

Supporting Information for

Diastereoselective Synthesis of Chroman Bearing Spirobenzofuranone Scaffolds via oxa-Michael/1,6-conjugated addition of *para*-Quinone Methides with Benzofuranone-type Olefins

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Experimental Section

General Information:

Unless otherwise noted, all the reagents were obtained from commercial supplier and used without further purification. Solvents used in the reactions were distilled from appropriate drying agents prior to use. ^1H NMR spectra and ^{13}C NMR spectra were recorded in CDCl_3 on a spectrometer operating at 400 and 100 MHz, respectively. Chemical shifts are reported in parts per million relative to the appropriate standard: TMS for ^1H and ^{13}C NMR spectra. IR was recorded on the Nicolet 6700. High resolution mass spectra were obtained on Bruker Daltonics micrOTOF-Q II spectrometer in ESI mode. Flash column chromatography was performed using 200-300 mesh silica gel. *ortho*-hydroxyphenyl-substituted *para*-quinone methides **1** with benzofuran-2-ones **2** used here are known compounds and prepared according to the reported procedure. ^[1-2]

General procedure for the Oxa-Michael/1,6-Conjugated Addition Reaction:

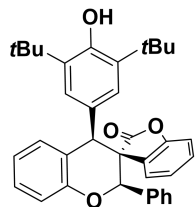
To a solution of *para*-quinone methides **1** (0.1 mmol) and arylmethylenbenzofuran-2-ones **2** (0.12 mmol) in THF (2 mL) was added Cs_2CO_3 (0.2 mmol). The reaction mixture was stirred under argon atmosphere at room temperature until the reaction completed (monitored by TLC), the reaction mixture was filtered and the solid powder was washed with ethyl acetate (10.0 mL). After the removal of solvent under the reduced pressure, the residue was purified through flash column chromatography on silica gel (petroleum ether: ethyl acetate = 10:1 - 4:1) to afford the desired cyclization product **3 or 4**.

Reference

1. Zhao, K.; Zhi, Y.; Shu T.; Valkonen, A.; Rissanen, K.; Enders, D. *Angew. Chem. Int. Ed.* **2016**, *55*, 12104.
2. Wang, D.; Wang, G, G. P.; Sun, Y-L.; Zhu, S. F.; Wei, Y.; Zhou, Q. L.; Shi, M. *Chem. Sci.* **2015**, *6*, 7319.

Spectra data for compounds 3-4

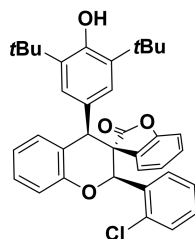
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-phenyl-2H-spiro[benzofuran-3,3'-chroman]-2-one (3a), $R_f = 0.5$ (petroleum ether/ethyl acetate= 30:1), yield: 75%, white



solid, mp 196-198 °C, dr >19:1, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ (ppm) 7.32-7.27 (m, 1H), 7.25-7.27 (m, 1H), 7.18-7.14 (m, 2H), 7.13-7.10 (m, 5H), 7.07-7.01 (m, 3H), 6.97-6.93 (m, 1H), 6.55 (d, $J = 7.58$ Hz, 1H), 6.14 (s, 1H), 5.68 (s, 1H), 5.08 (s, 1H), 5.02 (s, 1H),

1.41 (s, 9H), 0.98 (s, 9H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ (ppm) 175.9, 154.9, 153.2, 153.1, 135.3, 135.1, 130.2, 129.0, 128.7, 128.5, 127.9, 127.3, 126.84, 126.8, 124.6, 123.7, 123.2, 121.5, 116.7, 110.1, 81.6, 57.8, 51.8, 34.1, 30.2; **IR (KBr)**: γ 3443, 2953, 1798, 1618, 1482, 1461, 1229, 1136, 1080, 973, 885, 757, 679; **HRMS (ESI)**: calcd for $\text{C}_{36}\text{H}_{36}\text{O}_4$ $[\text{M}+\text{K}]^+$: 571.2207, found: 571.2203.

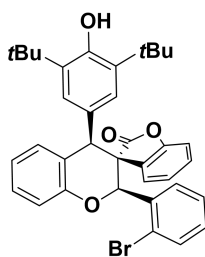
2'-(2-chlorophenyl)-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3b), $R_f = 0.4$ (petroleum ether/ethyl acetate= 30:1), yield: 69%,



white solid, mp 215-217 °C, dr >19:1, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ (ppm) 7.39-7.32 (m, 3H), 7.25-7.15 (m, 3H), 7.15-7.06 (m, 3H), 7.04-6.99 (m, 1H), 6.90-6.86 (m, 1H), 6.75-6.73 (m, 1H), 6.86 (d, $J = 7.85$ Hz, 1H), 6.38 (s, 1H), 6.22 (s, 1H), 5.23 (s, 1H), 5.07 (s, 1H),

1.44 (s, 9H), 1.03 (s, 9H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ (ppm) 174.6, 155.3, 153.5, 153.1, 135.1, 133.8, 132.9, 130.5, 130.1, 129.8, 129.3, 129.0, 128.5, 127.2, 126.7, 126.2, 124.7, 123.8, 123.4, 121.7, 116.7, 110.3, 76.8, 56.8, 52.4, 34.1, 30.1; **IR (KBr)**: γ 3433, 2958, 1805, 1617, 1438, 1232, 1140, 1079, 975, 880, 756; **HRMS (ESI)**: calcd for $\text{C}_{36}\text{H}_{35}\text{ClO}_4$ $[\text{M}+\text{K}]^+$: 605.1855, found: 605.1845.

2'-(2-bromophenyl)-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2H-spiro[benzofuran-

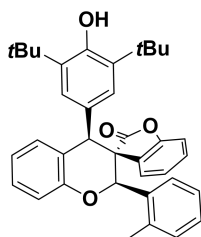


3,3'-chroman]-2-one (3c), $R_f = 0.5$ (petroleum ether/ethyl acetate= 30:1), yield: 67%, white solid, mp 234-235 °C, dr = 15:1,

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ (ppm) 7.54-7.52 (m, 1H), 7.32-7.27 (m, 2H), 7.21-7.17 (m, 2H), 7.12-7.03 (m, 4H), 6.89-6.86 (m, 1H), 6.85-6.65 (m, 1H), 6.63-6.31 (m, 2H), 6.30 (s,

1H), 6.17 (s, 1H), 5.19 (s, 1H), 5.02 (s, 1H), 1.40 (s, 9H), 1.00 (s, 9H); **$^{13}\text{C NMR}$ (100 MHz, CDCl_3):** δ (ppm) 174.6, 155.3, 153.5, 153.1, 135.1, 134.4, 133.3, 130.5, 130.5, 129.4, 129.2, 128.6, 127.2, 126.9, 126.7, 124.7, 124.3, 123.9, 123.4, 121.8, 116.8, 110.4, 79.4, 56.8, 52.5, 34.1, 30.3; **IR (KBr):** γ 3445, 2954, 1807, 1619, 1436, 1233, 1078, 974, 887, 755; **HRMS (ESI):** calcd for $\text{C}_{36}\text{H}_{35}\text{BrO}_4$ $[\text{M}+\text{K}]^+$:649.1350, found: 649.1341.

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(o-tolyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3d), $R_f = 0.5$ (petroleum ether/ethyl acetate= 30:1), yield: 64%, white

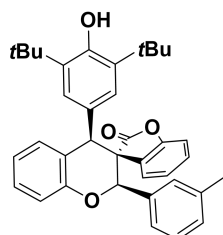


solid, mp 219-220 °C, dr >19:1, **$^1\text{H NMR}$ (400 MHz, CDCl_3):** δ

(ppm) 7.32-7.28 (m, 2H), 7.22-7.17 (m, 1H), 7.15-7.05 (m, 6H), 7.00-6.97 (m, 1H), 6.95-6.81 (m, 1H), 6.69-6.63 (m, 2H), 6.19 (s, 1H), 6.03 (s, 1H), 5.16 (s, 1H), 5.03 (s, 1H), 2.52 (s, 3H), 1.42 (s,

9H), 1.02 (s, 9H); **$^{13}\text{C NMR}$ (100 MHz, CDCl_3):** δ (ppm) 175.7, 155.6, 153.5, 153.0, 136.5, 135.1, 133.5, 130.7, 130.5, 129.1, 128.7, 128.5, 127.3, 126.9, 125.3, 125.0, 123.8, 123.4, 121.5, 116.8, 110.2, 77.1, 57.2, 52.8, 34.1, 30.1, 19.9; **IR (KBr):** γ 3437, 2955, 1803, 1618, 1460, 1436, 1291, 1232, 1079, 973, 882, 757; **HRMS (ESI):** calcd for $\text{C}_{37}\text{H}_{38}\text{O}_4$ $[\text{M}+\text{K}]^+$:585.2402, found: 585.2395.

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(m-tolyl)-2H-spiro[benzofuran-3,3'-chr

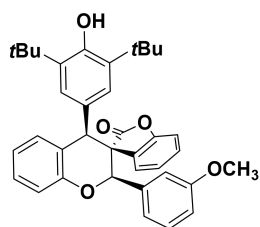


oman]-2-one (3e), $R_f = 0.5$ (petroleum ether/ethyl acetate= 30:1), yield: 75%, white solid, mp 214-216 °C, dr >19:1, **$^1\text{H NMR}$ (400**

MHz, CDCl_3): δ (ppm) 7.32-7.29 (m, 1H), 7.24-7.22 (m, 1H), 7.16-7.08 (m, 3H), 7.08-7.04 (m, 1H), 7.03-6.98 (m, 3H),

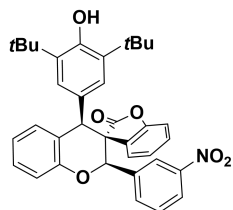
6.98-6.94 (m, 1H), 6.89-6.86 (m, 2H), 6.58 (d, $J = 7.96$ Hz, 1H), 6.15 (s, 1H), 5.63 (s, 1H), 5.07 (s, 1H), 5.01 (s, 1H), 2.16 (s, 3H), 1.40 (s, 9H), 0.99 (s, 9H); **^{13}C NMR (100 MHz, CDCl_3)**: δ (ppm) 175.9, 155.0, 153.2, 153.0, 137.4, 135.2, 135.1, 130.2, 129.4, 128.9, 128.5, 128.1, 127.7, 126.8, 124.8, 124.3, 123.6, 123.2, 121.4, 116.7, 110.0, 81.7, 57.7, 51.8, 34.0, 30.1, 21.2; **IR (KBr)**: γ 3435, 2962, 1799, 1617, 1435, 1230, 1078, 971, 889, 754; **HRMS (ESI)**: calcd for $\text{C}_{37}\text{H}_{38}\text{O}_4[\text{M}+\text{K}]^+$: 585.2402, found: 585.2398.

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(3-methoxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3f), $R_f = 0.4$ (petroleum ether/ethyl acetate= 30:1), yield:



72%, white solid, mp 205-207 °C, dr >19:1, **^1H NMR (400 MHz, CDCl_3)**: δ (ppm) 7.33-7.22 (m, 1H), 7.25-7.22 (m, 1H), 7.17-7.13 (m, 3H), 7.09-7.02 (m, 3H), 6.98-6.95 (m, 1H), 6.75-6.72 (m, 2H), 6.62-6.57 (m, 2H), 6.15 (s, 1H), 5.66 (s, 1H), 5.08 (s, 1H), 5.02 (s, 1H), 3.54 (s, 3H), 1.41 (s, 9H), 0.98 (s, 9H); **^{13}C NMR (100 MHz, CDCl_3)**: δ (ppm) 175.8, 159.0, 154.9, 153.3, 153.0, 136.7, 135.1, 130.2, 129.0, 128.9, 128.5, 126.7, 126.7, 124.8, 123.6, 123.2, 121.5, 119.9, 116.7, 115.3, 111.8, 110.2, 81.5, 57.7, 55.0, 51.8, 34.0, 30.2; **IR (KBr)**: γ 3433, 2955, 1808, 1602, 1435, 1234, 1079.42, 967, 871, 751; **HRMS (ESI)**: calcd for $\text{C}_{37}\text{H}_{38}\text{O}_5[\text{M}+\text{K}]^+$: 601.2351, found: 601.2353.

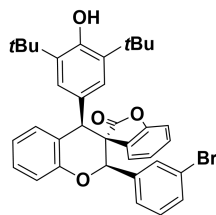
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2-oxo-2H-spiro[benzofuran-3,3'-chroman]-2'-yl)phenyl nitrate (3g), $R_f = 0.3$ (petroleum ether/ethyl acetate= 30:1), yield: 71%,



white solid, mp 209-211 °C, dr >19:1, **^1H NMR (400 MHz, CDCl_3)**: δ (ppm) 8.05 (d, $J = 8.19$ Hz, 1H), 7.98 (s, 1H), 7.52 (d, $J = 7.74$ Hz, 1H), 7.37-7.31 (m, 2H), 7.26-7.24 (m, 1H), 7.17-7.08 (m, 4H), 7.05-6.97 (m, 2H), 6.58-6.55 (m, 1H), 6.12 (m, 1H), 5.77 (s, 1H), 5.09 (s, 1H), 5.05 (s, 1H), 1.42 (s, 9H), 0.99 (s, 9H); **^{13}C NMR (100 MHz, CDCl_3)**: δ (ppm) 175.6, 154.2, 153.2, 153.0, 147.7, 137.6, 135.2, 133.4, 130.2, 129.6, 128.9, 128.8, 128.2, 126.7, 126.2, 125.0, 124.2, 123.6, 122.9, 122.4, 122.0, 116.7,

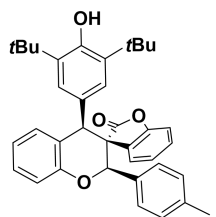
110.3, 80.2, 57.7, 51.6, 34.0, 30.2; **IR (KBr):** γ 3430, 2958, 1802, 1616, 1525, 1434, 1351, 1234, 1139, 1079, 968, 871, 752; **HRMS (ESI):** calcd for $C_{36}H_{35}NO_6[M+K]^+$: 616.2096, found: 616.2099.

2'-(3-bromophenyl)-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3h), $R_f = 0.5$ (petroleum ether/ethyl acetate= 10:1), yield: 75%,



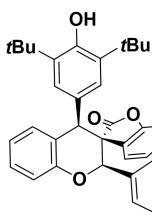
white solid, mp 209-211 °C, dr > 19:1, **1H NMR (400 MHz, $CDCl_3$):** δ (ppm) 8.06-8.04 (m, 1H), 7.98 (s, 1H), 7.52 (d, $J = 7.75$ Hz, 1H), 7.37-7.32 (m, 2H), 7.26-7.24 (m, 1H), 7.17-7.10 (m, 4H), 7.05-6.97 (m, 2H), 6.57-6.54 (m, 1H), 6.13 (s, 1H), 5.78 (s, 1H), 5.09 (s, 1H), 5.05 (s, 1H), 1.41 (s, 9H), 0.98 (s, 9H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ (ppm) 175.7, 154.2, 153.2, 152.9, 147.7, 137.6, 135.2, 133.4, 130.2, 129.6, 129.0, 128.8, 126.7, 126.2, 124.2, 123.6, 122.9, 122.4, 122.0, 116.7, 110.3, 80.2, 57.6, 51.6, 34.0, 30.2; **IR (KBr):** γ 3440, 2959, 1802, 1616, 1525, 1435, 1351, 1139, 1080, 970, 871, 752; **HRMS (ESI):** calcd for $C_{36}H_{35}BrO_4[M+K]^+$: 649.1350, found: 649.1346.

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(p-tolyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3i), $R_f = 0.5$ (petroleum ether/ethyl acetate= 30:1), yield: 73%, white



solid, mp 195-196 °C, dr = 10:1, **1H NMR (400 MHz, $CDCl_3$):** δ (ppm) 7.25-7.22 (m, 1H), 7.19-7.13 (m, 2H), 7.12-7.06 (m, 6H), 7.06-7.02 (m, 2H), 6.85 (s, 1H), 6.55 (d, $J = 7.54$ Hz, 1H), 6.17 (s, 1H), 5.64 (s, 1H), 5.05 (s, 1H), 5.01 (s, 1H), 2.33 (s, 3H), 1.41 (s, 9H), 0.99 (s, 9H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ (ppm) 176.1, 154.7, 153.2, 153.0, 138.6, 135.5, 135.0, 130.0, 129.0, 128.8, 127.9, 127.3, 126.9, 126.89, 124.7, 123.7, 122.6, 120.0, 117.1, 110.1, 81.6, 57.9, 51.7, 34.1, 30.1, 21.2; **IR (KBr):** γ 3436, 2960, 1798, 1619.65, 1459, 1388, 1231, 1138, 1079, 974, 886, 754; **HRMS (ESI):** calcd for $C_{37}H_{38}O_4[M+K]^+$: 585.2402, found: 585.2399.

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(4-methoxyphenyl)-2H-spiro[benzofura



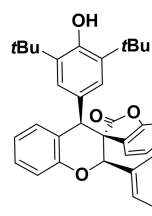
n-3,3'-chroman]-2-one (3j), $R_f = 0.3$ (petroleum ether/ethyl

acetate= 30:1), yield: 86%, white solid, mp 201-202 °C,

dr >19:1, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ (ppm) 7.31-7.28 (m,

7.24-7.21 (m, 1H), 7.14-7.08 (m, 3H), 7.07-7.05 (m, 1H), 7.03-6.98 (m, 3H), 6.96-9.92 (m, 1H), 6.64 (d, $J = 8.76$ Hz, 2H), 6.59 (d, $J = 7.88$ Hz, 1H), 6.24 (s, 1H), 5.62 (s, 1H), 5.06 (s, 1H), 5.01 (s, 1H), 3.69 (s, 3H), 1.41 (s, 9H), 0.99 (s, 9H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ (ppm) 176.0, 159.7, 155.0, 153.3, 153.2, 153.0, 135.1, 130.2, 129.0, 128.6, 128.5, 127.5, 126.8, 126.8, 124.7, 123.7, 123.2, 121.4, 116.7, 113.2, 110.2, 81.3, 57.8, 55.1, 51.8, 34.0, 30.2; **IR (KBr):** γ 3442, 2960, 1798, 1624, 1437, 1386, 1233, 1082, 980, 819, 751; **HRMS (ESI):** calcd for $\text{C}_{37}\text{H}_{38}\text{O}_5[\text{M}+\text{K}]^+$: 601.2351, found: 601.2356.

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(4-(trifluoromethyl)phenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3k), $R_f = 0.4$ (petroleum ether/ethyl acetate= 30:1),



yield: 82%, white solid, mp 199-201 °C, dr = 12:1, $^1\text{H NMR}$

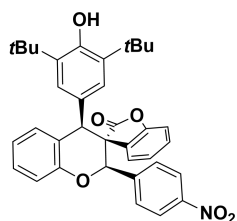
(400 MHz, CDCl_3): δ (ppm) 7.38 (d, $J = 8.20$ Hz, 2H),

7.34-7.30 (m, 1H), 7.26-7.21 (m, 3H), 7.14-7.08 (m, 3H),

7.06-7.02 (m, 2H), 6.99-6.95 (m, 1H), 6.58 (d, $J = 7.81$ Hz, 1H), 6.12 (s, 1H), 5.74 (s, 1H), 5.09 (s, 1H), 5.04 (s, 1H), 1.41 (s, 9H), 0.98 (s, 9H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ (ppm) 175.7, 154.5, 153.2, 153.1, 139.3, 135.2, 130.2 ($J = 27.8$ Hz), 129.3, 128.7, 127.7, 126.6, 126.4, 125.1, 124.8 ($J = 3.8$ Hz), 124.1, 123.9, 123.0, 121.8, 116.6, 110.3, 80.8, 57.6, 51.8, 34.0, 29.9; **IR (KBr):** γ 3441, 2962, 1796, 1620, 1436, 1325, 1232, 1170, 1131, 1069, 1019, 977, 885, 755; **HRMS (ESI):** calcd for $\text{C}_{37}\text{H}_{35}\text{F}_3\text{O}_4[\text{M}+\text{K}]^+$: 639.2119, found: 639.2108.

