57,12	-39,72	-30,69

Table S4. Study of tpGO/Pd-NP catalyst at a temperature of 40 °C. Ethylene-based feed mixture flow rate 400 ml								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,08	10,189	10,16	10,19	10,18	10,20	10,18
ethane	2,14	28,80	36,68	36,59	37,45	37,43	37,85	37,20
ethylene	2,18	47997,83	48547,71	48484,70	48621,06	48579,74	48668,86	48580,41
acetylene	3,31	403,01	395,92	395,75	397,25	397,75	395,94	396,52
t-2-butene	4,36	0,16	0,511	0,51	0,52	0,52	0,53	0,52
1-butene	4,52	0,34	1,206	1,22	1,23	1,24	1,26	1,23
c-2-butene	4,92	0,14	0,15	0,1	0,14	0,14	0,14	0,14
isopentane	5,17	0,13	0,404	0,40	0,41	0,41	0,42	0,41
1,3-butadiene	8,22	0,54	0,884	0,88	0,89	0,88	0,88	0,88
The sum of the areas		48320,05	48993,65	48930,41	49069,18	49028,33	49116,11	49027,54
Conversion			1,76	1,80	1,43	1,30	1,76	1,61
Ethylene Growth			-2,70	-2,46	-4,88	-5,35	-4,01	-3,88
Selectivity			-38,05	-33,90	-84,70	-101,72	-56,64	-63,00

Table S5. Study of tpGO/Pd-NP catalyst at a temperature of 50 °C. Ethylene-based feed mixture flow rate 400 ml								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,08	10,18	10,24	10,22	10,24	10,22	10,22
ethane	2,14	28,80	41,25	40,52	40,45	41,47	41,80	41,10
ethylene	2,18	47997,83	48567,20	48695,03	48745,06	48800,58	48700,16	48701,61
acetylene	3,31	403,01	394,18	394,41	393,99	394,44	394,35	394,27
t-2-butene	4,36	0,16	0,63	0,63	0,64	0,64	0,64	0,64
1-butene	4,52	0,34	1,48	1,49	1,49	1,50	1,49	1,49
c-2-butene	4,92	0,14	0,15	0,15	0,15	0,15	0,14	0,15
isopentane	5,17	0,13	0,49	0,50	0,49	0,50	0,50	0,50

1,3-butadiene	8,22	0,54	1,00	0,99	0,99	0,99	0,98	0,99
The sum of the areas		48562,12	49016,58	49143,99	49193,51	49250,54	49150,31	49150,99
Conversion			2,19	2,14	2,24	2,13	2,15	2,17
Ethylene Growth			-6,14	-5,72	-5,21	-6,71	-6,91	-6,13
Selectivity			-69,45	-66,45	-57,75	-78,37	-79,79	-70,36

Table S6. Study of tpGO/Pd-NP catalyst at a temperature of 60 °C. Ethylene-based feed mixture flow rate 400 ml								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,19	10,23	10,26	10,28	10,29	10,15	10,24
ethane	2,14	27,84	45,63	46,36	47,14	47,37	47,60	46,82
ethylene	2,18	48526,37	48857,99	48939,05	48802,51	49134,81	49073,88	48961,65
acetylene	3,31	405,09	387,56	388,01	388,68	389,79	389,32	388,67
t-2-butene	4,36	0,16	0,77	0,79	0,80	0,82	0,82	0,80
1-butene	4,52	0,35	1,74	1,79	1,82	1,84	1,85	1,81
c-2-butene	4,92	0,14	0,14	0,15	0,15	0,15	0,15	0,15
isopentane	5,17	0,13	0,60	0,61	0,62	0,63	0,64	0,62
1,3-butadiene	8,22	0,52	1,11	1,11	1,12	1,13	1,14	1,12
The sum of the areas		48938,74	49305,82	49388,17	49253,17	49586,88	49525,57	49411,92
Conversion			4,33	4,22	4,05	3,78	3,89	4,05
Ethylene Growth			-3,37	-4,65	-6,20	-7,60	-7,23	-5,81
Selectivity			-19,23	-27,23	-37,80	-49,69	-45,84	-35,95

