Electronic Supporting Information (ESI) for

Improvement of dye-sensitized solar cells toward the broader light harvesting of solar spectrum†

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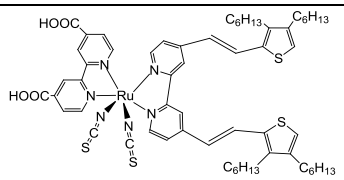
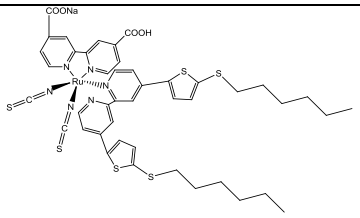
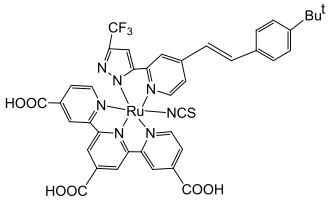
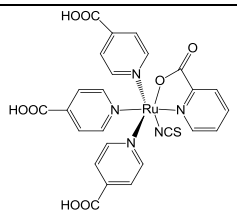
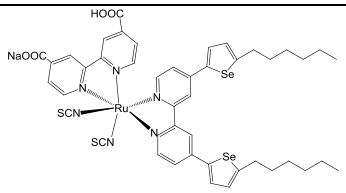
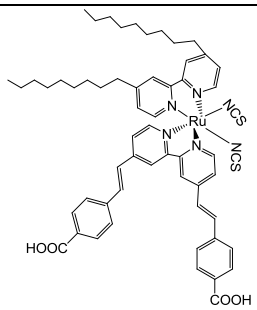
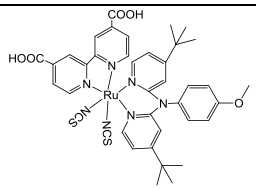
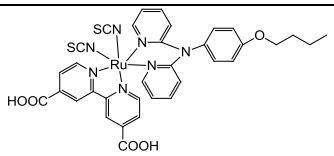
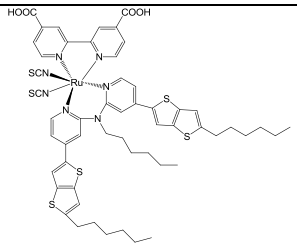
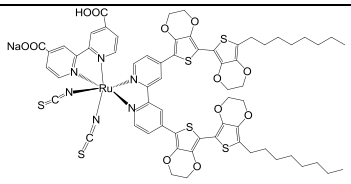
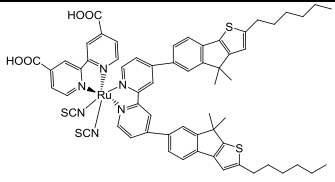
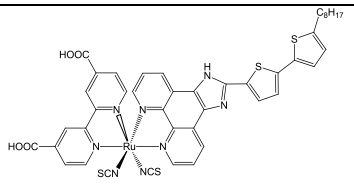
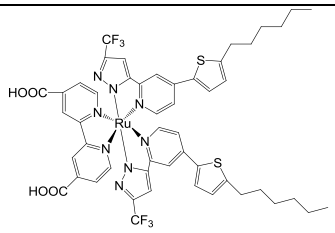
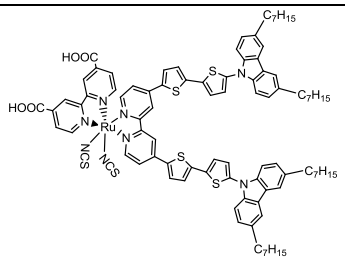
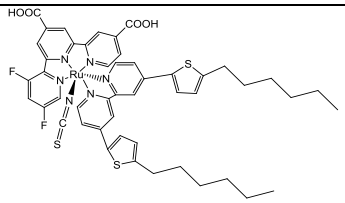
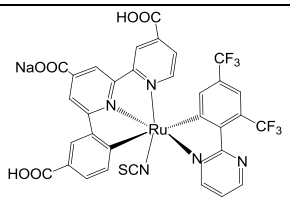
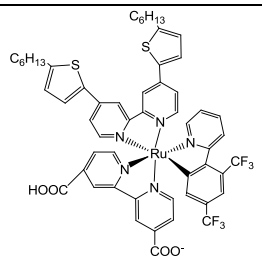
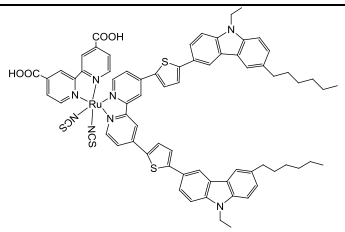
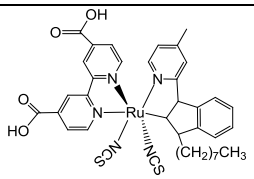
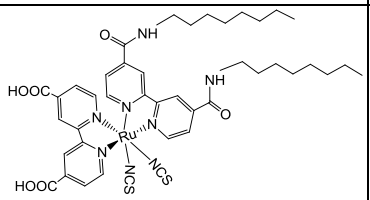
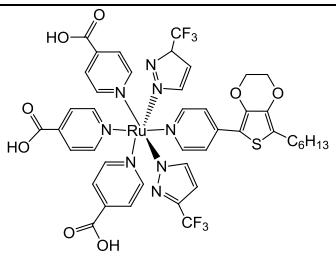
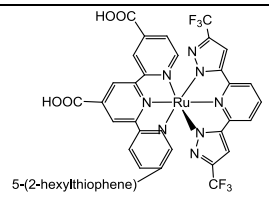
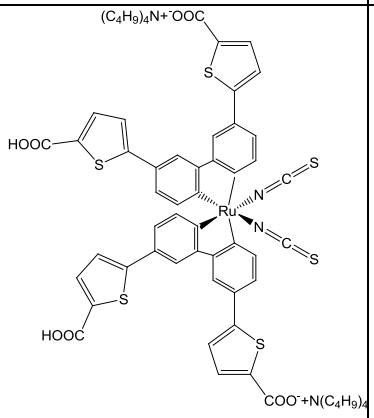
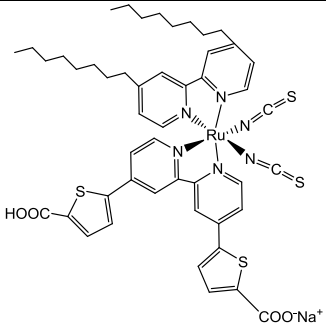
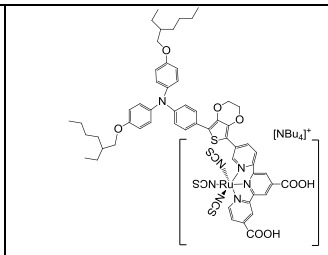
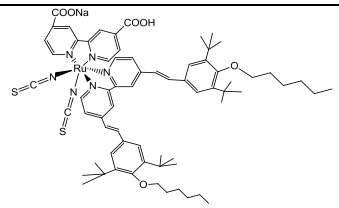
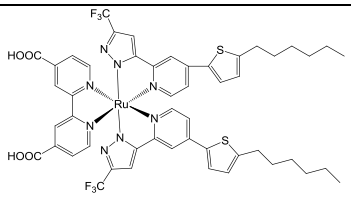
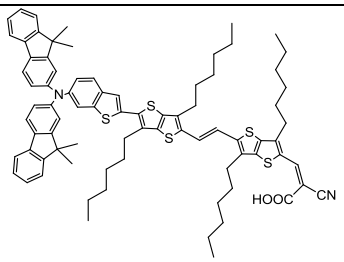
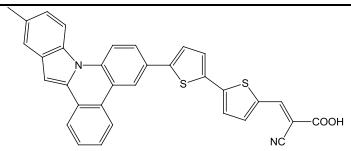
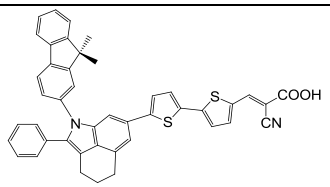
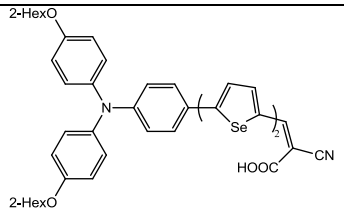
Table1. List of the most efficient dyes tested in dye-sensitized solar cells. The bar chart representation is shown in the manuscript. (R- Ruthenium based dyes, O- Organic dyes and P- Porphyrin dyes).