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(4-nitrophenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3l), $R_f = 0.3$ (petroleum ether/ethyl acetate= 30:1), yield: 85%, white solid, mp 230-232°C, dr = 12:1, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ (ppm) 7.99 (d, $J = 8.77$ Hz, 2H), 7.33 (d, $J = 8.77$ Hz, 3H), 7.22-7.20 (m, 1H), 7.16-7.09 (m, 3H),

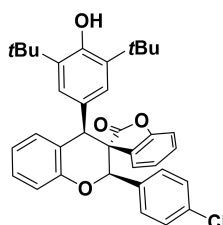
7.07-6.97 (m, 3H), 6.58 (s, $J = 7.66$ Hz, 1H), 6.11 (s, 1H), 5.78 (s, 1H), 5.09 (s, 1H),



5.05 (s, 1 H), 1.41 (s, 9 H), 0.98 (s, 9 H); ^{13}C NMR (100 MHz, CDCl_3): δ (ppm) 175.6, 154.2, 153.2, 153.0, 147.9, 142.4, 135.2, 130.3, 129.5, 128.8, 128.2, 126.6, 126.1, 124.0, 123.8, 123.0, 122.9, 122.0, 116.6, 110.4, 80.4, 57.6, 51.7, 34.0, 29.9; IR (KBr):

γ 3436, 2960, 1803, 1608, 1524, 1436, 1348, 1234, 1139, 1080, 979, 867, 750; HRMS (ESI): calcd for $\text{C}_{36}\text{H}_{35}\text{NO}_6[\text{M}+\text{K}]^+$: 616.2096, found: 616.2091.

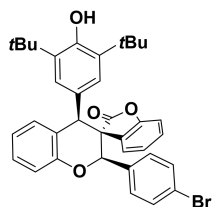
2'-(4-chlorophenyl)-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3m), $R_f = 0.5$ (petroleum ether/ethyl acetate= 30:1), yield: 83%,



white solid, mp 205-206 °C, dr >19:1, ^1H NMR (400 MHz, CDCl_3): δ (ppm) 7.32-7.28 (m, 1H), 7.20-7.18 (m, 1H), 7.13-7.08 (m, 5H), 7.07-7.01 (m, 4H), 6.98-6.94 (m, 1H), 6.59 (d, $J = 7.94$ Hz, 1H), 6.12 (s, 1H), 5.65 (s, 1H), 5.06 (s, 1H), 5.02 (s,

1H), 1.41 (s, 9H), 0.98 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3): δ (ppm) 175.8, 154.7, 153.2, 153.1, 135.1, 134.5, 133.9, 130.2, 129.2, 128.6, 128.1, 126.7, 126.5, 124.3, 123.8, 123.0, 121.7, 116.6, 110.3, 80.8, 57.7, 51.7, 34.0, 30.0; IR (KBr): γ 3431, 2960, 1803, 1619, 1437, 1233, 1141, 1082, 1018, 974, 880, 753; HRMS (ESI): calcd for $\text{C}_{36}\text{H}_{35}\text{ClO}_4[\text{M}+\text{K}]^+$: 605.1855, found: 605.1852.

2'-(4-bromophenyl)-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3n), $R_f = 0.5$ (petroleum ether/ethyl acetate= 30:1), yield: 81%,

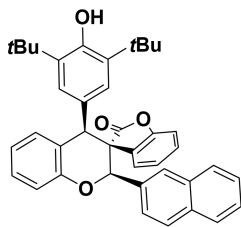


white solid, mp 207-209 °C, dr = 12:1, ^1H NMR (400 MHz, CDCl_3): δ (ppm) 7.32-7.28 (m, 1H), 7.26-7.24 (m, 2H), 7.20-7.18 (m, 1H), 7.14-7.09 (m, 3H), 7.06-6.99 (m, 3H), 6.97-6.93 (m, 2H), 6.69 (d, $J = 7.85$ Hz, 1H), 6.11 (s, 1H), 5.63 (s, 1H), 5.06 (s, 1H),

5.02 (s, 1H), 1.40 (s, 9H), 0.98 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3): δ (ppm) 175.8, 154.6, 153.2, 153.1, 135.2, 134.5, 131.0, 130.2, 129.2, 128.9, 128.2, 126.7, 126.5, 125.0, 124.3, 123.8, 123.0, 122.8, 121.7, 116.6, 110.3, 80.9, 57.6, 51.7, 34.0, 30.1; IR (KBr): γ 3428, 2958, 2921, 1797, 1484, 1463, 1436, 1364, 1291, 1232, 1139, 1081,

1011, 975, 755, 685; **HRMS (ESI):** calcd for $C_{36}H_{35}BrO_4[M+K]^+$: 649.1350, found: 649.1331.

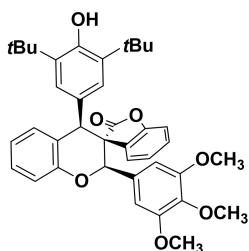
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(naphthalen-2-yl)-2H-spiro[benzofuran



-3,3'-chroman]-2-one (3o), $R_f = 0.4$ (petroleum ether/ethyl acetate= 30:1), yield: 74%, white solid, mp 209-211 °C, dr >19:1, **1H NMR (400 MHz, $CDCl_3$):** δ (ppm) 7.75-7.70 (m, 2H), 7.68 (s, 1H), 7.61 (d, $J = 8.6$ Hz, 1H), 7.46-7.41 (m, 2H),

7.39-7.34 (m, 2H). 7.23-7.08 (m, 6H), 7.03-7.00 (m, 1H), 6.53-6.51 (m, 1H), 6.21 (s, 1H), 5.89 (s, 1H), 5.18 (s, 1H), 5.05 (s, 1H), 1.45 (s, 9H), 1.03 (s, 9H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ (ppm) 175.9, 155.0, 153.2, 153.1, 135.1, 133.3, 132.9, 132.6, 130.3, 129.1, 128.6, 128.3, 127.5, 127.5, 127.2, 126.8, 126.7, 126.3, 126.0, 124.7, 124.5, 123.7, 123.2, 121.6, 116.7, 110.2, 81.8, 57.8, 52.0, 34.1, 30.1; **IR (KBr):** γ 3442, 2961, 1801, 1620, 1438, 1386, 1232, 1138, 1074, 971, 753, 672; **HRMS (ESI):** calcd for $C_{40}H_{38}O_4[M+Na]^+$: 605.2262, found: 605.2267.

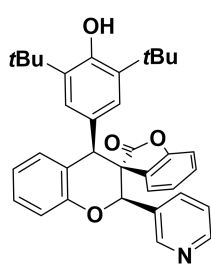
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(3,4,5-trimethoxyphenyl)-2H-spiro[ben



zofuran-3,3'-chroman]-2-one (3p), $R_f = 0.4$ (petroleum ether/ethyl acetate= 5:1), yield: 88%, white solid, mp 235-237 °C, dr = 12:1, **1H NMR (400 MHz, $CDCl_3$):** δ (ppm) 7.33-7.29 (m, 1H), 7.24 (d, $J = 7.42$ Hz, 1H), 7.14-7.12 (m, 3H), 7.08-7.02 (m, 2H), 6.99-6.94 (m, 1H), 6.65 (d, $J = 7.87$ Hz, 1H),

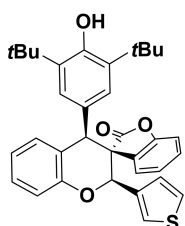
6.28 (s, 2H), 6.17 (s, 1H), 5.58 (s, 1H), 5.06 (s, 1H), 5.03 (s, 1H), 3.75 (s, 3H), 3.58 (s, 6H), 1.41 (s, 9H), 0.99 (s, 9H); **^{13}C NMR (100 MHz, $CDCl_3$):** δ (ppm) 175.9, 154.9, 153.5, 153.1, 152.5, 138.1, 135.2, 133.4, 130.5, 130.2, 129.0, 128.5, 126.7, 125.0, 123.5, 123.2, 121.6, 116.7, 110.4, 104.6, 81.7, 60.7, 57.8, 55.8, 51.8, 34.0, 30.1; **IR (KBr):** γ 3438, 2958, 1800, 1593, 1460, 1354, 1234, 1130, 1080, 970, 874, 757, 652; **HRMS (ESI):** calcd for $C_{39}H_{42}O_7[M+Na]^+$: 645.2823, found: 645.2830.

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(pyridin-3-yl)-2H-spiro[benzofuran-3,3'



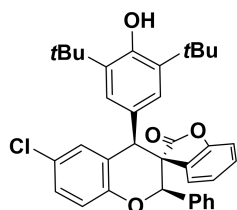
-chroman]-2-one (3q), $R_f = 0.3$ (petroleum ether/ethyl acetate= 5:1), yield: 79%, white solid, mp 198-200 °C, dr >19:1, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ (ppm) 8.44-8.39 (m, 2 H), 7.39 (d, $J = 7.96$ Hz, 1 H), 7.34-7.30 (m, 1 H), 7.24-7.22 (m, 1 H), 7.15-7.09 (m, 3 H), 7.07-7.02 (m, 3 H), 6.99-6.96 (m, 1 H), 6.95 (d, $J = 7.81$ Hz, 1 H), 6.13 (s, 1 H), 5.71 (s, 1 H), 5.08 (s, 1 H), 5.07 (s, 1 H), 1.41 (s, 9 H), 0.98 (s, 9 H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ (ppm) 175.6, 154.5, 153.2, 153.1, 150.0, 148.7, 135.2, 134.9, 131.1, 130.2, 129.5, 128.7, 126.7, 126.4, 124.0, 123.9, 123.0, 122.7, 121.9, 116.7, 110.3, 79.6, 57.5, 51.7, 34.0, 30.2; **IR (KBr)**: γ 3440, 2959, 1799, 1618, 1435, 1289, 1234, 1081, 978, 882, 756; **HRMS (ESI)**: calcd for $\text{C}_{35}\text{H}_{35}\text{NO}_4$ [M+H] $^+$: 534.2639, found: 534.2665.

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(thiophen-3-yl)-2H-spiro[benzofuran-3,



3'-chroman]-2-one (3r), $R_f = 0.4$ (petroleum ether/ethyl acetate= 30:1), yield: 80%, white solid, mp 201-203 °C, dr >19:1, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ (ppm) 7.33-7.29 (m, 1 H), 7.23 (d, $J = 7.39$ Hz, 1 H), 7.17-7.12 (m, 3 H), 7.08-7.01 (m, 4 H), 6.98-6.94 (m, 1 H), 6.69-6.68 (m, 1 H), 6.65 (d, $J = 7.96$ Hz, 1 H), 6.14 (s, 1 H), 5.79 (s, 1 H), 5.04 (s, 2 H), 1.42 (s, 9 H), 1.00 (s, 9 H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ (ppm) 176.1, 154.8, 153.3, 153.1, 136.6, 135.1, 130.2, 129.1, 128.5, 126.7, 126.5, 126.2, 125.4, 125.0, 124.1, 123.8, 123.1, 121.6, 116.7, 110.1, 78.2, 57.4, 51.6, 34.1, 30.0; **IR (KBr)**: γ 3433, 2962, 1795, 1619, 1435, 1292, 1233, 1139, 1083, 976, 872, 760, 646; **HRMS (ESI)**: calcd for $\text{C}_{34}\text{H}_{34}\text{O}_4\text{S}$ [M+K] $^+$: 577.1809, found: 577.1829.

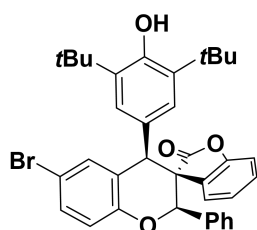
6'-chloro-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-phenyl-2H-spiro[benzofuran-



3,3'-chroman]-2-one (4a), $R_f = 0.5$ (petroleum ether/ethyl acetate= 30:1), yield: 73%, white solid, mp 226-228 °C, dr >19:1, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ (ppm) 7.28-7.25 (m, 1H), 7.20-7.16 (m, 2H), 7.14-7.10 (m, 4H), 7.09-7.05 (m, 4H), 7.02 (d, $J =$

1.20 Hz, 1H), 6.57 (d, $J = 7.47$ Hz, 1H), 6.12 (s, 1H), 5.66 (s, 1H), 5.05 (s, 1H), 5.03 (s, 1H), 1.41 (s, 9H), 1.00 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3): δ (ppm) 175.6, 153.5, 153.3, 153.2, 135.3, 134.9, 129.7, 129.2, 128.8, 128.7, 128.2, 127.9, 127.2, 126.6, 126.5, 125.9, 125.0, 124.3, 123.8, 118.1, 110.2, 81.8, 57.4, 51.7, 34.1, 30.1; IR (KBr): γ 3441, 2961, 1798, 1620, 1476, 1359, 1234, 1143, 1055, 980, 821, 751, 698; HRMS (ESI): calcd for $\text{C}_{36}\text{H}_{35}\text{ClO}_4[\text{M}+\text{K}]^+$: 605.1855, found: 605.1837.

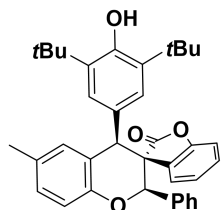
6'-bromo-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-phenyl-2H-spiro[benzofuran-



3,3'-chroman]-2-one (4b), $R_f = 0.5$ (petroleum ether/ethyl acetate= 30:1), yield: 65%, white solid, mp 233-235 °C, dr > 19:1, ^1H NMR (400 MHz, CDCl_3): δ (ppm) 7.42-7.39 (m, 1H), 7.19-7.16 (m, 3H), 7.14-7.05 (m, 7H), 7.03 (d, $J = 8.75$ Hz,

1H), 6.57 (d, $J = 7.70$ Hz, 1H), 6.12 (s, 1H), 5.65 (s, 1H), 5.08 (s, 1H), 5.05 (s, 1H), 1.41 (s, 9H), 1.01 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3): δ (ppm) 175.6, 154.1, 153.3, 153.2, 135.3, 134.9, 132.9, 132.6, 131.6, 129.2, 128.8, 127.9, 127.2, 126.5, 125.9, 125.5, 124.2, 123.7, 118.6, 113.8, 110.2, 81.8, 57.4, 51.6, 34.1, 30.1; IR (KBr): γ 3433, 2960, 1798, 1619, 1476, 1232, 1140, 1083, 979, 821, 752, 698; HRMS (ESI): calcd for $\text{C}_{36}\text{H}_{35}\text{BrO}_4[\text{M}+\text{K}]^+$: 649.1350, found: 649.1385.

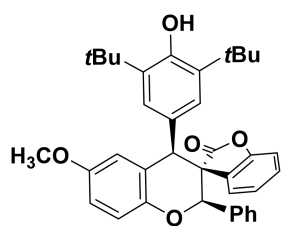
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-6'-methyl-2'-phenyl-2H-spiro[benzofuran



-3,3'-chroman]-2-one (4c), $R_f = 0.4$ (petroleum ether/ethyl acetate= 30:1), yield: 90%, white solid, mp 200-202 °C, dr > 19:1, ^1H NMR (400 MHz, CDCl_3): δ (ppm) 7.24-7.22 (m, 1H), 7.18-7.13 (m, 2H), 7.22-7.06 (m, 6H), 7.06-7.01 (m, 2H), 6.84 (s,

1H), 6.54 (d, $J = 7.52$ Hz, 1H), 6.16 (s, 1H), 5.64 (s, 1H), 5.05 (s, 1H), 5.01 (s, 1H), 2.23 (s, 3H), 1.41 (s, 9H), 0.99 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3): δ (ppm) 176.0, 153.2, 153.0, 152.8, 135.5, 135.0, 130.8, 130.3, 129.2, 128.9, 128.6, 127.8, 127.3, 126.9, 124.7, 123.6, 122.6, 116.4, 110.0, 81.5, 58.0, 51.8, 34.1, 30.1, 20.6; IR (KBr): γ 3435, 2957, 1798, 1618, 1495, 1436, 1239, 1139, 1080, 1024, 983, 885, 749; HRMS (ESI): calcd for $\text{C}_{37}\text{H}_{38}\text{O}_4[\text{M}+\text{K}]^+$: 585.2402, found: 585.2409.

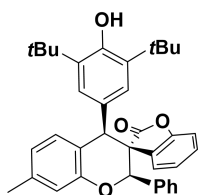
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-6'-methoxy-2'-phenyl-2H-spiro[benzofura



n-3,3'-chroman]-2-one (4d), $R_f = 0.5$ (petroleum ether/ethyl acetate= 30:1), yield: 80%, white solid, mp 238-240 °C, dr = 10:1, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ (ppm) 7.25-7.22 (m, 1H), 7.19-7.15 (m, 1H), 7.14-7.08 (m, 5H), 7.08-7.04 (m, 2H),

6.91 (d, $J = 8.61$ Hz, 1H), 6.69 (d, $J = 2.59$ Hz, 1H), 6.57-6.53 (m, 2H), 6.14 (s, 1H), 5.67 (s, 1H), 5.01 (s, 1H), 5.00 (s, 1H), 3.85 (s, 3H), 1.40 (s, 9H), 0.99 (s, 9H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ (ppm) 175.9, 159.8, 155.7, 153.2, 153.0, 135.3, 135.0, 130.9, 128.9, 128.7, 127.9, 127.3, 126.8, 124.6, 123.6, 115.1, 110.0, 108.6, 101.2, 81.2, 57.9, 55.4, 51.4, 34.0, 30.1; **IR (KBr)**: γ 3431, 2957, 1805, 1618, 1477, 1436, 1329, 1234, 1196, 1079, 969, 833, 755; **HRMS (ESI)**: calcd for $\text{C}_{37}\text{H}_{38}\text{O}_5[\text{M}+\text{K}]^+$: 601.2351, found: 601.2374.

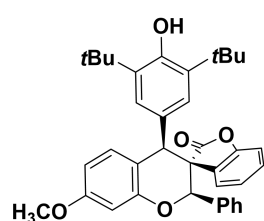
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-7'-methyl-2'-phenyl-2H-spiro[benzofuran



-3,3'-chroman]-2-one (4e), $R_f = 0.4$ (petroleum ether/ethyl acetate= 30:1), yield: 72%, white solid, mp 209-211 °C, dr > 19:1, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ (ppm) 7.24-7.22 (m, 1 H), 7.19-7.09 (m, 6 H), 7.08-7.03 (m, 2 H), 6.96 (s, 1 H), 6.89 (d, $J =$

7.95 Hz, 1 H), 6.77 (d, $J = 7.88$ Hz, 1 H), 6.56-6.54 (m, 1 H), 6.15 (s, 1 H), 5.65 (s, 1 H), 5.03 (s, 1 H), 5.00 (s, 1 H), 2.39 (s, 3 H), 1.40 (s, 9 H), 0.99 (s, 9 H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ (ppm) 176.0, 154.7, 153.2, 153.0, 138.6, 135.4, 135.0, 129.9, 128.9, 128.6, 127.8, 127.3, 126.9, 126.8, 124.7, 123.6, 122.5, 120.0, 117.0, 110.0, 81.5, 57.9, 51.6, 34.0, 30.0, 21.2; **IR (KBr)**: γ 3437, 2959, 2922, 1799, 1621, 1435, 1387, 1237, 1081, 970, 873, 749; **HRMS (ESI)**: calcd for $\text{C}_{37}\text{H}_{38}\text{O}_4[\text{M}+\text{K}]^+$: 585.2402, found: 585.2402.