Table S7. Study of tpGO/Pd-NP catalyst at a temperature of 70 °C. Ethylene-based feed mixture flow rate 400 ml								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,19	10,30	10,30	10,30	10,31	10,35	10,31
ethane	2,14	27,84	53,63	54,21	54,39	54,78	53,93	54,19
ethylene	2,18	48526,37	49060,37	49396,43	49100,26	49248,50	49456,80	49252,47
acetylene	3,31	405,09	384,15	383,15	383,44	384,01	384,09	383,77
t-2-butene	4,36	0,16	1,05	1,06	1,07	1,09	1,11	1,07
1-butene	4,52	0,35	2,28	2,32	2,35	2,38	2,42	2,35
c-2-butene	4,92	0,14	0,15	0,15	0,15	0,15	0,15	0,15
isopentane	5,17	0,13	0,80	0,81	0,82	0,83	0,84	0,82
1,3-butadiene	8,22	0,52	1,35	1,36	1,37	1,39	1,41	1,38
The sum of the areas		48938,74	49514,12	49849,83	49554,18	49703,46	49911,13	49706,54
Conversion			5,17	5,42	5,34	5,20	5,18	5,262
Ethylene Growth			-9,29	-8,95	-9,46	-10,50	-9,87	-9,614
Selectivity			-44,36	-40,78	-43,69	-49,82	-47,00	-45,13

Table S8. Study of tpGO/Pd-NP catalyst at a temperature of 80 °C. Ethylene-based feed mixture flow rate 400 ml								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,19	62,84	63,05	63,45	63,30	64,34	63,40
ethane	2,14	27,84	49302,36	49374,8	49264,06	49269,84	48991,79	49240,58
ethylene	2,18	48526,37	373,26	374,36	373,43	370,98	372,31	372,87
acetylene	3,31	405,09	1,44	1,46	1,47	1,48	1,48	1,47
t-2-butene	4,36	0,16	3,07	3,10	3,13	3,17	3,18	3,13
1-butene	4,52	0,35	0,15	0,15	0,15	0,15	0,15	0,15
c-2-butene	4,92	0,14	1,09	1,11	1,12	1,13	1,13	1,11
isopentane	5,17	0,13	1,74	1,74	1,75	1,77	1,79	1,76

1,3-butadiene	8,22	0,52	62,84	63,05	63,45	63,30	64,34	63,40
The sum of the areas		48938,74	49756,31	49830,18	49718,91	49722,18	49446,50	49694,82
Conversion			7,86	7,59	7,82	8,42	8,09	7,95
Ethylene Growth			-9,49	-10,88	-10,39	-7,87	-10,25	-9,77
Selectivity			-29,81	-35,42	-32,82	-23,08	-31,28	-30,48

Table S10. Study of tpGO/Pd-NP catalyst at a temperature of 90 °C. Ethylene-based feed mixture flow rate 400 ml

Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,19	10,32	10,28	10,28	10,29	10,32	10,30
ethane	2,14	27,84	73,07	75,45	74,42	76,29	76,28	75,10
ethylene	2,18	48526,37	49418,79	49223,70	49246,06	49229,78	49252,55	49274,18
acetylene	3,31	405,09	359,75	357,24	356,97	357,84	357,60	357,88
t-2-butene	4,36	0,16	1,96	1,96	1,97	1,98	1,99	1,97
1-butene	4,52	0,35	4,06	4,07	4,10	4,12	4,16	4,10
c-2-butene	4,92	0,14	0,15	0,15	0,16	0,16	0,15	0,15
isopentane	5,17	0,13	1,48	1,48	1,49	1,51	1,51	1,49
1,3-butadiene	8,22	0,52	2,29	2,28	2,29	2,30	2,31	2,29
The sum of the areas		48938,74	49871,92	49676,64	49697,77	49684,31	49706,91	49727,51
Conversion			11,19	11,81	11,88	11,66	11,72	11,652
Ethylene Growth			-8,67	-8,49	-7,26	-10,06	-9,90	-8,87
Selectivity			-19,12	-17,74	-15,08	-21,30	-20,84	-18,81

