

Supporting Information

Electrochemical dehydrogenative cross-coupling of xanthenes with ketones

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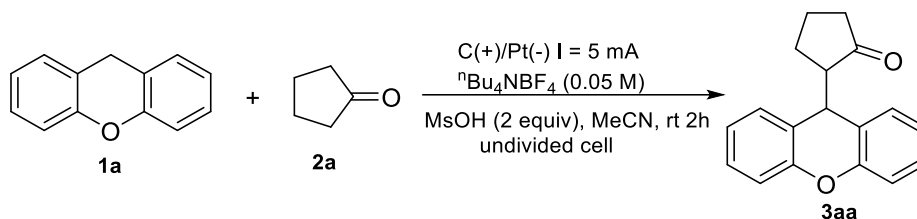
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(A) Typical experimental procedure

(a) General Procedure for the C-H alkylation reaction of Xanthene:



In an oven-dried undivided three-necked bottle (10 mL) equipped with a stir bar, xanthene (0.25 mmol), ketones (2 equiv), $n\text{Bu}_4\text{NBF}_4$ (0.4 mmol) and MeCN (8 mL) were combined and added. Subsequently, MsOH (2 equiv) was added. Then the bottle was equipped with graphite electrode (ϕ 6 mm, about 18 mm immersion depth in solution) as anode and platinum plate (10 mm $\times$ 10 mm $\times$ 1 mm) as cathode. The reaction mixture was stirred and electrolyzed at a constant current of 5 mA for 2 h and stopped until complete consumption of xanthene (monitored by TLC). When the reaction was finished, the reaction mixture was washed with water and extracted with ethyl acetate (3 $\times$ 5 mL). The organic layers were combined, dried over Na_2SO_4 , and concentrated. The pure product was obtained by flash column chromatography on silica gel to afford the **3aa** (54.1 mg, 82%).



Figure S1. Undivided cell for current controlled electrolysis

(b) Gram-scale synthesis of 2-(9*H*-xanthen-9-yl)cyclopentan-1-one

(3aa):

In an oven-dried undivided three-necked bottle (50 mL) equipped with a stir bar, xanthene (1 g, 5.5 mmol), ketones (2 equiv), ⁿBu₄NBF₄ (1 mmol) and MeCN (20 mL) were combined and added. Subsequently, MsOH (2 equiv) was added. Then the bottle was equipped with graphite electrode as anode and platinum plate as cathode. The reaction mixture was stirred and electrolyzed at a constant current of 5 mA for 18h. When the reaction was finished, the reaction mixture was washed with water and extracted with ethyl acetate (3 × 10 mL). The organic layers were combined, dried over Na₂SO₄, and concentrated. The pure product was obtained by flash column chromatography on silica gel to afford the desired product **3aa** (1.13 g, 78%).

(c) Synthesis of 2-(9*H*-xanthen-9-yl)cyclopentan-1-one (3aa) by IKA

Electrasyn:

Charge the ElectraSyn vial (10 mL volume) with a Teflon-coated magnetic stir bar, xanthene (0.25 mmol), ketones (2 equiv), MsOH (2 equiv), ⁿBu₄NPF₆ (0.4 mmol), MeCN (8 mL). Using the commercial graphite electrode as the anode and commercial Pt electrode as the cathode. Cover the screw thread area of the vial with a rubber septum to ensure that the seal is airtight. Select "new experiments" at "constant current" and adjust the current to 5.0 mA. Select "No" for "use of reference electrode" and adjust the reaction time to "2 hours". Adjust "mmols substrate" to "0.25 mmol" and choose not to alternate the polarity. Review the parameters and start the experiment. After electrolysis, disconnect the reaction vial from ElectraSyn 2.0, gently remove the cap with electrodes from the vial and transfer the reaction media to a separatory funnel. Wash both electrodes with ethyl acetate (30 mL) to transfer any residual product. Add 20 mL ethyl acetate to the separatory funnel and wash the organic solution with water and brine. Dry the organic layer with anhydrous sodium sulfate and concentrated under reduced pressure. The residue was subjected to flash

column chromatography on silica gel (eluted with hexanes/ethyl acetate) to yield the desired product in 80% yield.



Figure S2. IKA ElectraSyn 2.0 for current controlled electrolysis

(d) Procedure for cyclic voltammetry (CV):

Cyclic voltammetry was performed in a three-electrode cell connected to a schlenk line under nitrogen at room temperature. The working electrode was a steady glassy carbon disk electrode while the counter electrode was a platinum plate. The reference was an Ag/AgCl electrode submerged in saturated aqueous KCl solution, and separated from reaction by a salt bridge. 10 mL solvent containing 0.05 M $n\text{Bu}_4\text{NBF}_4$ were poured into the electrochemical cell in cyclic voltammetry experiments. The scan rate was 0.10 V/s, ranging from -1.5 V to 3.0 V.

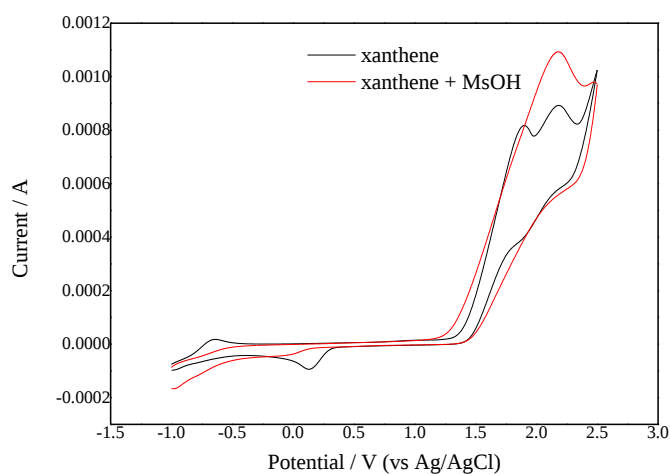
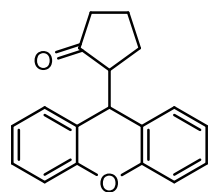


Figure S3. CV of compounds 1a and 1a+MsOH

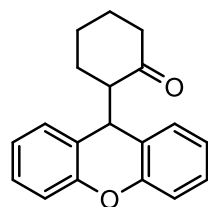
(B) Analytical data

2-(9H-Xanthen-9-yl)cyclopentan-1-one (3aa):



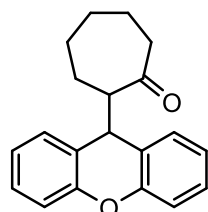
54.1 mg, 82% yield; White solid; mp 88.1-89.6 °C (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.26-7.20 (m, 3H), 7.12 (m, 4H), 7.01-6.97 (m, 1H), 4.76 (d, J = 3.0 Hz, 1H), 2.46-2.42 (m, 1H), 2.28-2.22 (m, 1H), 1.81-1.74 (m, 2H), 1.67-1.61 (m, 1H), 1.57-1.51 (m, 1H), 1.45-1.36 (m, 1H); ^{13}C NMR (125 MHz, CDCl_3) δ : 172.0, 142.2, 141.2, 137.6, 132.9, 130.3, 128.9, 128.8, 128.7, 128.5, 127.4, 124.4, 119.7, 61.5, 31.6, 10.0; LRMS (EI, 70eV) m/z (%): 183 (6), 181 (100), 180 (17), 152 (40), 127 (6); HRMS m/z (ESI) calcd for $\text{C}_{18}\text{H}_{17}\text{O}_2$ ($[\text{M}+\text{H}]^+$) 265.1223, found 265.1220.

2-(9H-Xanthen-9-yl)cyclohexan-1-one (3ab):



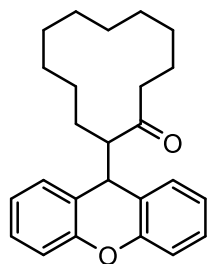
47.3 mg, 68% yield; White solid; mp 114.4-116.1 °C (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.43-7.41 (m, 1H), 7.25-7.18 (m, 3H), 7.08-7.01 (m, 4H), 4.93 (d, J = 3.0 Hz, 1H), 2.54-2.49 (m, 1H), 2.44-2.39 (m, 1H), 2.27-2.20 (m, 1H), 1.94-1.89 (m, 1H), 1.78-1.74 (m, 1H), 1.71-1.68 (m, 1H), 1.48-1.40 (m, 2H), 1.14-1.06 (m, 1H); ^{13}C NMR (125 MHz, CDCl_3) δ : 210.8, 153.3, 153.0, 130.5, 128.8, 127.8, 127.6, 125.6, 123.5, 123.2, 122.8, 116.3, 116.1, 60.6, 42.1, 36.7, 27.6, 26.7, 24.7; LRMS (EI, 70eV) m/z (%): 278 (M^+ , 2), 182 (16), 181 (100), 152 (13), 127 (3), 89 (1); HRMS m/z (ESI) calcd for $\text{C}_{19}\text{H}_{19}\text{O}_2$ ($[\text{M}+\text{H}]^+$) 279.1380, found 279.1379.

2-(9H-Xanthen-9-yl)cycloheptan-1-one (3ac):



60.6 mg, 83% yield; White solid; mp 80.4-81.0 °C (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.27-7.22 (m, 3H), 7.12-7.05 (m, 4H), 7.01 (t, J = 5.0 Hz, 1H), 4.66-4.65 (d, J = 5.0 Hz, 1H), 2.61-2.57 (m, 1H), 2.38-2.34 (m, 1H), 2.12-2.07 (m, 1H), 1.77-1.73 (m, 3H), 1.38-1.14 (m, 4H), 1.05-0.97 (m, 1H); ^{13}C NMR (125 MHz, CDCl_3) δ : 216.5, 153.1, 152.9, 129.0, 128.6, 128.1, 127.8, 124.4, 123.6, 123.1, 121.8, 116.5, 116.3, 62.4, 44.7, 42.0, 29.8, 28.4, 24.9, 24.7; LRMS (EI, 70eV) m/z (%): 292 (M^+ , 4), 183 (59), 181 (100), 152 (86), 127 (14); HRMS m/z (ESI) calcd for $\text{C}_{20}\text{H}_{21}\text{O}$ ($[\text{M}+\text{H}]^+$) 293.1536, found 293.1530.

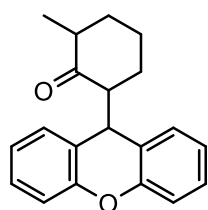
2-(9H-Xanthen-9-yl)cyclododecan-1-one (3ad):



63.3 mg, 70% yield; White solid; mp 78.8-79.2 °C (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.26-7.20 (m, 2H), 7.17-7.12 (m, 4H), 7.09-7.02 (m, 2H), 4.07 (d, J = 8.5 Hz, 1H), 2.94-2.90 (m, 1H), 2.48-2.45 (m, 1H), 2.35-2.29 (m, 1H), 1.74-1.65 (m, 4H), 1.32-1.17 (m, 14H); ^{13}C NMR (125 MHz, CDCl_3) δ : 214.2, 153.3, 153.3, 129.5, 129.0, 127.9, 127.8, 125.1, 124.3, 123.4, 123.0, 116.6, 116.6, 57.0, 42.9, 42.7, 40.4, 28.3, 26.1, 26.0, 25.4, 25.2, 24.7, 24.6, 24.3,

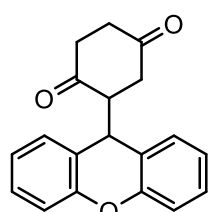
24.2, 23.8, 22.6, 22.3, 22.3; LRMS (EI, 70eV) m/z (%): 207 (1), 181 (100), 182 (15), 152 (6); HRMS m/z (ESI) calcd for $C_{25}H_{31}O_2$ ($[M+H]^+$) 363.2319, found 363.2316.

2-Methyl-6-(9H-xanthen-9-yl)cyclohexan-1-one (3ae):



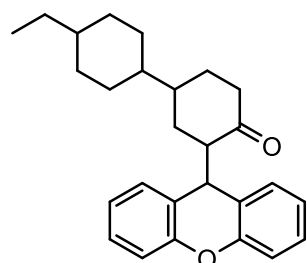
50.4 mg, 69% yield; White solid; mp 109.1-111.3 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.46-7.48 (m, 1H), 7.21-7.18 (m, 2H), 7.08-7.01 (m, 4H), 4.86 (d, J = 3.5 Hz, 1H), 2.56-2.51 (m, 1H), 2.33-2.28 (m, 1H), 1.93-1.99 (m, 1H), 1.80-1.74 (m, 1H), 1.70-1.64 (m, 1H), 1.55-1.46 (m, 1H), 1.22-1.18 (m, 1H), 1.10-1.07 (m, 1H), 1.03 (d, J = 6.5 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 212.1, 153.3, 152.9, 130.6, 128.9, 127.6, 127.5, 126.1, 123.4, 123.1, 123.0, 116.2, 116.0, 60.4, 45.5, 36.8, 36.3, 29.3, 25.0, 14.6; LRMS (EI, 70eV) m/z (%): 292 (2), 207 (1), 182 (14), 181 (100), 152 (9), 127 (1); HRMS m/z (ESI) calcd for $C_{20}H_{21}O_2$ ($[M+H]^+$) 293.1536, found 293.1538.

2-(9H-Xanthen-9-yl)cyclohexane-1,4-dione (3af):



29.2 mg, 40% yield; White solid; mp 164.9-166.0 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.26-7.23 (m, 3H), 7.17-7.15 (m, 1H), 7.11-7.08 (m, 3H), 7.03-7.00 (m, 1H), 5.08 (d, J = 3.0 Hz, 1H), 2.87-2.83 (m, 1H), 2.71-2.63 (m, 1H), 2.49-2.38 (m, 4H), 2.27-2.24 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 208.7, 208.2, 153.1, 152.6, 129.1, 128.8, 128.3, 128.1, 123.9, 123.6, 122.7, 120.3, 116.8, 116.6, 55.6, 38.1, 37.6, 37.5, 35.7; LRMS (EI, 70eV) m/z (%): 292 (1), 182 (13), 181 (100), 152 (9), 127 (3), 89 (1); HRMS m/z (ESI) calcd for $C_{19}H_{17}O_3$ ($[M+H]^+$) 293.1172, found 293.1170.

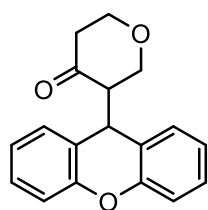
4'-Ethyl-3-(9H-xanthen-9-yl)-[1,1'-bi(cyclohexan)]-4-one (3ag):



58.2 mg, 60% yield; White solid; mp 125.6-126.8 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.41-7.39 (m, 1H), 7.23-7.18 (m, 3H), 7.09-7.00 (m, 4H), 4.93 (d, J = 3.0 Hz, 1H), 2.56-2.51 (m, 1H), 2.43-2.38 (m, 1H), 2.28-2.22 (m, 1H), 1.92-1.87 (m, 1H), 1.71-1.66 (m, 3H), 1.51-1.48 (m, 2H), 1.42-1.36 (m, 1H), 1.27-1.24 (m, 1H), 1.23-1.19 (m, 1H), 1.17-1.10 (m, 2H), 0.98-0.93 (m, 2H), 0.87-0.85 (m, 1H), 0.83-0.80 (m, 4H), 0.78-0.74 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 211.2, 153.3, 153.0, 130.3, 128.7, 127.7, 127.5, 125.5, 123.4, 123.1, 122.7, 116.2, 116.0, 59.9, 42.2, 41.7, 41.4, 39.3, 36.6, 32.8, 32.8, 30.9, 30.3, 29.8, 29.4, 29.2, 11.4; LRMS

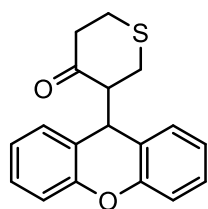
(EI, 70eV) m/z (%): 385 (7), 236 (100), 221 (5), 192 (11), 165 (2), 93 (5); HRMS m/z (ESI) calcd for $C_{27}H_{33}O_2$ ($[M+H]^+$) 389.2475, found 389.2472.

3-(9H-Xanthen-9-yl)tetrahydro-4H-pyran-4-one (3ah):



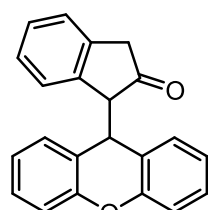
42.7 mg, 61% yield; White solid; mp 136.3-137.1 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.39-7.37 (m, 1H), 7.25-7.21 (m, 3H), 7.10-7.03 (m, 4H), 4.92 (d, J = 4.0 Hz, 1H), 4.08-4.04 (m, 1H), 3.90-3.86 (m, 1H), 3.56-3.54 (m, 1H), 3.25-3.21 (m, 1H), 2.78-2.74 (m, 1H), 2.60-2.53 (m, 1H), 2.46-2.42 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 206.2, 153.1, 152.8, 130.1, 128.4, 128.1, 128.0, 124.3, 123.7, 123.4, 121.8, 116.5, 116.4, 68.6, 67.8, 60.1, 42.3, 34.9; LRMS (EI, 70eV) m/z (%): 183 (14), 181 (100), 152 (11), 127 (2), 89 (1); HRMS m/z (ESI) calcd for $C_{18}H_{17}O_3$ ($[M+H]^+$) 281.1172, found 281.1174.

3-(9H-Xanthen-9-yl)tetrahydro-4H-thiopyran-4-one (3ai):



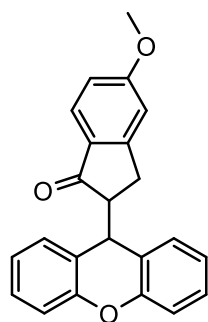
52.5 mg, 71% yield; White solid; mp 135.2-136.9 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.36-7.35 (m, 1H), 7.26-7.21 (m, 3H), 7.11-7.03 (m, 4H), 4.99 (d, J = 4.0 Hz, 1H), 2.88-2.74 (m, 4H), 2.69-2.59 (m, 2H), 2.50-2.45 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 208.1, 153.2, 153.0, 130.0, 128.6, 128.1, 128.0, 124.4, 123.7, 123.4, 121.9, 116.5, 62.0, 44.1, 37.4, 30.5, 29.5; LRMS (EI, 70eV) m/z (%): 296 (M^+ , 2), 181 (100), 182 (18), 152 (15), 127 (2), 87 (12); HRMS m/z (ESI) calcd for $C_{18}H_{17}SO_2$ ($[M+H]^+$) 297.0944, found 297.0940.

1-(9H-Xanthen-9-yl)-1,3-dihydro-2H-inden-2-one (3aj):



54.6 mg, 70% yield; White solid; mp 169.5-170.7 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.31-7.28 (m, 1H), 7.23-7.21 (m, 1H), 7.17-7.12 (m, 2H), 7.11-7.07 (m, 4H), 7.04 (d, J = 7.5 Hz, 1H), 6.95-6.92 (m, 1H), 6.87-6.85 (m, 1H), 6.62 (d, J = 8.0 Hz, 1H), 4.86 (s, 1H), 3.77 (d, J = 3.5 Hz, 1H), 3.31-2.92 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 216.9, 152.6, 152.4, 138.5, 137.5, 128.6, 128.4, 128.4, 128.3, 127.8, 127.1, 125.2, 124.3, 123.6, 123.0, 122.0, 120.5, 116.5, 116.4, 62.9, 43.8, 42.5. LRMS (EI, 70eV) m/z (%): 283 (2), 207 (11), 181 (100), 152 (17), 91 (9); HRMS m/z (ESI) calcd for $C_{22}H_{17}O_2$ ($[M+H]^+$) 313.1223, found 313.1220.

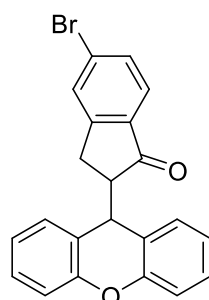
5-Methoxy-2-(9H-xanthen-9-yl)-2,3-dihydro-1H-inden-1-one (3ak):



50.4 mg, 59% yield; White solid; mp 139.3-140.9 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.67-7.64 (m, 1H), 7.39 (t, J = 7.0 Hz, 1H), 7.28-7.24 (m, 1H), 7.15-7.07 (m, 4H), 7.01 (t, J = 6.5 Hz, 1H), 6.82-6.79 (m, 2H), 6.63 (t, J = 4.0 Hz, 1H), 5.02-5.00 (m, 1H), 3.77 (t, J = 1.5 Hz, 3H), 3.10-3.08 (m, 1H), 2.87-2.70 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 204.5, 165.2, 157.1, 152.6, 152.3, 130.3, 129.6, 128.5, 128.1, 127.8, 125.4, 124.2, 123.7, 123.3, 120.5, 116.4, 116.2, 115.3, 109.3, 58.3, 55.5, 38.6, 27.9; LRMS (EI, 70eV)

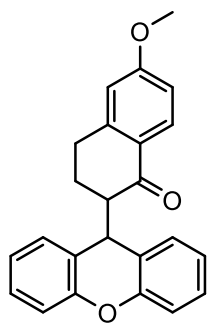
m/z (%): 342 (M^+ , 2), 181 (100), 152 (9), 133 (2), 89 (2); HRMS m/z (ESI) calcd for $C_{23}H_{19}O_3$ ($[M+H]^+$) 343.1329, found 343.1331.