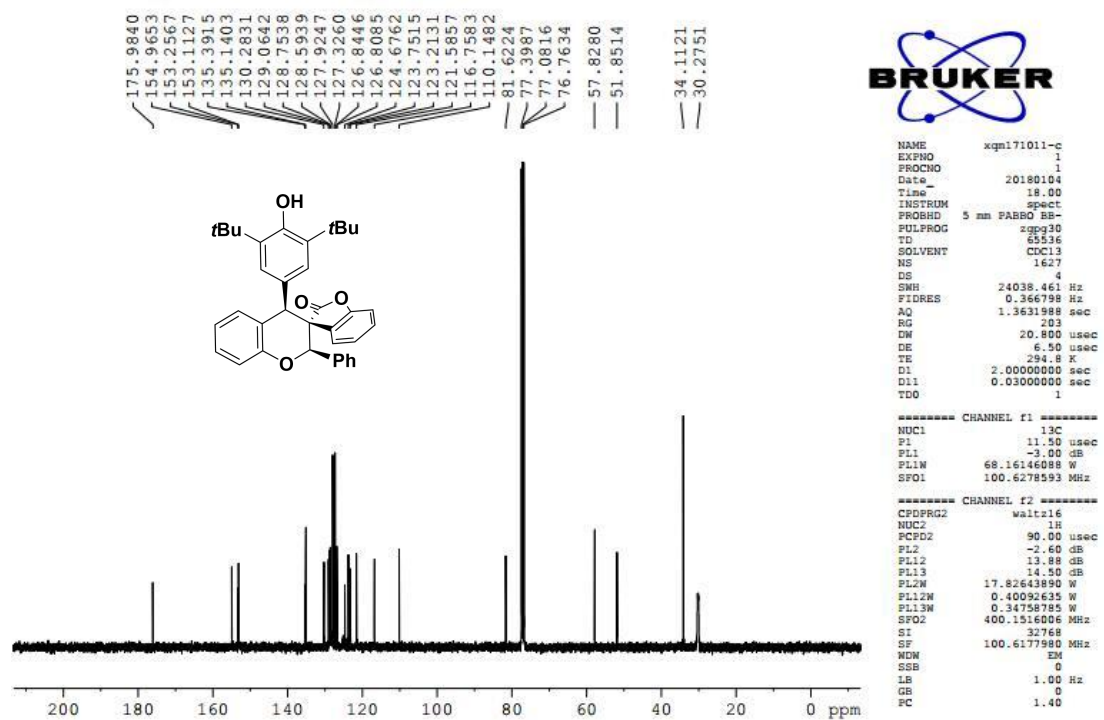
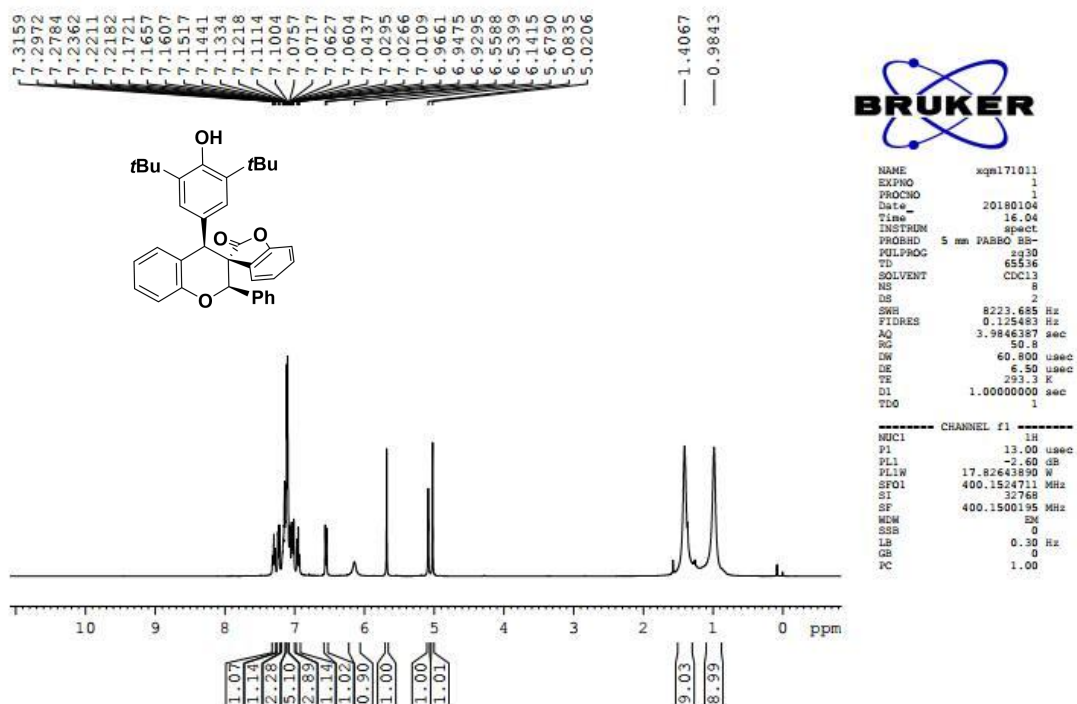
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-7'-methoxy-2'-phenyl-2H-spiro[benzofuran-3,3'-chroman]-2-one (4f), $R_f = 0.4$ (petroleum ether/ethyl acetate= 30:1), yield:



66%, white solid, mp 234-236 °C, dr = 10:1, **$^1\text{H NMR}$ (400 MHz, CDCl_3):** δ (ppm) 7.25-7.22 (m, 1 H), 7.19-7.12 (m, 3 H), 7.11-7.09 (m, 3 H), 7.08-7.04 (m, 2 H), 6.91 (d, $J = 8.86$ Hz, 1 H), 6.69 (d, $J = 2.49$ Hz, 1 H), 6.56-6.53 (m, 2 H), 6.14 (s, 1 H), 5.67 (s, 1 H), 5.01 (s, 1 H), 5.00 (s, 1 H), 3.85 (s, 3 H), 1.40 (s, 9 H), 0.99 (s, 9 H); **$^{13}\text{C NMR}$ (100 MHz, CDCl_3):** δ (ppm) 176.0, 159.9, 155.7, 153.2, 153.1, 135.3, 135.1, 131.0, 129.0, 128.7, 127.9, 127.3, 126.9, 126.87, 124.6, 123.7, 115.2, 110.1, 108.6, 101.2, 81.8, 57.9, 55.4, 51.5, 34.1, 30.2; **IR (KBr):** γ 3432, 2958, 2921, 1803, 1618, 1436, 1329, 1235, 1195, 1079, 970, 833, 754; **HRMS (ESI):** calcd for $\text{C}_{37}\text{H}_{38}\text{O}_5[\text{M}+\text{K}]^+$:601.2351, found: 601.2356.

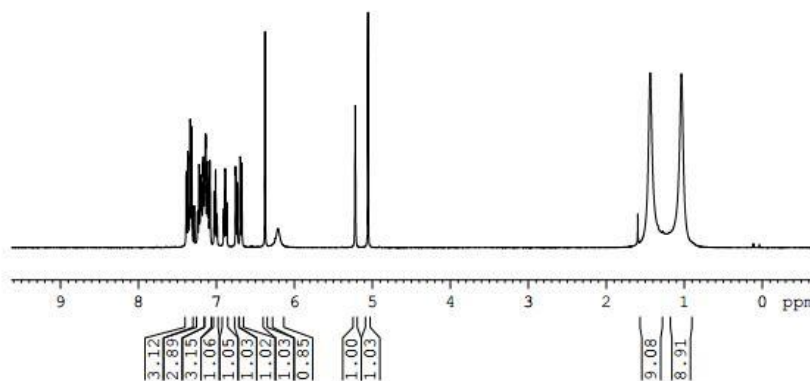
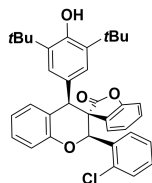
NMR spectra for compounds 3-4

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-phenyl-2H-spiro[benzofuran-3,3'-chroman]-2-one (3a)



2'-(2-chlorophenyl)-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3b)

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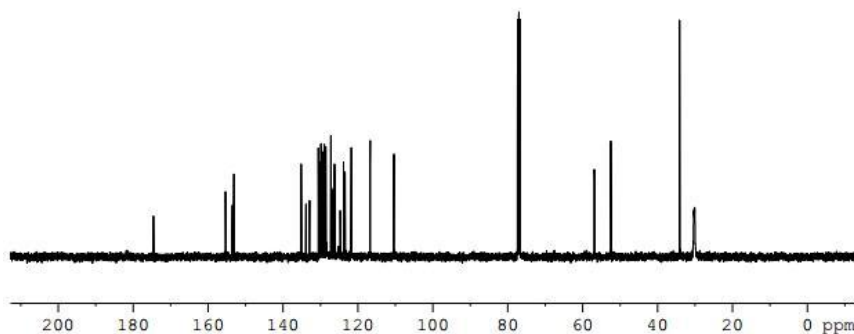
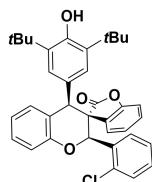


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DE         6.50 usec
TE         296.5 K
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TD0        1

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SF         400.1500000 MHz
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LB         0.30 Hz
GB         0
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34.1169
30.1074



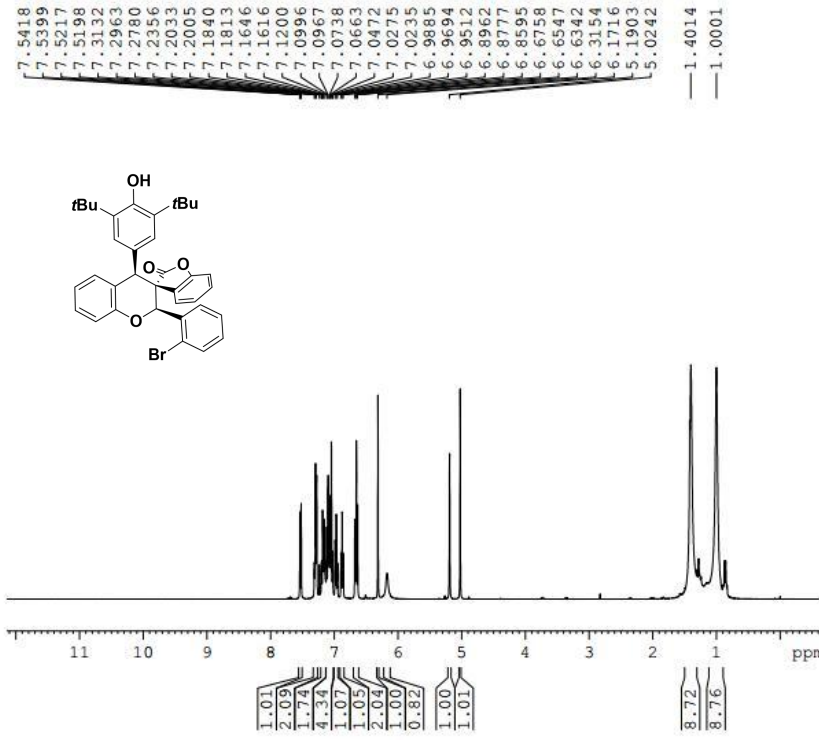
```

NAME      xqm171218-2-CC
EXPNO     1
PROCNO    1
Date_     20180315
Time      15.51
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         74
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
LW         20.800 usec
DE         6.50 usec
TE         297.5 K
D1         2.00000000 sec
D11        0.03000000 sec
TD0        1

===== CHANNEL f1 =====
NUC1       13C
P1         11.50 usec
PL1        -3.00 dB
PL1W       68.16146088 W
SFO1       100.6278593 MHz

===== CHANNEL f2 =====
CPDPRG2   waltz16
NUC2       1H
PCPD2     90.00 usec
PL2        -2.60 dB
PL12       13.88 dB
PL13       14.50 dB
PL1W       17.82643890 W
PL12W     0.40092635 W
PL13W     0.34758785 W
SFO2       400.1516006 MHz
SI         32768
SF         100.6177980 MHz
WDW        EM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
    
```

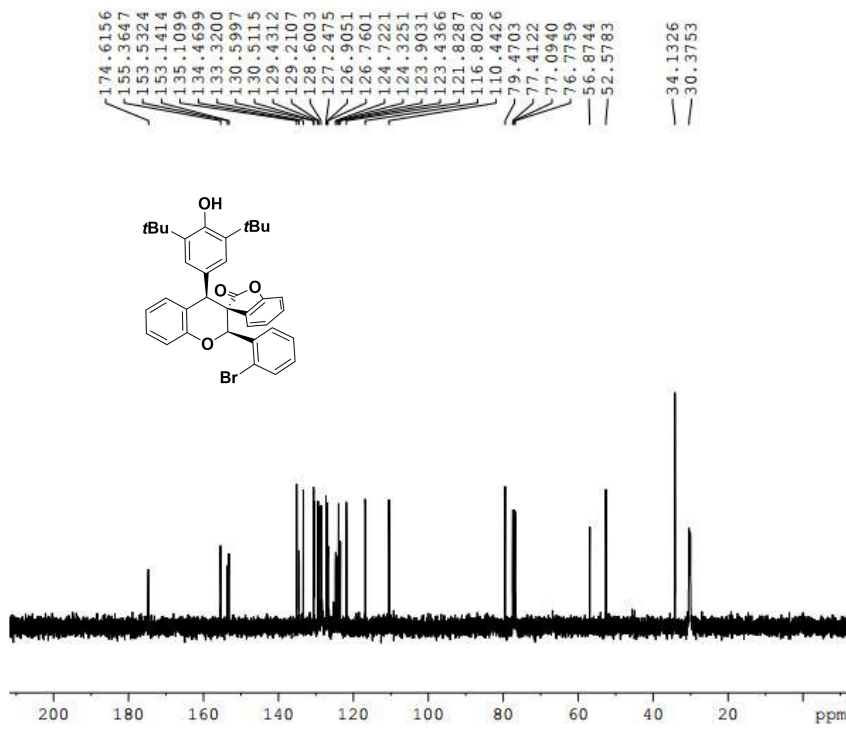
2'-(2-bromophenyl)-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3c)



```

NAME      xqml71220-H
EXPNO     1
PROCNO    1
Date_     20180129
Time      11.16
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8223.685 Hz
FIDRES     0.125483 Hz
AQ         3.9846387 sec
RG         101
DW         60.800 usec
DE         6.50 usec
TE         294.8 K
D1         1.0000000 sec
TD0        1

===== CHANNEL f1 =====
NUC1      1H
P1        13.00 usec
PL1       -2.60 dB
PL1W      17.82643890 W
SFO1      400.1524711 MHz
SI         32768
SF         400.1500184 MHz
WDW        EM
SSB        0
LB         0.30 Hz
GB         0
PC         1.00
    
```



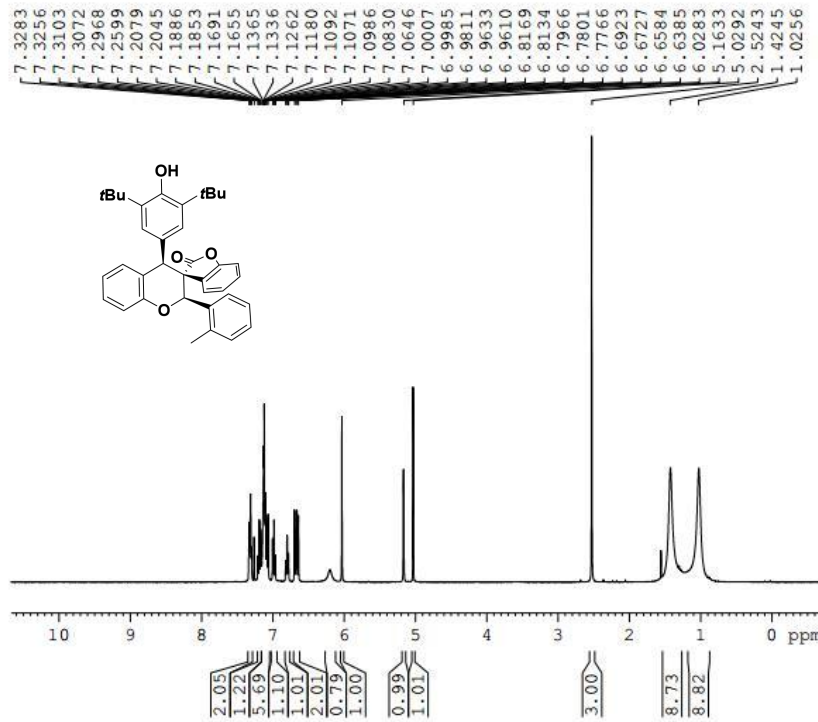
```

NAME      xqml71220-c
EXPNO     1
PROCNO    1
Date_     20180129
Time      11.25
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         14
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
LW         20.800 usec
DE         6.50 usec
TE         295.6 K
D1         2.0000000 sec
D11        0.03000000 sec
TD0        1

===== CHANNEL f1 =====
NUC1      13C
P1        11.50 usec
PL1       -3.00 dB
PL1W      68.16146088 W
SFO1      100.6278593 MHz

===== CHANNEL f2 =====
CPDPRG2   waltz16
NUC2      1H
PCPD2     90.00 usec
PL2       -2.60 dB
PL2W      13.88 dB
PL13      14.50 dB
PL2W      17.82643890 W
PL12W     0.40092635 W
PL13W     0.34758785 W
SFO2      400.1516006 MHz
SI         32768
SF         100.6177980 MHz
WDW        EM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
    
```

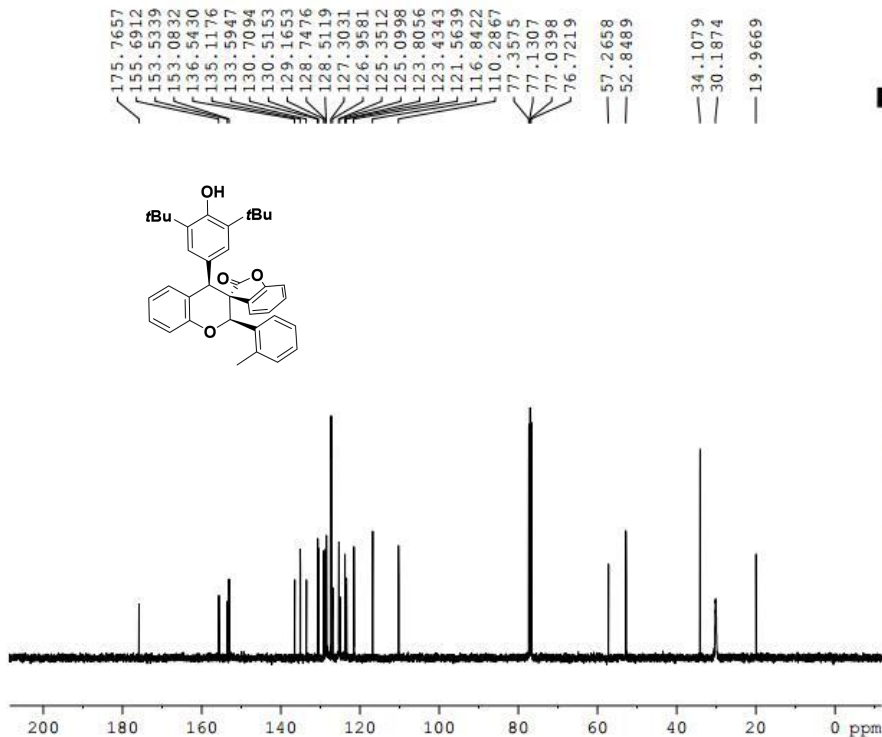

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(o-tolyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3d)



```

NAME      xqm18-2CH3-2-H
EXPNO     1
PROCNO    1
Date_     20180330
Time      14.57
INSTRUM   spect
PROBHD    5 mm FAPBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8223.685 Hz
FIDRES     0.125483 Hz
AQ         3.9846387 sec
RG         128
DW         60.800 usec
DE         6.50 usec
TE         297.6 K
D1         1.00000000 sec
TD0        1

===== CHANNEL f1 =====
NUC1       1H
P1         13.00 usec
PL1        -2.60 dB
PL1W       17.82643890 W
SFO1       400.1524711 MHz
SI         32768
SF         400.1500088 MHz
WDW        EM
SSB        0
LB         0.30 Hz
GB         0
PC         1.00
    
```