Table S11. Study of chrGO/Pd-NP-2 catalyst at a temperature of 30 °C. Ethylene-based feed mixture flow rate 400 ml. Day-1								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,19	10,15	10,19	10,21	10,25	10,24	10,21
ethane	2,13	27,84	162,09	161,13	163,96	158,61	158,40	160,84
ethylene	2,17	48526,37	49034,93	49077,84	49103,97	49226,46	49194,63	49127,57
acetylene	3,18	405,09	0,50	0,13	0,03	$6{,}00\times10^{-3}$	$3{,}15\times10^{-3}$	0,13
t-2-butene	4,12	0,16	38,03	36,27	34,42	32,68	30,94	34,47
1-butene	4,26	0,35	25,08	28,27	31,09	33,49	35,50	30,68
c-2-butene	4,60	0,14	0,19	0,19	0,193	0,19	0,19	0,19
isopentane	4,82	0,13	25,14	23,59	22,10	20,73	19,48	22,21
1,3-butadiene	7,53	0,52	$4{,}38\times10^{-3}$	0,01	0,031	0,08	0,20	0,06
The sum of the areas		48087,82	49296,14	49337,65	49366,02	49482,52	49449,62	49386,39
Conversion			99,88	99,97	99,99	100,00	100,00	99,96
Ethylene Growth			181,70	183,10	180,86	186,85	187,92	184,08
Selectivity			43,96	44,26	43,71	45,15	45,41	44,49

Table S12. Study of chrGO/Pd-NP-2 catalyst at a temperature of 35 °C. Ethylene-based feed mixture flow rate 400 ml. Day-1								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,19	10,25	10,25	10,25	10,22	10,23	10,24
ethane	2,13	27,84	151,50	152,00	152,46	150,36	150,35	151,33
ethylene	2,17	48526,37	49326,13	49344,20	49398,49	49143,15	49307,85	49303,96
acetylene	3,17	405,09	$1{,}88\times10^{-4}$	$2{,}51\times10^{-3}$	$4{,}18\times10^{-3}$	$2{,}66\times10^{-4}$	$3{,}96\times10^{-4}$	$0{,}16\times10^{-3}$
t-2-butene	4,12	0,161	24,274	23,75	23,26	22,65	22,12	23,21
1-butene	4,25	0,355	39,704	39,62	39,55	39,24	39,05	39,43
c-2-butene	4,60	0,148	0,192	0,19	0,19	0,20	0,20	0,19
isopentane	4,82	0,133	15,064	14,84	14,56	14,21	13,90	14,51

1,3-butadiene	7,40	0,529	1,87	2,64	3,28	3,94	4,60	3,26
The sum of the areas		48087,82	49569,00	49587,53	49642,08	49384,01	49548,32	49546,19
Conversion			100,00	100,00	100,00	100,00	100,00	100
Ethylene Growth			200,04	199,58	199,32	202,05	202,44	200,68
Selectivity			48,34	48,23	48,17	48,83	48,92	48,49

Table S13. Study of chrGO/Pd-NP-2 catalyst at a temperature of 40 °C. Ethylene-based feed mixture flow rate 400 ml. Day-1

Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	9,99	10,22	10,19	10,20	10,17	10,16	10,19
ethane	2,13	17,97	149,10	150,11	150,84	148,17	146,24	148,89
ethylene	2,17	47622,53	49089,61	48993,1	49017,17	48862,7	48848,83	48962,28
acetylene	3,18	413,81	1,91E-03	----	----	0,005	0,04	0,009
t-2-butene	4,12	0,11	19,98	19,56	19,08	18,62	18,21	19,09
1-butene	4,25	0,21	37,81	37,47	37,26	36,95	36,81	37,26
c-2-butene	4,60	0,14	0,21	0,20	0,207	0,20	0,20	0,20
isopentane	4,83	0,09	13,20	12,95	12,69	12,39	12,14	12,67
1,3-butadiene	7,4	0,55	1,87	2,64	3,28	3,94	4,60	3,26
The sum of the areas		48043,07	49326,15	49230,13	49254,44	49096,57	49080,37	49197,53
Conversion			100,00	100,00	100,00	100,00	99,99	99,99
Ethylene Growth			206,37	205,88	205,64	209,04	211,38	207,66
Selectivity			49,87	49,75	49,69	50,52	51,09	50,18

Table S14. Study of chrGO/Pd-NP-2 catalyst at a temperature of 30 °C. Ethylene-based feed mixture flow rate 800 ml. Day-2

Products	Time (h)	Peak area						
		feed mixture	measurement	measurement	measurement	measurement	measurement	measurement

			1	2	3	4	5	average
methane	2,06	9,98	10,08	10,12	10,13	10,16	10,141	10,13
ethane	2,13	14,44	132,47	134,30	132,75	130,29	132,989	132,56
ethylene	2,17	47944,42	48520,61	48488,75	48665,67	48650,48	48683,09	48601,72
acetylene	3,14	417,30	77,54	87,12	94,64	115,385	122,01	99,34
t-2-butene	4,11	0,13	14,21	13,32	12,53	10,837	10,298	12,23
1-butene	4,24	0,23	31,07	29,87	28,60	25,968	25,055	28,11
c-2-butene	4,58	0,14	0,18	0,18	0,17	0,165	0,175	0,17
isopentane	4,80	0,10	8,81	8,44	8,14	7,479	7,291	8,03
1,3-butadiene	7,32	0,40	11,02	11,77	12,15	12,596	12,798	12,06
The sum of the areas		48430,14	48806,01	48783,89	48964,81	48963,37	49003,85	48904,39
Conversion			81,42	79,12	77,32	72,35	70,76	76,19
Ethylene Growth			157,35	147,61	143,62	129,87	122,00	140,09
Selectivity			46,31	44,71	44,51	43,02	41,32	43,97

Table S15. Study of chrGO/Pd-NP-2 catalyst at a temperature of 35 °C. Ethylene-based feed mixture flow rate 800 ml. Day-2								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,07	9,98	10,17	10,16	10,18	10,17	10,18	10,17
ethane	2,14	14,44	143,40	143,26	143,90	145,43	145,84	144,37
ethylene	2,18	47944,42	48603,89	48662,76	48441,64	48832,34	48673,07	48642,74
acetylene	3,16	417,30	143,26	147,53	151,15	154,06	157,10	150,62
t-2-butene	4,13	0,13	8,80	8,65	8,52	8,40	8,26	8,52
1-butene	4,27	0,23	23,16	22,87	22,61	22,30	21,99	22,59
c-2-butene	4,61	0,14	0,17	0,17	0,17	0,17	0,17	0,17
isopentane	4,84	0,10	6,80	6,68	6,63	6,56	6,46	6,63
1,3-butadiene	7,42	0,40	10,64	10,35	10,09	9,82	9,55	10,09
The sum of the areas		48430,14	48950,32	49012,47	48794,93	49189,27	49032,65	48995,93

Conversion			65,67	64,65	63,78	63,08	62,35	63,906
Ethylene Growth			96,33	93,05	89,47	85,83	83,18	89,57
Selectivity			35,15	34,49	33,62	32,60	31,97	33,56