5-Bromo-2-(9H-xanthen-9-yl)-2,3-dihydro-1H-inden-1-one (3al):



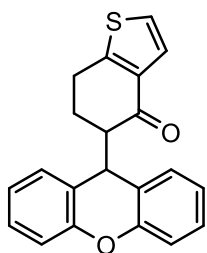
39.0 mg, 40% yield; White solid; mp 169.2-168.1 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.57 (d, J = 8.5 Hz, 1H), 7.42-7.25 (m, 3H), 7.28-7.25 (m, 1H), 7.15-7.06 (m, 4H), 7.03-7.01 (m, 1H), 6.83-6.80 (m, 1H), 5.01 (d, J = 3.0 Hz, 1H), 3.11-3.08 (m, 1H), 2.91-2.75 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 205.26, 155.68, 152.65, 152.34, 135.74, 130.90, 130.21, 129.64, 129.41, 128.44, 128.36, 128.06, 124.94, 123.85, 123.76, 123.41, 120.22, 116.58, 116.41, 58.12, 38.71, 27.64; LRMS (EI, 70eV) m/z (%): 182 (29), 181 (100), 152 (13), 91 (2), 56 (2); HRMS m/z (ESI) calcd for $C_{22}H_{16}BrO_2$ ($[M+H]^+$) 391.0328, found 391.0329.

6-Methoxy-2-(9H-xanthen-9-yl)-3,4-dihydronaphthalen-1(2H)-one (3am):



63.2 mg, 71% yield; White solid; mp 140.6-141.7 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 8.08 (d, J = 9.0 Hz, 1H), 7.32-7.30 (m, 2H), 7.27-7.23 (m, 1H), 7.16-7.10 (m, 3H), 7.04-7.02 (m, 1H), 6.94-6.90 (m, 1H), 6.82-6.80 (m, 1H), 6.55 (d, J = 2.5 Hz, 1H), 5.36 (d, J = 2.5 Hz, 1H), 3.80 (s, 3H), 2.79-2.65 (m, 3H), 1.91-1.86 (m, 1H), 1.54-1.46 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 196.2, 163.5, 153.0, 153.0, 146.5, 130.1, 129.8, 128.6, 127.8, 127.7, 126.4, 124.9, 123.6, 123.3, 122.2, 116.2, 116.0, 113.2, 112.2, 58.5, 55.4, 37.2, 29.4, 22.9; LRMS (EI, 70eV) m/z (%): 182 (14), 181 (100), 152 (9), 115 (2), 91 (3); HRMS m/z (ESI) calcd for $C_{24}H_{21}O_3$ ($[M+H]^+$) 357.1485, found 357.1488.

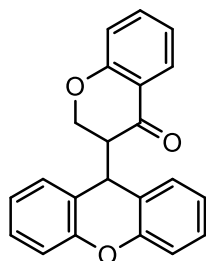
5-(9H-Xanthen-9-yl)-6,7-dihydrobenzo[b]thiophen-4(5H)-one (3an):



46.5 mg, 56% yield; White solid; mp 150.3-151.7 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.44 (d, J = 5.5 Hz, 1H), 7.34-7.24 (m, 4H), 7.19-7.16 (m, 1H), 7.13-7.10 (m, 2H), 7.05-7.03 (m, 2H), 6.97-6.94 (m, 1H), 5.34 (d, J = 2.0 Hz, 1H), 2.92-2.87 (m, 1H), 2.82-2.71 (m, 2H), 2.02-1.97 (m, H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 192.3, 155.6, 153.1, 153.0, 137.2, 129.9, 128.6, 127.9, 127.8, 125.1, 124.8, 123.7, 123.4, 123.3, 121.9, 116.3, 116.1, 57.6, 36.6,

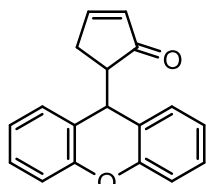
24.9, 24.2; LRMS (EI, 70eV) m/z (%): 332 (M^+ , 2), 207 (2), 181 (100), 152 (10), 96 (3); HRMS m/z (ESI) calcd for $C_{21}H_{17}O_2S$ ($[M+H]^+$) 333.0944, found 333.0948.

3-(9H-Xanthen-9-yl)chroman-4-one (3ao):



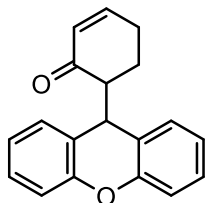
41.0 mg, 50% yield; White solid; mp 147.3-148.8 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.95-7.93 (m, 1H), 7.42-7.39 (m, 1H), 7.33-7.32 (m, 1H), 7.29-7.26 (m, 1H), 7.22-7.17 (m, 2H), 7.15-7.09 (m, 2H), 7.08-7.06 (m, 1H), 7.02-6.98 (m, 1H), 6.97-6.94 (s, 1H), 6.84-6.82 (m, 1H), 5.09 (d, J = 4.0 Hz, 1H), 4.33-4.30 (m, 1H), 3.98-3.94 (m, 1H), 3.00-2.96 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 192.1, 161.4, 153.0, 152.9, 135.9, 129.5, 128.5, 128.4, 128.3, 127.4, 123.8, 123.4 (2C), 121.3, 121.2, 121.0, 117.7, 116.6, 116.4, 67.4, 55.3, 35.5; LRMS (EI, 70eV) m/z (%): 281 (2), 207 (30), 181 (100), 182 (13), 152 (12), 135 (3); HRMS m/z (ESI) calcd for $C_{22}H_{17}O_3$ ($[M+H]^+$) 329.1172, found 329.1174.

5-(9H-Xanthen-9-yl)cyclopent-2-en-1-one (3ap):



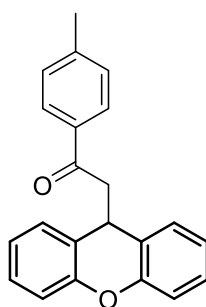
47.2 mg, 72% yield; White solid; mp 93.2-94.5 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.47-7.45 (m, 1H), 7.34-7.32 (m, 1H), 7.26-7.22 (m, 1H), 7.20-7.16 (m, 1H), 7.12-7.04 (m, 4H), 6.10-6.08 (m, 1H), 4.83 (d, J = 3.0 Hz, 1H), 2.77-2.74 (m, 1H), 2.47-2.41 (m, 1H), 2.36-2.31 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 210.1, 165.3, 152.6, 152.2, 134.3, 129.5, 128.5, 128.2, 127.9, 123.9, 123.7, 123.2, 120.0, 116.5, 116.3, 55.2, 38.6, 30.9; LRMS (EI, 70eV) m/z (%): 182 (15), 181 (100), 152 (13), 91 (2); HRMS m/z (ESI) calcd for $C_{18}H_{15}O_2$ ($[M+H]^+$) 263.1067, found 263.1066.

6-(9H-Xanthen-9-yl)cyclohex-2-en-1-one (3aq):

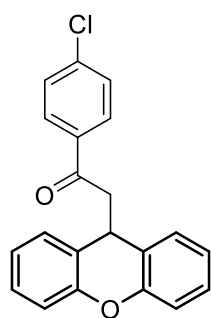


38.6 mg, 56% yield; White solid; mp 106.5-108.7 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.29-7.17 (m, 5H), 7.11-7.03 (m, 3H), 7.00-6.97 (m, 1H), 6.86-6.82 (m, 1H), 6.04-6.01 (m, 1H), 5.19 (d, J = 2.0 Hz, 1H), 2.59-2.55 (m, 1H), 2.18-2.15 (m, 2H), 1.80-1.75 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 198.7, 153.1, 153.0, 150.4, 129.9, 129.8, 128.5, 127.9, 127.7, 124.6, 123.6, 123.3, 121.9, 116.2, 116.0, 57.5, 36.6, 29.7, 25.7, 22.2; LRMS (EI, 70eV) m/z (%): 283 (4), 273 (8), 254 (9), 118 (6), 107 (6), 99 (100); HRMS m/z (ESI) calcd for $C_{19}H_{17}O_2$ ($[M+H]^+$) 277.1223, found 277.1220.

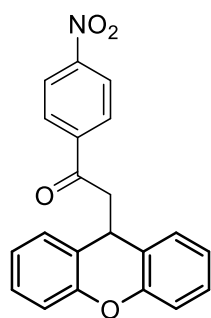
1-(p-Tolyl)-2-(9H-xanthen-9-yl)ethan-1-one (3ar):



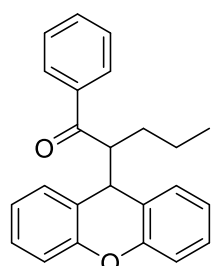
40.0 mg, 51% yield; White solid; mp 116.9-118.1 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.70 (d, J = 8.5 Hz, 2H), 7.32-7.30 (m, 2H), 7.25-7.15 (m, 4H), 7.12-7.10 (m, 2H), 7.03-7.00 (m, 2H), 4.84 (t, J = 6.5 Hz, 1H), 3.32 (d, J = 6.5 Hz, 2H), 2.35 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 197.5, 152.2, 143.9, 134.4, 129.1, 128.8, 128.2, 127.8, 125.5, 123.4, 116.5, 49.6, 34.6, 21.6; LRMS (EI, 70eV) m/z (%): 314 (M^+ , 22), 194 (10), 181 (100), 152 (54), 119 (24), 91 (37); HRMS m/z (ESI) calcd for $C_{22}H_{19}O$ ($[M+H]^+$) 315.1380, found 315.1382.

1-(4-Chlorophenyl)-2-(9H-xanthen-9-yl)ethan-1-one (3as):

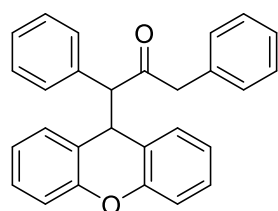
35.1 mg, 42% yield; White solid; mp 100.3-102.6 °C (uncorrected); ¹H NMR (500 MHz, CDCl₃) δ: 7.71 (d, *J* = 9.0 Hz, 2H), 7.34-7.29 (m, 4H), 7.23-7.19 (m, 2H), 7.12-7.11 (m, 2H), 7.04-7.00 (m, 2H), 4.82 (t, *J* = 6.5 Hz, 1H), 3.30 (d, *J* = 6.5 Hz, 2H); ¹³C NMR (125 MHz, CDCl₃) δ: 196.8, 152.3, 139.6, 135.2, 129.5, 128.8, 128.7, 127.9, 125.3, 123.5, 116.6, 49.5, 34.8; LRMS (EI, 70eV) *m/z* (%): 334 (M⁺, 9), 194 (5), 181 (100), 165 (10), 152 (35), 127 (6), 111 (14), 89 (6); HRMS *m/z* (ESI) calcd for C₂₁H₁₆³⁵ClO₂ ([M+H]⁺) 335.0833, found 335.0831.

1-(4-Nitrophenyl)-2-(9H-xanthen-9-yl)ethan-1-one (3at):

32.8 mg, 38% yield; White solid; mp 146.2-147.4 °C (uncorrected); ¹H NMR (500 MHz, CDCl₃) δ: 8.20-8.18 (m, 2H), 7.90-7.89 (m, 2H), 7.31-7.29 (m, 2H), 7.22-7.21 (m, 2H), 7.13-7.12 (m, 2H), 7.05-7.01 (m, 2H), 4.82 (t, *J* = 6.5 Hz, 1H), 3.37 (d, *J* = 6.5 Hz, 2H); ¹³C NMR (125 MHz, CDCl₃) δ: 196.6, 152.3, 150.1, 141.2, 129.1, 128.6, 128.1, 124.9, 123.7, 123.6, 116.7, 49.8, 35.0; LRMS (EI, 70eV) *m/z* (%): 345 (M⁺, 7), 195 (12), 181 (100), 165 (23), 152 (14), 91 (4); HRMS *m/z* (ESI) calcd for C₂₁H₁₆NO₄ ([M+H]⁺) 346.1074, found 346.1077.

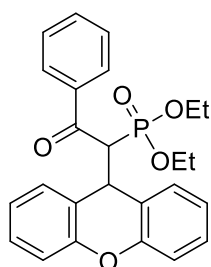
1-Phenyl-2-(9H-xanthen-9-yl)pentan-1-one (3au):

42.7 mg, 50% yield; White solid; mp 105.3-106.6 °C (uncorrected); ¹H NMR (500 MHz, CDCl₃) δ: 7.64-7.62 (m, 2H), 7.45-7.42 (m, 1H), 7.32-7.29 (m, 2H), 7.28-7.24 (m, 2H), 7.19-7.18 (m, 1H), 7.14-7.13 (m, 1H), 7.11-7.10 (m, 1H), 7.08-7.07 (m, 2H), 6.86-6.83 (m, 1H), 4.26 (d, *J* = 8.0 Hz, 1H), 3.67-3.63 (m, 1H), 1.80-1.72 (m, 1H), 1.39-1.32 (m, 1H), 1.12-1.07 (m, 1H), 0.93-0.88 (m, 1H), 0.70 (t, *J* = 7.0 Hz, 3H); ¹³C NMR (125 MHz, CDCl₃) δ: 204.1, 153.3, 153.2, 138.4, 132.7, 129.7, 128.9, 128.3, 128.0, 127.8, 127.7, 124.9, 124.1, 123.3, 123.0, 116.6, 116.4, 53.3, 43.2, 32.4, 20.7, 14.2; LRMS (EI, 70eV) *m/z* (%): 207 (4), 182 (15), 181 (100), 152 (9), 105 (6); HRMS *m/z* (ESI) calcd for C₂₄H₂₃O₂ ([M+H]⁺) 343.1693, found 343.1690.

1,3-Diphenyl-1-(9H-xanthen-9-yl)propan-2-one (3av):

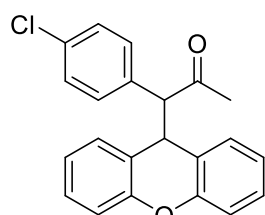
68.2 mg, 70% yield; White solid; mp 128.5-129.5 °C (uncorrected); ¹H NMR (500 MHz, CDCl₃) δ: 7.31-7.29 (m, 1H), 7.24-7.18 (m, 2H), 7.16-7.16 (m, 5H), 7.08-7.00 (m, 4H), 6.91-6.89 (m, 2H), 6.72-6.70 (m, 2H), 6.64-6.61 (m, 1H), 4.62 (d, *J* = 9.5 Hz, 1H), 3.89 (d, *J* = 9.5 Hz, 1H), 3.43-3.24 (m, 16.0 2H); ¹³C NMR (125 MHz, CDCl₃) δ 206.7, 153.2, 153.1, 135.2, 133.2, 129.8, 129.3, 129.3, 129.2, 128.4, 128.4, 127.8, 127.5, 127.4, 126.7, 124.9, 123.7, 123.2, 122.4, 116.5, 115.9, 77.2, 64.5, 50.6, 43.2; LRMS (EI, 70eV) *m/z* (%): 281 (2), 207 (7), 182 (21), 181 (100), 152 (13), 127 (2), 91 (6); HRMS *m/z* (ESI) calcd for C₂₈H₃₃O₂ ([M+H]⁺) 391.1693, found 391.1690.

Diethyl (2-oxo-2-phenyl-1-(9H-xanthen-9-yl)ethyl)phosphonate (3aw):



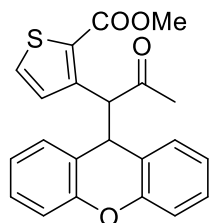
87.2 mg, 80% yield; White liquid; ^1H NMR (500 MHz, CDCl_3) δ : 7.72-7.70 (m, 1H), 7.51-7.49 (m, 2H), 7.41-7.38 (m, 1H), 7.29-7.23 (m, 3H), 7.18-7.12 (m, 2H), 7.10-7.01 (m, 3H), 6.81-6.78 (m, 1H), 4.39-4.33 (m, 1H), 3.95-3.78 (m, 4H), 1.07-1.05 (m, 3H), 1.02-0.99 (m, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ : 196.30, 196.26, 153.97, 153.52, 137.71, 137.69, 132.91, 130.21, 129.20, 128.17, 128.16, 127.97, 127.94, 124.37, 124.24, 124.13, 124.11, 123.29, 123.25, 116.46, 116.36, 62.63, 62.58, 62.12, 62.06, 54.05, 53.00, 40.48, 40.45, 15.98, 15.94, 15.92, 15.89; ^{31}P NMR (202 MHz, CHCl_3) δ : 20.16 (s); LRMS (EI, 70eV) m/z (%): 418 (4), 331 (16), 299 (10), 297 (58), 181 (100), 152 (10), 105 (9); HRMS m/z (ESI) calcd for $\text{C}_{25}\text{H}_{26}\text{O}_5\text{P}$ ($[\text{M}+\text{H}]^+$) 437.1512, found 437.1510.

1-(4-Chlorophenyl)-2-(9H-xanthen-9-yl)ethan-1-one (3ax):



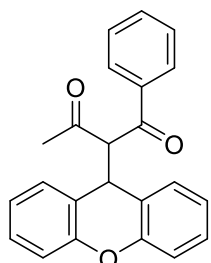
42.6 mg, 49% yield; White solid; mp 158.5-159.5 $^\circ\text{C}$ (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.32-7.30 (m, 1H), 7.26-7.22 (m, 1H), 7.14-7.10 (m, 3H), 7.09-7.05 (m, 2H), 7.04-7.02 (m, 1H), 6.82-6.79 (m, 2H), 6.75-6.72 (m, 1H), 6.59-6.55 (m, 1H), 4.65 (d, J = 9.0 Hz, 1H), 3.80 (d, J = 9.0 Hz, 1H), 1.84 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ : 207.28, 153.21, 153.15, 133.89, 133.58, 130.42, 129.49, 129.40, 128.48, 127.96, 127.72, 124.83, 123.41, 123.18, 122.72, 116.55, 116.08, 65.80, 42.85, 31.29; LRMS (EI, 70eV) m/z (%): 181 (100), 152 (62), 127 (9), 103 (11), 89 (14); HRMS m/z (ESI) calcd for $\text{C}_{22}\text{H}_{18}\text{ClO}_2$ ($[\text{M}+\text{H}]^+$) 349.0990, found 349.0993.

Methyl 3-(2-oxo-1-(9H-xanthen-9-yl)propyl)thiophene-2-carboxylate (3ay):



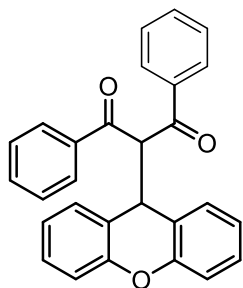
53.9 mg, 57% yield; White solid; mp 158.5-159.5 $^\circ\text{C}$ (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.41 (d, J = 3.0 Hz, 1H), 7.26-7.21 (m, 2H), 7.14-7.19 (m, 2H), 7.06-7.00 (m, 3H), 6.76-6.73 (m, 1H), 6.56-6.54 (m, 1H), 5.37 (d, J = 9.0 Hz, 1H), 4.61 (d, J = 9.0 Hz, 1H), 3.63 (s, 3H), 1.88 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ : 207.58, 162.14, 153.48, 153.18, 142.24, 130.22, 129.84, 129.61, 129.14, 128.54, 127.93, 127.73, 124.21, 123.16, 122.95, 122.38, 116.71, 115.82, 58.08, 51.79, 42.76, 31.81; LRMS (EI, 70eV) m/z (%): 181 (100), 152 (42), 127 (16), 89 (14); HRMS m/z (ESI) calcd for $\text{C}_{22}\text{H}_{19}\text{SO}_4$ ($[\text{M}+\text{H}]^+$) 379.0999, found 379.0997.

1-Phenyl-2-(9H-xanthen-9-yl)butane-1,3-dione (3az):



73.5 mg, 86% yield; White solid; mp 120.4-121.9 $^\circ\text{C}$ (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.66-7.64 (m, 4H), 7.42-7.38 (m, 2H), 7.30-7.23 (m, 6H), 7.08-7.07 (m, 4H), 6.90-6.84 (m, 2H), 5.75 (m, J = 9.0 Hz, 1H), 5.33 (m, J = 9.5 Hz, 1H); ^{13}C NMR (125 MHz, CDCl_3) δ : 172.9, 142.9, 133.9, 132.2, 129.0, 128.6, 128.6, 127.2, 126.6, 126.0, 125.7, 125.7, 125.2, 119.8, 119.5, 62.0, 31.7, 10.1; LRMS (EI, 70eV) m/z (%): 365 (M^+ , 50), 195 (100), 167 (85), 115 (57), 91 (94); HRMS m/z (ESI) calcd for $\text{C}_{26}\text{H}_{24}\text{NO}$ ($[\text{M}+\text{H}]^+$) 366.1852, found 366.1859.