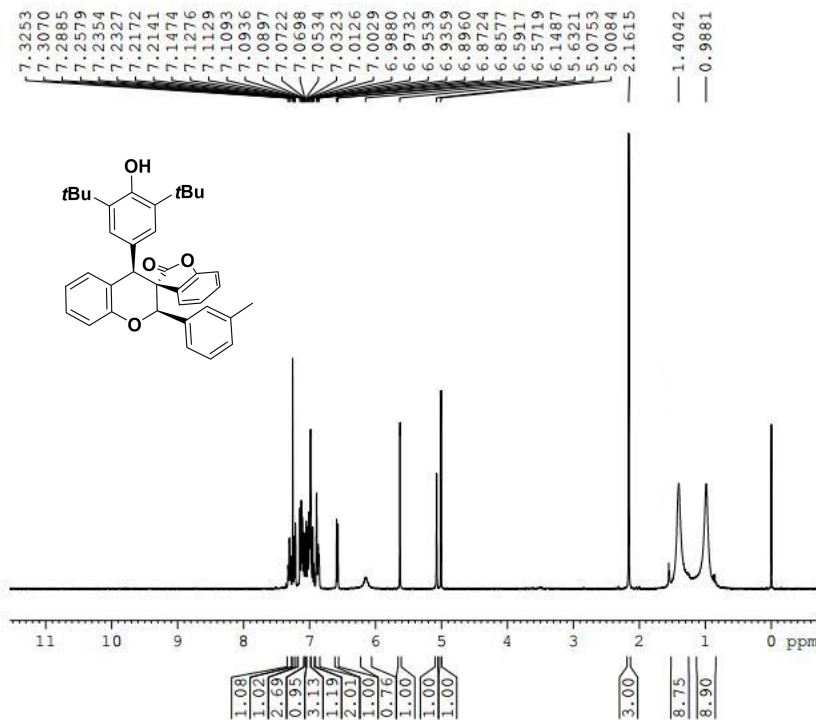
```

NAME      xqm18-2CH3-2-C
EXPNO     1
PROCNO    1
Date_     20180330
Time      16.49
INSTRUM   spect
PROBHD    5 mm FAPBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         92
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
DW         20.800 usec
DE         6.50 usec
TE         299.0 K
D1         2.00000000 sec
D11        0.03000000 sec
TD0        1

===== CHANNEL f1 =====
NUC1       13C
P1         11.50 usec
PL1        -3.00 dB
PL1W       68.16146088 W
SFO1       100.6278593 MHz

===== CHANNEL f2 =====
CPDPRG2   waltz16
NUC2       1H
PCPD2     90.00 usec
PL2        -2.60 dB
PL12       13.88 dB
PL13       14.50 dB
PL2W       17.82643890 W
PL12W      0.40092635 W
PL13W      0.34758785 W
SFO2       400.1516006 MHz
SI         32768
SF         100.6177980 MHz
WDW        EM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
    
```

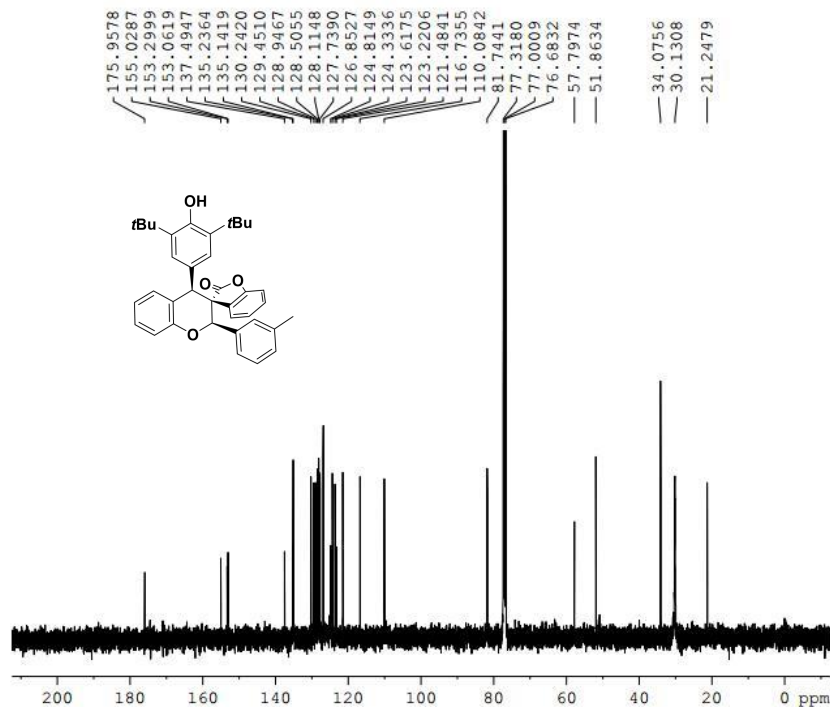
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(m-tolyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3e)



```

NAME      xqm171218-10-H
EXPNO    1
PROCNO   1
Date_    20180313
Time     15.55
INSTRUM  spect
PROBHD   5 mm PARBO BB-
PULPROG  zg30
TD        65536
SOLVENT  cdcl3
NS        8
DS        2
SWH       8223.685 Hz
FIDRES   0.125483 Hz
AQ        3.9846387 sec
RG        203
DW        60.800 usec
DE        6.50 usec
TE        296.4 K
D1        1.00000000 sec
TD0       1

===== CHANNEL f1 =====
NUC1      1H
P1        13.00 usec
PL1       -2.60 dB
PL1W      17.82643890 W
SFO1      400.1524711 MHz
SI        32768
SF        400.1500096 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
    
```



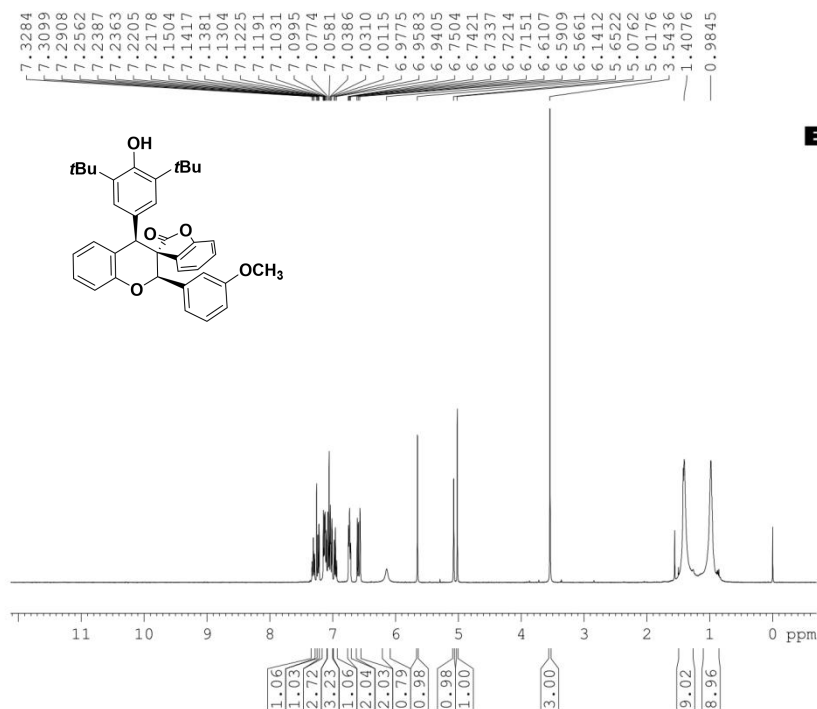
```

NAME      xqm171218-10-c-1
EXPNO    1
PROCNO   1
Date_    20180313
Time     18.46
INSTRUM  spect
PROBHD   5 mm PARBO BB-
PULPROG  zgpg30
TD        65536
SOLVENT  cdcl3
NS        1024
DS        4
SWH       24038.461 Hz
FIDRES   0.366798 Hz
AQ        1.3631988 sec
RG        203
DW        20.800 usec
DE        6.50 usec
TE        298.5 K
D1        2.00000000 sec
D11       0.03000000 sec
TD0       1

===== CHANNEL f1 =====
NUC1      13C
P1        11.50 usec
PL1       -3.00 dB
PL1W      68.16146088 W
SFO1      100.6278593 MHz

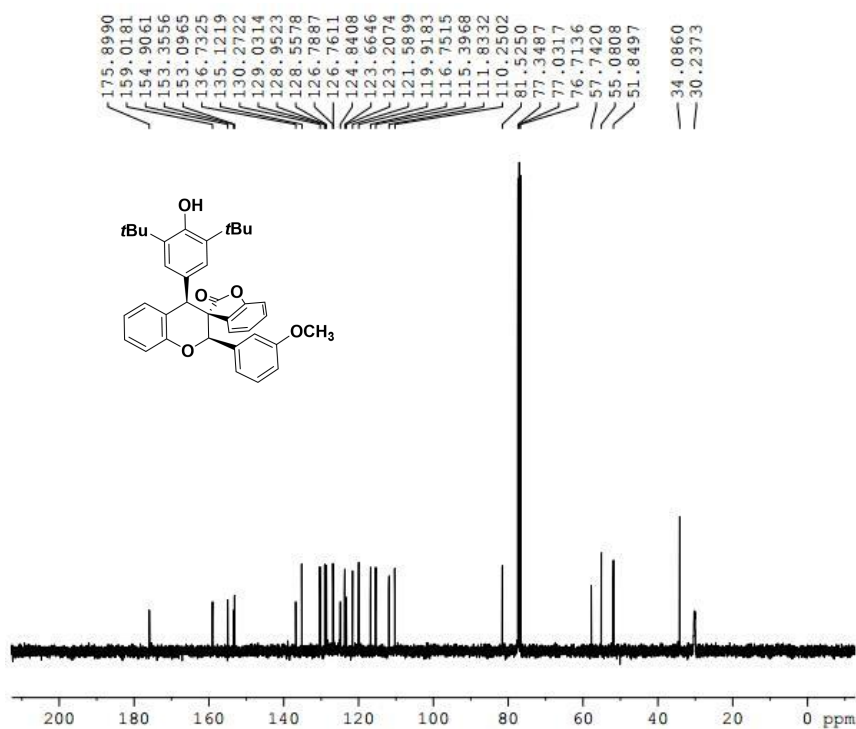
===== CHANNEL f2 =====
CPDPRG2  waltz16
NUC2      1H
PCPD2     90.00 usec
PL2       -2.60 dB
PL12      13.88 dB
PL13      14.50 dB
PL2W      17.82643890 W
PL12W     0.40092635 W
PL13W     0.34758785 W
SFO2      400.1516006 MHz
SI        32768
SF        100.6177980 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
    
```

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(3-methoxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one(3f)



```

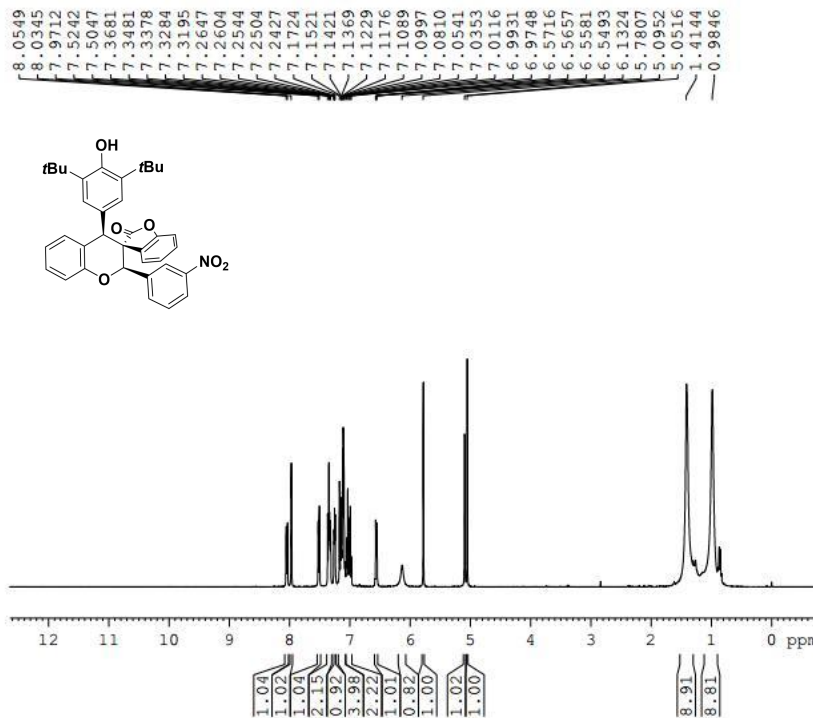
NAME      xqm171218-13-H
EXPNO    1
PROCNO   1
Date_    20180129
Time     11.08
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD       65536
SOLVENT  CDCl3
NS       8
DS       2
SWH      8223.685 Hz
FIDRES   0.125483 Hz
AQ       3.9846387 sec
RG       203
DW       60.800 usec
DE       6.50 usec
TE       294.6 K
D1       1.00000000 sec
TDO      1
===== CHANNEL f1 =====
NUC1     1H
P1       13.00 usec
PL1     -2.60 dB
PL1W    17.82643890 W
SF01    400.1524711 MHz
SI       32768
SF      400.1500104 MHz
WDW      EM
SSB      0
LB       0.30 Hz
GB       0
PC       1.00
    
```



```

NAME      xqm171218-13-c
EXPNO    1
PROCNO   1
Date_    20180129
Time     11.43
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD       65536
SOLVENT  CDCl3
NS       131
DS       4
SWH      24038.461 Hz
FIDRES   0.366798 Hz
AQ       1.3631988 sec
RG       203
DW       20.800 usec
DE       6.50 usec
TE       296.1 K
D1       2.00000000 sec
D11      0.83000000 sec
TDO      1
===== CHANNEL f1 =====
NUC1     13C
P1       11.50 usec
PL1     -3.00 dB
PL1W    68.16146088 W
SF01    100.6278593 MHz
===== CHANNEL f2 =====
CPDPRG2  waltz16
NUC2     1H
PCPD2    90.00 usec
PL2     -2.60 dB
PL12    13.88 dB
PL13    14.50 dB
PL2W    17.82643890 W
PL12W   0.40092635 W
PL13W   0.34758785 W
SF02    400.1516006 MHz
SI       32768
SF      100.6177980 MHz
WDW      EM
SSB      0
LB       1.00 Hz
GB       0
PC       1.40
    
```

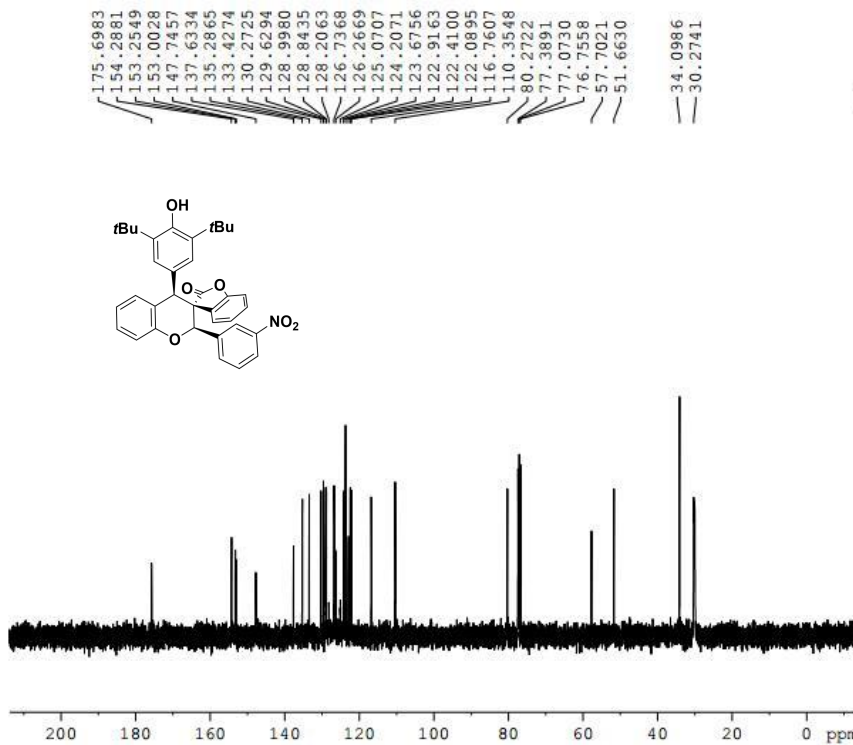
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2-oxo-2H-spiro[benzofuran-3,3'-chroman]-2'-yl)phenyl nitrate (3g)



```

NAME      xqm171218-1-H
EXPNO     1
PROCNO    1
Date_     20180128
Time      10.51
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8223.685 Hz
FIDRES     0.125483 Hz
AQ         3.9846387 sec
RG         128
DW         60.800 usec
DE         6.50 usec
TE         294.5 K
D1         1.00000000 sec
TDO        1

===== CHANNEL f1 =====
NUC1      1H
P1        13.00 usec
PL1       -2.60 dB
PL1W      17.82643890 W
SFO1      400.1524711 MHz
SI        32768
SF        400.1500110 MHz
WDW        EM
SSB        0
LB         0.30 Hz
GB         0
PC         1.00
    
```



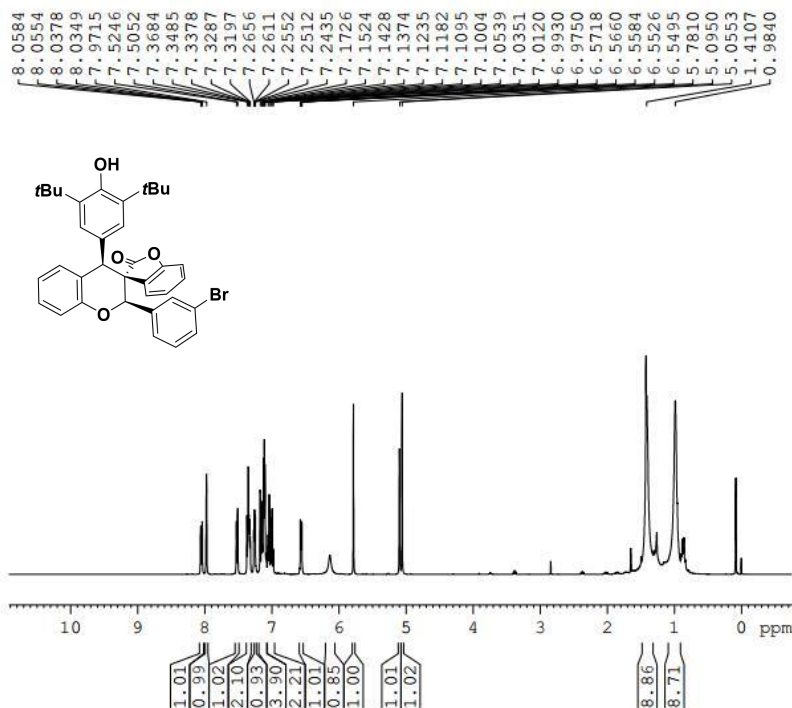
```

NAME      xqm171218-1-c
EXPNO     1
PROCNO    1
Date_     20180128
Time      15.44
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         27
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
DW         20.800 usec
DE         6.50 usec
TE         295.9 K
D1         2.00000000 sec
D11        0.03000000 sec
TDO        1

===== CHANNEL f1 =====
NUC1      13C
P1        11.50 usec
PL1       -3.00 dB
PL1W      68.16146088 W
SFO1      100.6278593 MHz

===== CHANNEL f2 =====
CPDPRG2   waltz16
NUC2      1H
PCPD2     90.00 usec
PL2       -2.60 dB
PL12      13.88 dB
PL13      14.50 dB
PL1W      17.82643890 W
PL12W     0.40092635 W
PL13W     0.34758785 W
SFO2      400.1516006 MHz
SI        32768
SF        100.6177980 MHz
WDW        EM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
    
```


2'-(3-bromophenyl)-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3h)