Table S16. Study of chrGO/Pd-NP-2 catalyst at a temperature of 40 °C. Ethylene-based feed mixture flow rate 800 ml. Day-2								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	9,98	10,19	10,21	10,21	10,20	10,20	10,20
ethane	2,13	14,44	147,92	151,09	151,16	154,43	152,41	151,40
ethylene	2,17	47944,42	48755,87	48803,05	48789,21	48725,04	48770,5	48768,74
acetylene	3,17	417,30	141,84	144,15	146,78	148,87	152,13	146,76
t-2-butene	4,14	0,13	8,79	8,72	8,64	8,56	8,48	8,64
1-butene	4,28	0,23	23,96	23,85	23,65	23,49	23,34	23,66
c-2-butene	4,63	0,14	0,17	0,17	0,16	0,16	0,16	0,17
isopentane	4,85	0,10	6,98	6,92	6,81	6,78	6,73	6,84
1,3-butadiene	7,45	0,40	9,29	9,11	8,91	8,78	8,62	8,94
The sum of the areas		48430,14	49105,06	49157,31	49145,57	49086,34	49032,65	49105,39
Conversion			66,01	65,46	64,83	64,32	63,54	64,83
Ethylene Growth			93,57	88,50	86,40	81,46	80,64	86,11
Selectivity			33,97	32,40	31,94	30,35	30,41	31,81

Table S17. Study of chrGO/Pd-NP-2 catalyst at a temperature of 45 °C. Ethylene-based feed mixture flow rate 800 ml. Day-2								
Products	Time (h)	Peak area						
		feed mixture	measurement	measurement	measurement	measurement	measurement	measurement

			1	2	3	4	5	average
methane	2,06	9,98	10,247	10,23	10,22	10,23	10,15	10,22
ethane	2,13	14,44	157,59	159,66	160,82	160,66	160,49	159,84
ethylene	2,17	47944,42	48914,85	48853,42	48911,86	48897,07	48724,56	48860,35
acetylene	3,18	417,30	133,55	134,60	137,83	140,53	141,60	137,62
t-2-butene	4,15	0,13	9,01	8,93	8,88	8,80	8,73	8,87
1-butene	4,292	0,23	25,29	25,08	25,13	24,99	24,82	25,06
c-2-butene	4,64	0,14	0,17	0,17	0,17	0,16	0,16	0,17
isopentane	4,87	0,10	7,22	7,17	7,14	7,07	7,05	7,13
1,3-butadiene	7,49	0,40	8,62	8,51	8,45	8,31	8,30	8,44
The sum of the areas		48430,14	49266,57	49207,81	49270,55	49257,86	49085,90	49217,74
Conversion			68,00	67,74	66,97	66,32	66,07	67,02
Ethylene Growth			91,04	88,36	84,07	81,96	81,42	85,37
Selectivity			32,09	31,26	30,08	29,61	29,53	30,51

Table S18. Study of chrGO/Pd-NP-2 catalyst at a temperature of 50 °C. Ethylene-based feed mixture flow rate 800 ml. Day-2

Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,13	10,21	10,23	10,23	10,22	10,26	10,23
ethane	2,13	16,80	164,92	162,80	161,25	165,28	165,99	164,05
ethylene	2,17	47920,07	48697,34	48767,77	48811,76	48750,70	48888,88	48783,29
acetylene	3,18	419,10	120,36	122,10	125,29	126,90	128,69	124,67
t-2-butene	4,15	0,13	9,149	9,07	9,06	9,00	8,97	9,05
1-butene	4,29	0,23	26,45	26,34	26,3	26,14	26,16	26,28
c-2-butene	4,64	0,14	0,18	0,18	0,18	0,17	0,17	0,17
isopentane	4,87	0,10	7,50	7,49	7,44	7,40	7,38	7,44
1,3-butadiene	7,50	0,42	8,42	8,47	8,49	8,47	8,48	8,47
The sum of the areas		48430,14	49044,57	49114,47	49160,07	49104,31	49245,03	49133,69

Conversion			71,28	70,87	70,10	69,72	69,29	70,25
Ethylene Growth			99,84	100,36	98,76	93,46	90,92	96,66
Selectivity			33,42	33,79	33,61	31,98	31,31	32,82

Table S19. Study of chrGO/Pd-NP-2 catalyst at a temperature of 55 °C. Ethylene-based feed mixture flow rate 800 ml. Day-2

Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,13	10,22	10,23	10,23	10,22	10,24	10,23
ethane	2,13	16,80	168,90	165,07	167,90	166,88	166,72	167,10
ethylene	2,18	47920,07	48818,92	48792,52	48805,46	48784,09	48866,23	48813,44
acetylene	3,19	419,10	106,58	108,03	108,14	109,10	109,83	108,33
t-2-butene	4,16	0,13	9,46	9,42	9,33	9,34	9,32	9,37
1-butene	4,30	0,23	27,73	27,75	27,69	27,61	27,60	27,68
c-2-butene	4,65	0,14	0,18	0,18	0,17	0,17	0,17	0,17
isopentane	4,88	0,10	7,88	7,85	7,81	7,74	7,76	7,81
1,3-butadiene	7,52	0,42	8,74	8,71	8,75	8,75	8,76	8,74
The sum of the areas		48430,14	49158,66	49129,79	49145,51	49123,96	49206,68	49152,92
Conversion			74,57	74,22	74,20	73,97	73,79	74,15
Ethylene Growth			107,33	109,80	107,01	107,20	106,62	107,59
Selectivity			34,34	35,30	34,41	34,58	34,47	34,62

Table S20. Study of chrGO/Pd-NP-2 catalyst at a temperature of 60 °C. Ethylene-based feed mixture flow rate 800 ml. Day-2

Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average

methane	2,06	10,13	10,11	10,29	10,25	10,24	10,22	10,22
ethane	2,13	16,80	170,65	170,64	167,62	170,68	173,26	170,57
ethylene	2,18	47920,07	48825,44	49074,07	48935,44	48855,17	48770,26	48892,08
acetylene	3,20	419,10	92,83	88,57	93,33	88,55	93,94	91,45
t-2-butene	4,17	0,13	9,75	9,73	9,70	9,66	9,62	9,69
1-butene	4,31	0,23	29,17	29,27	29,14	29,03	28,94	29,11
c-2-butene	4,66	0,14	0,18	0,19	0,19	0,19	0,20	0,19
isopentane	4,89	0,10	8,25	8,27	8,19	8,16	8,13	8,20
1,3-butadiene	7,56	0,42	8,96	9,08	8,96	8,96	8,95	8,98
The sum of the areas		49155,38	49400,16	49262,86	49180,69	49103,55	49155,38	49220,53
Conversion			77,85	78,86	77,73	78,87	77,58	78,17
Ethylene Growth			117,13	120,98	119,65	121,55	113,78	118,61
Selectivity			35,90	36,60	36,73	36,77	34,99	36,19

Table S21 Study of chrGO/Pd-NP-2 catalyst at a temperature of 70 °C. Ethylene-based feed mixture flow rate 800 ml. Day-2

Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,13	10,24	10,25	10,25	10,25	10,25	10,25
ethane	2,13	16,80	173,25	175,08	173,04	173,76	175,24	174,07
ethylene	2,18	47920,07	48870,34	48864,05	48929,75	48766,73	48873,33	48860,84
acetylene	3,21	419,10	57,49	57,44	57,92	58,36	58,85	58,01
t-2-butene	4,18	0,13	10,39	10,36	10,34	10,31	10,27	10,33
1-butene	4,32	0,23	31,76	31,66	31,55	31,47	31,38	31,56
c-2-butene	4,67	0,14	0,21	0,22	0,25	0,24	0,24	0,23
isopentane	4,90	0,10	9,22	9,20	9,13	9,12	9,09	9,15
1,3-butadiene	7,58	0,42	9,10	9,12	9,11	9,04	9,04	9,08
The sum of the areas		49155,38	49172,04	49167,41	49231,37	49069,29	49177,75	49163,57
Conversion			86,28	86,29	86,18	86,07	85,96	86,15

Ethylene Growth			145,37	143,71	145,44	144,51	142,65	144,33
Selectivity			40,20	39,74	40,27	40,06	39,60	39,97