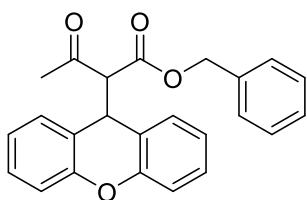
1,3-Diphenyl-2-(9H-xanthen-9-yl)propane-1,3-dione (3aA):



56.6 mg, 56% yield; White solid; mp 170.3-171.6 °C (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.66-7.64 (m, 4H), 7.42-7.38 (m, 2H), 7.30-7.23 (m, 6H), 7.08-7.07 (m, 4H), 6.90-6.84 (m, 2H), 5.75 (m, J = 9.0 Hz, 1H), 5.33 (m, J = 9.5 Hz, 1H); ^{13}C NMR (125 MHz, CDCl_3) δ : 172.9, 142.9, 133.9, 132.2, 129.0, 128.6, 128.6, 127.2, 126.6, 126.0, 125.7, 125.7, 125.2, 119.8, 119.5, 62.0, 31.7, 10.1; LRMS (EI, 70eV) m/z (%): 365 (M^+ , 50), 195 (100), 167 (85), 115 (57), 91 (94); HRMS m/z (ESI)

calcd for $\text{C}_{26}\text{H}_{24}\text{NO}$ ($[\text{M}+\text{H}]^+$) 366.1852, found 366.1859.

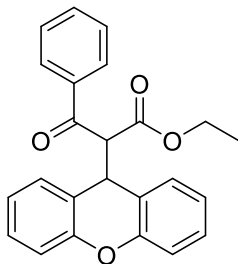
Benzyl 3-oxo-2-(9H-xanthen-9-yl)butanoate (3aB):



47.4 mg, 51% yield; White solid; mp 84.6-86.0 °C (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.39-7.21 (m, 3H), 7.28-7.26 (m, 1H), 7.24-7.21 (m, 3H), 7.15-7.10 (m, 4H), 7.05-7.03 (m, 1H), 7.00-6.97 (m, 1H), 4.99-4.92 (m, 2H), 4.84 (d, J = 9.5 Hz, 1H), 3.84 (d, J = 9.5 Hz, 1H), 1.85 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ : 201.5, 167.1, 153.3,

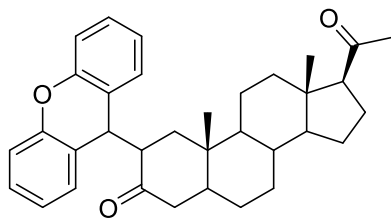
153.2, 134.9, 129.2, 129.0, 128.5, 128.4, 128.3, 128.2, 123.5, 123.4, 123.0, 122.9, 116.7, 116.6, 67.2, 66.3, 39.6, 31.5; LRMS (EI, 70eV) m/z (%): 238 (5), 195 (3), 183 (15), 181 (100), 152 (13), 126 (2), 91 (2); HRMS m/z (ESI) calcd for $\text{C}_{24}\text{H}_{21}\text{O}_4$ ($[\text{M}+\text{H}]^+$) 373.1434, found 373.1430.

Ethyl 3-oxo-3-phenyl-2-(9H-xanthen-9-yl)propanoate (3aC):



57.7 mg, 62% yield; White solid; mp 117.3-119.6 °C (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.76-7.34 (m, 2H), 7.48-7.45 (m, 1H), 7.39-7.37 (m, 1H), 7.34-7.25 (m, 4H), 7.18-7.16 (m, 1H), 7.12-7.05 (m, 3H), 6.92-6.88 (m, 1H), 5.07 (d, J = 10.0 Hz, 1H), 4.62 (d, J = 9.5 Hz, 1H), 3.97-3.90 (m, 2H), 1.01 (t, J = 7.5 Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ : 193.2, 167.4, 153.6, 153.3, 136.5, 133.4, 129.7, 129.1, 128.5, 128.4, 128.3, 128.1, 123.7, 123.5, 123.4, 123.4, 116.6, 116.5, 61.5, 61.3, 39.8, 13.8; LRMS (EI, 70eV) m/z (%): 355 (6), 281 (19), 207 (100), 181 (80), 152 (11), 133 (12), 96 (15), 89 (4); HRMS m/z (ESI) calcd for $\text{C}_{24}\text{H}_{21}\text{O}_4$ ($[\text{M}+\text{H}]^+$) 373.1434, found 373.1432.

Rac-(10R,13R,17R)-17-acetyl-10,13-dimethyl-2-(9H-xanthen-9-yl)hexadecahydro-3H-cyclopenta[a]phenanthren-3-one (3aD):

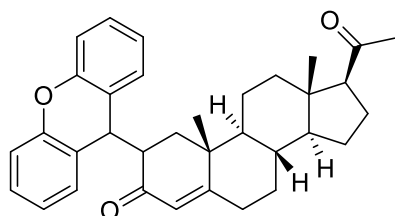


74.4 mg, 60% yield; White solid; mp 116.9-118.1 °C (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.42-7.40 (m, 1H), 7.22-7.19 (m, 3H), 7.08-7.04 (m, 3H), 7.03-7.00 (m, 1H), 5.01 (s, 1H), 2.60-2.56 (m, 1H), 2.48-2.45 (m, 1H), 2.25-2.19 (m, 1H), 2.16-2.10 (m, 2H), 2.08 (s, 3H), 1.95-1.91 (m, 1H), 1.69-1.62

(m, 4H), 1.38-1.33 (m, 2H), 1.22-1.11 (m, 4H), 1.07-1.03 (m, 1H), 0.89-0.83 (m, 4H), 0.79 (s, 3H), 0.61-0.58 (m, 1H), 0.53 (m, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ : 210.21, 209.46, 153.38, 153.05, 130.44, 128.46, 127.74, 127.65, 125.22, 123.53, 123.19, 122.74, 116.18, 116.13, 63.75, 56.95, 56.30, 53.34, 46.12, 44.65, 44.13, 38.88, 38.86,

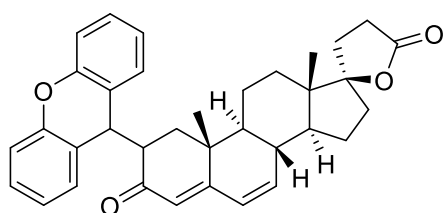
36.48, 35.74, 35.12, 31.50, 31.43, 28.38, 24.36, 22.72, 21.21, 13.34, 12.13; HRMS m/z (ESI) calcd for $C_{34}H_{41}O_3$ ($[M+H]^+$) 497.3050, found 497.3052.

(8S,9S,10R,13S,14S,17S)-17-Acetyl-10,13-dimethyl-2-(9H-xanthen-9-yl)-1,2,6,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-3H-cyclopenta[a]phenanthren-3-one (3aE):



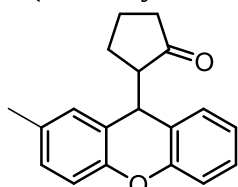
82.7 mg, 67% yield; White solid; mp 236.5-237.2 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.35-7.33 (m, 1H), 7.24-7.18 (m, 3H), 7.10-7.04 (m, 3H), 7.01-6.98 (m, 1H), 5.72 (d, J = 2.0 Hz, 1H), 5.21 (d, J = 2.5 Hz, 1H), 2.65-2.61 (m, 1H), 2.45 (t, J = 9.0 Hz, 1H), 2.28-2.22 (m, 2H), 2.16-2.11 (m, 1H), 2.08 (s, 3H), 1.98-1.94 (m, 1H), 1.72 (s, 1H), 1.69-1.66 (m, 1H), 1.64-1.57 (m, 2H), 1.37-1.32 (m, 2H), 1.30-1.28 (m, 1H), 1.26 (s, 1H), 1.21-1.14 (m, 2H), 1.10 (d, J = 13.5 Hz, 1H), 1.04-0.99 (m, 1H), 0.92 (s, 3H), 0.75-0.70 (m, 1H), 0.55 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 209.2, 198.1, 170.6, 153.2, 153.0, 130.2, 128.2, 127.7, 127.6, 124.6, 123.9, 123.6, 123.2, 122.0, 116.1, 116.0, 63.4, 55.7, 53.2, 53.1, 43.8, 38.7, 38.5, 36.2, 35.2, 35.2, 32.3, 31.5, 31.4, 24.2, 22.6, 20.7, 17.3, 13.1; HRMS m/z (ESI) calcd for $C_{34}H_{39}O_3$ ($[M+H]^+$) 495.2894, found 495.2890.

(8R,9S,10R,13S,14S,17R)-10,13-Dimethyl-2-(9H-xanthen-9-yl)-1,3',4',8,9,10,11,12,13,14,15,16-dodecahydro-5'H-spiro[cyclopenta[a]phenanthrene-17,2'-furan]-3,5'(2H)-dione (3aF):



80.6 mg, 62% yield; White solid; mp 225.0-226.3 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.29-7.27 (m, 1H), 7.24-7.17 (m, 3H), 7.12-7.04 (m, 3H), 6.98-6.95 (m, 1H), 6.07-6.00 (m, 2H), 5.69 (s, 1H), 5.27 (d, J = 2.5 Hz, 1H), 2.83-2.79 (m, 1H), 2.57-2.43 (m, 2H), 2.32-2.24 (m, 2H), 2.18-2.13 (m, 1H), 1.88-1.79 (m, 3H), 1.67-1.62 (m, 4H), 1.53-1.48 (m, 2H), 1.42-1.38 (m, 1H), 1.15-1.12 (m, 1H), 1.00-0.95 (m, 1H), 0.91 (d, J = 8.5 Hz, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 198.5, 176.6, 162.8, 153.2, 153.0, 139.8, 130.0, 128.2, 127.8, 127.8, 127.8, 124.3, 124.1, 123.7, 123.3, 122.0, 116.2, 116.1, 95.3, 53.5, 49.9, 46.8, 46.3, 37.5, 37.0, 36.1, 35.4, 33.2, 31.4, 31.1, 29.2, 22.4, 19.9, 16.9, 14.2; HRMS m/z (ESI) calcd for $C_{35}H_{37}O_4$ ($[M+H]^+$) 521.2686, found 521.2688.

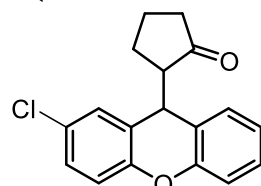
2-(2-Methyl-9H-xanthen-9-yl)cyclopentan-1-one (3ba):



48.6 mg, 70% yield; White solid; mp 107.9-108.6 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.25-7.06 (m, 3H), 7.05-7.04 (m, 1H), 7.02-7.00 (m, 1H), 6.99-6.89 (m, 2H), 4.71 (t, J = 3.0 Hz, 1H), 2.47-2.41 (m, 1H), 2.31 (s, 1H), 2.25 (s, 3H), 1.81-1.75 (m, 2H), 1.66-1.61 (m, 1H), 1.57-1.50 (m, 1H), 1.44-1.37 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 153.20, 152.57, 150.96, 150.28, 132.96, 132.79, 129.22, 129.11, 128.76, 128.35, 128.33, 128.11, 128.05, 127.63, 124.48, 124.03, 123.40, 123.19, 121.82, 121.51, 116.28, 116.20, 116.02, 115.95, 77.25, 77.00, 76.75, 59.81, 59.79, 39.27, 38.01, 37.95, 23.91, 20.70, 20.29; LRMS (EI, 70eV) m/z (%):

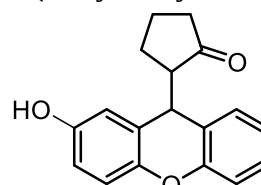
281 (3), 207 (4), 195 (100), 194 (11), 165 (8), 152 (3), 115 (2) ; HRMS m/z (ESI) calcd for $C_{19}H_{19}O_2$ ($[M+H]^+$) 279.1380, found 279.1379.

2-(2-Chloro-9H-xanthen-9-yl)cyclopentan-1-one (3ca):



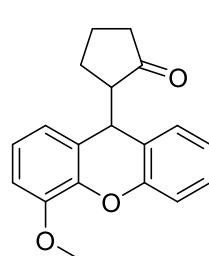
53.6 mg, 72% yield; White solid; mp 135.9-137.6 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.24-7.21 (m, 2H), 7.19-7.16 (m, 1H), 7.11-7.06 (m, 2H), 7.02-6.99 (m, 2H), 4.72 (d, J = 3.0 Hz, 1H), 2.45-2.40 (m, 1H), 2.29-2.23 (m, 1H), 1.81-1.75 (m, 2H), 1.70-1.65 (m, 1H), 1.60-1.53 (m, 1H), 1.41-1.33 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 152.7, 151.0, 129.1, 128.4, 128.2, 127.8, 126.1, 123.7, 121.1, 117.8, 116.29, 59.66, 39.1, 37.8, 23.9, 20.2, 20.2; LRMS (EI, 70eV) m/z (%): 298 (M^+ , 13), 214 (100), 205 (8), 180 (38), 152 (67), 126 (11); HRMS m/z (ESI) calcd for $C_{18}H_{16}ClO_2$ ($[M+H]^+$) 299.0833, found 299.0835.

2-(2-Hydroxy-9H-xanthen-9-yl)cyclopentan-1-one (3da):



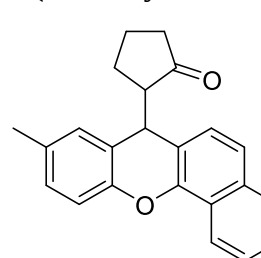
29.4 mg, 42% yield; White solid; mp 112.3-114.6 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.26-7.20 (m, 2H), 7.09-7.05 (m, 2H), 6.98 (d, J = 8.5 Hz, 1H), 6.76-6.74 (m, 1H), 6.64 (d, J = 3.0 Hz, 1H), 5.90 (s, 1H), 4.71 (d, J = 2.5 Hz, 1H), 2.49-2.44 (m, 1H), 2.33-2.27 (1H), 1.92-1.84 (m, 1H), 1.82-1.77 (m, 1H), 1.72-1.68 (m, 1H), 1.59-1.54 (m, 1H), 1.49-1.40 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 152.71, 151.74, 147.00, 128.04, 127.77, 123.75, 123.39, 122.40, 117.35, 116.33, 115.42, 114.67, 59.95, 39.41, 38.14, 23.91, 20.28; LRMS (EI, 70eV) m/z (%): 281 (18), 289 (3), 180 (100), 168 (17), 152 (4), 91 (3); HRMS m/z (ESI) calcd for $C_{18}H_{17}O_3$ ($[M+H]^+$) 281.1172, found 281.1170.

2-(4-Methoxy-9H-xanthen-9-yl)cyclopentan-1-one (3ea):



58.8 mg, 80% yield; White solid; mp 144.9-145.6 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 7.23-7.21 (m, 2H), 7.12-7.10 (m, 1H), 7.05-6.98 (m, 2H), 6.86-6.82 (m, 2H), 4.76 (d, J = 3.0 Hz, 1H), 3.94 (d, J = 3.5 Hz, 3H), 2.47-2.43 (m, 1H), 2.28-2.22 (m, 1H), 1.83-1.75 (m, 2H), 1.65-1.62 (m, 1H), 1.56-1.52 (m, 1H), 1.45-1.37 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 152.9, 147.8, 141.9, 129.0, 128.1, 125.4, 123.6, 123.3, 121.6, 119.7, 116.6, 109.9, 59.6, 56.0, 39.3, 37.9, 23.9, 20.3; LRMS (EI, 70eV) m/z (%): 294 (M^+ , 19), 211 (100), 196 (86), 168 (96), 139 (58); HRMS m/z (ESI) calcd for $C_{19}H_{19}O_3$ ($[M+H]^+$) 295.1329, found 295.1319.

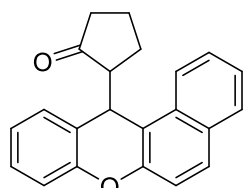
2-(9-Methyl-7H-benzo[c]xanthen-7-yl)cyclopentan-1-one (3fa):



49.2 mg, 60% yield; White solid; mp 106.8-108.5 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 8.42-8.40 (m, 1H), 7.80-7.78 (m, 1H), 7.57-7.45 (m, 3H), 7.18-7.14 (m, 2H), 7.11-7.10 (m, 1H), 7.08-7.05 (m, 1H), 4.87 (d, J = 3.0 Hz, 1H), 2.54-2.49 (m, 1H), 2.35 (s, 3H), 2.27-2.21 (m, 1H), 1.82-1.71 (m, 2H), 1.59-1.49 (m, 2H), 1.43-1.35 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 150.24, 148.13, 133.41, 133.32, 128.33, 128.32, 127.49, 126.59, 126.23, 125.83, 124.03, 123.94, 122.66, 121.58, 116.19, 115.61, 59.78, 39.33, 38.27, 23.92, 20.79, 20.30; LRMS (EI, 70eV) m/z (%): 328 (M^+ ,

2), 245 (100), 215 (7), 202 (4), 165 (1), 122 (2), 107(1); HRMS m/z (ESI) calcd for $C_{23}H_{21}O_2$ ($[M+H]^+$) 329.1536, found 329.1533.

2-(12H-benzo[a]xanthen-12-yl)cyclopentan-1-one (3ga):

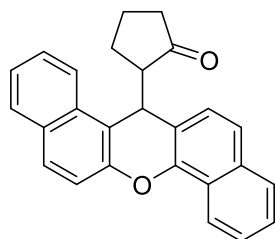


dr = 1.5:1

42.4 mg, 54% yield; White solid; mp 142.3-143.4 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 8.12 (d, J = 8.5 Hz, 1H), 7.86-7.84 (m, 1H), 7.75 (d, J = 9.0 Hz, 1H), 7.60-7.57 (m, 1H), 7.46-7.43 (m, 1H), 7.30 (d, J = 9.0 Hz, 1H), 7.27-7.25 (m, 1H), 7.23-7.21 (m, 1H), 7.17-7.15 (m, 1H), 7.07-7.04 (m, 1H), 5.50 (d, J = 2.5 Hz, 1H), 2.70-2.65 (m, 1H), 2.30-2.24 (m, 1H), 1.86-1.79 (m, 1H), 1.73-1.71 (m, 1H), 1.65-1.62 (m, 1H), 1.51-1.40 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 219.8, 152.7, 150.1, 130.8, 130.6, 129.1, 128.9, 128.5, 128.2, 127.1, 124.3, 123.8, 121.8, 121.7, 117.7, 116.2, 115.6, 77.2, 56.6, 39.3, 34.2, 24.1, 20.3.

1H NMR (500 MHz, $CDCl_3$) δ : 8.04 (d, J = 8.5 Hz, 1H), 7.82-7.80 (m, 1H), 7.75 (d, J = 8.0 Hz, 1H), 7.54-7.50 (m, 1H), 7.48-7.44 (m, 1H), 7.41-7.38 (m, 1H), 7.36-7.34 (m, 1H), 7.28-7.25 (m, 1H), 7.18-7.14 (m, 2H), 5.33 (s, 1H), 2.43-2.38 (m, 1H), 2.16-2.10 (m, 1H), 1.92-1.86 (m, 1H), 1.67-1.63 (m, 1H), 1.54-1.46 (m, 2H), 1.38-1.32 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 152.24, 151.36, 131.38, 130.70, 128.72, 128.53, 128.45, 127.64, 126.75, 126.06, 124.24, 123.98, 123.40, 117.79, 116.23, 115.24, 59.30, 38.44, 34.56, 25.52, 20.32; LRMS (EI, 70eV) m/z (%): 314 (M^+ , 7), 236 (100), 180 (23), 152 (27), 91 (5); HRMS m/z (ESI) calcd for $C_{22}H_{19}O_2$ ($[M+H]^+$) 315.1380, found 315.1382.

2-(14H-dibenzo[a,h]xanthen-14-yl)cyclopentan-1-one (3ha):

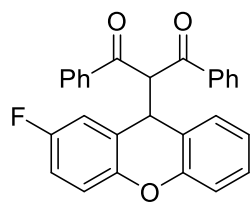


dr = 1.5:1

39.1 mg, 43% yield; White solid; mp 184.2-185.7 °C (uncorrected); 1H NMR (500 MHz, $CDCl_3$) δ : 8.48-8.46 (m, 1H), 8.19 (d, J = 8.5 Hz, 1H), 7.90-7.88 (m, 1H), 7.85-7.80 (m, 2H), 7.63-7.58 (m, 2H), 7.56-7.52 (m, 2H), 7.49-7.45 (m, 2H), 7.29 (d, J = 8.5 Hz, 1H), 5.64 (d, J = 2.5 Hz, 1H), 2.78-2.73 (m, 1H), 2.30-2.24 (m, 1H), 1.85-1.77 (m, 1H), 1.75-1.70 (m, 1H), 1.62-1.56 (m, 1H), 1.52-1.37 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 219.95, 151.35, 147.07, 133.19, 131.46, 130.88, 128.70, 128.46, 127.60, 126.81, 126.22, 126.19, 126.09, 124.38, 123.94, 123.70, 123.58, 121.38, 119.79, 117.87, 115.21, 59.30, 38.51, 34.89, 25.39, 20.38.