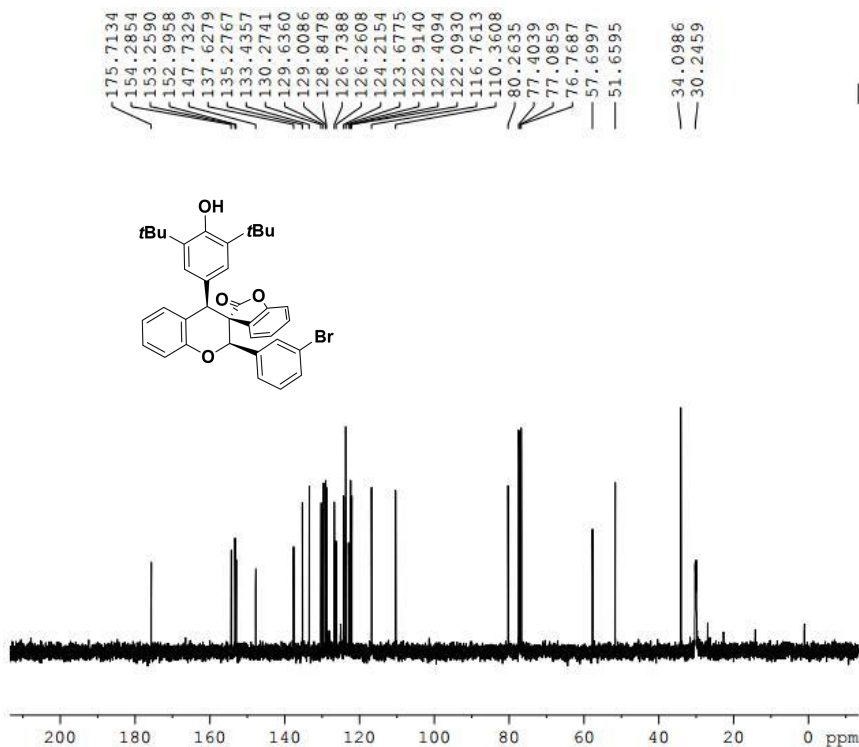


```

NAME      xqm171218-5-H
EXPNO    1
PROCNO   1
Date_    20180123
Time     10.46
INSTRUM  spect
PROBHD   5 mm PABBO Bb-
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        8
DS        2
SWH      8223.685 Hz
FIDRES   0.125483 Hz
AQ        3.9846387 sec
RG        36
DW        60.800 usec
DE        6.50 usec
TE        293.2 K
D1        1.00000000 sec
TDO
  
```

```

===== CHANNEL f1 =====
NUC1      1H
P1        13.00 usec
PL1       -2.60 dB
PL1W      18.28352737 W
SF01      400.1524711 MHz
SI        32768
SF        400.1500107 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
  
```



```

NAME      xqm171218-5-C
EXPNO    1
PROCNO   1
Date_    20180123
Time     11.01
INSTRUM  spect
PROBHD   5 mm PABBO Bb-
PULPROG  zgpg30
TD        65536
SOLVENT  CDCl3
NS        22
DS        4
SWH      24038.461 Hz
FIDRES   0.366798 Hz
AQ        1.3631988 sec
RG        203
DW        20.800 usec
DE        6.50 usec
TE        294.0 K
D1        2.00000000 sec
D11       0.03000000 sec
TDO      1
  
```

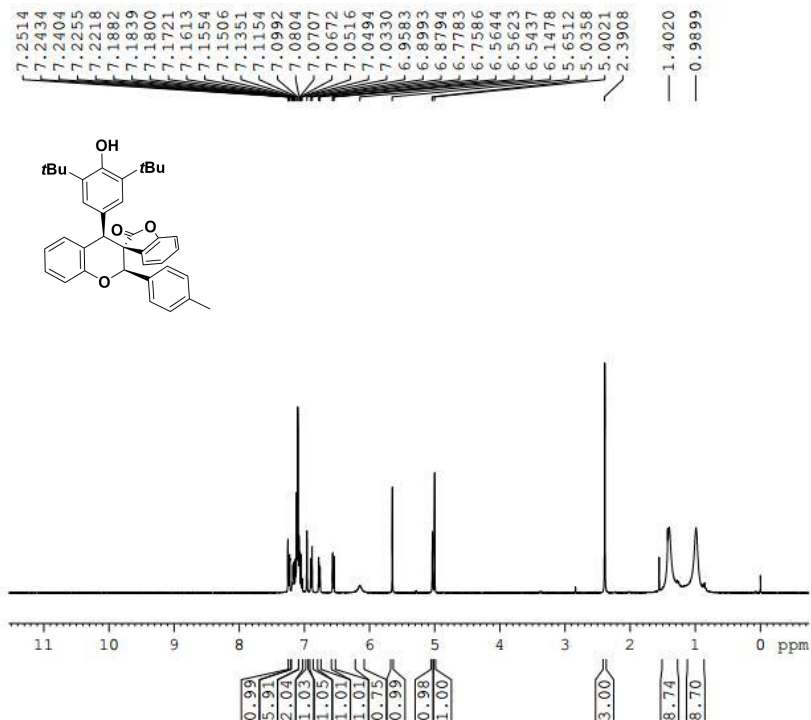
```

===== CHANNEL f1 =====
NUC1      13C
P1        11.50 usec
PL1       -3.00 dB
PL1W      68.16146088 W
SF01      100.6278593 MHz
  
```

```

===== CHANNEL f2 =====
CPDPRG2  waltz16
NUC2      1H
PCPD2    90.00 usec
PL2       -2.60 dB
PL12     13.88 dB
PL13     14.50 dB
PL2W     17.82643890 W
PL12W    0.40092635 W
PL13W    0.34758785 W
SF02     400.1516006 MHz
SI        32768
SF        100.6177980 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
  
```

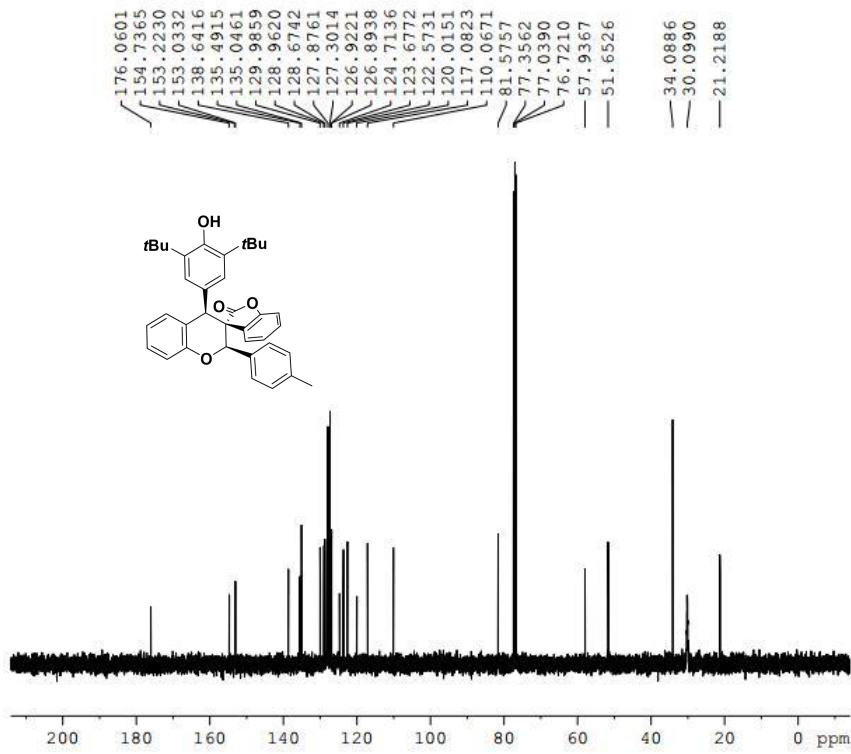
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(p-tolyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3i)



```

NAME      xqml71221-5-H
EXPNO    1
PROCNO   1
Date_    20180129
Time     17.49
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        8
DS        2
SWH       8223.685 Hz
FIDRES   0.125483 Hz
AQ        3.9846387 sec
RG        203
DW        60.800 usec
DE        6.50 usec
TE        295.2 K
D1        1.00000000 sec
TDO       1

===== CHANNEL f1 =====
NUC1     1H
P1       13.00 usec
PL1      -2.60 dB
PL1W    17.82643890 W
SFO1    400.1524711 MHz
SI       32768
SF       400.1500122 MHz
WDW      EM
SSB      0
LB       0.30 Hz
GB       0
FC       1.00
    
```



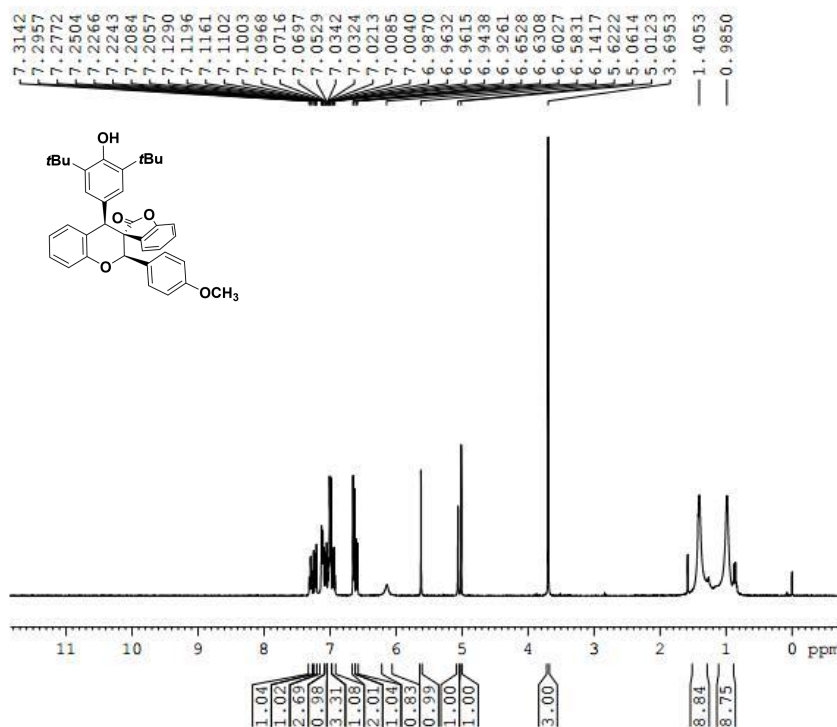
```

NAME      xqml71221-5-c
EXPNO    1
PROCNO   1
Date_    20180129
Time     16.29
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD        65536
SOLVENT  CDCl3
NS        53
DS        4
SWH       24038.461 Hz
FIDRES   0.366798 Hz
AQ        1.3631988 sec
RG        203
DW        20.800 usec
DE        6.50 usec
TE        295.9 K
D1        2.00000000 sec
D11      0.03000000 sec
TDO       1

===== CHANNEL f1 =====
NUC1     13C
P1       11.50 usec
PL1      -3.00 dB
PL1W    68.16146088 W
SFO1    100.6278593 MHz

===== CHANNEL f2 =====
CPDPRG2  waltz16
NUC2     1H
PCPD2    90.00 usec
PL2      -2.60 dB
PL12     13.88 dB
PL13     14.50 dB
PL1W    17.82643890 W
PL12W   0.40092635 W
PL13W   0.34758785 W
SFO2    400.1516006 MHz
SI       32768
SF       100.6177980 MHz
WDW      EM
SSB      0
LB       1.00 Hz
GB       0
FC       1.40
    
```

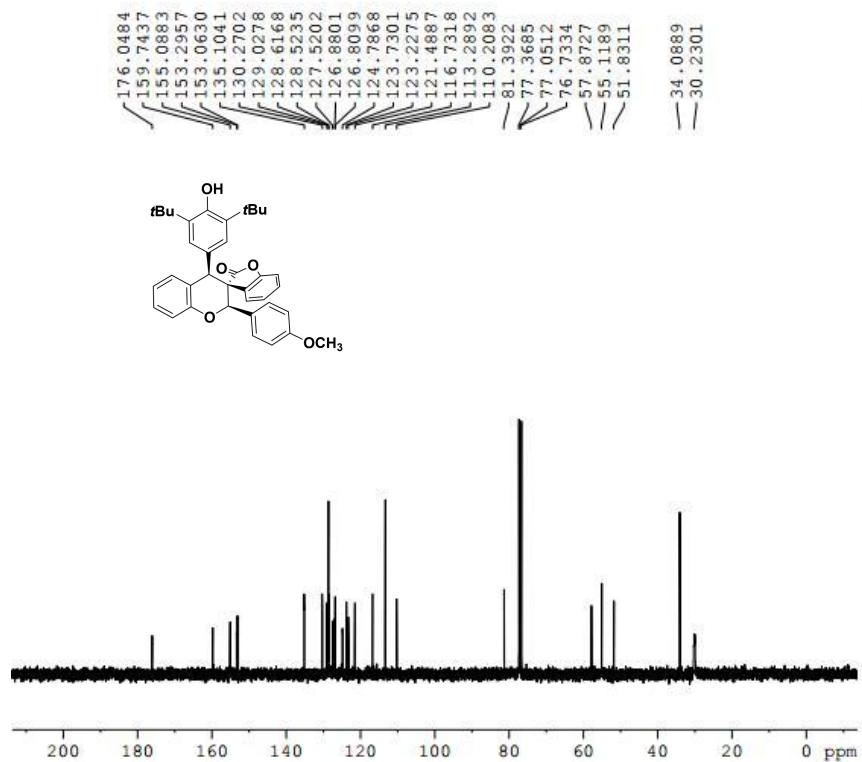
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(4-methoxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3j)



```

NAME      xqnl171218-14-H
EXPNO     1
PROCNO    1
Date_     20180129
Time      11.04
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8223.685 Hz
FIDRES     0.125483 Hz
AQ         3.9846387 sec
RG         203
DW         60.800 usec
DE         6.50 usec
TE         295.8 K
D1         1.00000000 sec
TDO        1

----- CHANNEL f1 -----
NUC1      1H
P1         13.00 usec
PL1        -2.60 dB
PL1W       17.82643890 W
SFO1       400.1524711 MHz
SI         32768
SF         400.1500126 MHz
WDW        EM
SSB        0
LB         0.30 Hz
GB         0
PC         1.00
    
```



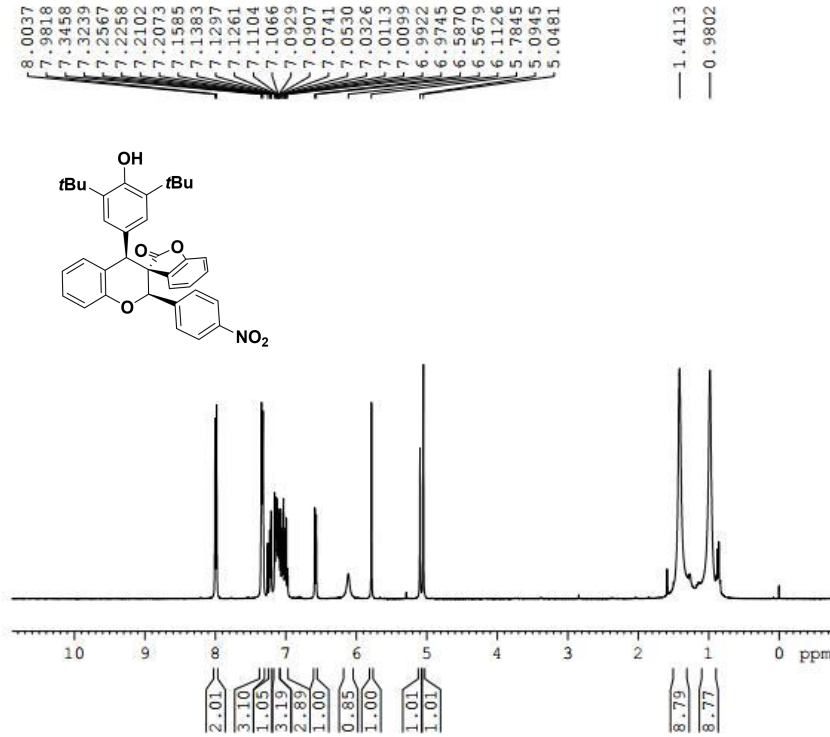
```

NAME      xqnl171218-14-c
EXPNO     1
PROCNO    1
Date_     20180129
Time      11.37
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         30
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
DW         20.800 usec
DE         6.50 usec
TE         295.8 K
D1         2.00000000 sec
D11        0.03000000 sec
TDO        1

----- CHANNEL f1 -----
NUC1      13C
P1         11.50 usec
PL1        -3.00 dB
PL1W       68.16146088 W
SFO1       100.6278593 MHz

----- CHANNEL f2 -----
CPDPRG2   waltz16
NUC2      1H
PCPD2     90.00 usec
PL2        -2.60 dB
PL12       13.68 dB
PL13       14.50 dB
PL2W       17.82643890 W
PL12W      0.40092635 W
PL13W      0.34758755 W
SFO2       400.1516006 MHz
SI         32768
SF         100.6177980 MHz
WDW        EM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
    
```

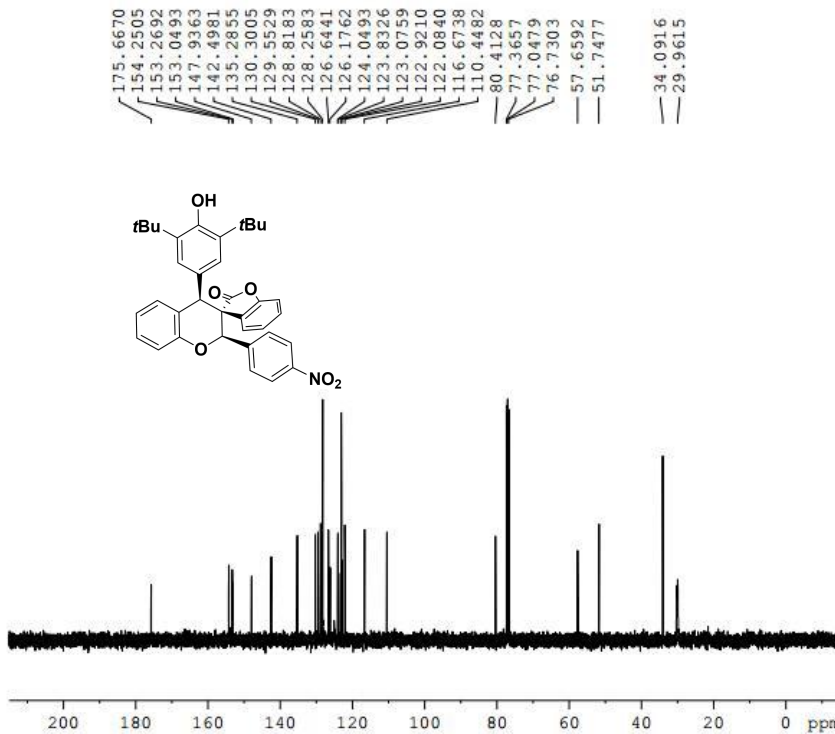

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(4-nitrophenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3l)



```

NAME      xqm171218-9-H
EXPNO    1
PROCNO   1
Date_    20180129
Time     10.35
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        8
DS        2
SWH       8223.685 Hz
FIDRES    0.125483 Hz
AQ        3.9846387 sec
RG        203
DW        60.800 usec
DE        6.50 usec
TE        294.5 K
D1        1.00000000 sec
TDO       1

===== CHANNEL f1 =====
NUC1      1H
P1        13.00 usec
PL1       -2.60 dB
PL1W      17.82643890 W
SFO1      400.1524711 MHz
SI        32768
SF        400.1500101 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
    
```