Table S22. Study of chrGO/Pd-NP-2 catalyst at a temperature of 80 °C. Ethylene-based feed mixture flow rate 800 ml. Day-2								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	10,13	10,26	10,28	10,29	10,30	10,29	10,28
ethane	2,13	16,80	177,35	178,00	175,94	177,52	179,68	177,70
ethylene	2,18	47920,07	48934,06	49054,33	48998,13	49086,74	48993,76	49013,40
acetylene	3,22	419,10	37,99	38,61	39,19	39,67	40,10	39,11
t-2-butene	4,18	0,13	10,59	10,56	10,53	10,52	10,46	10,53
1-butene	4,32	0,23	32,82	32,79	32,63	32,62	32,50	32,67
c-2-butene	4,68	0,14	0,23	0,24	0,26	0,25	0,25	0,25
isopentane	4,92	0,10	10,16	10,17	10,12	10,10	10,10	10,13
1,3-butadiene	7,61	0,42	8,79	8,82	8,82	8,87	8,89	8,84
The sum of the areas		49155,38	49222,30	49343,84	49285,94	49376,62	49286,05	49302,95
Conversion			90,93	90,79	90,65	90,53	90,43	90,66
Ethylene Growth			158,83	157,56	159,26	157,19	154,77	157,52
Selectivity			41,68	41,41	41,92	41,43	40,84	41,45

Table S23. Study of chrGO/Pd-2 catalyst at a temperature of 30 °C. Ethylene-based feed mixture flow rate 400 ml. Day-3		
Products	Time	Peak area

	(h)	feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	9,91	9,84	10,07	10,10	10,10	10,12	10,05
ethane	2,13	17,86	179,09	182,15	182,83	186,97	184,67	183,14
ethylene	2,18	47417,43	46701,28	47860,56	47988,39	47966,44	48114,21	47726,18
acetylene	3,20	415,40	198,71	200,76	200,44	201,46	199,96	200,27
t-2-butene	4,18	0,18	5,606	5,98	6,098	6,147	6,18	6,00
1-butene	4,32	0,32	16,01	17,01	17,28	17,50	17,59	17,0
c-2-butene	4,68	0,14	0,16	0,16	0,17	0,18	0,17	0,17
isopentane	4,91	0,13	4,73	5,01	5,07	5,12	5,14	5,01
1,3-butadiene	7,59	0,54	5,57	5,99	6,10	6,16	6,22	6,01
The sum of the areas		47861,95	47121,03	48287,73	48416,51	48400,12	48544,31	48153,94
Conversion			52,16	51,67	51,75	51,50	51,86	51,78
Ethylene Growth			24,77	17,35	16,40	10,85	14,42	16,75
Selectivity			11,43	8,08	7,63	5,07	6,69	7,78

Table S24. Study of chrGO/Pd-2 catalyst at a temperature of 40 °C. Ethylene-based feed mixture flow rate 400 ml. Day-3

Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	9,91	10,18	10,19	10,17	10,14	10,12	10,16
ethane	2,13	17,86	184,88	185,89	185,32	185,02	185,39	185,30
ethylene	2,17	47417,43	48527,07	48538,95	48313,49	48181,77	48272,89	48366,83
acetylene	3,21	415,40	148,42	147,59	145,73	145,38	144,38	146,30
t-2-butene	4,18	0,18	7,87	7,88	7,87	7,87	7,86	7,87
1-butene	4,32	0,32	23,14	23,25	23,23	23,34	23,40	23,27
c-2-butene	4,68	0,14	0,17	0,18	0,18	0,18	0,17	0,17
isopentane	4,91	0,13	6,68	6,67	6,65	6,65	6,64	6,66
1,3-butadiene	7,61	0,54	8,11	8,14	8,18	8,20	8,22	8,174
The sum of		47861,95	48916,55	48928,77	48700,86	48568,60	48659,11	48754,78

the areas								
Conversion			64,27	64,47	64,92	65,00	65,24	64,78
Ethylene Growth			55,04	54,70	57,15	57,69	58,30	56,576
Selectivity			20,61	20,42	21,19	21,36	21,51	21,018