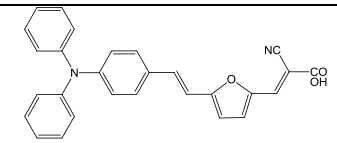
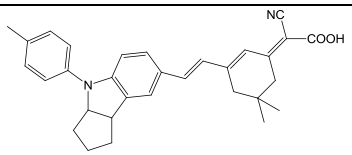
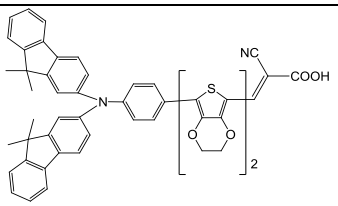
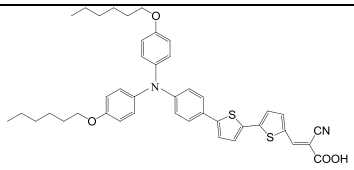
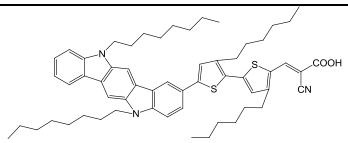
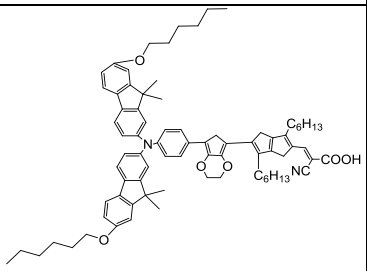
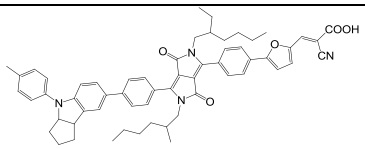
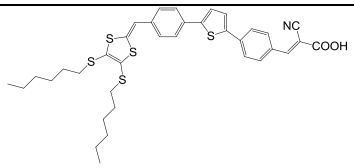
No.	Compound	Wavelength (nm)	λmax/nm ($\varepsilon M^{-1}cm^{-1}$)	Jsc [mA/cm^2]	Voc [V]	FF	PCE [%]	Ref.
R1		350~700	546(21700)	14.7	0.756	0.695	7.70	1
R2		350-750	550(18700)	18.28	0.749	0.772	10.57	2
R3		350-800	424(16600) 519(12200)	21.6	0.714	0.652	10.05	3
R4		350-800	518(6500)	19.81	0.677	0.721	9.66	4

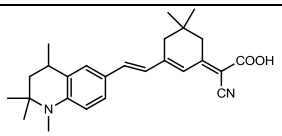
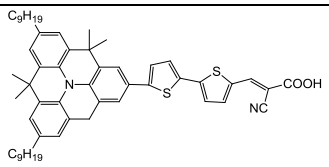
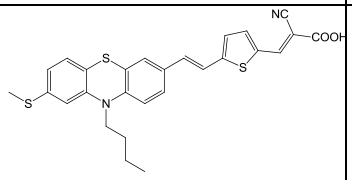
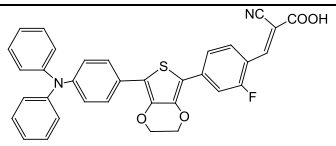
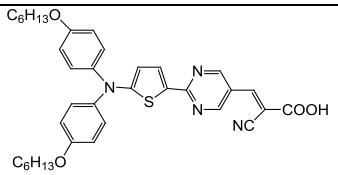
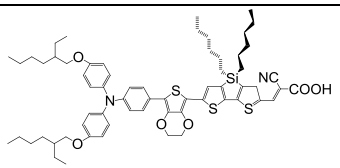
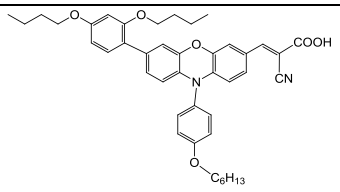
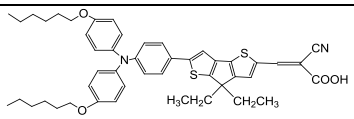
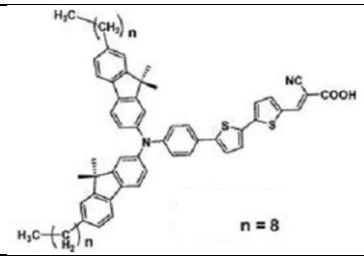
R5		350-800	550(18400)	18.09	0.748	0.744	10.06	5
R6		350-725	433(17500) 533(17400)	15.73	0.708	0.669	7.45	6
R7		350-700	381(14700) 514(9600)	17.3	0.64	0.65	7.2	7
R8		350-650	377(N/A), 505(N/A)	15.65	0.703	0.712	7.83	8
R9		350-700	418(27340) 525(15580)	18.32	0.68	0.72	9.03	9
R10		350-700	550(20500)	18.35	0.760	0.748	10.4	10
R11		350~700	378(42600) 522(15640)	18.60	0.72	0.71	9.54	11