1H NMR (500 MHz, $CDCl_3$) δ : 8.47 (d, J = 8.5 Hz, 1H), 8.08 (d, J = 8.5 Hz, 1H), 7.86-7.80 (m, 3H), 7.66-7.44 (m, 1H), 7.62-7.58 (m, 1H), 7.56-7.52 (m, 4H), 7.44-7.41 (m, 1H), 5.47 (s, 1H), 2.48-2.44 (m, 1H), 2.16-2.11 (m, 1H), 1.88-1.84 (m, 1H), 1.68-1.62 (m, 2H), 1.52-1.44 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ : 219.97, 151.37, 147.09, 133.22, 131.48, 130.90, 128.72, 128.49, 127.62, 126.84, 126.24, 126.21, 126.11, 124.40, 123.96, 123.73, 123.60, 121.41, 119.82, 117.89, 115.23, 59.33, 38.54, 34.91, 29.72, 25.42, 20.41; LRMS (EI, 70eV) m/z (%): 364 (M^+ , 50), 195 (100), 180 (23), 167 (5), 152 (7), 91 (4); HRMS m/z (ESI) calcd for $C_{26}H_{21}O_2$ ($[M+H]^+$) 365.1536, found 365.1539.

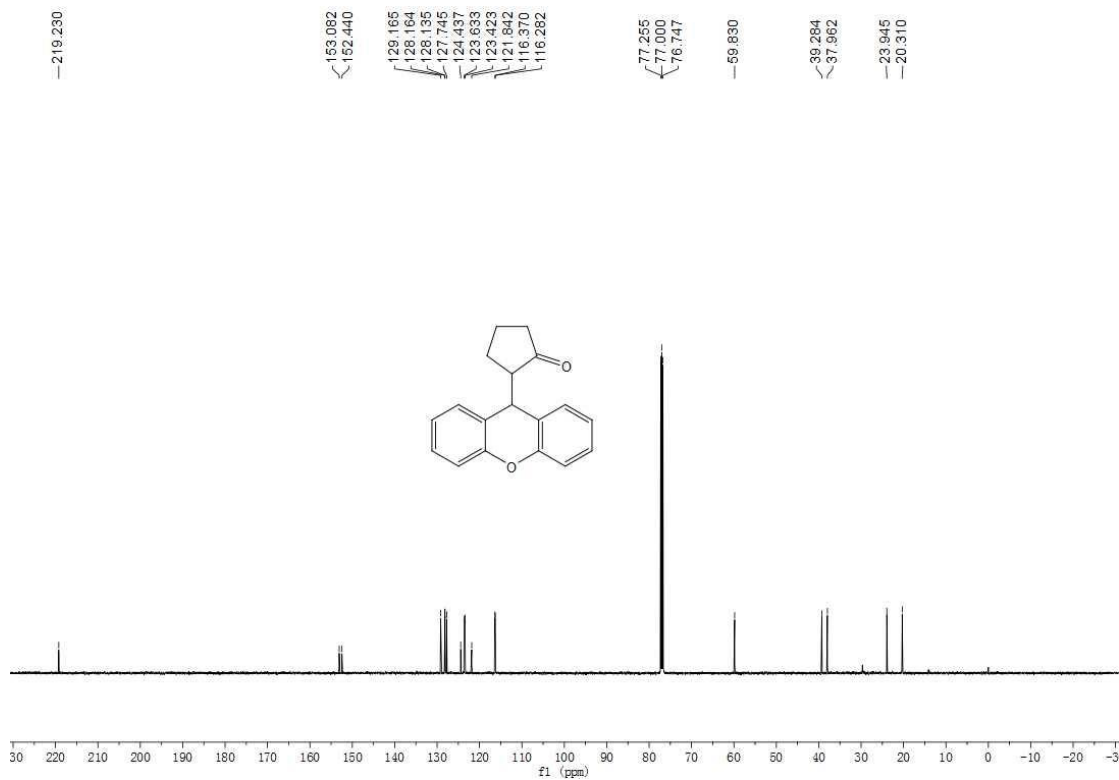
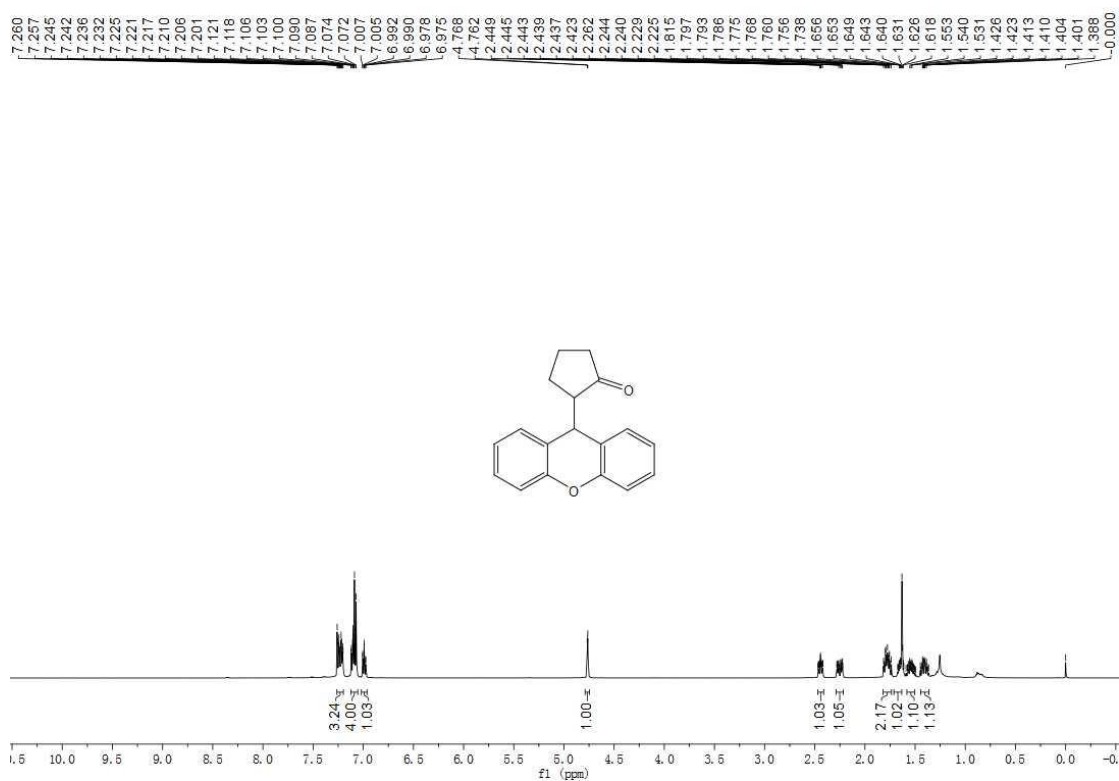
2-(2-Fluoro-9H-xanthen-9-yl)-1,3-diphenylpropane-1,3-dione (3ia):



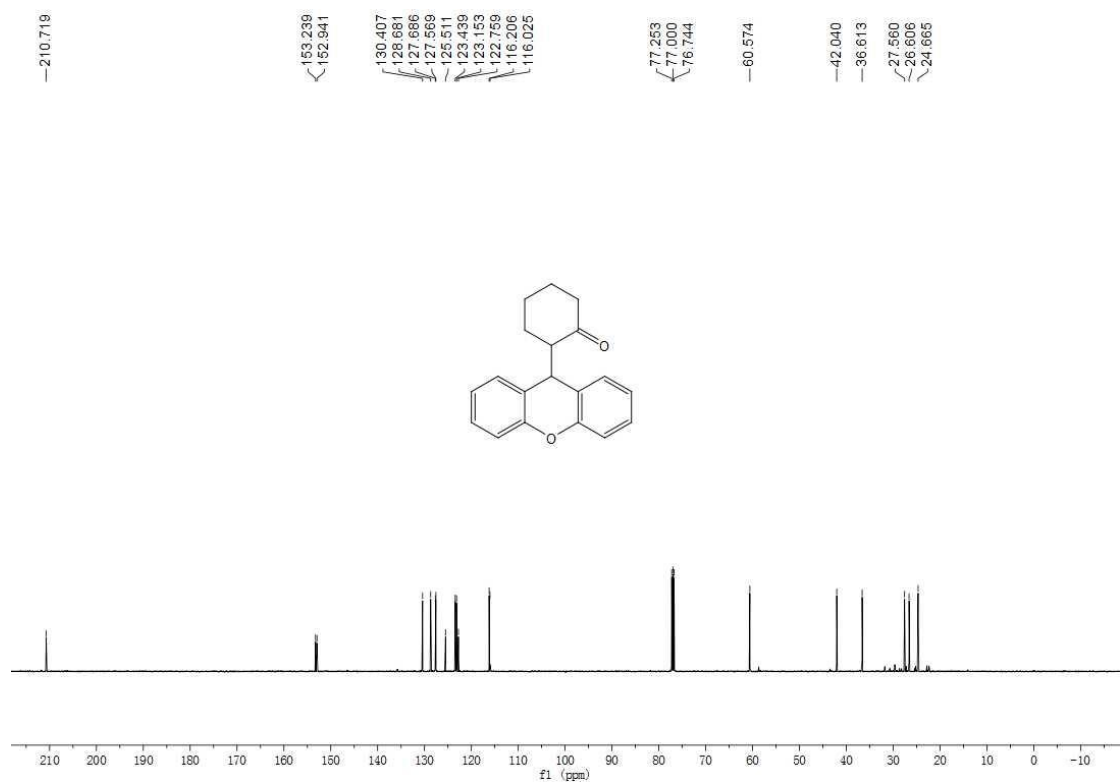
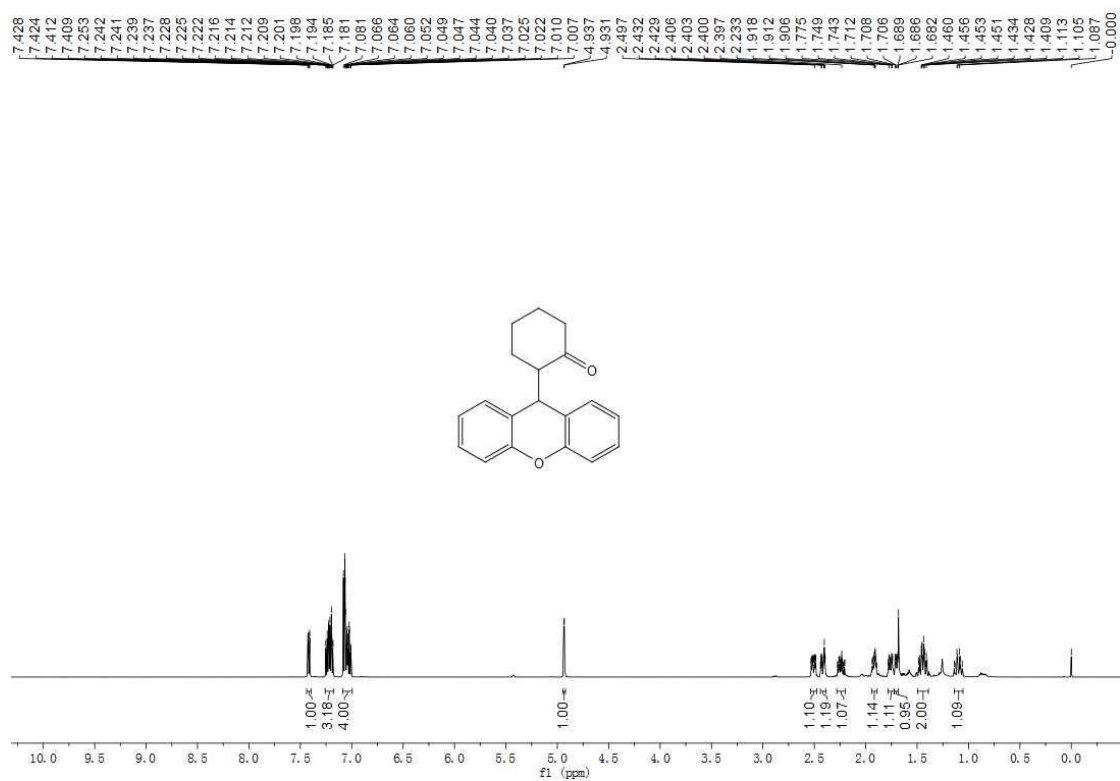
68.6 mg, 65% yield; White solid; mp 141.6-142.8 °C (uncorrected); ^1H NMR (500 MHz, CDCl_3) δ : 7.69-7.64 (m, 4H), 7.45-7.40 (m, 2H), 7.29-7.24 (m, 5H), 7.10-7.01 (m, 4H), 6.89-6.86 (m, 1H), 6.80-6.76 (m, 1H), 5.73 (d, $J = 9.5$ Hz, 1H), 5.30 (d, $J = 9.5$ Hz, 1H); ^{13}C NMR (125 MHz, CDCl_3) δ 193.50, 193.36, 159.40, 157.48, 153.63, 149.74, 149.73, 136.42, 136.36, 133.42, 133.32, 129.73, 128.60, 128.54, 128.30, 128.26, 123.69, 123.12, 117.58, 117.51, 116.48, 116.25, 116.05, 114.93, 114.74, 62.03, 40.57; ^{19}F NMR (471MHz, CDCl_3) δ : -119.5 (s); LRMS (EI, 70eV) m/z (%): 200 (15), 199 (100), 170 (12), 151 (2), 125 (1); HRMS m/z (ESI) calcd for $\text{C}_{28}\text{H}_{22}\text{FO}_3$ ($[\text{M}+\text{H}]^+$) 423.1391, found 423.1390.

(C) Spectra

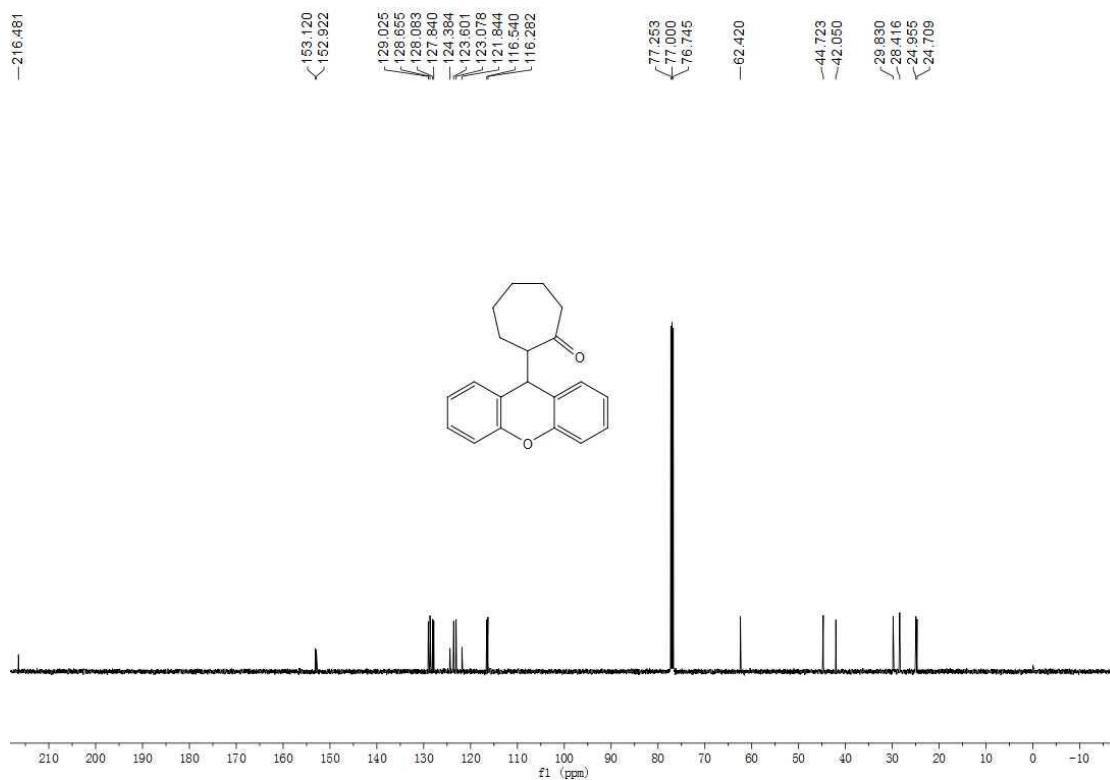
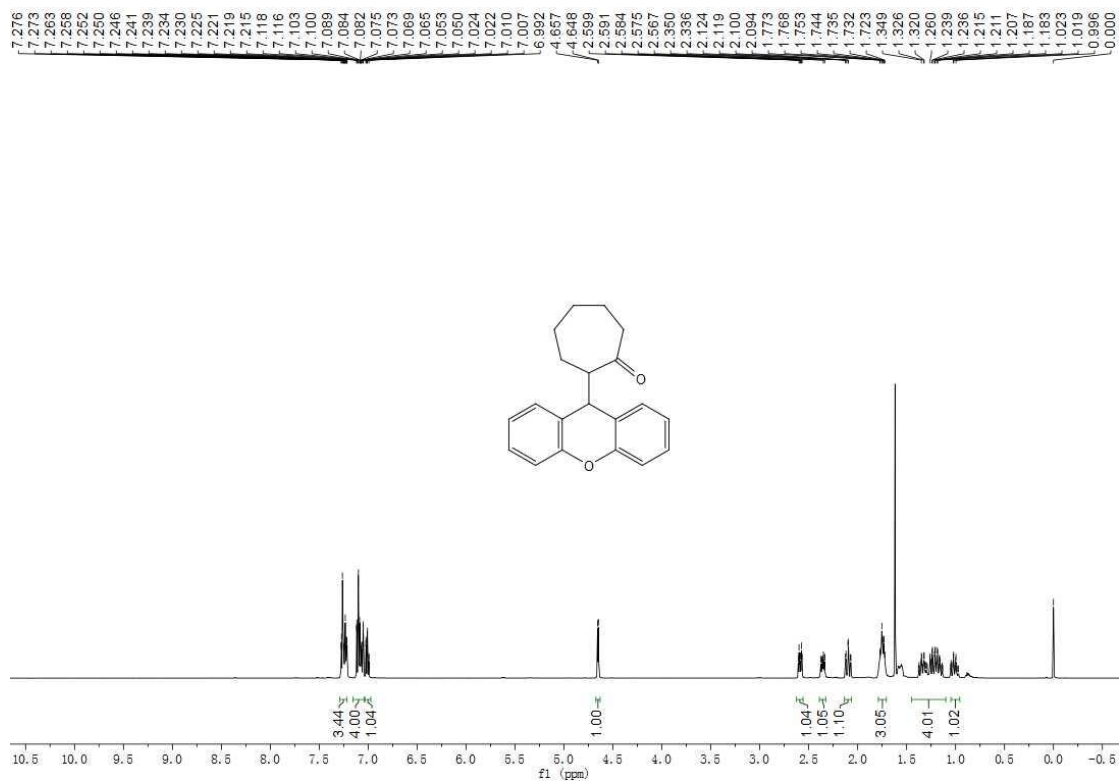
2-(9*H*-Xanthen-9-yl)cyclopentan-1-one (3aa)