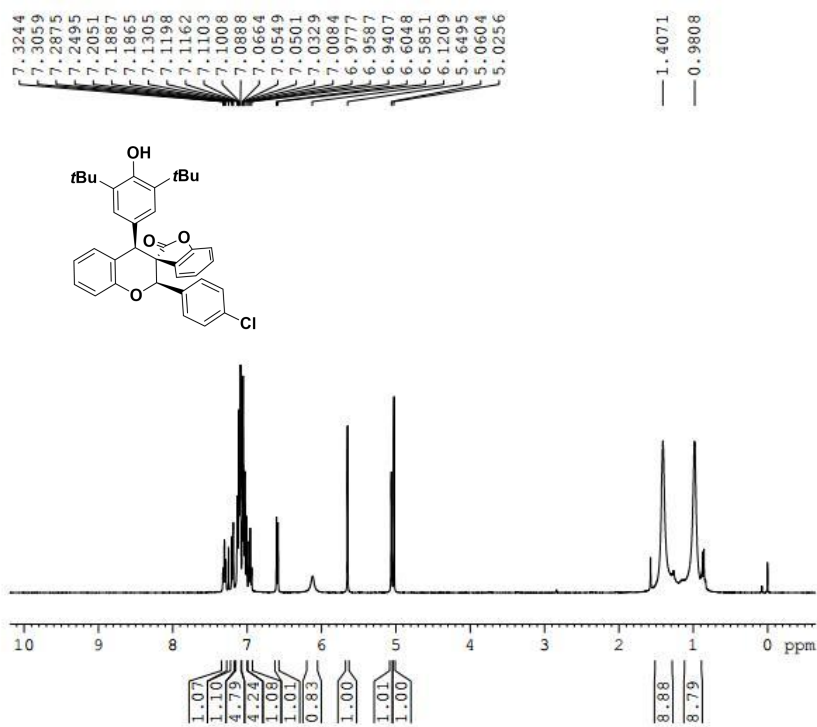
```

NAME      xqm171218-9-c
EXPNO    1
PROCNO   1
Date_    20180129
Time     15.54
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD        65536
SOLVENT  CDCl3
NS        31
DS        4
SWH       24038.461 Hz
FIDRES    0.366798 Hz
AQ        1.3631988 sec
RG        203
DW        20.800 usec
DE        6.50 usec
TE        296.1 K
D1        2.00000000 sec
D11       0.03000000 sec
TDO       1

===== CHANNEL f1 =====
NUC1      13C
P1        11.50 usec
PL1       -3.00 dB
PL1W      68.16146088 W
SFO1      100.6278593 MHz

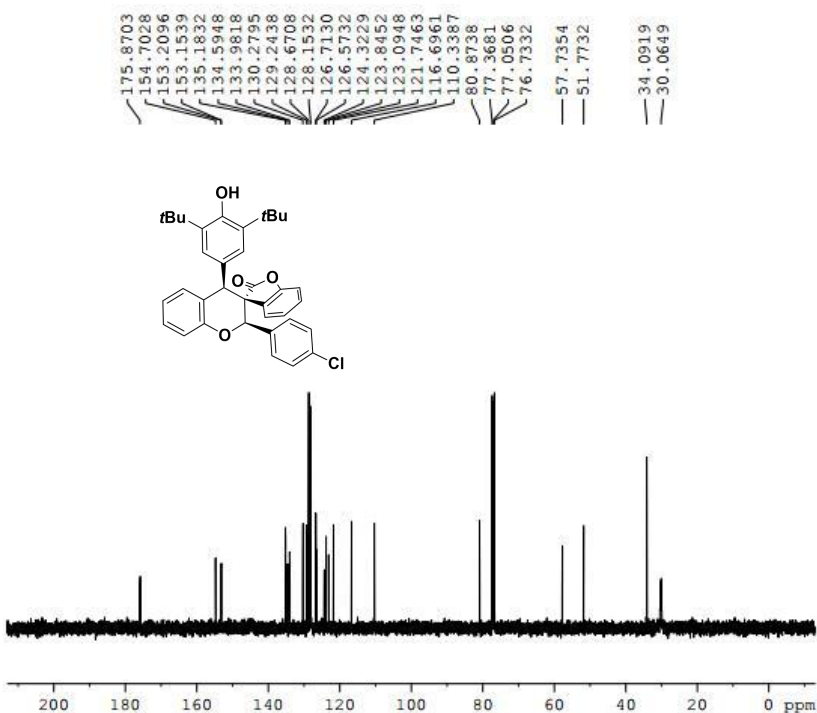
===== CHANNEL f2 =====
CPDPRG2  waltz16
NUC2      1H
PCPD2    90.00 usec
PL2       -2.60 dB
PL12     13.88 dB
PL13     14.30 dB
PL2W     17.82643890 W
PL12W    0.40092635 W
PL13W    0.34758785 W
SFO2     400.1516006 MHz
SI        32768
SF        100.6177980 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
    
```

2'-(4-chlorophenyl)-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3m)



```

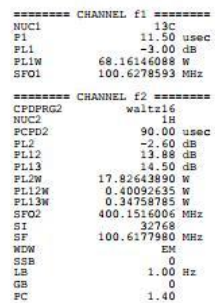
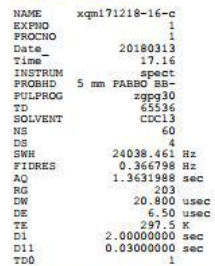
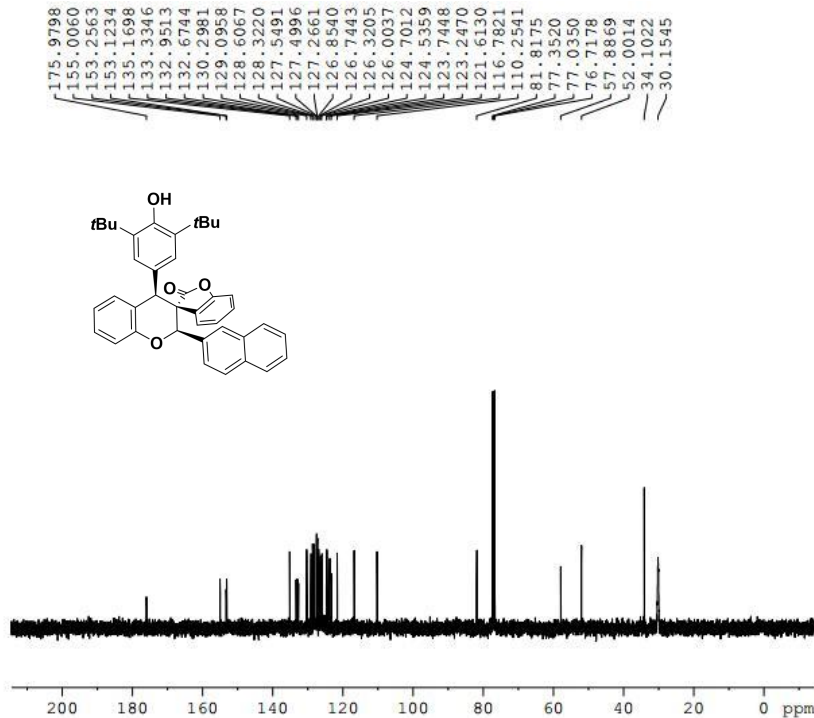
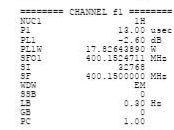
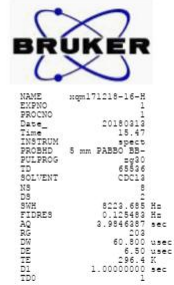
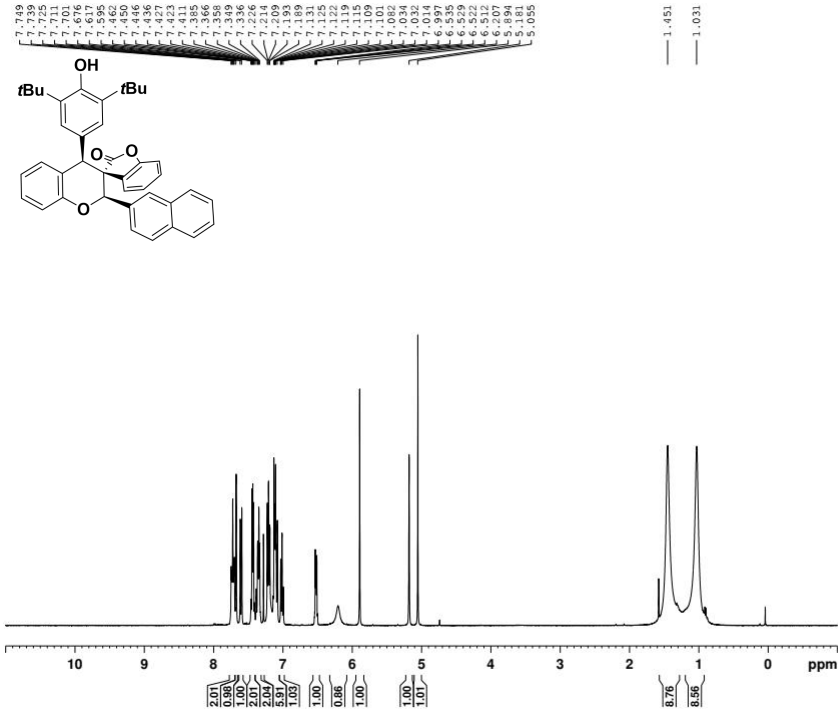
NAME      xqm171218-8-h
EXPNO     1
PROCNO    1
Date_     20180129
Time      10.46
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8223.685 Hz
FIDRES     0.125483 Hz
AQ         3.9846387 sec
RG         203
DW         60.800 usec
DE         6.50 usec
TE         294.7 K
D1         1.00000000 sec
D11        1
===== CHANNEL f1 =====
NUC1       1H
P1         13.00 usec
PL1        -2.60 dB
PL1W       17.82643890 W
SFO1       400.1524711 MHz
SI         32768
SF         400.1500130 MHz
WDW        EM
SSB        0
LB         0.30 Hz
GB         0
PC         1.00
    
```



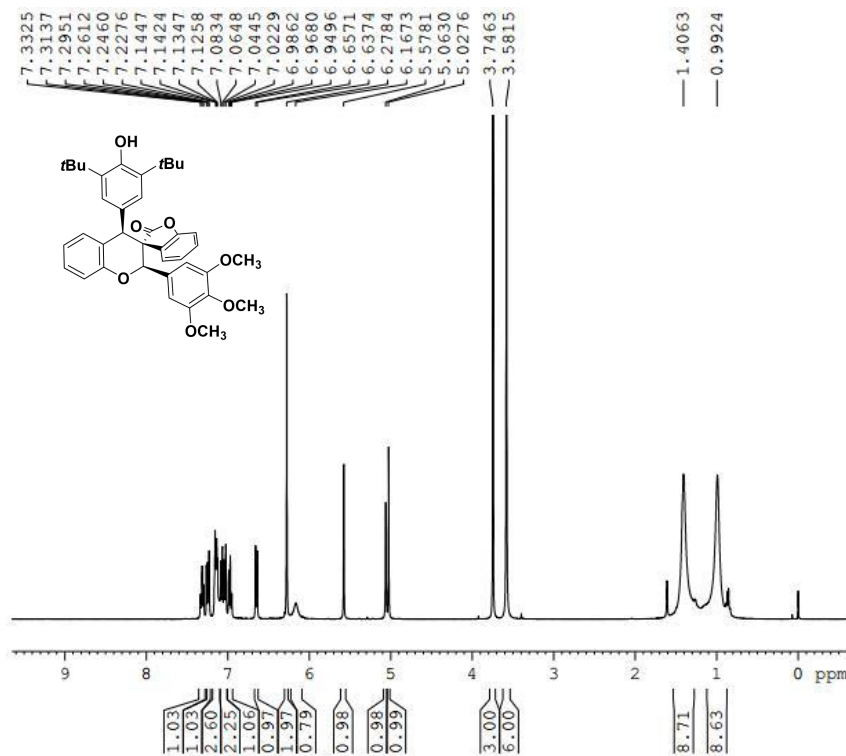
```

NAME      xqm171218-8-c
EXPNO     1
PROCNO    1
Date_     20180129
Time      15.21
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         27
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
DW         20.800 usec
DE         6.50 usec
TE         296.3 K
D1         2.00000000 sec
D11        0.03000000 sec
TQ         1
===== CHANNEL f1 =====
NUC1       13C
P1         11.50 usec
PL1        -3.00 dB
PL1W       68.16146088 W
SFO1       100.6278593 MHz
===== CHANNEL f2 =====
CQDPRG2    waltz16
NUC2       1H
PCPD2      90.00 usec
PL2        -2.60 dB
PL12       13.88 dB
PL13       14.50 dB
PL2W       17.82643890 W
PL12W      0.40052635 W
PL13W      0.14758785 W
SFO2       400.1516006 MHz
SI         32768
SF         100.6177950 MHz
WDW        EM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
    
```


4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(naphthalen-2-yl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (30)



4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(3,4,5-trimethoxyphenyl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3p)

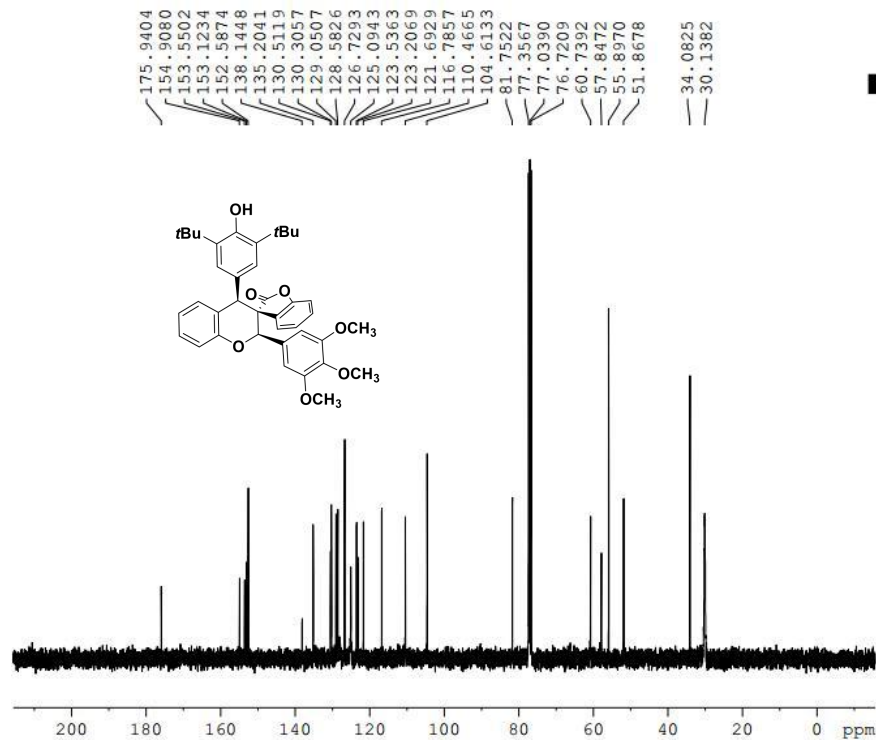


```

NAME      xqm171218-17-h
EXPNO     1
PROCNO    1
Date_     20180322
Time      14.53
INSTRUM   spect
PROBHD    5 mm FAPBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8223.685 Hz
FIDRES     0.125483 Hz
AQ         3.9846387 sec
RG         161
DW         60.800 usec
DE         6.50 usec
TE         296.1 K
D1         1.00000000 sec
D11        1
TDO        1
    
```

```

===== CHANNEL f1 =====
NUC1      1H
P1         13.00 usec
PL1        -2.60 dB
PL1W      17.82643890 W
SFO1      400.1524711 MHz
SI         32768
SF         400.1500083 MHz
WDW        EM
SSB        0
LB         0.30 Hz
GB         0
PC         1.00
    
```



```

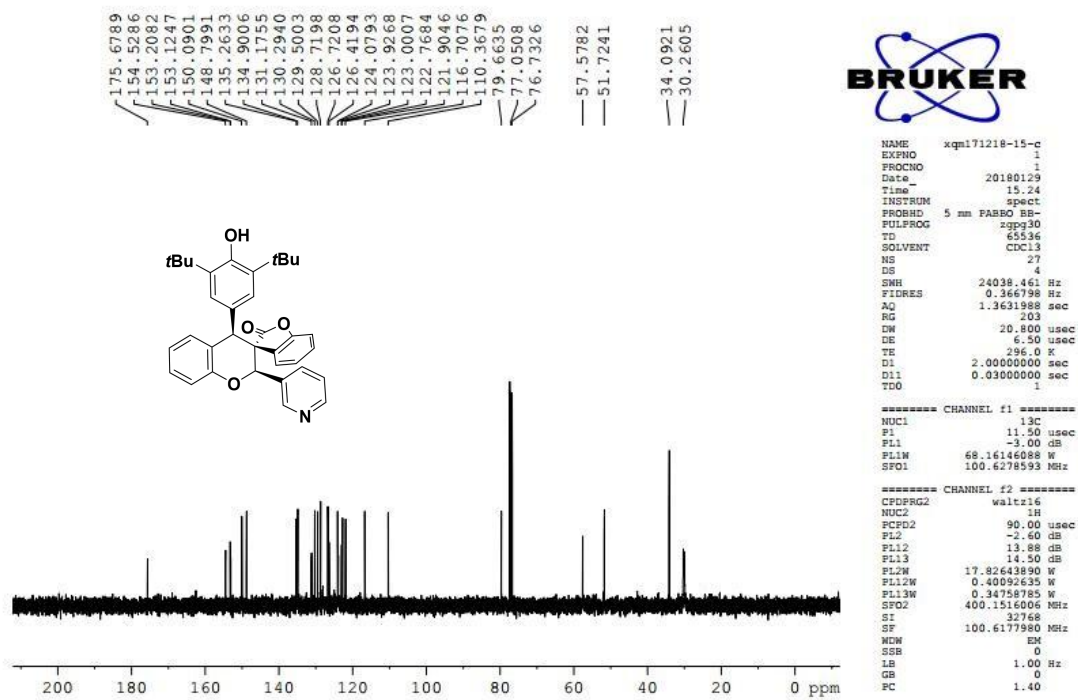
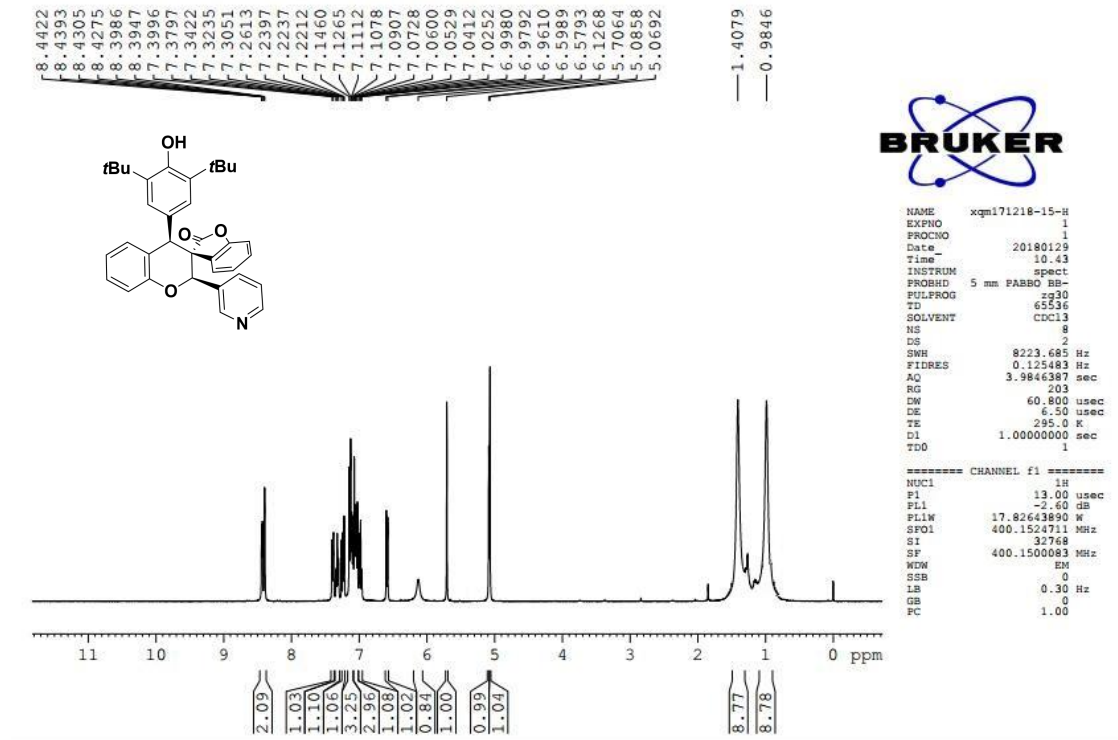
NAME      xqm171218-17-c
EXPNO     1
PROCNO    1
Date_     20180322
Time      15.08
INSTRUM   spect
PROBHD    5 mm FAPBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         4
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
DW         20.800 usec
DE         6.50 usec
TE         297.3 K
D1         2.00000000 sec
D11        0.03000000 sec
TDO        1
    
```

```

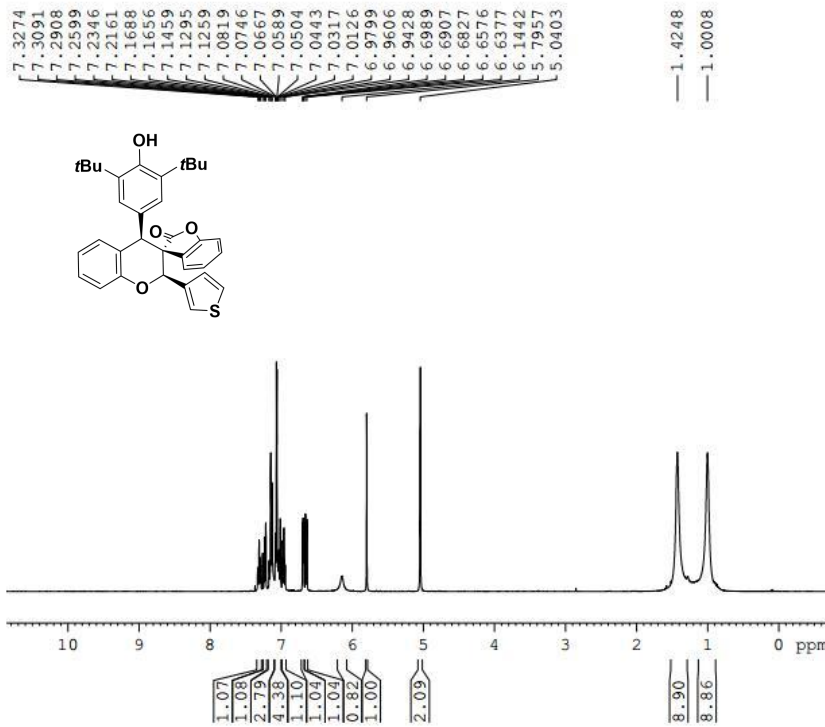
===== CHANNEL f1 =====
NUC1      13C
P1         11.50 usec
PL1        -3.00 dB
PL1W      68.16146088 W
SFO1      100.6278593 MHz

===== CHANNEL f2 =====
CPDPRG2   waltz16
NUC2      1H
PCPD2     90.00 usec
PL2        -2.60 dB
PL12      13.88 dB
PL13      14.50 dB
PL2W      17.82643890 W
PL12W     0.40092635 W
PL13W     0.34758785 W
SFO2      400.1516006 MHz
SI         32768
SF         100.6177980 MHz
WDW        EM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
    
```