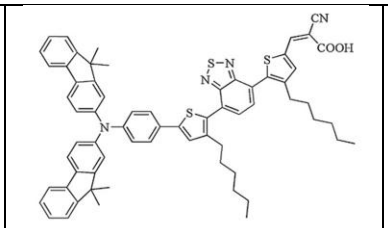
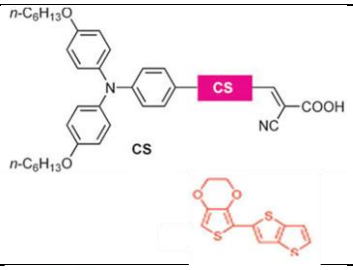
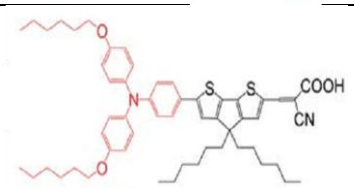
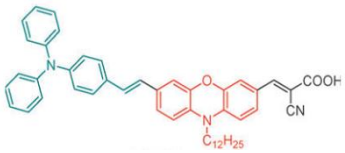
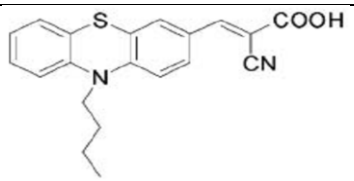
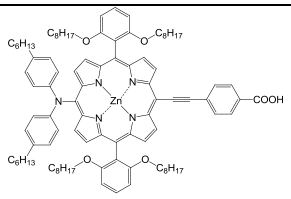
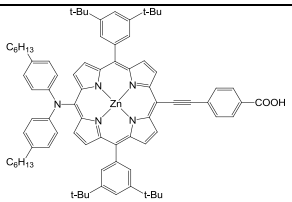
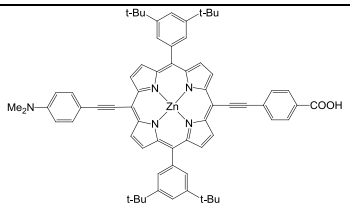
R12		350~700	383(39500) 520(12600)	18.3	0.73	0.71	9.5	12
R13		350~650	424(23400) 460(21900) 533(16400)	17.15	0.820	0.678	9.54	13
R14		350~750	412(43000) 551(21900)	17.4	0.788	0.654	8.96	14
R15		350~650	391(19800), 527(18000)	19.63	0.74	0.72	10.39	15
R16		350~800	556(11200)	20.8	0.72	0.71	10.7	16
R17		350~800	404(29000) 555(26000)	16.3	0.66	0.68	7.3	17
R18		350~750	421(29424) 540(13892)	16.21	0.71	0.70	8.01	18

R19		350~800	442(11000) 535(9000)	20.0	0.730	0.664	9.69	19
R20		350~750	397(16000) 539(17500)	11.83	0.778	0.78	7.25	20
R21		350~800	426(21956) 513(21890)	21.39	0.76	0.660	10.7	21
R22		350-750	513(11568)	19.0	0.710	0.681	9.21	22
R23		350~750	537(8005)	15.08	0.737	0.69	7.7	23
R24		350~750	548(16000)	14.8	0.71	0.72	7.6	24

R25		350~800	362(28770) 475(33276) 600(7394)	17.8	0.72	0.690	8.86	25
R26		350-750	548(16800)	16.40	0.708	0.720	8.36	26
R27		350~650	356(65000), 498(64000)	12.0	0.83	0.72	7.2	27
O1		350-600	365(50400) 490(85000)	17.6	0.710	0.72	9.1	28
O2		350-700	411(37600)	15.81	0.73	0.72	8.34	29
O3		350-550	445(15188)	17.43	0.680	0.71	8.42	30
O4		350-700	549(35100)	14.57	0.720	0.740	7.77	31

O5		350-600	469(33000)	16.59	0.69	0.64	7.36	32
O6		350-650	497(37600)	18.63	0.634	0.63	7.41	33
O7		350-650	544(38500)	14.85	0.696	0.736	7.61	34
O8		350-600	458(37000)	14.10	0.728	0.71	7.25	35
O9		350-600	492(36000)	15.4	0.71	0.67	7.3	36
O10		350~600	370(69600) 466(45100)	17.49	0.70	0.70	8.70	37
O11		350~625	526(46000)	13.40	0.76	0.73	7.43	38
O12		350~550	427(38300)	14.35	0.83	0.69	8.29	39

O13		350-620	514(18620)	14.05	0.66	0.75	7.0	40
O14		350-600	463(12614)	16.8	0.75	0.70	8.71	41
O15		350-700	478(29300)	15.2	0.691	0.70	7.44	42
O16		350~500	420(42200)	15.58	0.787	0.67	8.22	43
O17		350~700	506(29300)	13.79	0.77	0.72	7.64	44
O18		350~650	493(57500)	14.96	0.693	0.736	7.6	45
O19		350~650	500(20300)	13.09	0.80	0.70	7.40	46
O20		350~700	548(50000)	14.28	0.793	0.70	8	47
O21		350~600	368(45090) 447(36630)	15.43	0.74	0.74	8.39	48

O22		350~600	370(72000) 468(19290)	12.03	0.72	0.76	6.61	49
O23		350~700	552(45000)	16.1	0.803	0.759	9.8	50
O24		350~650	517(58900)	13.30	0.95	0.74	9.3	51
O25		350~650	390(33000) 517(28000)	14.7	0.733	0.71	7.7	52
O26		350~600	452(19400)	10.9	0.712	0.71	5.5	53
P1		350-750	650(N/A)	17.3	0.965	0.71	11.9	54
P2		350~700	444(21700) 589(10800) 648(33700)	13.40	0.710	0.69	6.56	55
P3		350~700	458(536000) 672(489000)	13.08	0.68	0.68	6.12	56