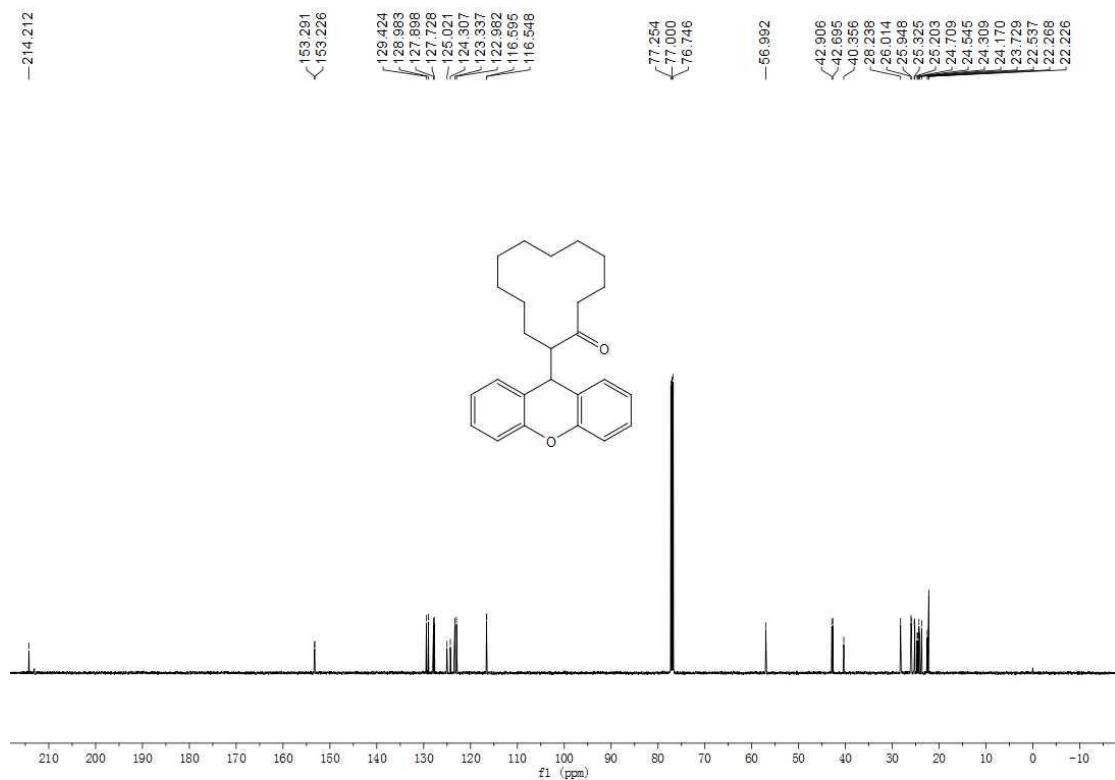
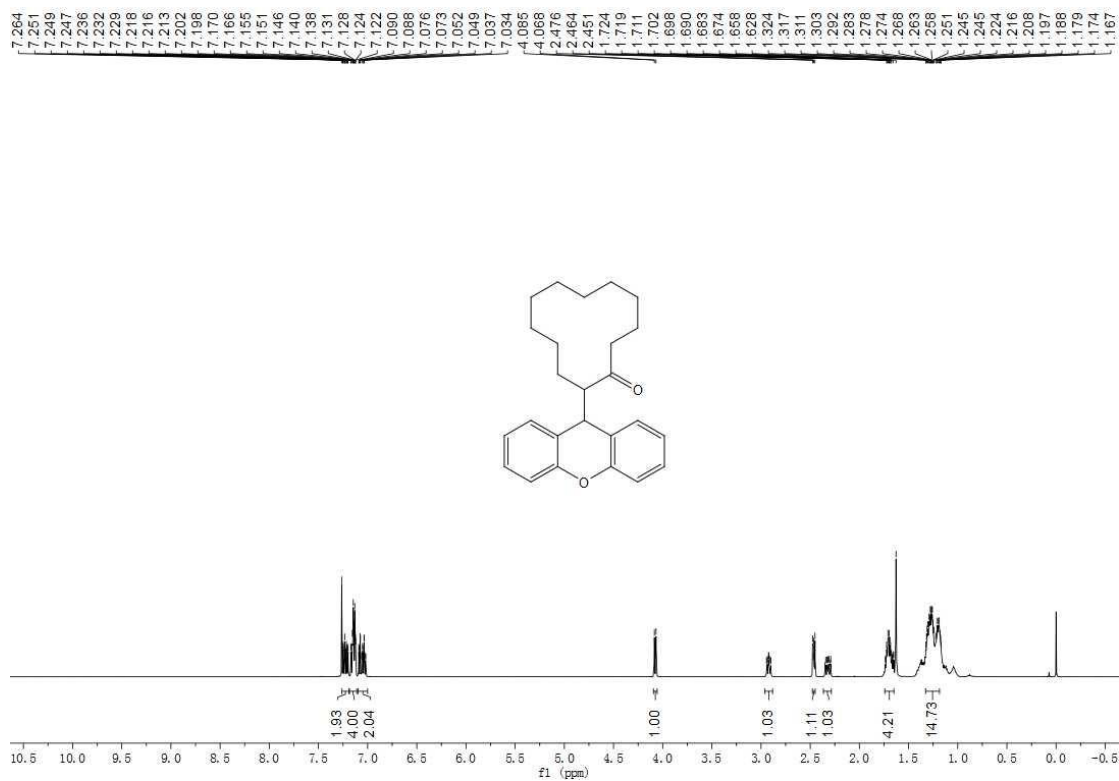
2-(9H-Xanthen-9-yl)cyclohexan-1-one (3ab)



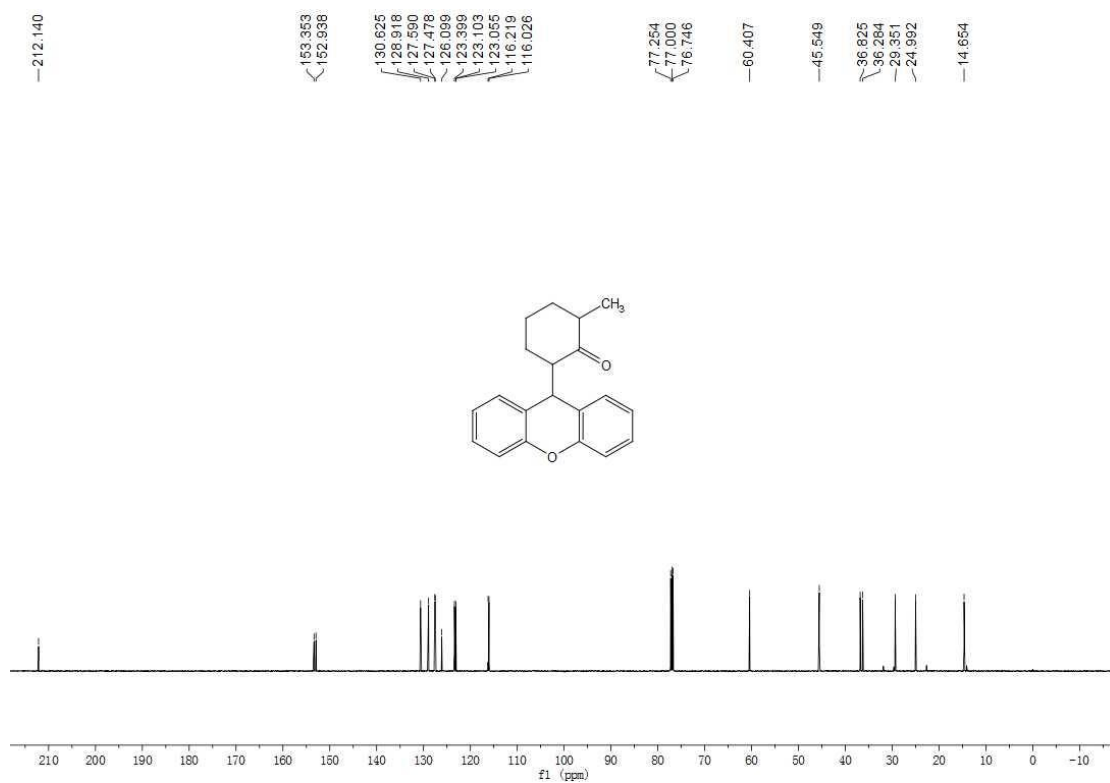
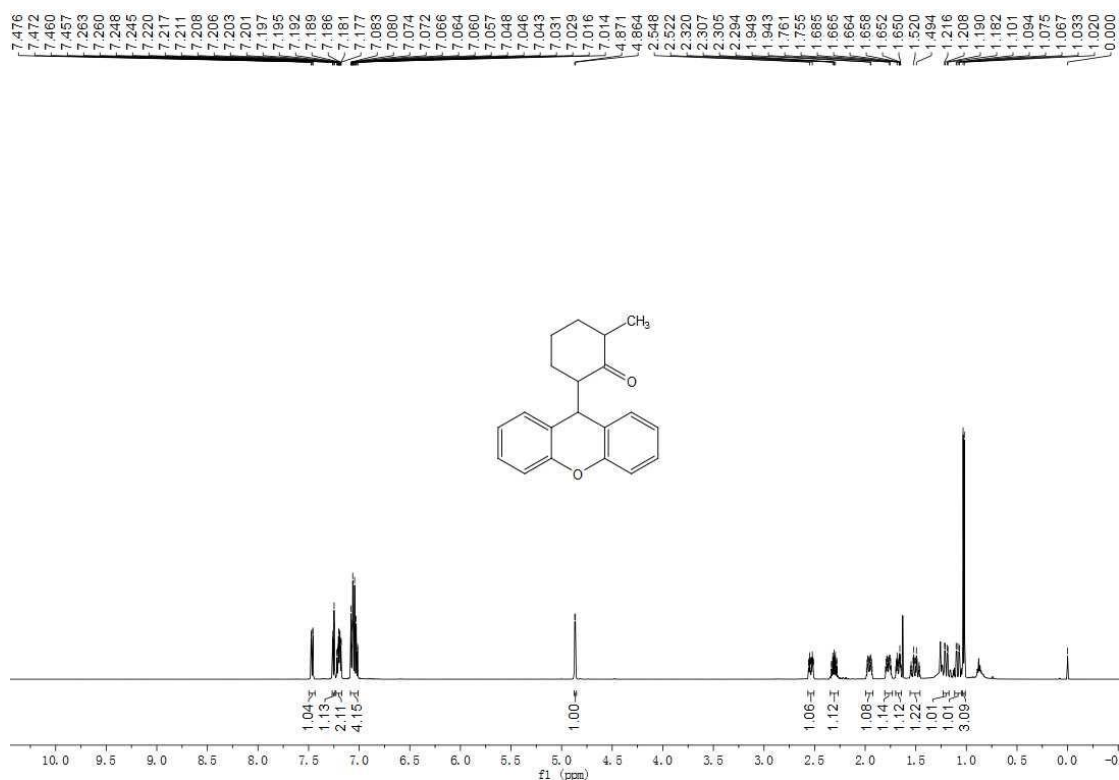
2-(9H-Xanthen-9-yl)cycloheptan-1-one (3ac)



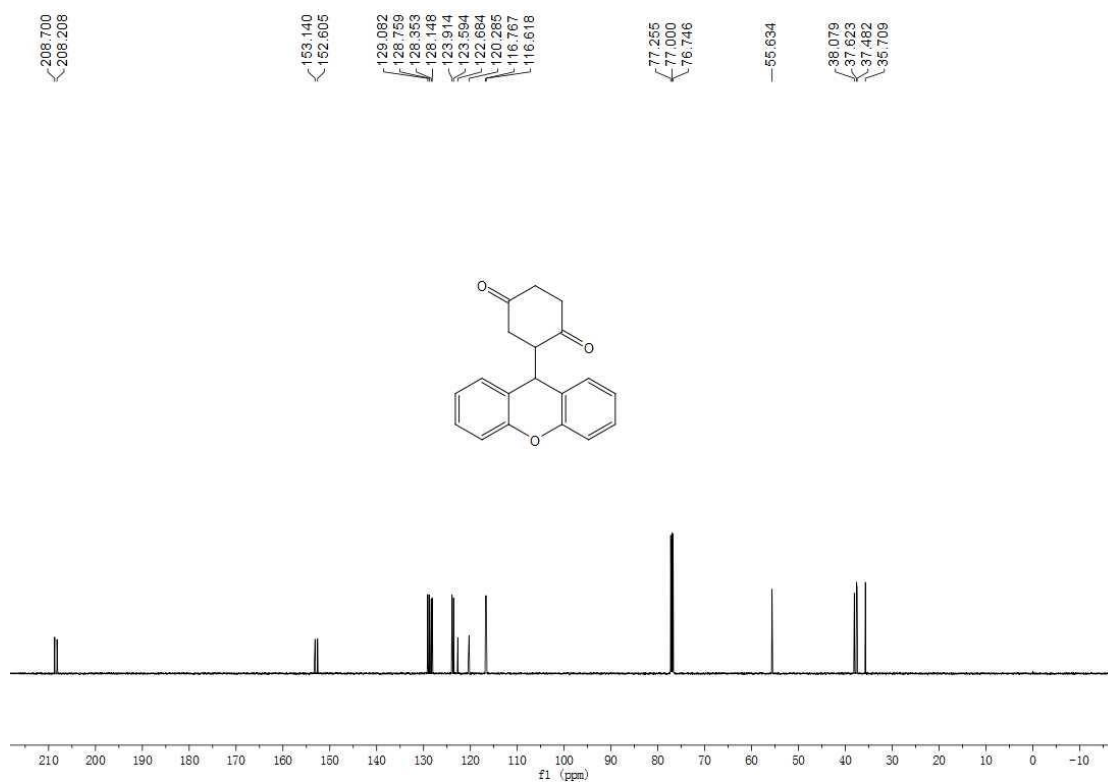
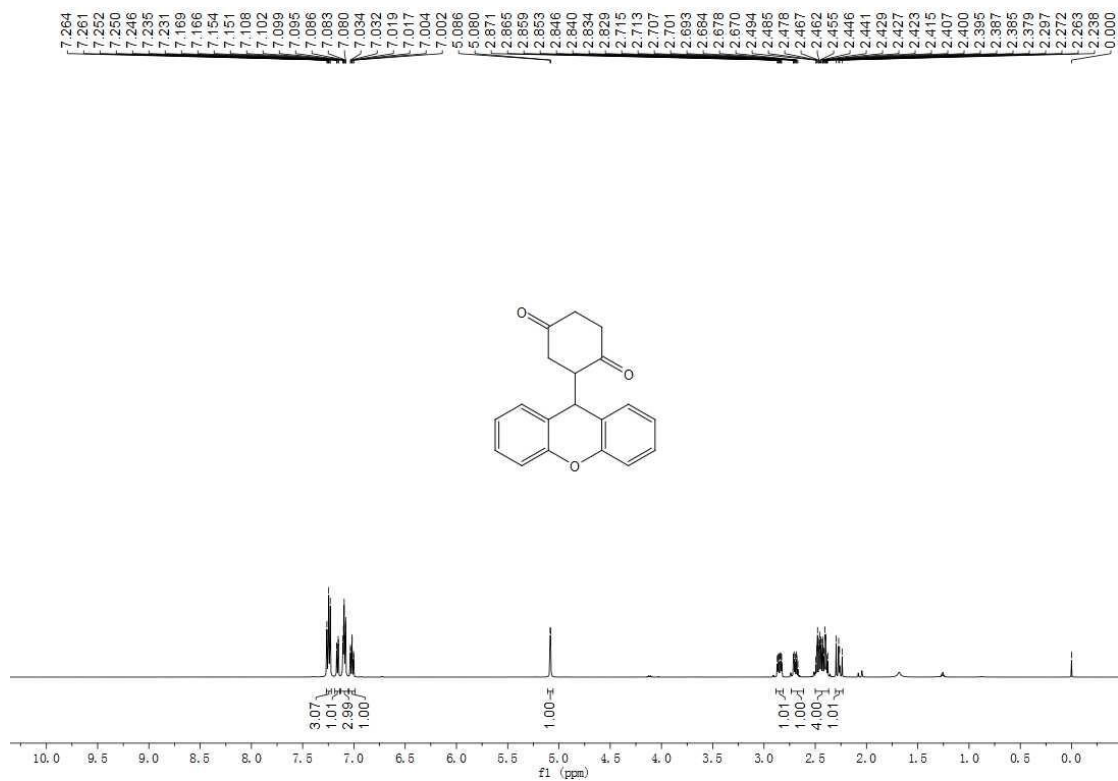
2-(9H-Xanthen-9-yl)cyclododecan-1-one (3ad)



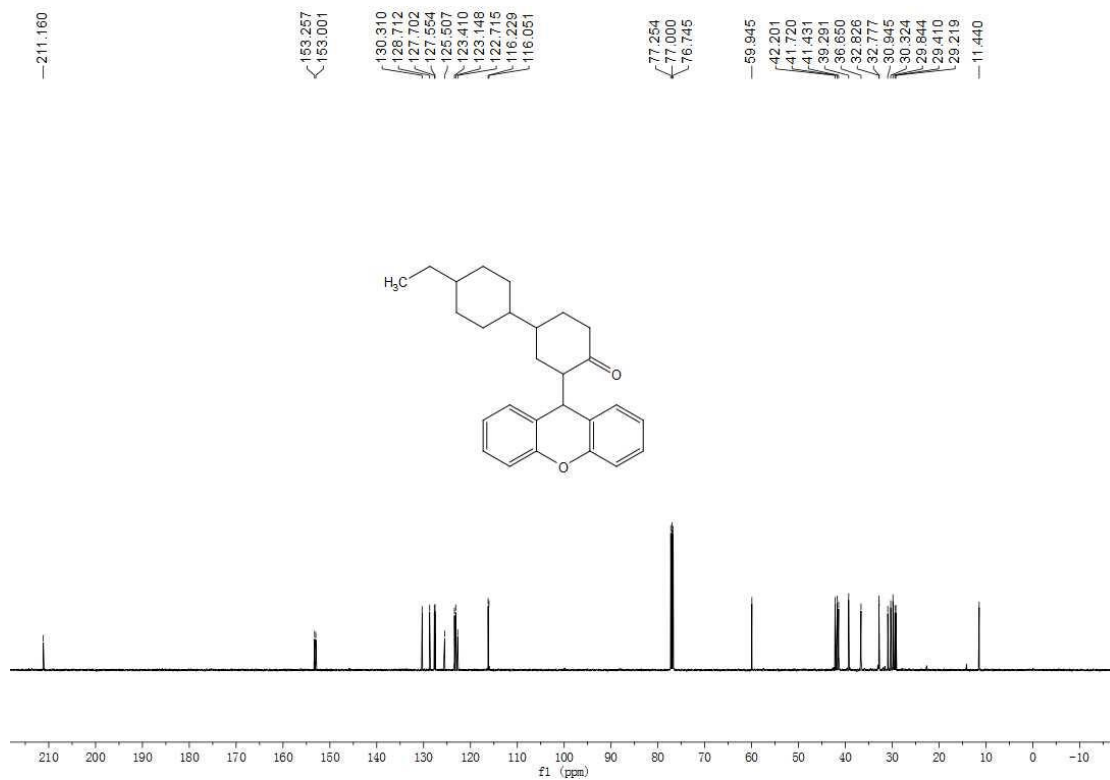
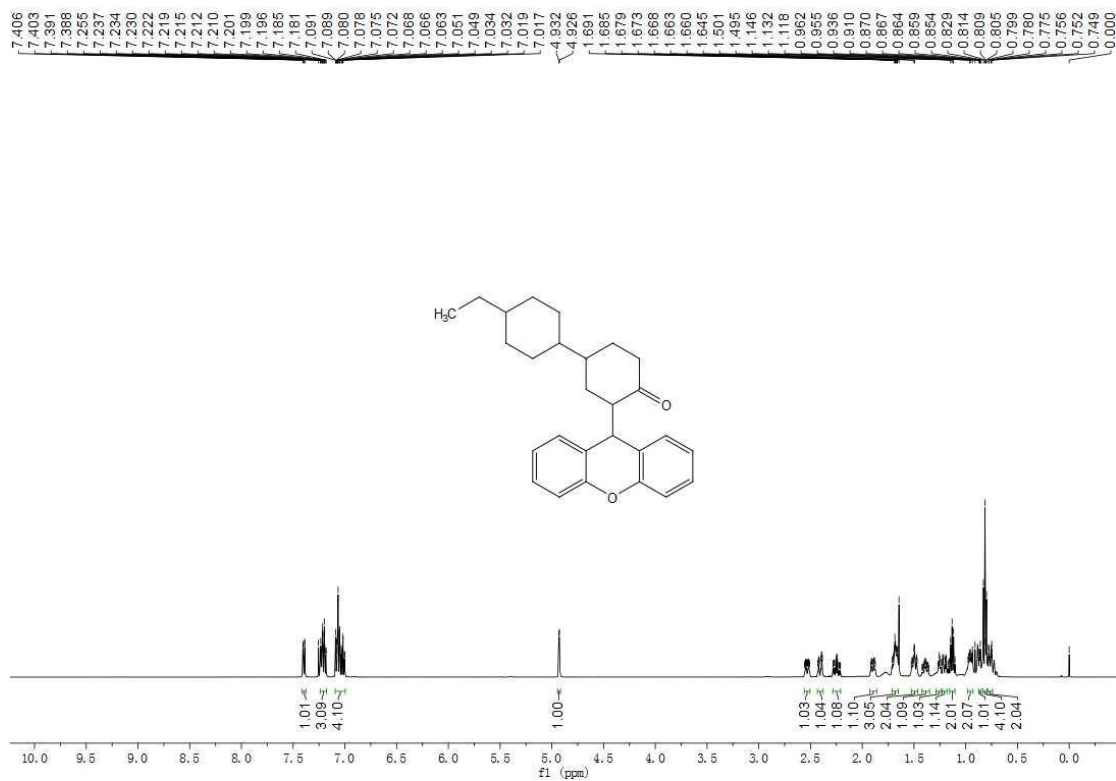
2-Methyl-6-(9H-xanthen-9-yl)cyclohexan-1-one (3ae)