4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(pyridin-3-yl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3q)



4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-(thiophen-3-yl)-2H-spiro[benzofuran-3,3'-chroman]-2-one (3r)

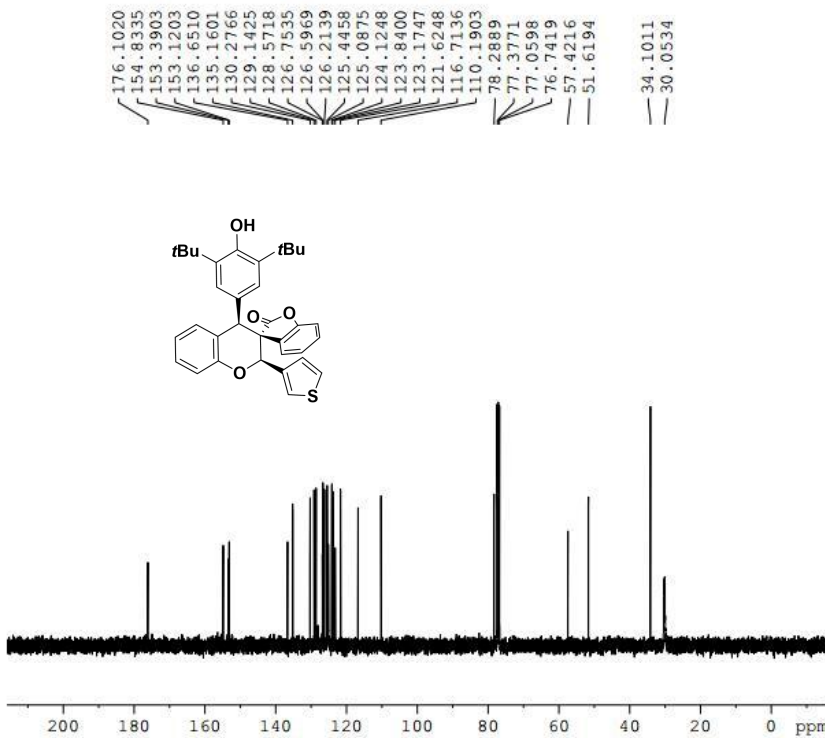


```

NAME      xqm1801-saifen-2
EXPNO    1
PROCNO    1
Date_     20180129
Time      11.20
INSTRUM   spect
PROBHD    5 mm FAPBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8223.685 Hz
FIDRES     0.125483 Hz
AQ         3.9846387 sec
RG         161
DW         60.800 usec
DE         6.50 usec
TE         294.9 K
D1         1.00000000 sec
TDO        1
    
```

```

===== CHANNEL f1 =====
NUC1      1H
P1         13.00 usec
PL1        -2.60 dB
PL1W       17.82643890 W
SFO1       400.1524711 MHz
SI         32768
SF         400.1500087 MHz
WDW        EM
SSB        0
LB         0.30 Hz
GB         0
PC         1.00
    
```



```

NAME      xqm1801-saifen-2-c
EXPNO    1
PROCNO    1
Date_     20180129
Time      11.23
INSTRUM   spect
PROBHD    5 mm FAPBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         22
DS         4
SWH        24039.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
DW         20.800 usec
DE         6.50 usec
TE         295.8 K
D1         2.00000000 sec
D11        0.03000000 sec
TDO        1
    
```

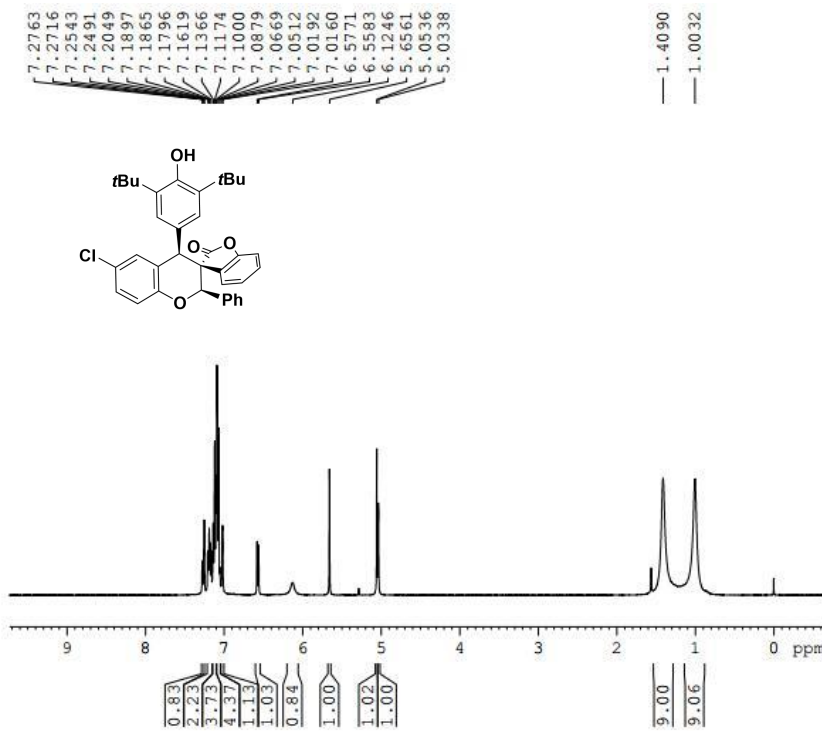
```

===== CHANNEL f1 =====
NUC1      13C
P1         11.50 usec
PL1        -1.00 dB
PL1W       68.16146088 W
SFO1       100.6278593 MHz
    
```

```

===== CHANNEL f2 =====
CPDPRG2   waltz16
NUC2      1H
PCPD2     90.00 usec
PL2        -2.60 dB
PL12       13.88 dB
PL13       14.50 dB
PL2W       17.82643890 W
PL12W      0.4009665 W
PL13W      0.34758785 W
SFO2       400.1516006 MHz
SI         32768
SF         100.6177980 MHz
WDW        EM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
    
```

6'-chloro-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-phenyl-2H-spiro[benzofuran-3,3'-chroman]-2-one (4a)

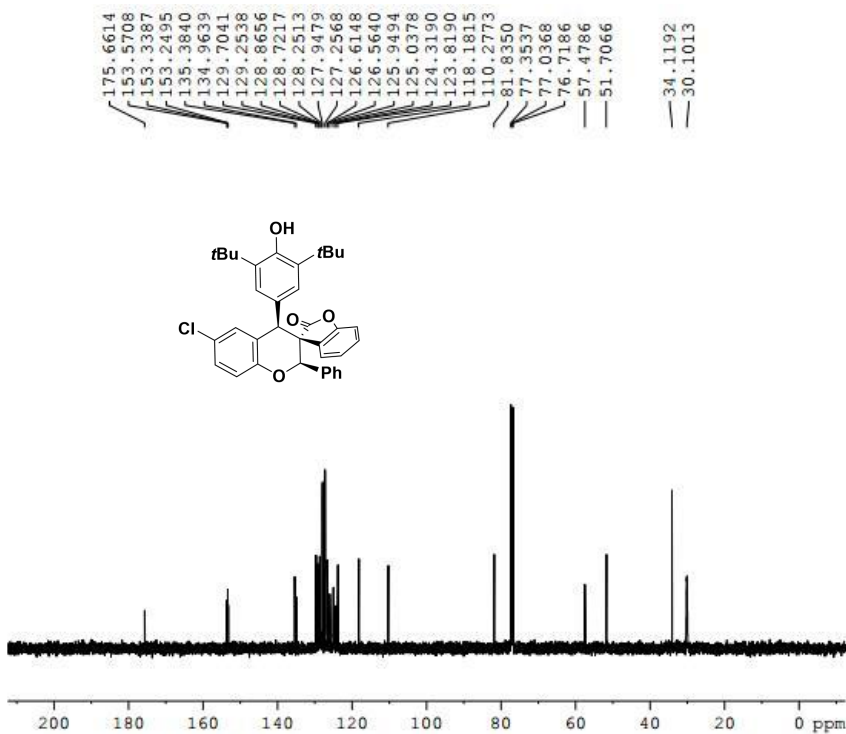


```

NAME      XQM171221-1-H
EXPNO     1
PROCNO    1
Date_     20180313
Time      16.15
INSTRUM   spect
PROBHD    5 mm FAPBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SMH        8223.685 Hz
FIDRES    0.125483 Hz
AQ         3.9846387 sec
RG         203
DM         60.800 usec
DE         6.50 usec
TE         296.4 K
D1         1.00000000 sec
TDO        1
    
```

```

----- CHANNEL f1 -----
NUC1      1H
P1         13.00 usec
PL1        -2.60 dB
PL1W      17.82643890 W
SFO1      400.1524711 MHz
SI         32768
SF         400.1500131 MHz
WDW        EM
SSB         0
LB          0.30 Hz
GB          0
PC          1.00
    
```



```

NAME      xqm171221-1-c
EXPNO     1
PROCNO    1
Date_     20180313
Time      17.11
INSTRUM   spect
PROBHD    5 mm FAPBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         58
DS         4
SMH        24038.461 Hz
FIDRES    0.366798 Hz
AQ         1.3631988 sec
RG         203
DM         20.800 usec
DE         6.50 usec
TE         297.3 K
D1         2.00000000 sec
D11        0.03000000 sec
TDO        1
    
```

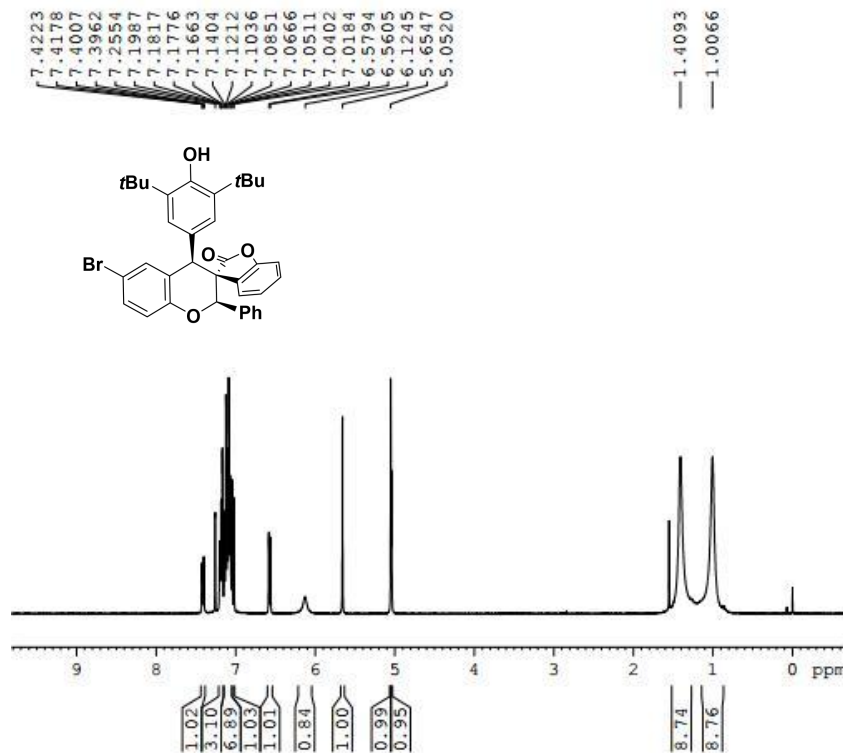
```

----- CHANNEL f1 -----
NUC1      13C
P1         11.50 usec
PL1         -3.00 dB
PL1W      68.16146088 W
SFO1      100.6278593 MHz
    
```

```

----- CHANNEL f2 -----
CPDPRG2   waltz16
NUC2      1H
PCPD2     90.00 usec
PL2        -2.60 dB
PL12      13.88 dB
PL13      14.50 dB
PL2W      17.82643890 W
PL12W     0.40092635 W
PL13W     0.34759785 W
SFO2      400.1516006 MHz
SI         32768
SF         100.6177980 MHz
WDW        EM
SSB         0
LB          1.00 Hz
GB          0
PC          1.40
    
```

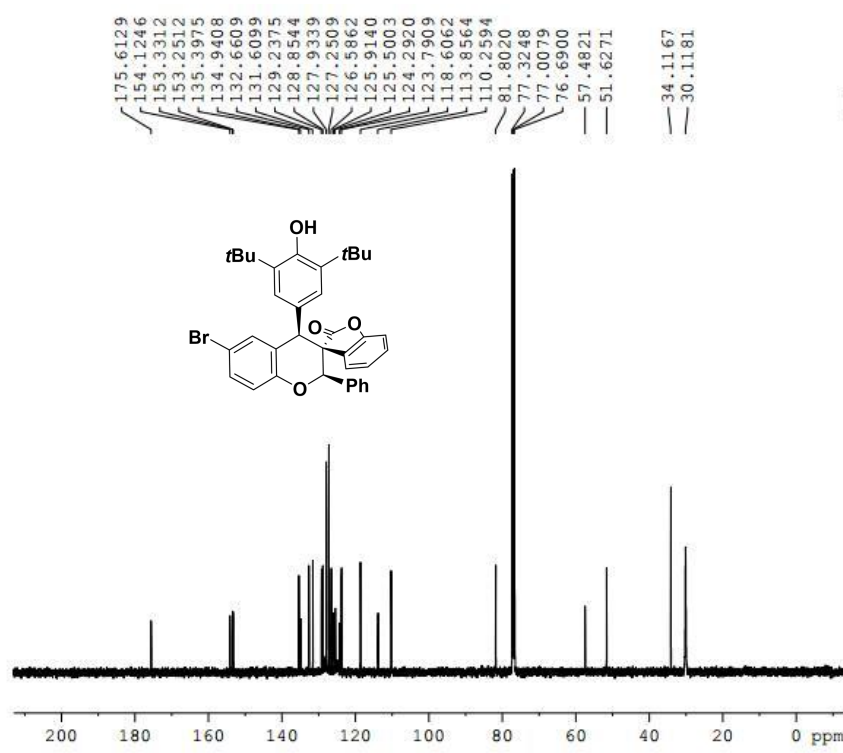

6'-bromo-4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-2'-phenyl-2H-spiro[benzofuran-3,3'-chroman]-2-one (4b)



```

NAME      xqm171221-2-HH
EXPNO     1
PROCNO    1
Date_     20180315
Time      15.33
INSTRUM   spect
PROBHD    5 mm PABBO BBO
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH       8223.685 Hz
FIDRES    0.125483 Hz
AQ        3.9846387 sec
RG         203
DM        60.800 usec
DE        6.50 usec
TE        296.5 K
D1        1.00000000 sec
TDO       1

----- CHANNEL f1 -----
NUC1      1H
P1        13.00 usec
PL1       -2.60 dB
PL1W     17.82643890 W
SFO1     400.1524711 MHz
SI        32768
SF        400.1500107 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
    
```



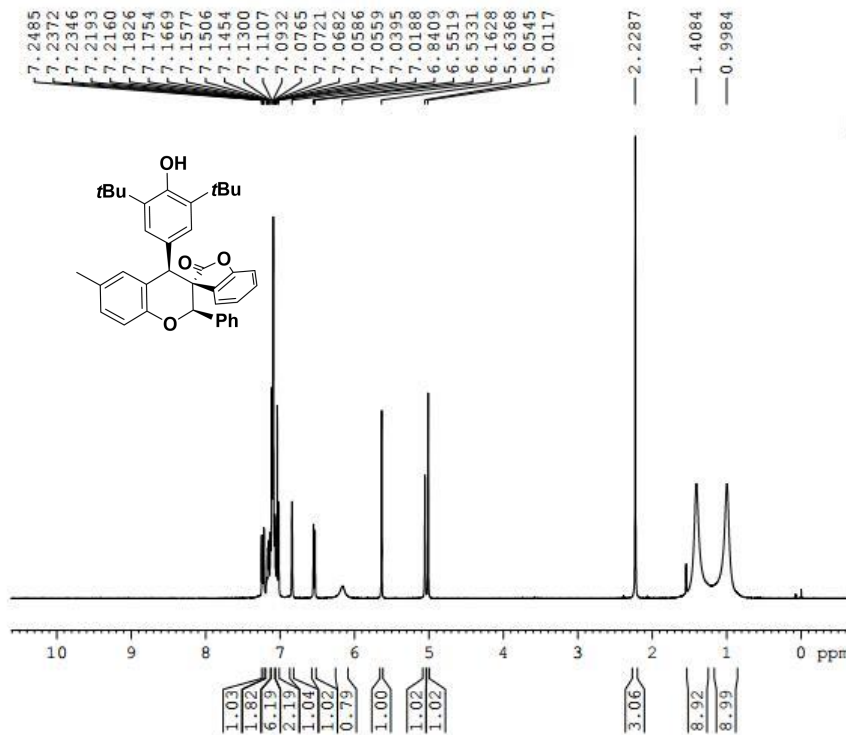
```

NAME      xqm171221-2-C
EXPNO     1
PROCNO    1
Date_     20180315
Time      18.32
INSTRUM   spect
PROBHD    5 mm PABBO BBO
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         4
DS         4
SWH       24038.461 Hz
FIDRES    0.366798 Hz
AQ        1.3631988 sec
RG         203
DM        20.800 usec
DE        6.50 usec
TE        298.7 K
D1        2.00000000 sec
D11       0.03000000 sec
TDO       1

----- CHANNEL f1 -----
NUC1      13C
P1        11.50 usec
PL1       -3.00 dB
PL1W     68.16146088 W
SFO1     100.6278593 MHz

----- CHANNEL f2 -----
CPDPRG2   waltz16
NUC2      1H
PCPD2     90.00 usec
PL2       -2.60 dB
PL12     13.88 dB
PL13     14.50 dB
PL2W     17.82643890 W
PL12W    0.40092635 W
PL13W    0.34758785 W
SFO2     400.1516006 MHz
SI        32768
SF        100.6177980 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
    
```

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-6'-methyl-2'-phenyl-2H-spiro[benzofuran-3,3'-chroman]-2-one (4c)