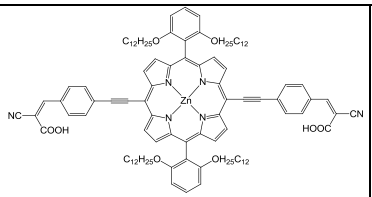
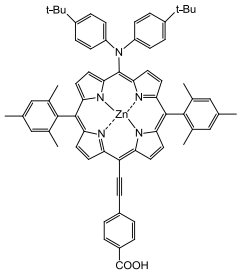
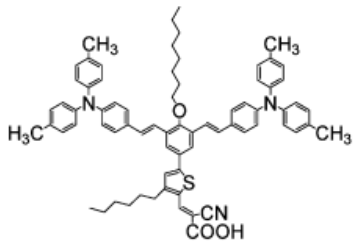
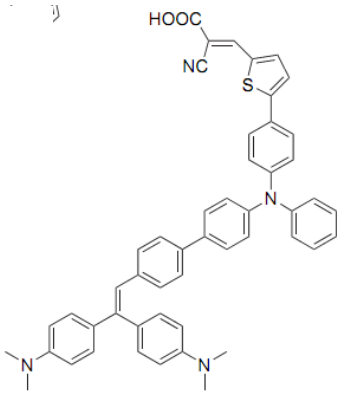
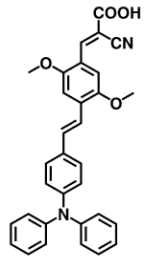
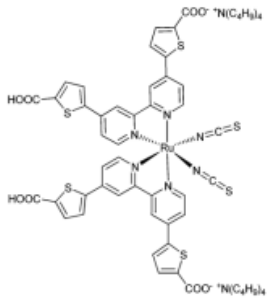
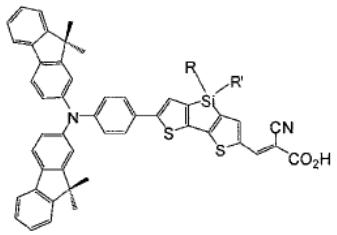
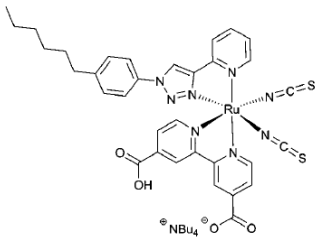
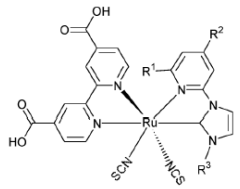
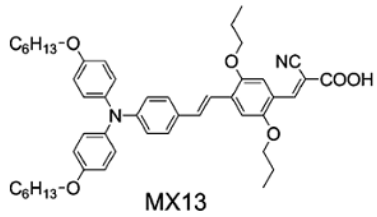
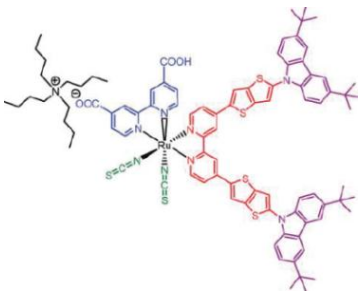
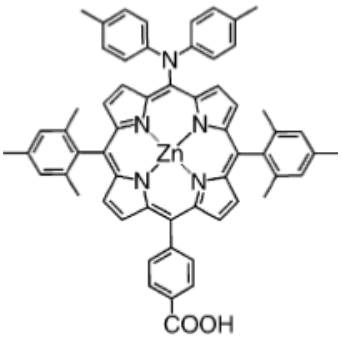
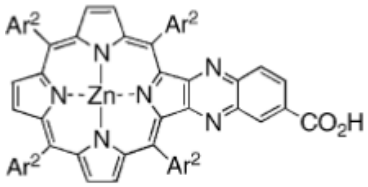
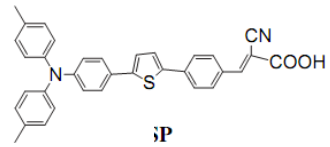
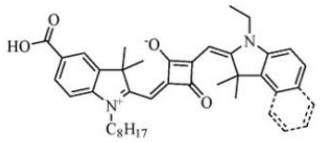
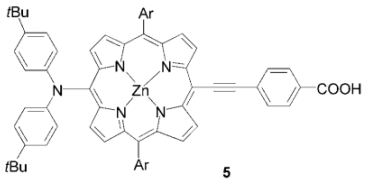
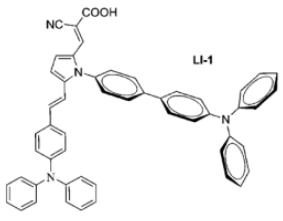
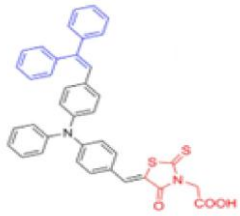
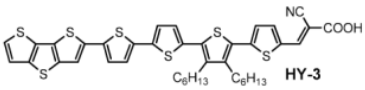
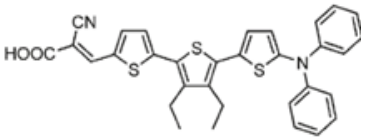
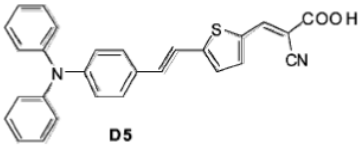
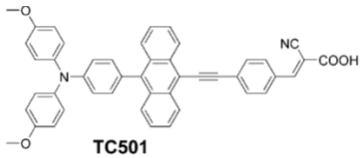
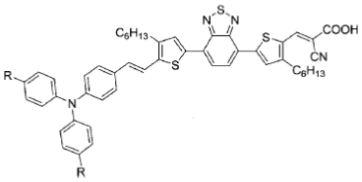
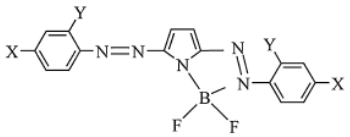
P4		350~750	465(390000) 670(110000)	11.3	0.680	0.70	5.5	57
P5		350~700	438(150000) 572(8000) 634(16000)	16.2	0.66	0.65	6.9	58

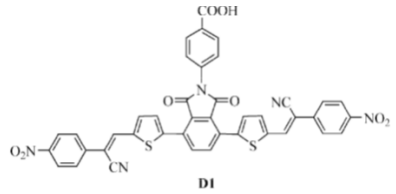
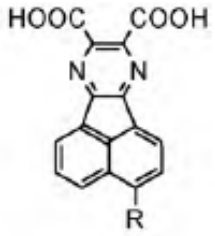
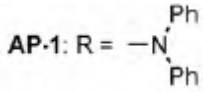
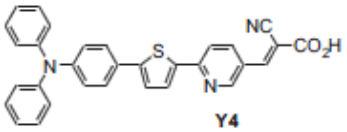
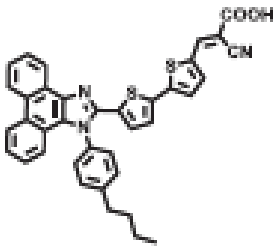
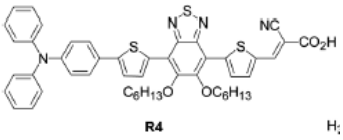
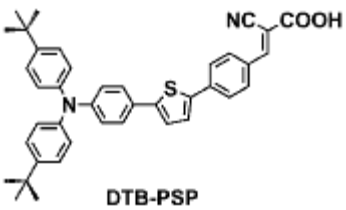
Table 2. List of the efficient dyes tested in dye-sensitized solar cells