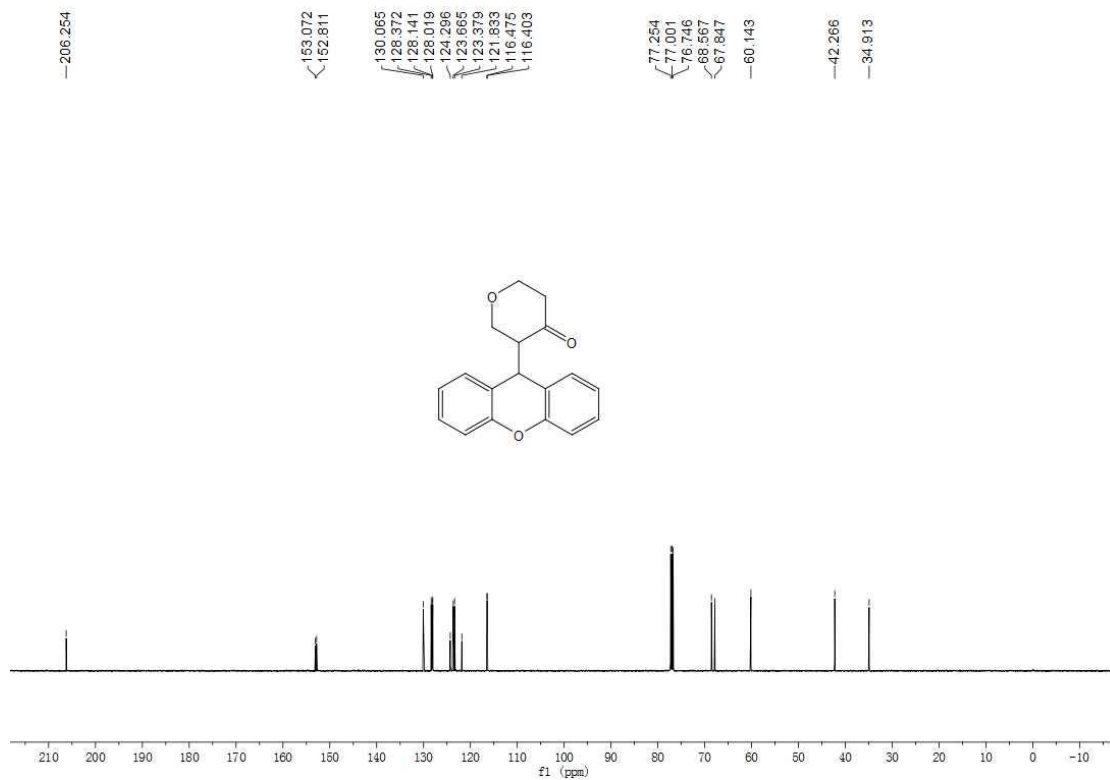
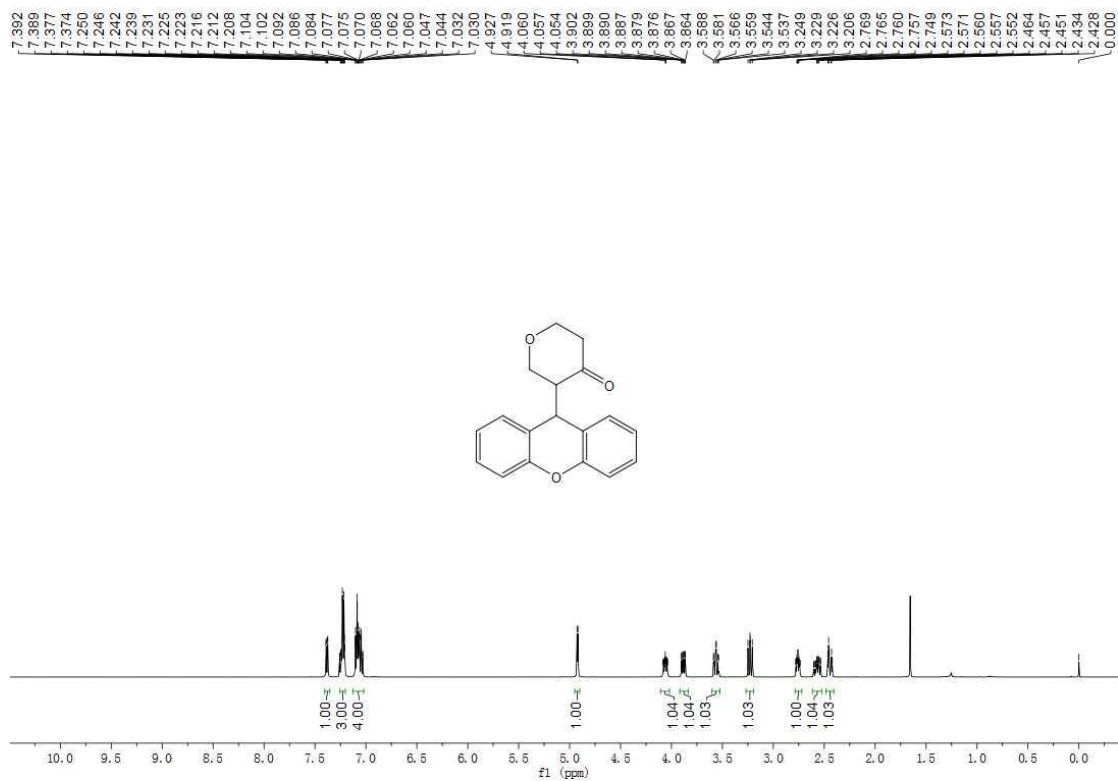
2-(9H-Xanthen-9-yl)cyclohexane-1,4-dione (3af)



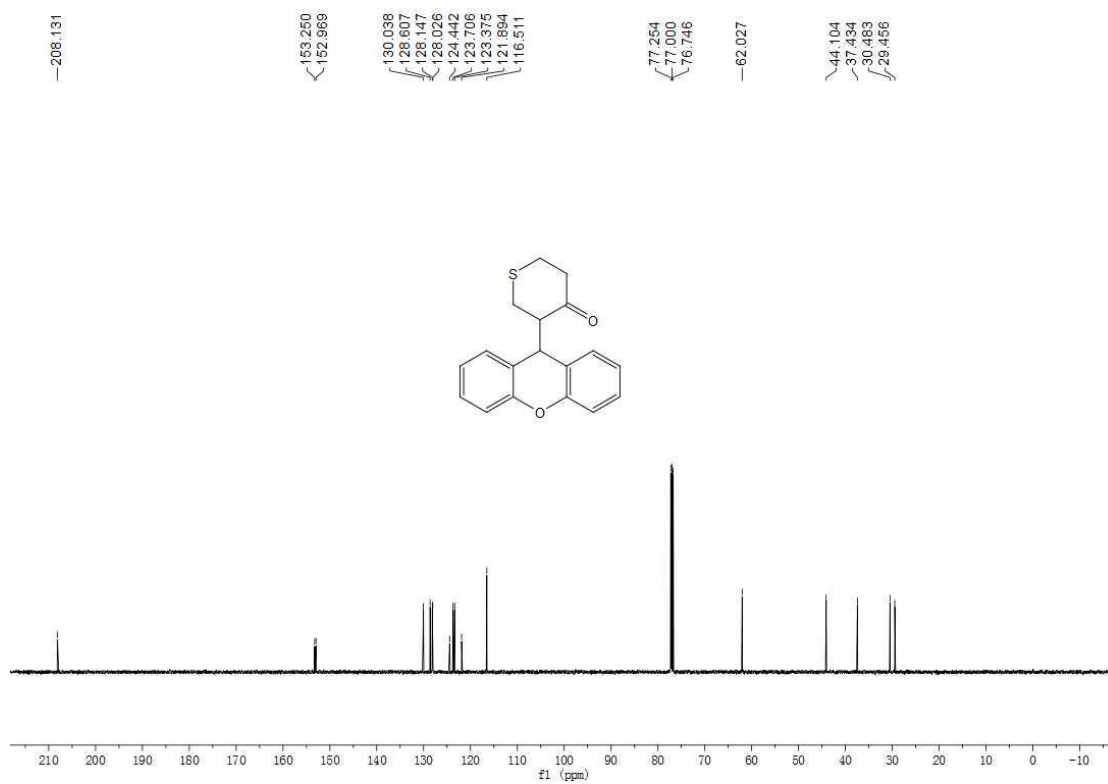
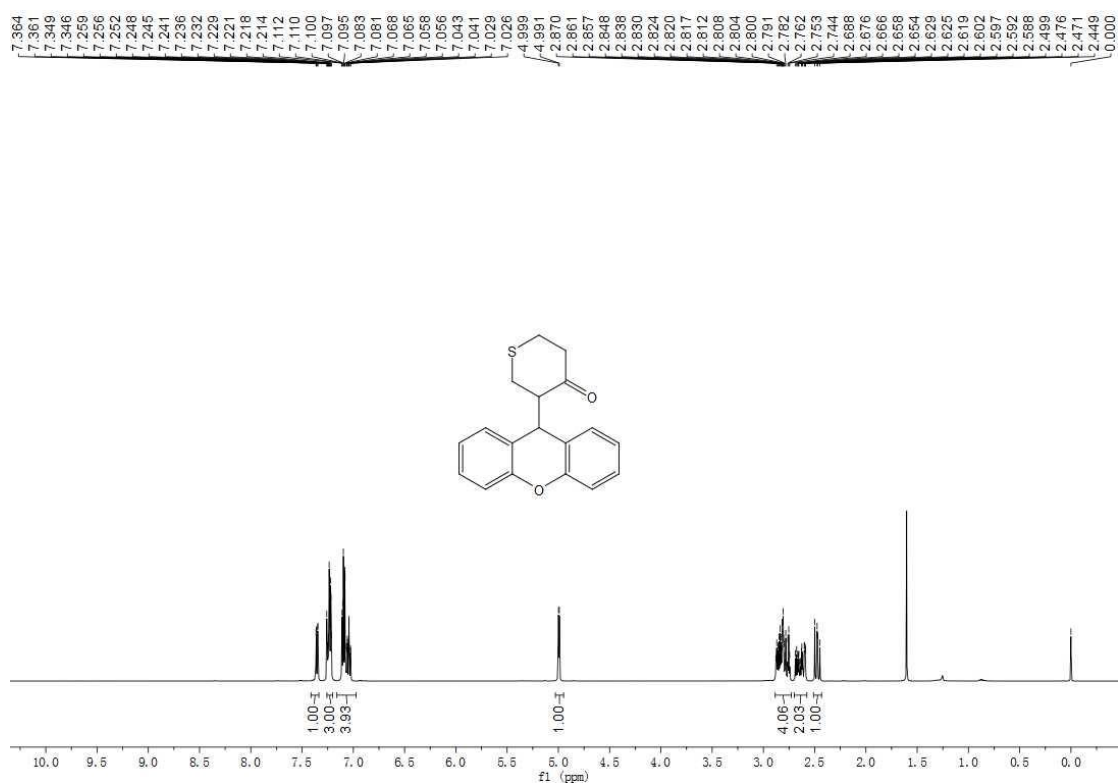
4'-Ethyl-3-(9H-xanthen-9-yl)-[1,1'-bi(cyclohexan)]-4-one (3ag)



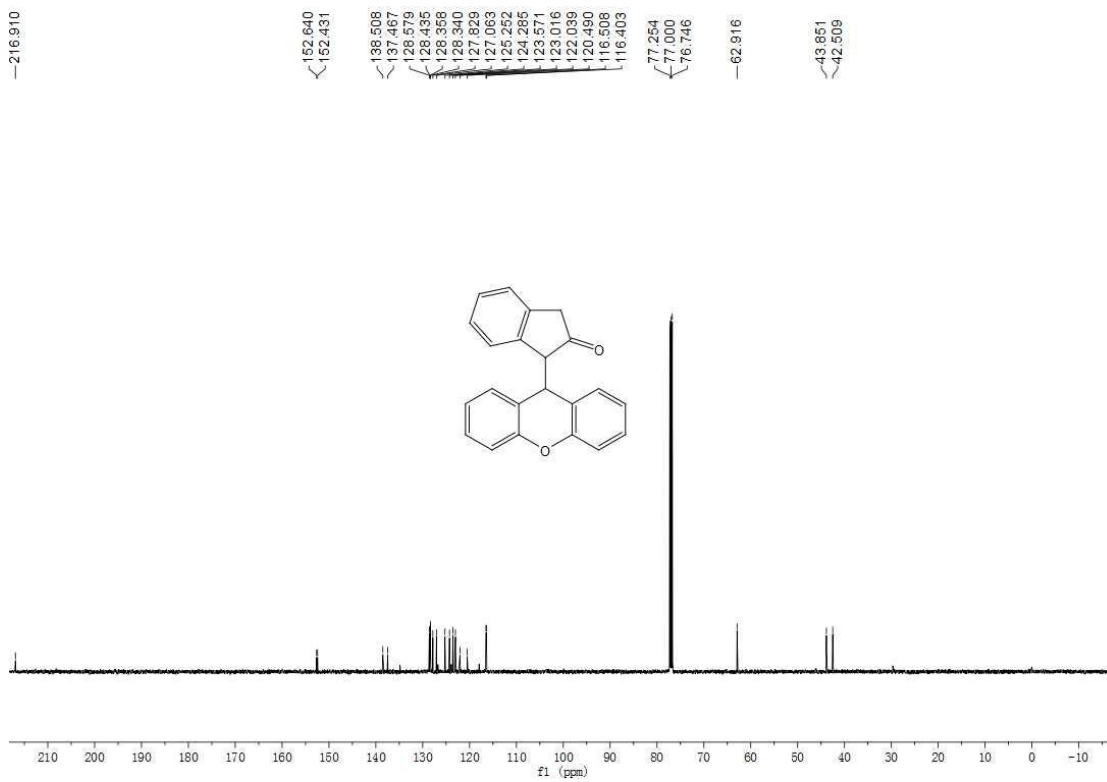
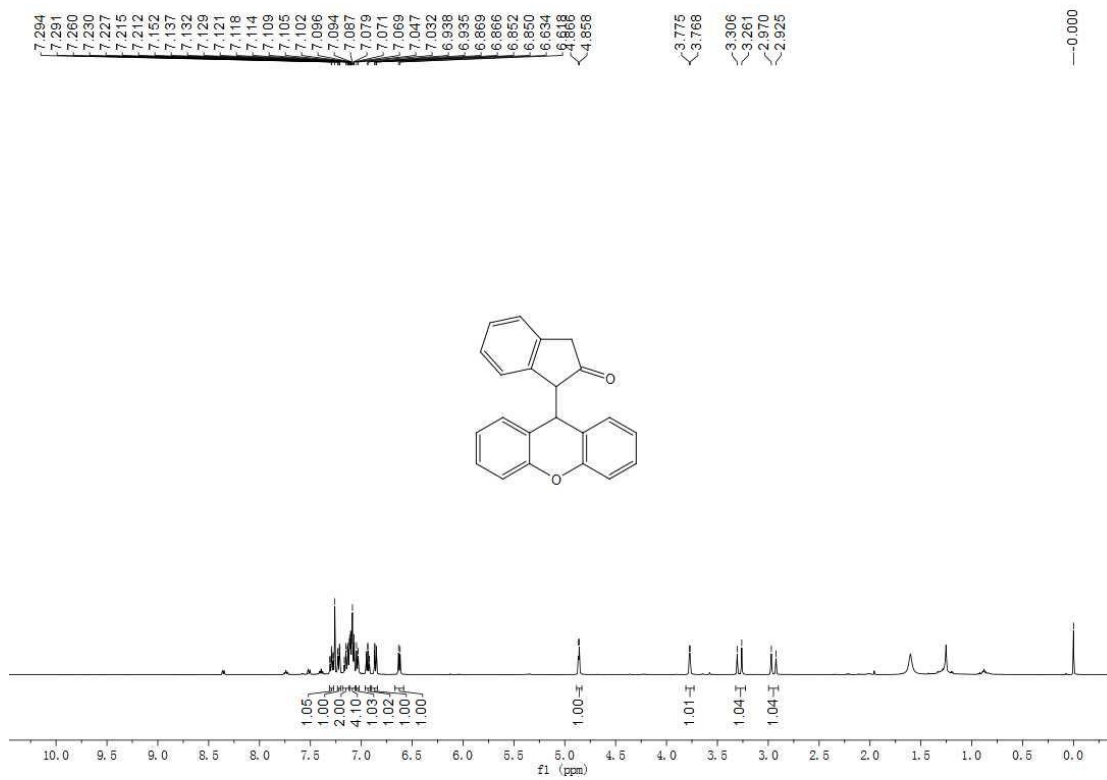
3-(9H-Xanthen-9-yl)tetrahydro-4H-pyran-4-one (3ah)



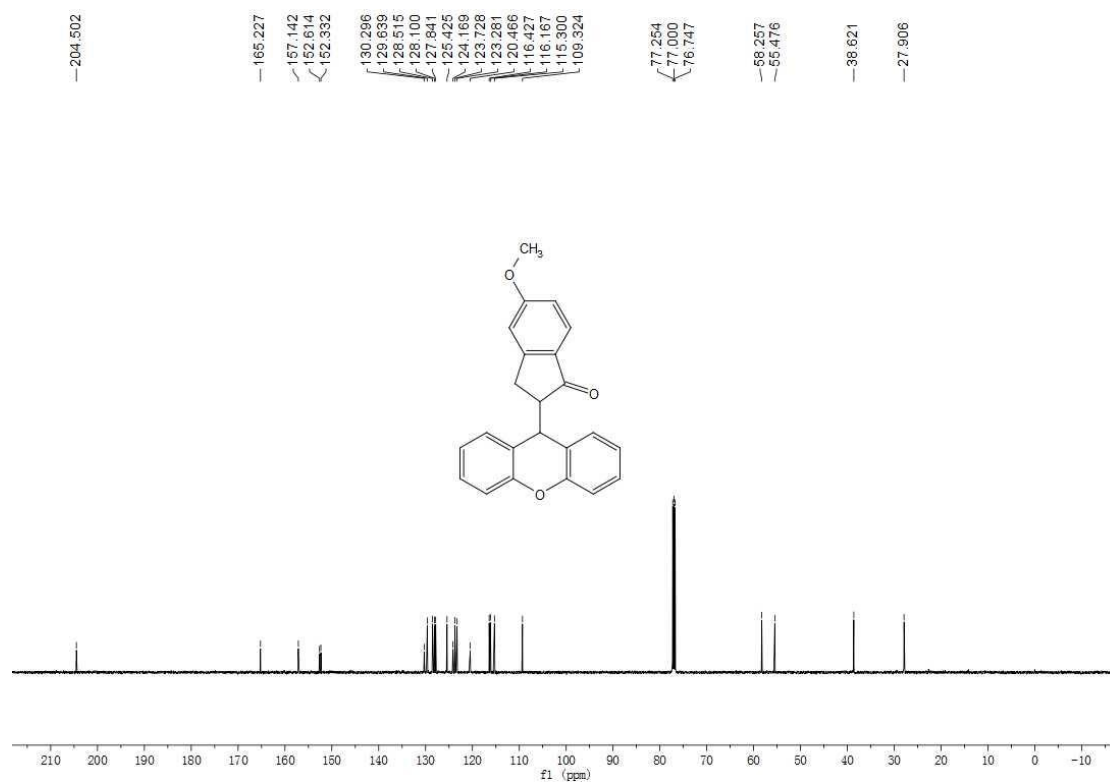
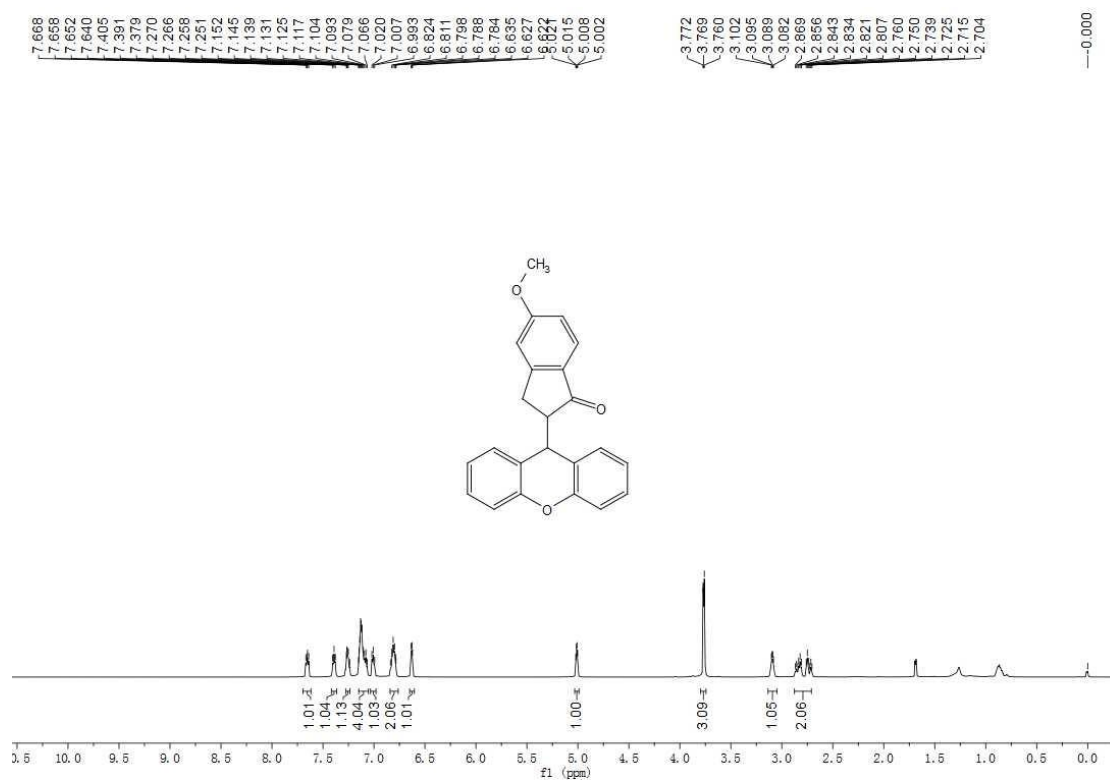
3-(9*H*-Xanthen-9-yl)tetrahydro-4*H*-thiopyran-4-one (3ai)