Table S25. Study of chrGO/Pd-2 catalyst at a temperature of 50 °C. Ethylene-based feed mixture flow rate 400 ml. Day-3								
Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	9,91	10,14	10,15	10,12	10,15	10,13	10,14
ethane	2,13	17,86	187,56	181,54	185,62	185,36	183,39	184,69
ethylene	2,17	47417,43	48355,09	48386,49	48301,09	48369,15	48268,03	48335,97
acetylene	3,22	415,40	93,48	93,30	92,47	92,18	91,90	92,67
t-2-butene	4,19	0,18	9,32	9,32	9,29	9,30	9,29	9,30
1-butene	4,33	0,32	28,46	28,53	28,54	28,62	28,60	28,55
c-2-butene	4,69	0,14	0,19	0,19	0,18	0,18	0,18	0,18
isopentane	4,92	0,13	8,06	8,06	8,05	8,07	8,08	8,06
1,3-butadiene	7,63	0,54	9,64	9,64	9,67	9,69	9,69	9,67
The sum of the areas		47861,95	48701,97	48727,26	48645,05	48712,74	48609,33	48679,27
Conversion			77,49	77,54	77,74	77,81	77,88	77,692
Ethylene Growth			97,64	103,75	100,55	100,93	103,22	101,21
Selectivity			30,33	32,21	31,14	31,23	31,91	31,36

Table S26. Study of chrGO/Pd-2 catalyst at a temperature of 60 °C. Ethylene-based feed mixture flow rate 400 ml. Day-3		
Products	Time	Peak area

	(h)	feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	9,91	10,13	10,12	10,13			10,13
ethane	2,14	17,86	183,06	184,00	183,04			183,3
ethylene	2,18	47417,43	48380,42	48234,91	48169,73			48261,69
acetylene	3,24	415,40	52,10	51,98	52,10			52,06
t-2-butene	4,20	0,18	10,39	10,37	10,40			10,39
1-butene	4,35	0,32	32,64	32,61	32,50			32,58
c-2-butene	4,71	0,14	0,21	0,20	0,20			0,20
isopentane	4,94	0,13	9,21	9,21	9,21			9,21
1,3-butadiene	7,63	0,54	10,09	10,05	9,96			10,03
The sum of the areas		47861,95	48688,29	48543,50	48477,28			48569,69
Conversion			87,46	87,48	87,46			87,46
Ethylene Growth			136,65	135,93	136,97			136,51
Selectivity			37,61	37,40	37,70			37,57

Table S27. Study of chrGO/Pd-2 catalyst at a temperature of 70 °C. Ethylene-based feed mixture flow rate 400 ml. Day-3

Products	Time (h)	Peak area						
		feed mixture	measurement 1	measurement 2	measurement 3	measurement 4	measurement 5	measurement average
methane	2,06	9,91	10,18	10,16	10,14	10,11	10,15	10,15
ethane	2,13	17,86	183,93	184,87	185,10	183,46	184,63	184,40
ethylene	2,17	47417,43	48261,07	48218,50	48436,72	48462,97	48443,90	48364,63
acetylene	3,24	415,40	27,90	28,01	28,22	28,48	28,68	28,26
t-2-butene	4,20	0,18	10,99	10,94	10,96	11,00	10,95	10,97
1-butene	4,3	0,32	34,69	34,68	34,51	34,49	34,44	34,56
c-2-butene	4,719	0,14	0,24	0,23	0,23	0,22	0,23	0,23
isopentane	4,95	0,13	10,34	10,27	10,28	10,27	10,28	10,29
1,3-butadiene	7,69	0,54	9,43	9,41	9,27	9,28	9,27	9,33
The sum of		47861,95	48548,79	48507,10	48725,47	48750,32	48732,57	48652,85

the areas								
Conversion			93,28	93,25	93,21	93,14	93,09	93,19
Ethylene Growth			156,79	155,92	155,77	157,18	155,85	156,30
Selectivity			40,46	40,25	40,23	40,62	40,30	40,37