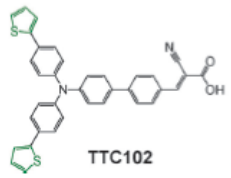
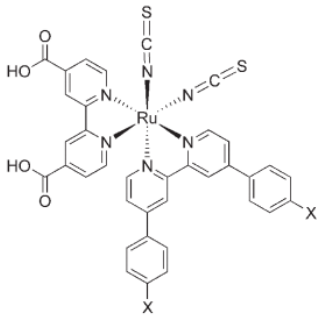
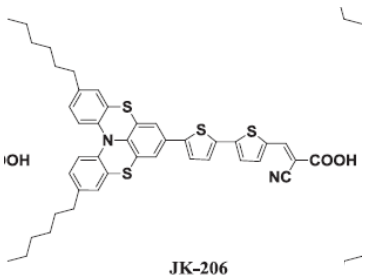
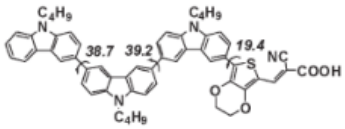
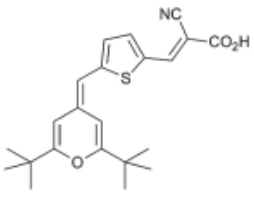
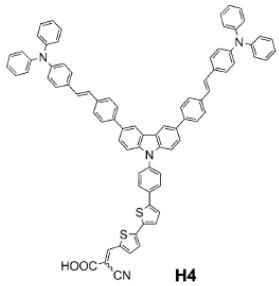
Compound	Wavelength (nm)	λmax/nm ($\varepsilon M^{-1}cm^{-1}$)	Jsc [mA/cm^2]	Voc [V]	FF	PCE [%]	Ref.
	350-500	401(74000)	9.56	0.71	0.756	5.13	59
	350~600	384(134800) 463(90100)	10.8	0.690	0.61	4.54	60
	350-500	433(46100)	13.83	0.677	0.692	6.49	61
	350-750	426(24800) 563(23200)	15.8	0.66	0.73	7.6	62

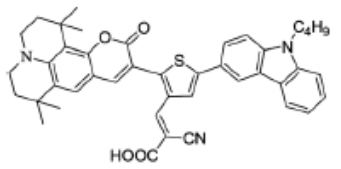
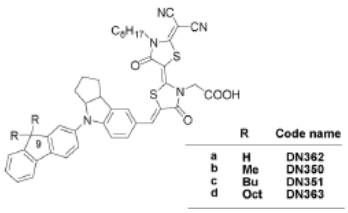
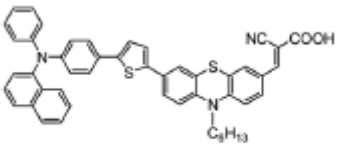
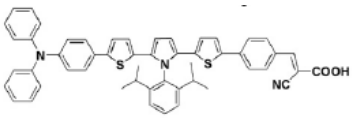
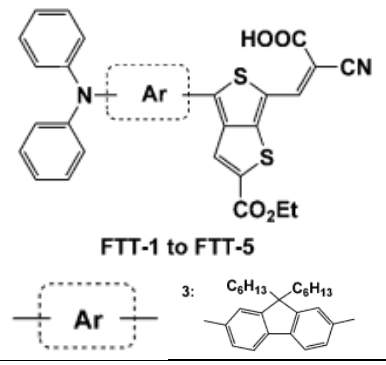
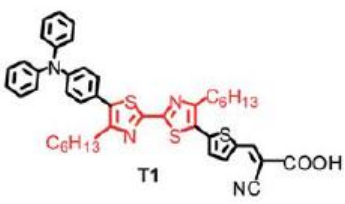
 7b = *DTS-Ph*$_2$	350~600	369(53500) 459(24100)	13.9	0.739	0.73	7.50	63
	350~850	284(33000) 369(12000) 493(7600)	13.2	0.761	0.77	7.8	64
 CifPR (3) : R^1 = H, R^2 = methyl, R^3 = 3,5-difluorobenzyl	350~800	384(8800) 537(6000)	13.44	0.770	0.700	7.24	65
 MX13	350~600	472(21000)	15.5	0.697	0.65	7.02	66
	350~800	555(22400)	17.9	0.703	0.74	9.4	67

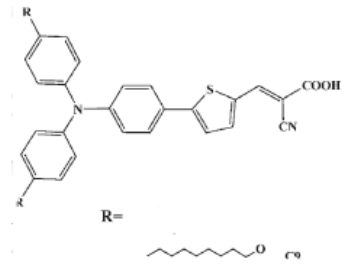
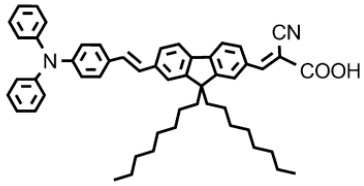
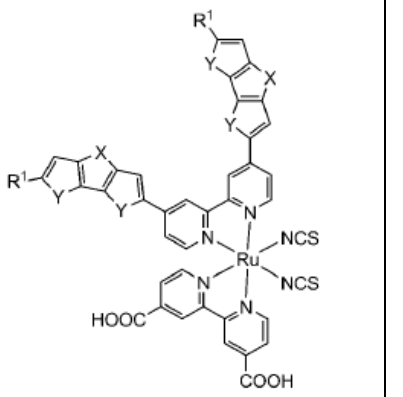
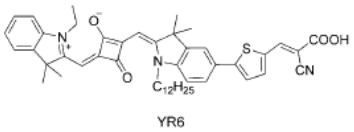
	350~700	415(199000) 563(14000) 615(9000)	13.1	0.72	0.69	6.5	68
	350~650	415(183700) 458(56200) 578(13600) 622(12600)	13.2	0.71	0.67	6.3	69
	400-550	445(37400)	16.34	0.68	0.55	6.05	70
	550-700	662(319000)	11.3	0.667	0.72	5.4	71
	400-500	448(19400) 601(8300) 654(29700)	13.60	0.701	0.629	6.0	72
	N/A	448(40500)	16.34	0.72	0.61	7.21	73