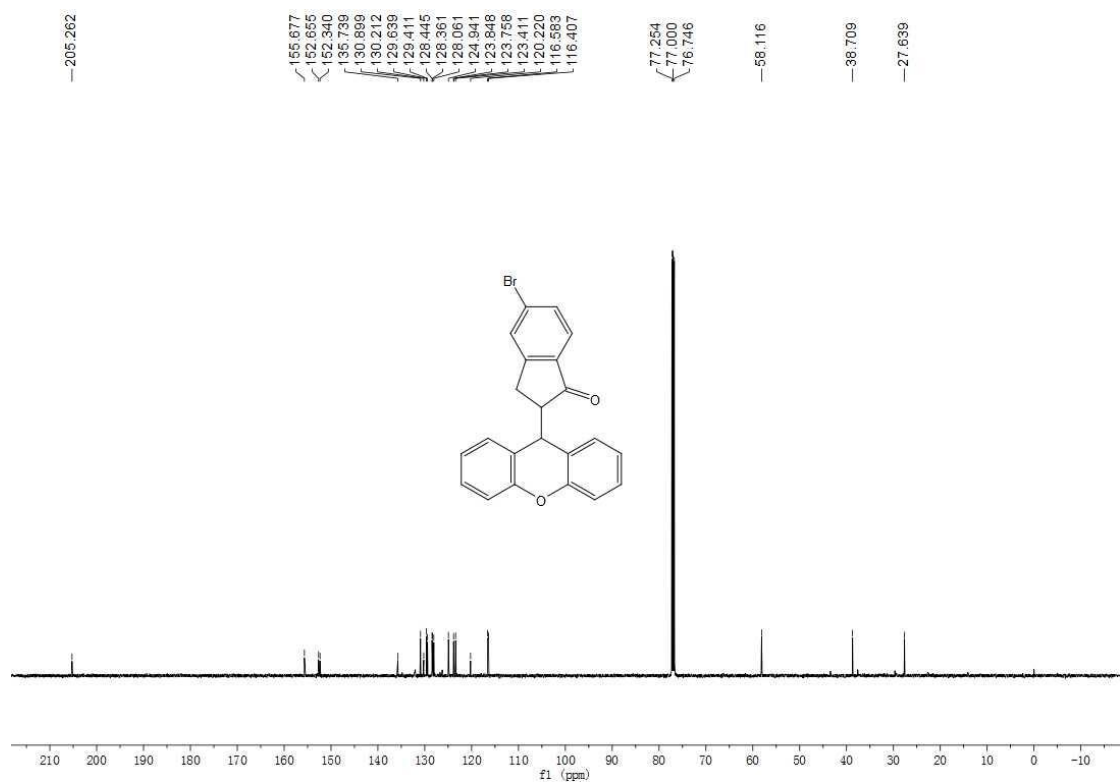
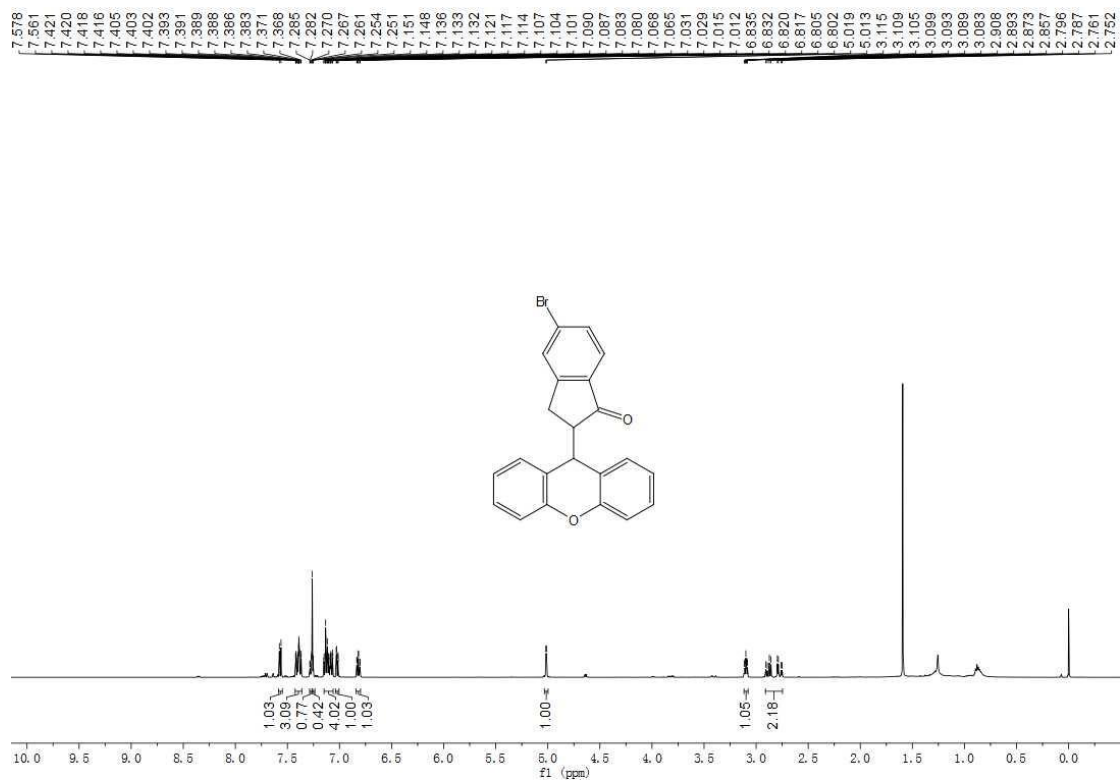
1-(9*H*-Xanthen-9-yl)-1,3-dihydro-2*H*-inden-2-one (3aj)



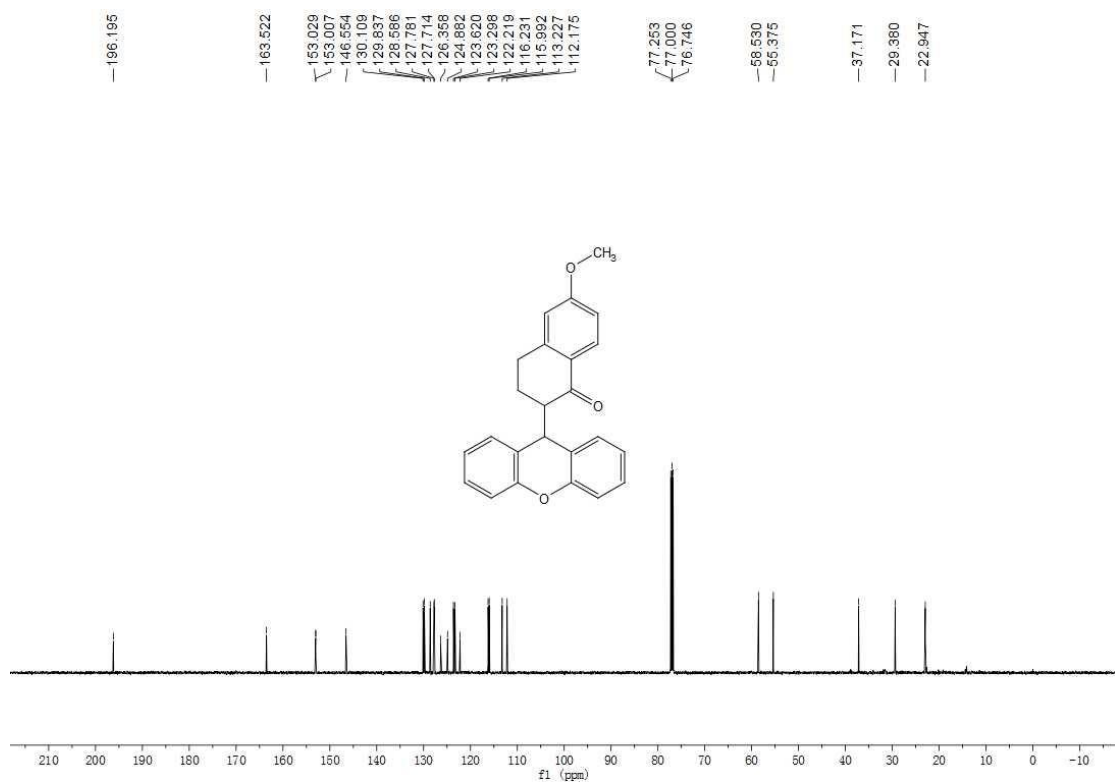
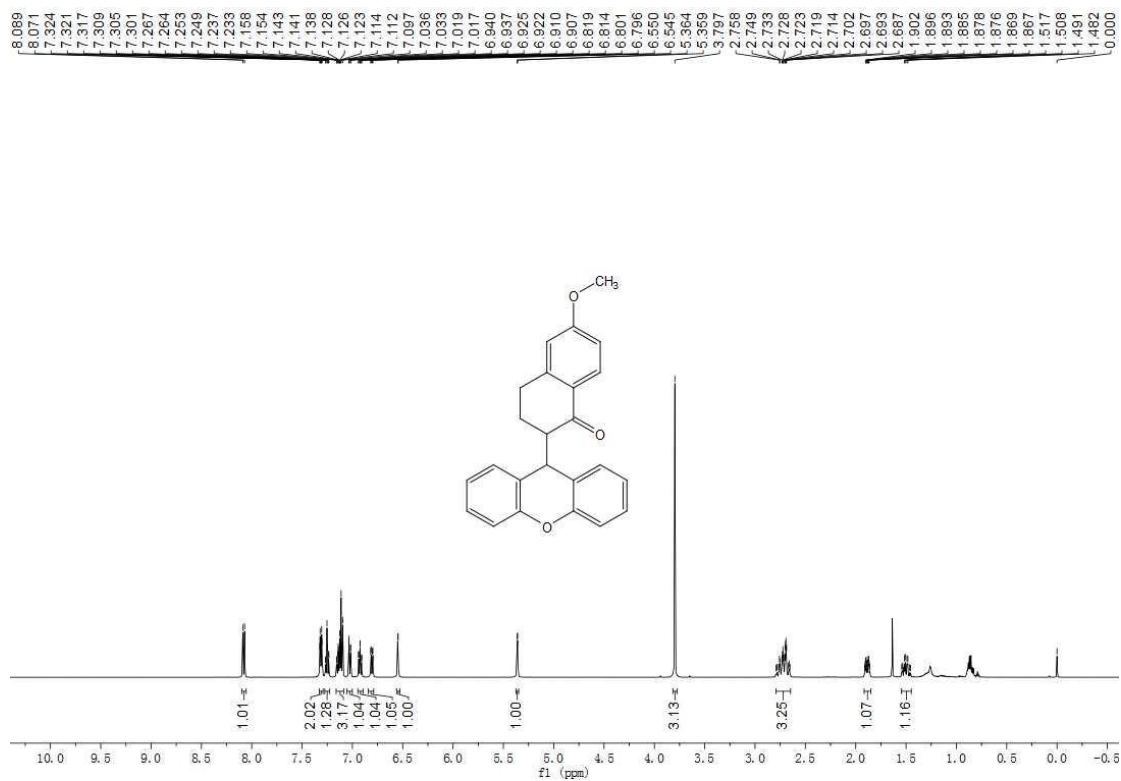
5-Methoxy-2-(9H-xanthen-9-yl)-2,3-dihydro-1H-inden-1-one (3ak)



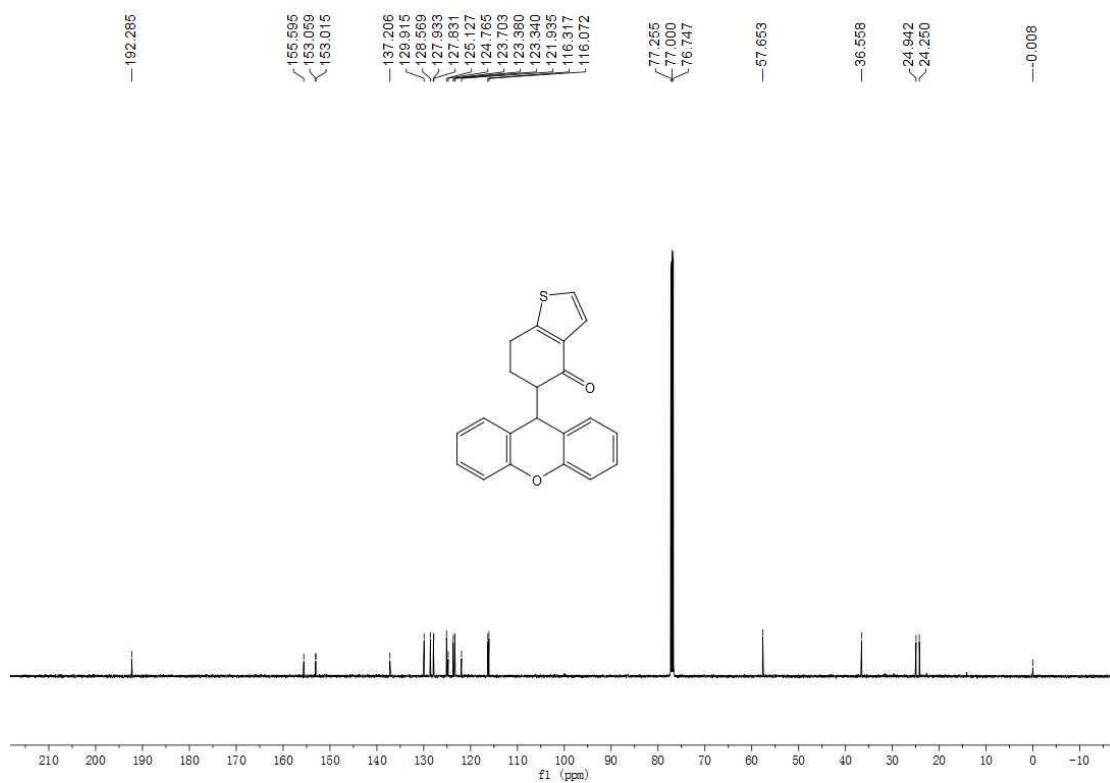
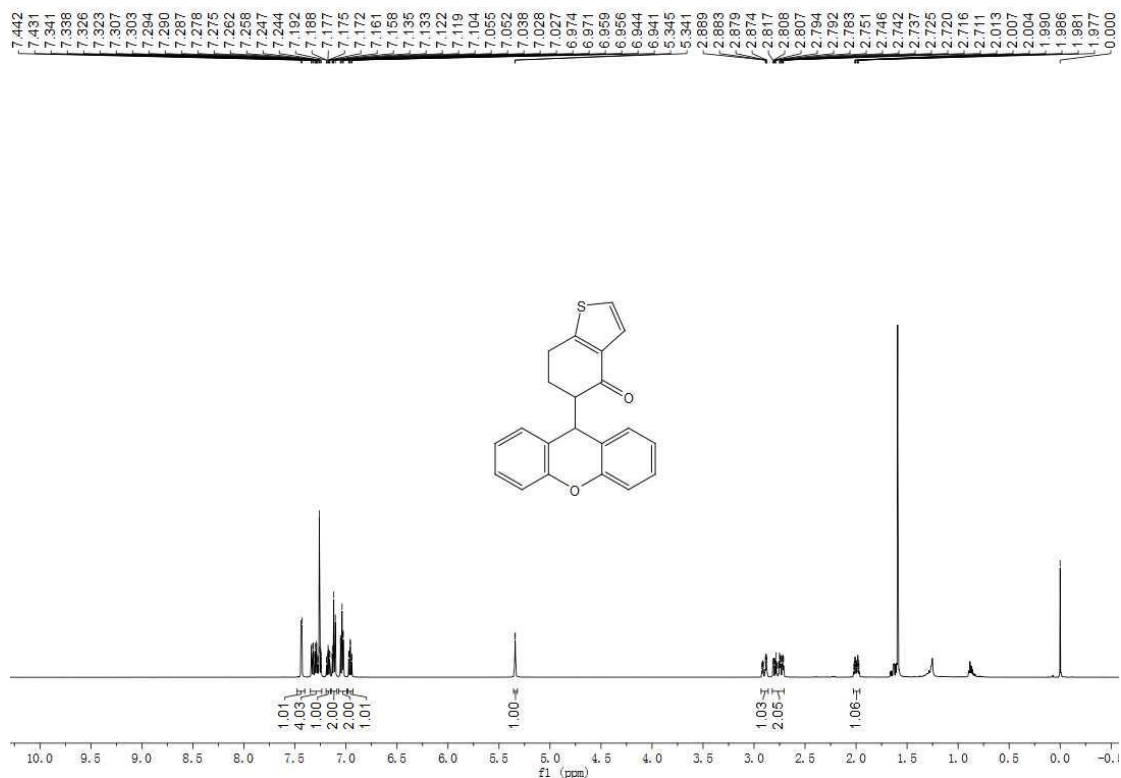
5-Bromo-2-(9H-xanthen-9-yl)-2,3-dihydro-1H-inden-1-one (3a)



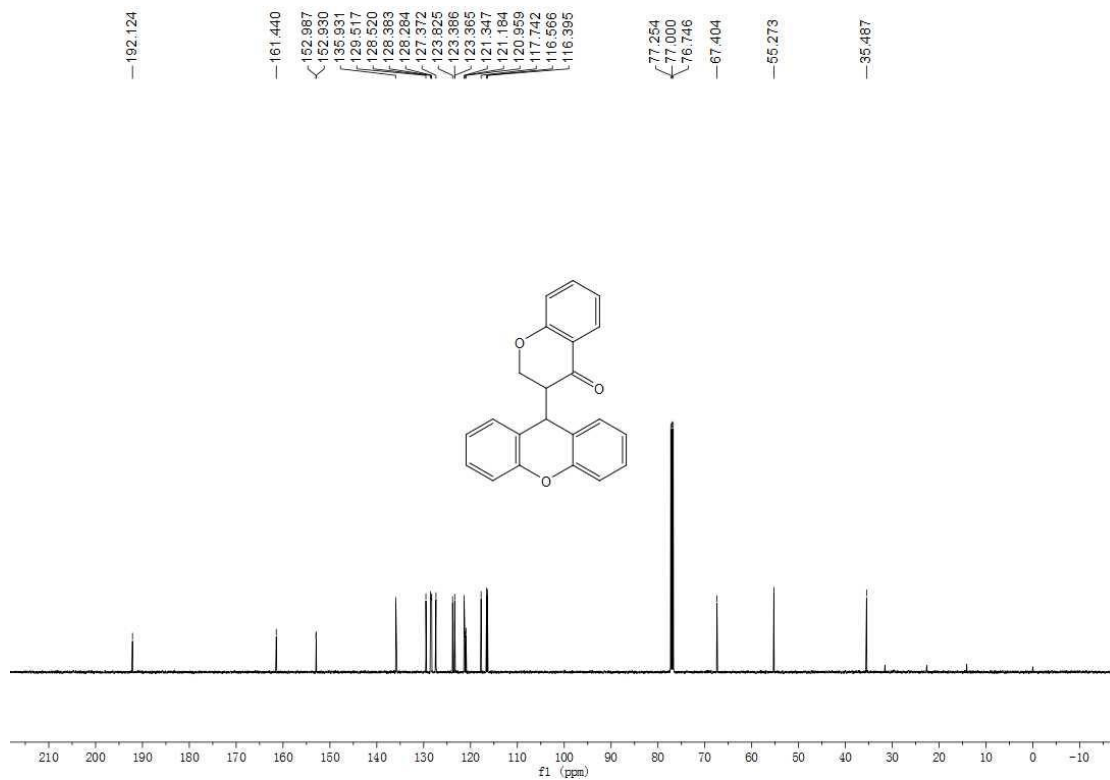
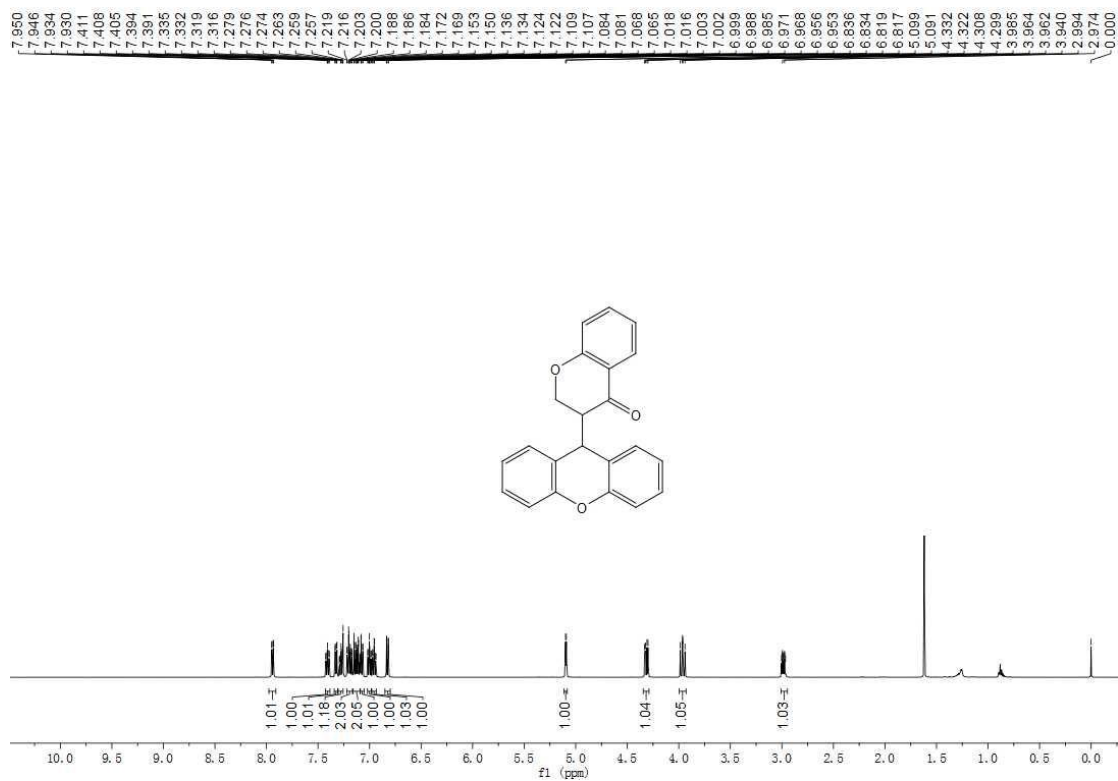
6-Methoxy-2-(9H-xanthen-9-yl)-3,4-dihydronaphthalen-1(2H)-one (3am)