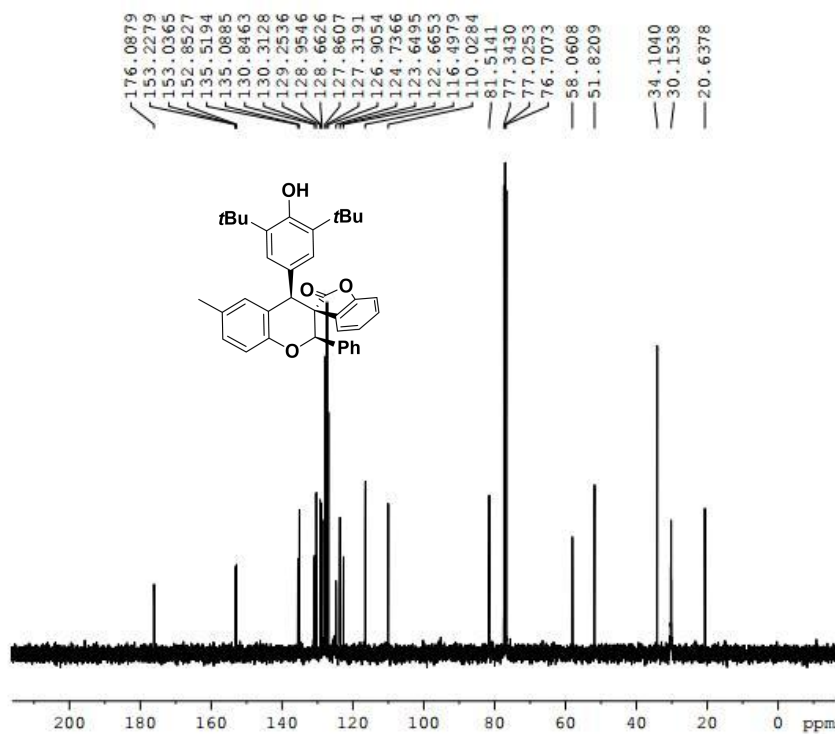


```

NAME      xqm171221-3-HH
EXPNO     1
PROCNO    1
Date_     20180315
Time      15.37
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8223.685 Hz
FIDRES     0.125483 Hz
AQ         3.9846387 sec
RG         203
DW         60.800 usec
DE         6.50 usec
TE         296.5 K
D1         1.0000000 sec
D11        0
TDO        1
    
```

```

----- CHANNEL f1 -----
NUC1      1H
P1         13.00 usec
PL1        -2.60 dB
PL1W       17.82643890 W
SFO1       400.1524711 MHz
SI         32768
SF         400.1500134 MHz
WDW        EM
SSB        0
LB         0.30 Hz
GB         0
PC         1.00
    
```



```

NAME      xqm171221-3-cc
EXPNO     1
PROCNO    1
Date_     20180315
Time      16.22
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         91
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
DW         20.800 usec
DE         6.50 usec
TE         298.0 K
D1         2.0000000 sec
D11        0.0300000 sec
TDO        1
    
```

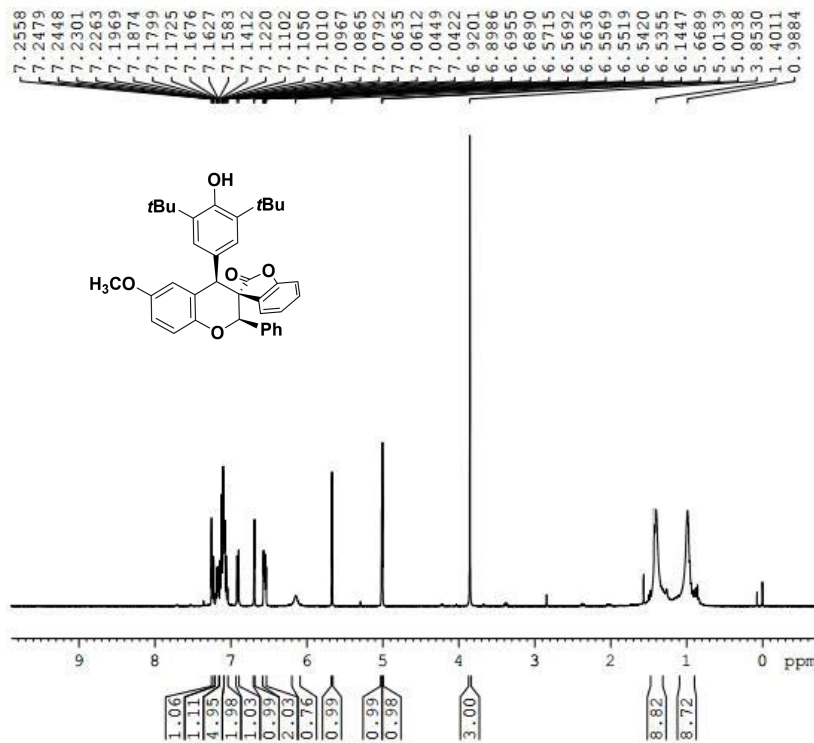
```

----- CHANNEL f1 -----
NUC1      13C
P1         11.50 usec
PL1        -3.00 dB
PL1W       68.16146088 W
SFO1       100.6278593 MHz
    
```

```

----- CHANNEL f2 -----
CPDPRG2   waltz16
NUC2       1H
PCPD2     90.00 usec
PL2        -2.60 dB
PL12       13.88 dB
PL13       14.50 dB
PL1W       17.82643890 W
PL12W      0.40092635 W
PL13W      0.34758785 W
SFO2       400.1516006 MHz
SI         32768
SF         100.6177980 MHz
WDW        EM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
    
```

4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-6'-methoxy-2'-phenyl-2H-spiro[benzofuran-3,3'-chroman]-2-one (4d)

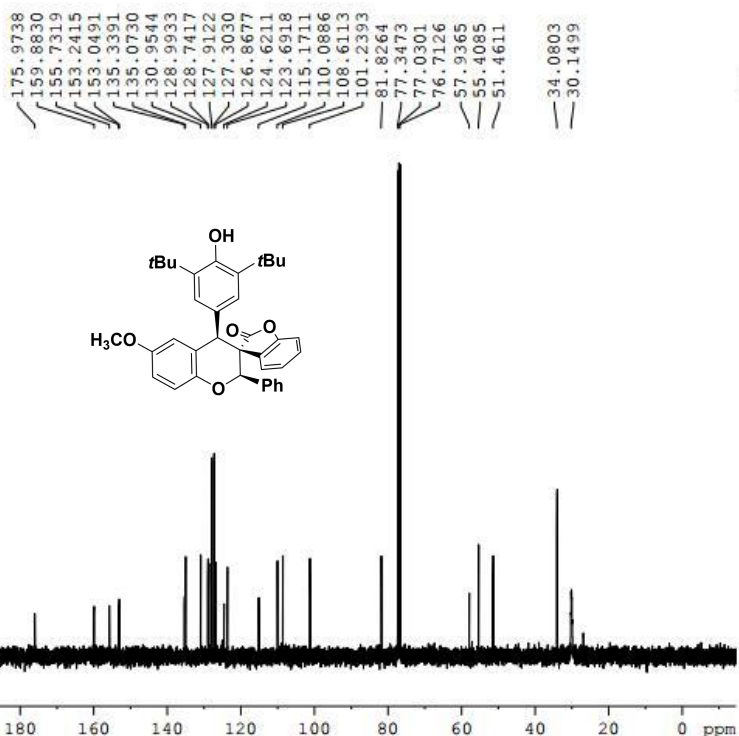


```

NAME      xqm171221-4-H
EXPNO    1
PROCNO   1
Date_    20180129
Time     17.46
INSTRUM  spect
PROBHD   5 mm PABBO B8-
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        8
DS        2
SWH       8223.685 Hz
FIDRES    0.125483 Hz
AQ        3.9846387 sec
RG        203
DW        60.800 usec
DE        6.50 usec
TE        294.2 K
D1        1.00000000 sec
TDO       1
    
```

```

----- CHANNEL f1 -----
NUC1      1H
P1        13.00 usec
PL1       -2.60 dB
PL1W      17.82643890 W
SFO1      400.1524711 MHz
SI        32768
SF        400.1500105 MHz
WDM       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
    
```



```

NAME      xqm171221-4-c
EXPNO    1
PROCNO   1
Date_    20180129
Time     16.25
INSTRUM  spect
PROBHD   5 mm PABBO B8-
PULPROG  zgpg30
TD        65536
SOLVENT  CDCl3
NS        97
DS        4
SWH       24038.461 Hz
FIDRES    0.366798 Hz
AQ        1.3631988 sec
RG        203
DW        20.800 usec
DE        6.50 usec
TE        296.2 K
D1        2.00000000 sec
D11       0.03000000 sec
TDO       1
    
```

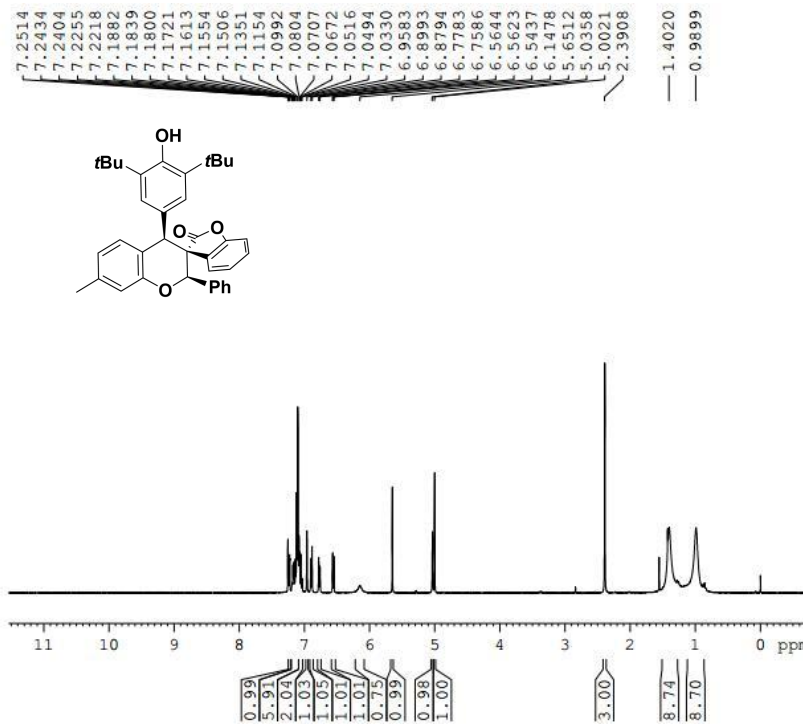
```

----- CHANNEL f1 -----
NUC1      13C
P1        11.50 usec
PL1       -3.00 dB
PL1W      68.16146088 W
SFO1      100.6278593 MHz
    
```

```

----- CHANNEL f2 -----
CPDPRG2  waltz16
NUC2      1H
PCPD2    90.00 usec
PL2       -2.60 dB
PL12     13.88 dB
PL13     14.50 dB
PL2W     17.82643890 W
PL12W    0.40092635 W
PL13W    0.34758785 W
SFO2     400.1516006 MHz
SI        32768
SF        100.6177980 MHz
WDM       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
    
```

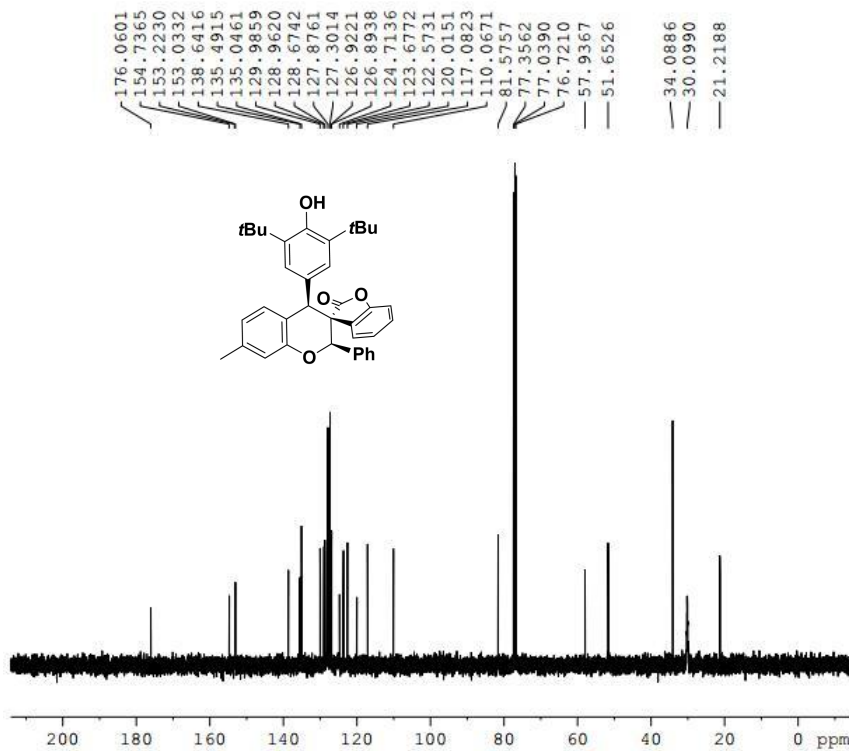
4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-7'-methyl-2'-phenyl-2H-spiro[benzofuran-3,3'-chroman]-2-one (4e)



```

NAME      xqm171221-5-H
EXPNO     1
PROCNO    1
Date_     20180129
Time      17.49
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8223.685 Hz
FIDRES     0.125483 Hz
AQ         3.9846387 sec
RG         203
DW         60.800 usec
DE         6.50 usec
TE         295.2 K
D1         1.00000000 sec
TD0        1

===== CHANNEL f1 =====
NUC1       1H
P1         13.00 usec
PL1        -2.60 dB
PL1W       17.82643890 W
SF01       400.1524711 MHz
SI         32768
SF         400.1500122 MHz
WDW        EM
SSB         0
LB         0.30 Hz
GB         0
PC         1.00
    
```



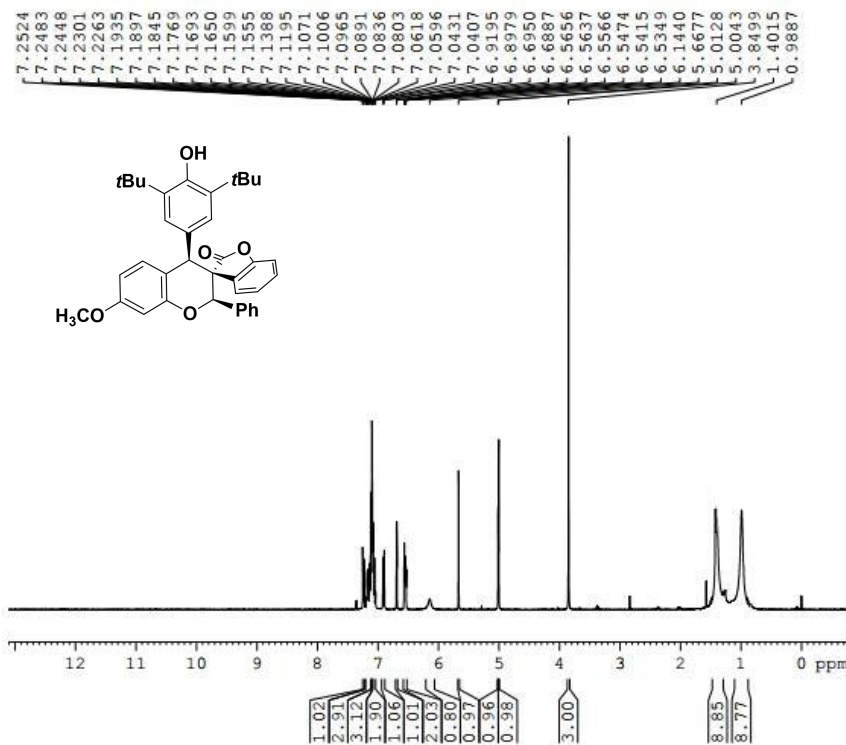
```

NAME      xqm171221-5-c
EXPNO     1
PROCNO    1
Date_     20180129
Time      16.29
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         53
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
DW         20.800 usec
DE         6.50 usec
TE         295.9 K
D1         2.00000000 sec
D11        0.03000000 sec
TD0        1

===== CHANNEL f1 =====
NUC1       13C
P1         11.50 usec
PL1        -3.00 dB
PL1W       68.16146088 W
SF01       100.6278593 MHz

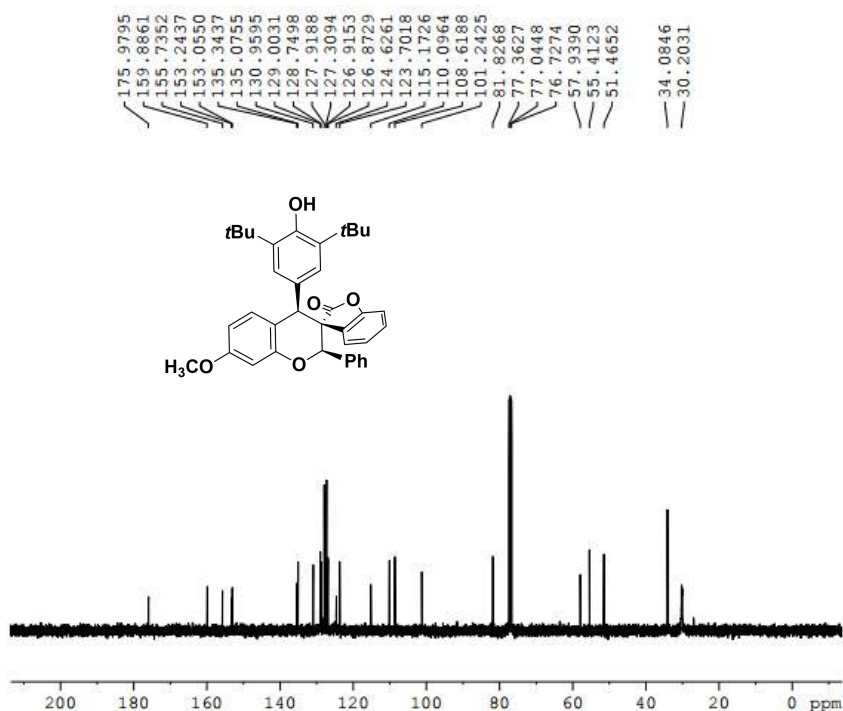
===== CHANNEL f2 =====
CPDPRG2   waltz16
NUC2       1H
PCPD2     90.00 usec
PL2        -2.60 dB
PL2W      13.88 dB
PL2W      14.50 dB
PL2W      17.82643890 W
PL12W     0.40092635 W
PL13W     0.34758785 W
SF02      400.1516006 MHz
SI         32768
SF         100.6177980 MHz
WDW        EM
SSB         0
LB         1.00 Hz
GB         0
PC         1.40
    
```


4'-(3,5-di-tert-butyl-4-hydroxyphenyl)-7'-methoxy-2'-phenyl-2H-spiro[benzofuran-3,3'-chroman]-2-one (4f)



```

NAME      xqm171221-6-H
EXPNO     1
PROCNO    1
Date_     20180129
Time      17.41
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8223.685 Hz
FIDRES     0.125483 Hz
AQ         3.9846387 sec
RG         203
DM         60.800 usec
DE         6.50 usec
TE         294.5 K
D1         1.00000000 sec
TDO        1
----- CHANNEL f1 -----
NUC1      1H
P1         13.00 usec
PL1        -2.60 dB
PL1W       17.82643890 W
SFO1       400.1524711 MHz
SI         32768
SF         400.1500117 MHz
WEN        EM
SSB         0
LB         0.30 Hz
GB         0
PC         1.00
    
```



```

NAME      xqm171221-6-c
EXPNO     1
PROCNO    1
Date_     20180129
Time      16.18
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         53
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         203
DM         20.800 usec
DE         6.50 usec
TE         296.4 K
D1         2.00000000 sec
D11        0.03000000 sec
TDO        1
----- CHANNEL f1 -----
NUC1      13C
P1         11.50 usec
PL1        -3.00 dB
PL1W       68.16146088 W
SFO1       100.6278593 MHz
----- CHANNEL f2 -----
CPDPRG2   waltz16
NUC2      1H
PCPD2     90.00 usec
PL2        -2.60 dB
PL12       13.88 dB
PL13       14.50 dB
PL2W       17.82643890 W
PL12W      0.40092635 W
PL13W      0.34758785 W
SFO2       400.1534006 MHz
SI         32768
SF         100.6177980 MHz
WEN        EM
SSB         0
LB         1.00 Hz
GB         0
PC         1.40
    
```