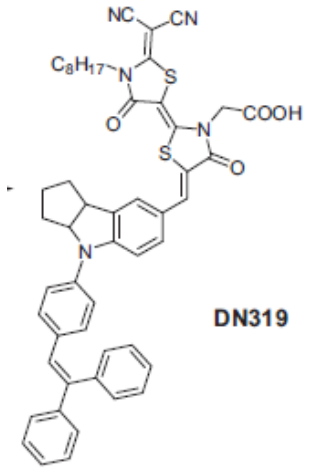
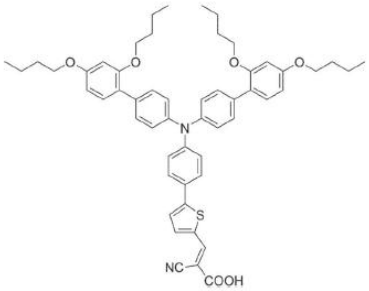
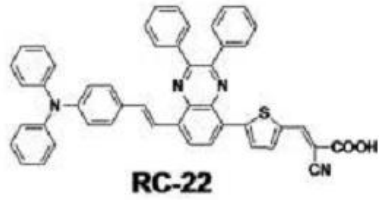
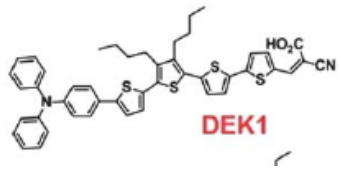
	350-600	468(44700)	15.5	0.64	0.63	6.27	74
 HY-3	350-550	440(57200)	13.31	0.62	0.62	5.15	75
 1 (L-3T-DPA)	350-650	450(19600)	13.5	0.76	0.659	6.8	76
 D5	350-550	490(29000)	12.41	0.663	0.760	6.25	77
 TC501	350-600	452(20100)	12.96	0.720	0.753	7.03	78
 BzTCA: R = H	350-750	393(46600) 557(46700)	16.46	0.545	0.67	6.04	79
 D1 : X = COOH, Y = H	350-700	439(N/A) 551(N/A)	12.50	0.71	0.67	5.96	80

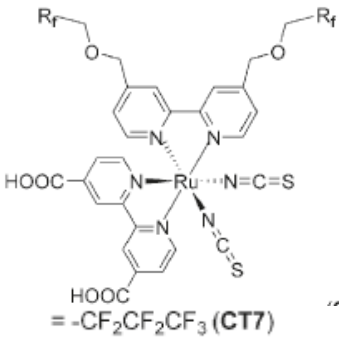
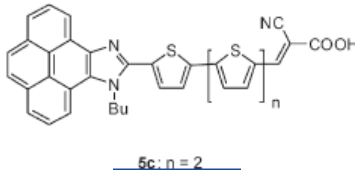
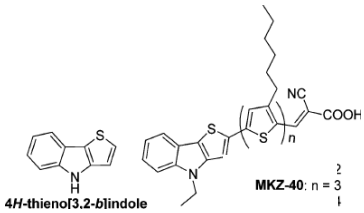
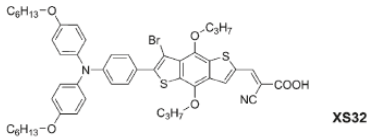
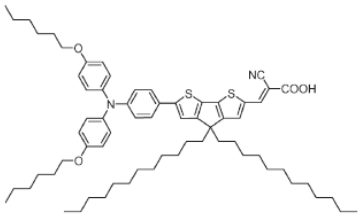
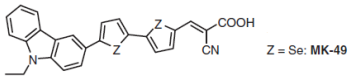
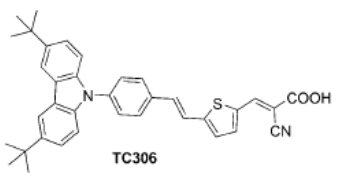
 D1	350-750	632(N/A)	13.70	0.68	0.62	5.80	81
 AP  AP-1: R =	350-550	461(8700)	8.11	0.693	0.719	4.04	82
 Y4	350-550	436(25100)	12.33	0.63	0.68	5.27	83
	350-500	432(38625)	10.98	0.68	0.687	5.12	84
 R4 H;	350-600	371(27600) 501(25500)	15.2	0.67	0.66	6.72	85
 DTB-PSP	350-550	439(34000)	13.96	0.67	0.66	6.14	86

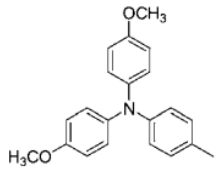
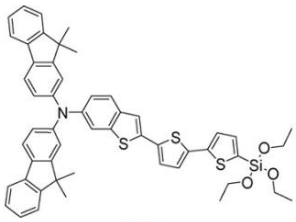
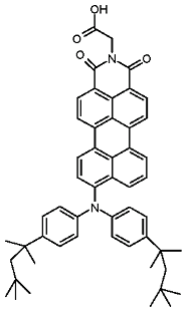
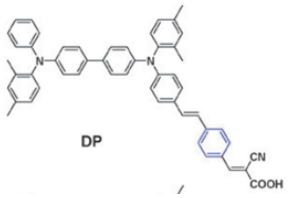
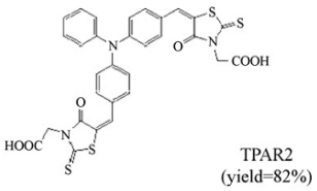
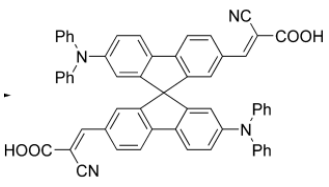
 TTC102	350-550	425(27100)	11.61	0.766	0.586	5.21	87
 X=OMe	350-600	388(15600) 530(13200)	16.0	0.717	0.724	8.30	88
 JK-206	350-600	432(13090)	13.44	0.71	0.74	7.08	89
	350-550	444(34400)	11.67	0.796	0.68	6.33	90
 (d) SFO-346	350-650	551(36399)	12.10	0.610	0.728	5.37	91
 H4	350-500	390(10100) 441(37500)	13.7	0.68	0.70	6.52	92

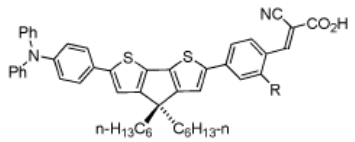
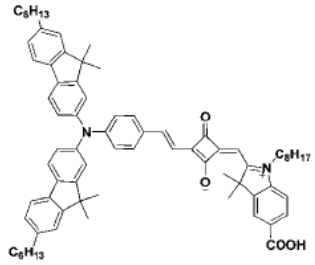
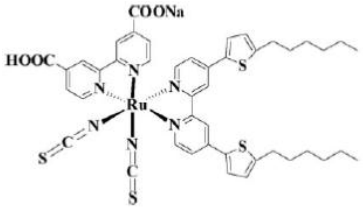
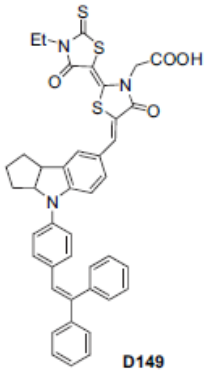
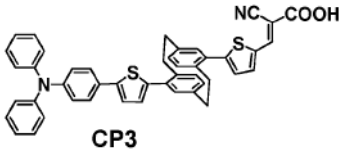
 MS-C	350-700	395(44000) 507(23000)	13.47	0.61	0.68	5.53	93
 DN350	350-650	397(31900) 567(74800)	13.07	0.66	0.65	5.55	94
 NSPt-C6	350-550	442(19300)	14.42	0.69	0.63	6.22	95
 TPTDYE-2	350-550	455(58000)	13.50	0.72	0.69	6.71	96
 FTT-1 to FTT-5	350-600	477(35800)	12.2	0.64	0.68	5.31	97
 T1	350-550	457(34400)	11.78	0.81	0.60	5.73	98

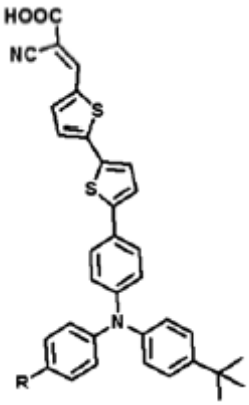
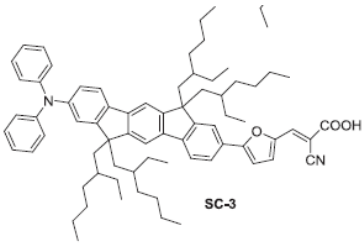
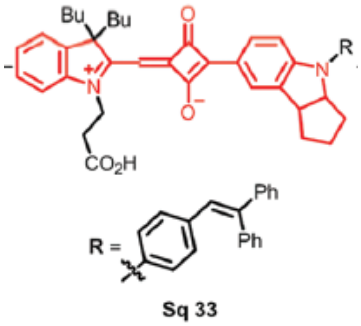
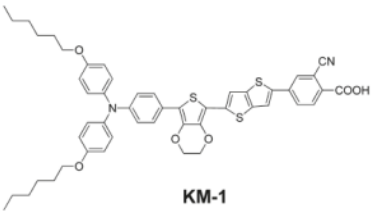
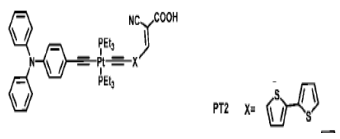
	350-650	504(30300)	11.48	0.77	0.68	6.04	99
	350-500	440(N/A)	11.33	0.86	0.57	5.56	100
 **YS-3**: X = $C(C_6H_{13})_2$; Y = CH=CH; R^1 = 2	350-700	375(69100) 539(18800)	15.90	0.70	0.62	6.91	101
 YR6	550-700	660(280000)	14.8	0.642	0.71	6.74	102

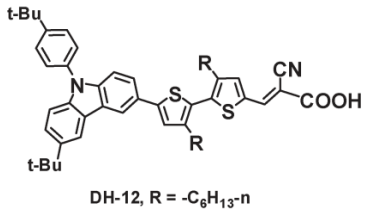
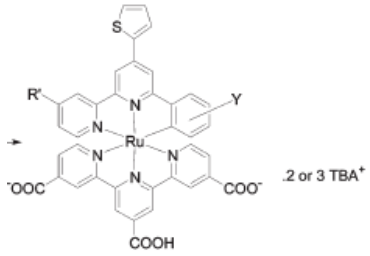
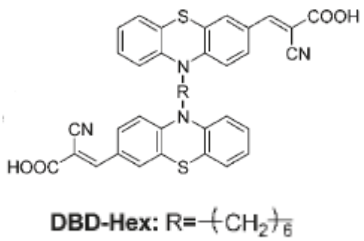
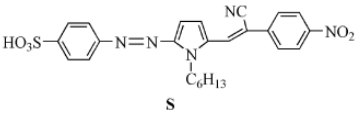
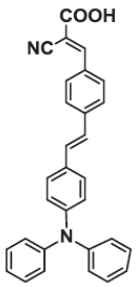
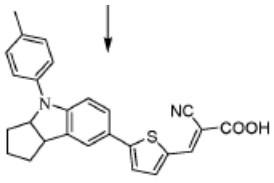
 DN319	350-670	400(36700) 566(68000)	11.82	0.66	0.65	5.01	103
 D35	350-650	500(31300)	12.34	0.785	0.70	6.74	104
 RC-22	350~600	458(35800)	11.4	0.66	0.74	5.56	105
 DEK1	350~700	477(53500)	14.2	0.765	0.66	7.17	106

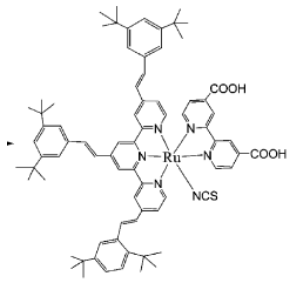
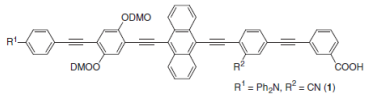
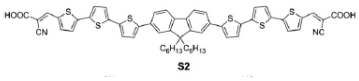
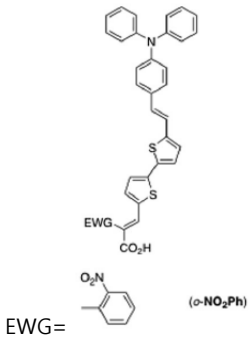
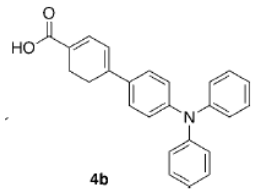
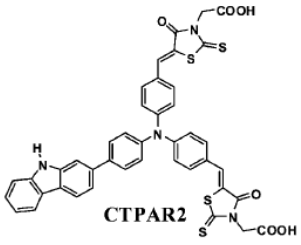
 = -$CF_2CF_2CF_3$ (**CT7**)	350~700	370(14600) 520(12400)	15.44	0.68	0.66	6.93	107
 **5c**: n = 2	350~600	358(24200) 464(44900)	15.5	0.543	0.67	5.65	108
 4*H*-thieno[3.2-*b*]indole **MKZ-40**: n = 3	350~630	496(45000)	14.6	0.70	0.76	7.8	109
 **XS32**	350~600	355(29000) 472(22000)	11.9	0.713	0.67	5.68	110
	N/A	555(55000)	10.90	0.860	0.69	6.5	111
 Z = Se: **MK-49**	N/A	490(33400)	11.92	0.599	0.763	5.44	112
 **TC306**	350~550	429(21000)	7.12	0.939	0.781	5.22	113

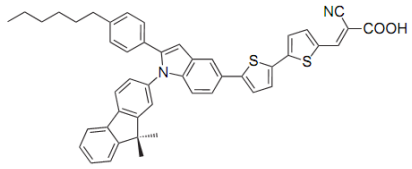
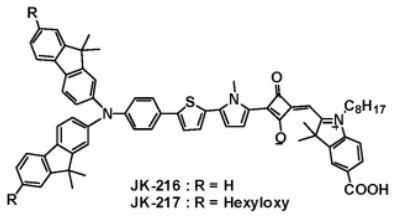
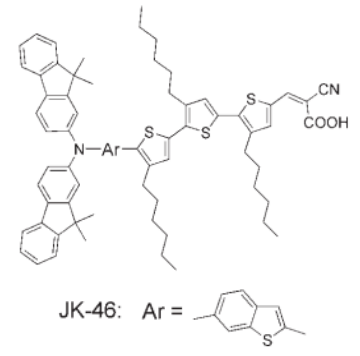
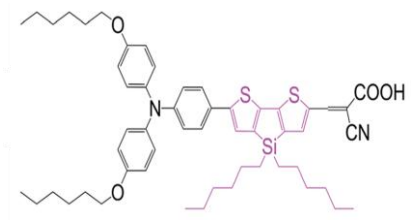
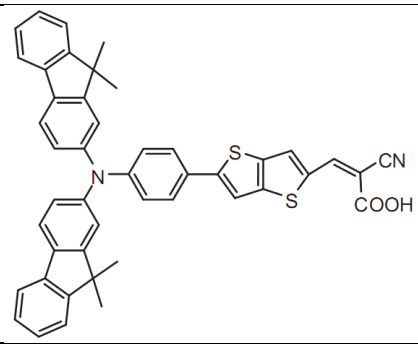
 P1	350-650	460(24000)	9.43	0.584	0.69	3.78	114
 JK-54	350-500	373(62800) 419(56300)	7.52	0.71	0.75	4.01	115
	400-700	590(25000)	8.7	0.640	0.57	3.2	116
 DP	350-600	447(36000)	6.04	0.737	0.81	3.60	117
 TPAR2 (yield=82%)	350-600	467(44827)	14.2	0.560	0.60	4.77	118
 SSD1	350-550	392(47000)	8.9	0.63	0.67	3.75	119

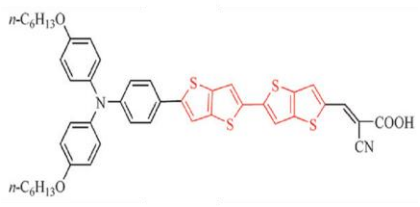
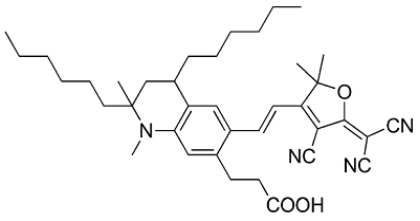
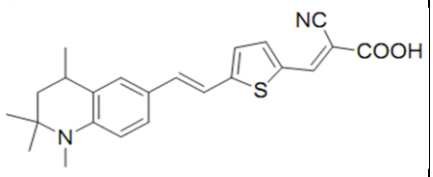
 R = H, A2-H; R = F, A2-F R = F, A2-F	350~600	460(53740)	7.52	0.91	0.71	4.86	120
 JK-64Hx	350~800	472(7860) 662(55000)	12.82	0.54	0.75	5.20	121
	400~700	540(N/A)	8.193	0.800	0.69	4.5	122
 D149	350~650	395(33300) 550(69700)	11.04	0.66	0.61	4.48	123
 CP3	350~500	377(41700)	7.88	0.69	0.70	3.83	124

 R= OCH3/ D-OCH3	350~650	449(35300)	9.26	0.717	53.5	3.56	125
 SC-3	350~550	370(30000) 430(54000)	8.20	0.71	0.7	4.05	126
 Sq 33	500~700	643(86200)	13.64	0.480	0.57	3.75	127
 KM-1	350-520	437(66700)	7.8	0.60	0.705	3.3	128
	350-600	359(41500) 510(46900)	9.32	0.659	0.69	4.21	129

 DH-12, R = -C_6H_{13}-n	350-550	417(18500)	9.44	0.66	0.63	3.75	130
 T68: Y = *p*-F, R' = H	350-800	410(13500) 518(13500)	8.8	0.555	0.63	3.06	131
 **DBD-Hex:** R=$-(CH_2)_6-$	350~550	310(49000) 435(31000)	8.27	0.750	0.68	4.22	132
 S	350~700	602(N/A)	10.8	0.69	0.56	4.17	133
	350~550	433(27100)	10.44	0.64	0.62	4.12	134
	350~600	492(37400)	10.38	0.725	0.62	4.58	135

 m-BL-5	350~800	523(10023)	10.40	0.684	0.77	5.40	136
	350~570	490(67000) 521(72000)	7.8	0.74	0.71	4.1	137
 S2	350~700	484(111900)	12.27	0.61	0.63	4.73	138
 EWG=	350~700	416(37100)	9.91	0.58	0.70	4.05	139
 4b	350~470	400(23000)	9.40	0.660	0.65	4.03	140
 CTPAR2	350~600	491(28702)	12.70	0.598	0.61	4.63	141

	N/A	431(29370)	13.62	0.705	0.74	7.18	142
	500~800	672(77900)	13.93	0.61	0.74	6.29	143
	350~600	372(35000) 430(29200)	17.45	0.664	0.742	8.60	144
	350~700	514(48200)	12.17	0.99	0.75	9.0	145
	350~650	366(47300) 514(41200)	13.35	0.777	0.749	7.8	146

	350~700	524(47000)	13	0.664	0.75	6.5	147
	450~700	615(88867)	13.35	0.519	0.73	5.1	148
	350~700	525(22000)	14.5	0.651	0.68	6.4	149

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