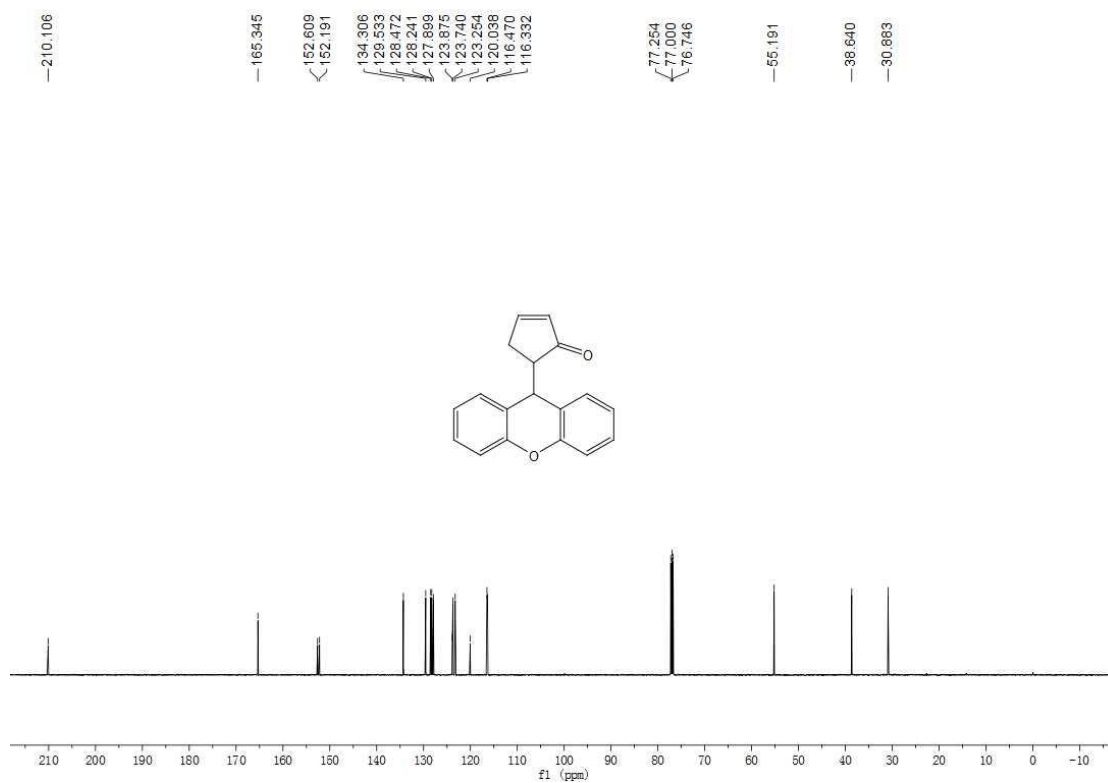
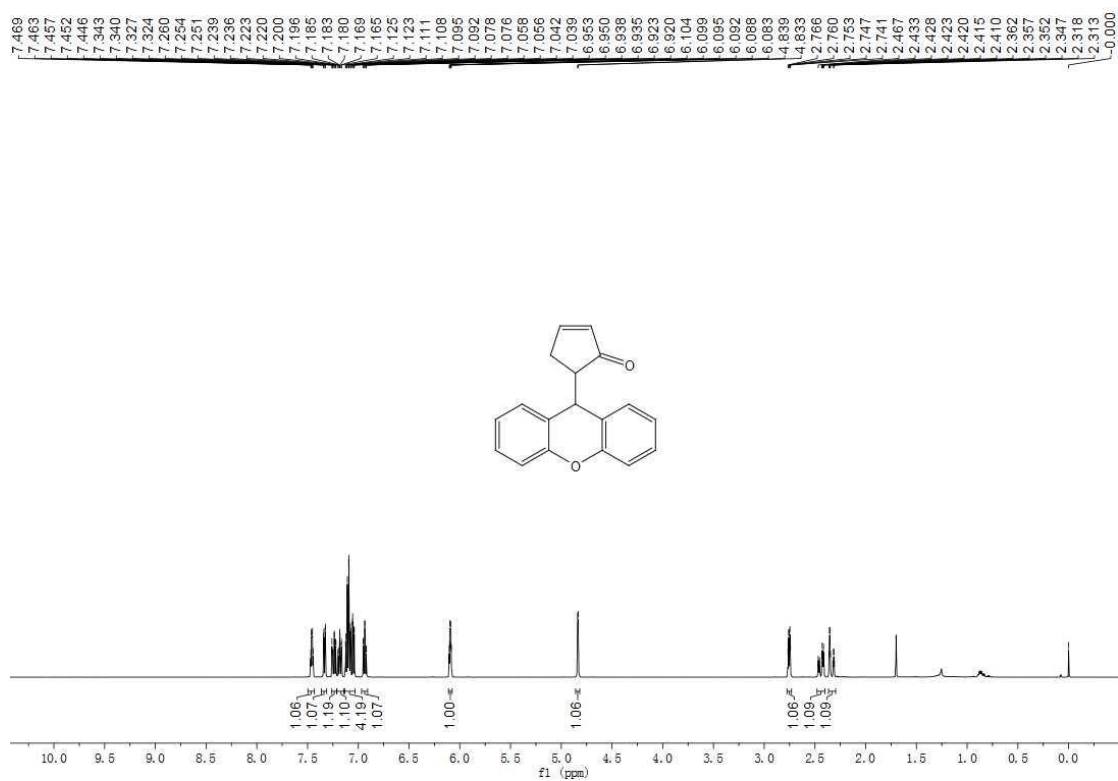
5-(9H-Xanthen-9-yl)-6,7-dihydrobenzo[b]thiophen-4(5H)-one (3an)



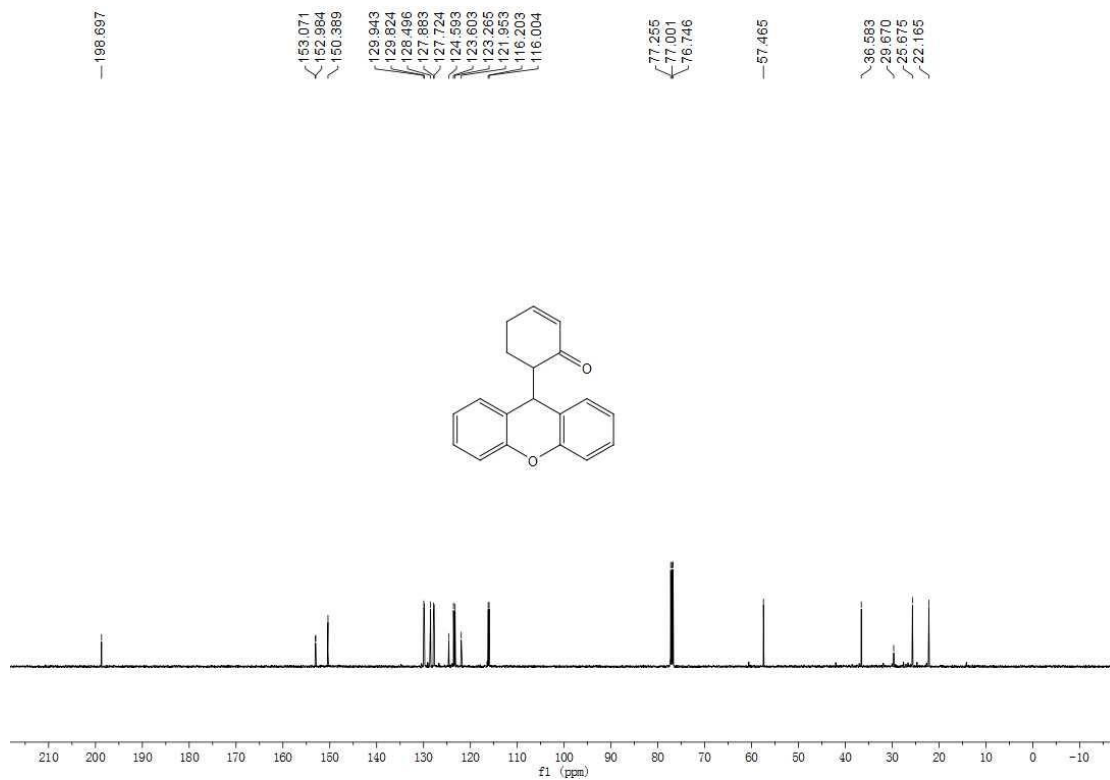
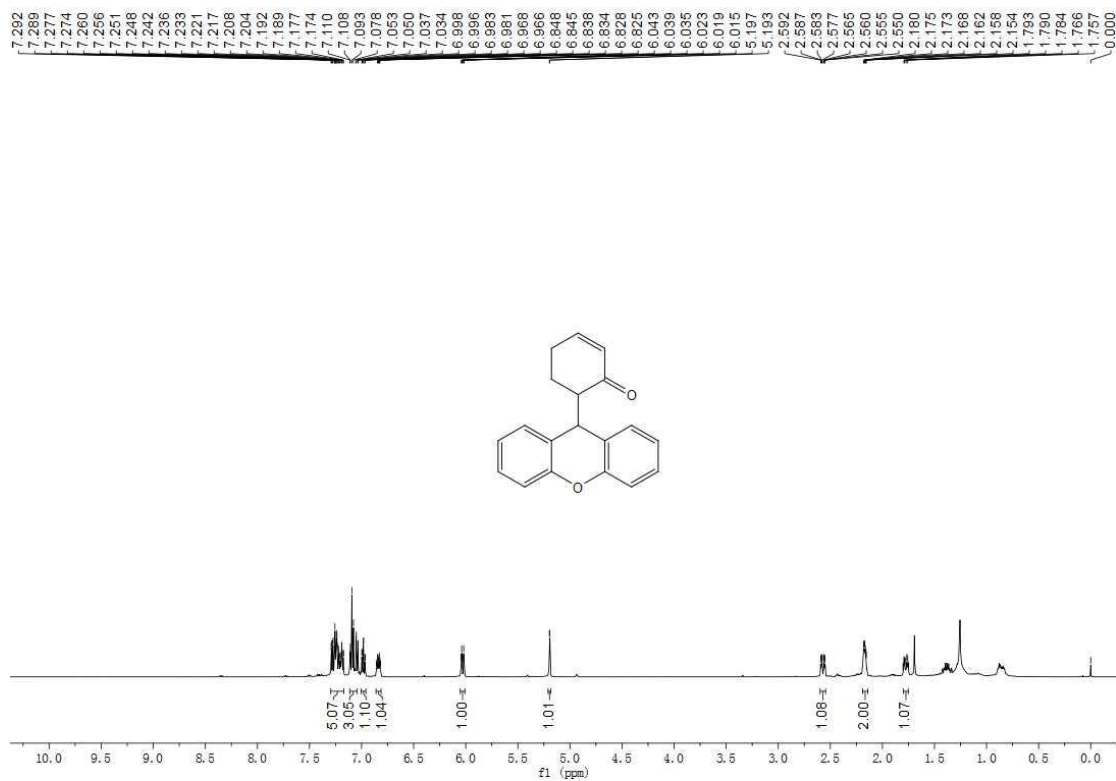
3-(9*H*-Xanthen-9-yl)chroman-4-one (3ao)



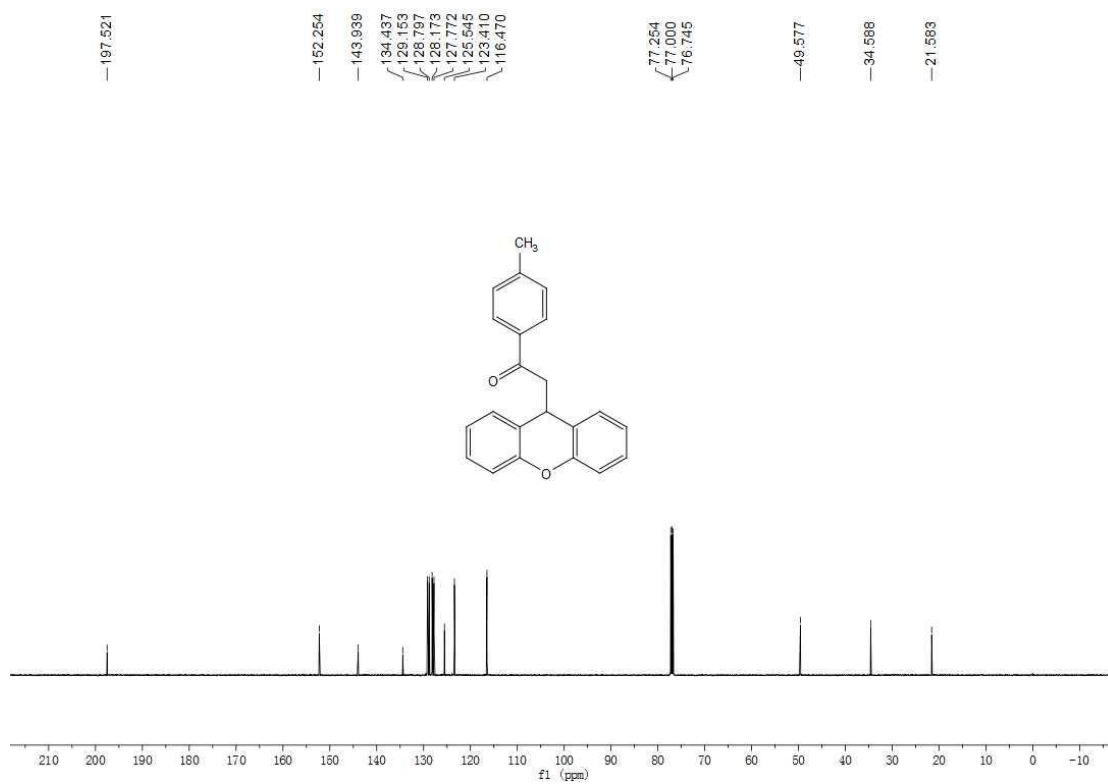
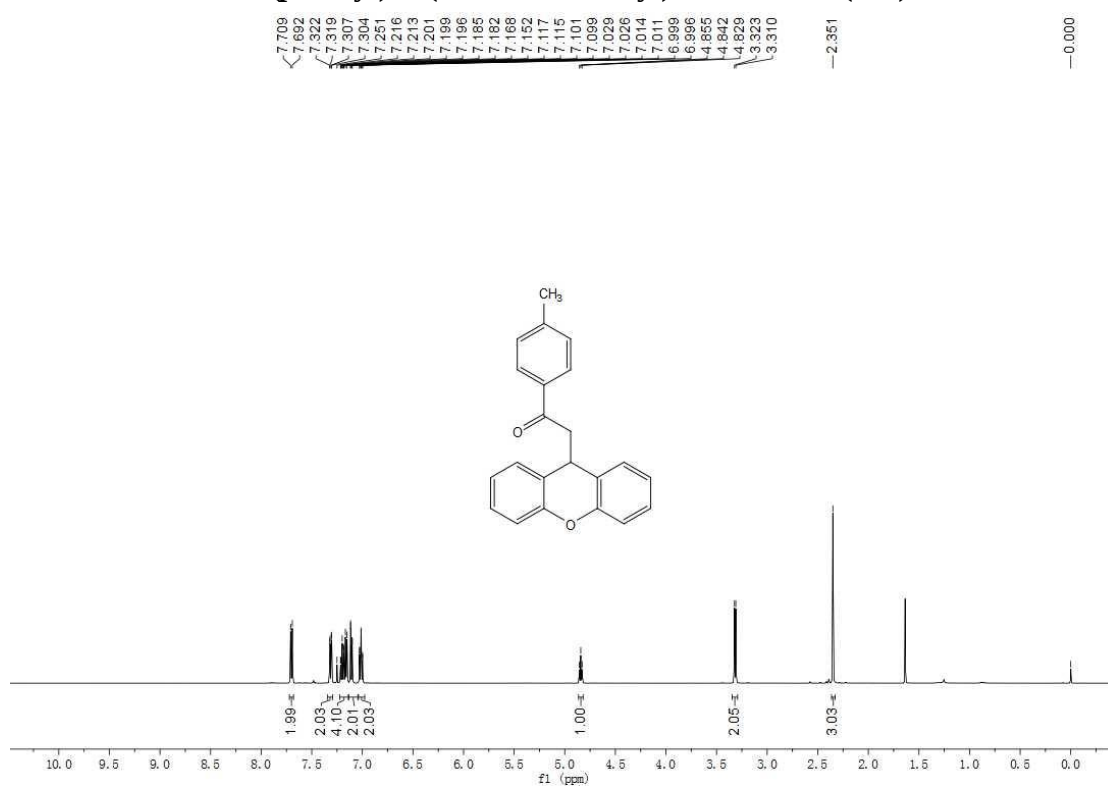
5-(9H-Xanthen-9-yl)cyclopent-2-en-1-one (3ap)



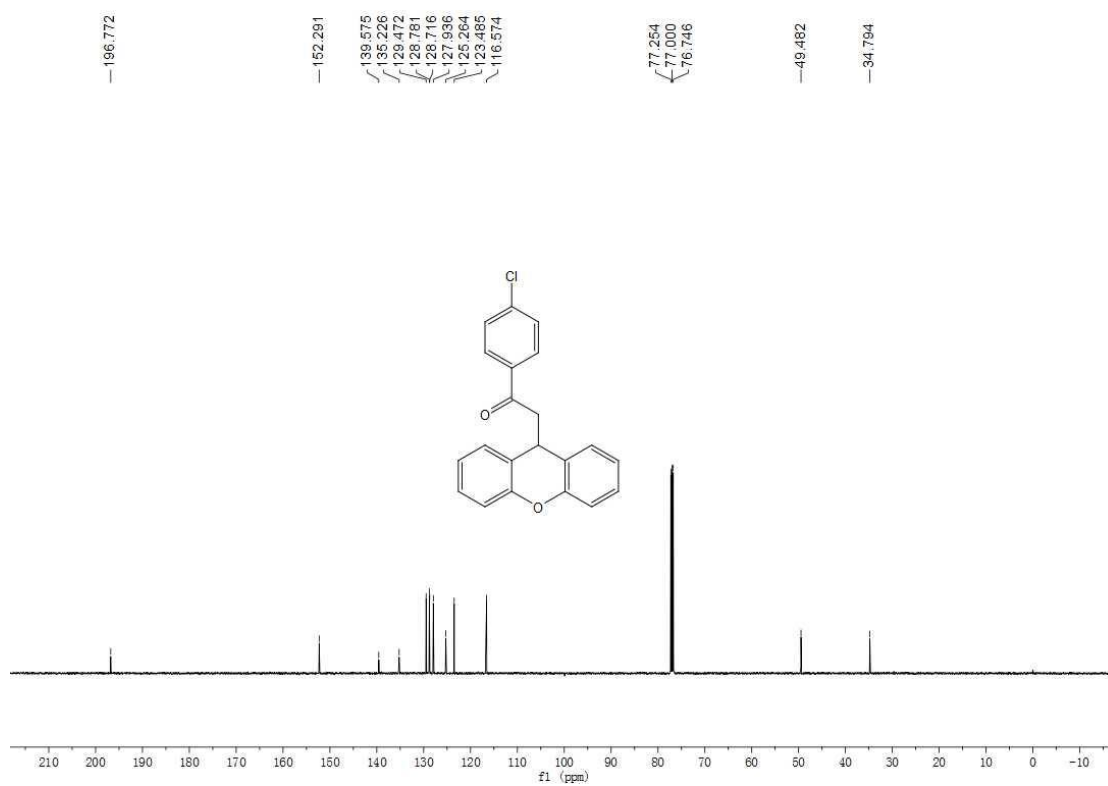
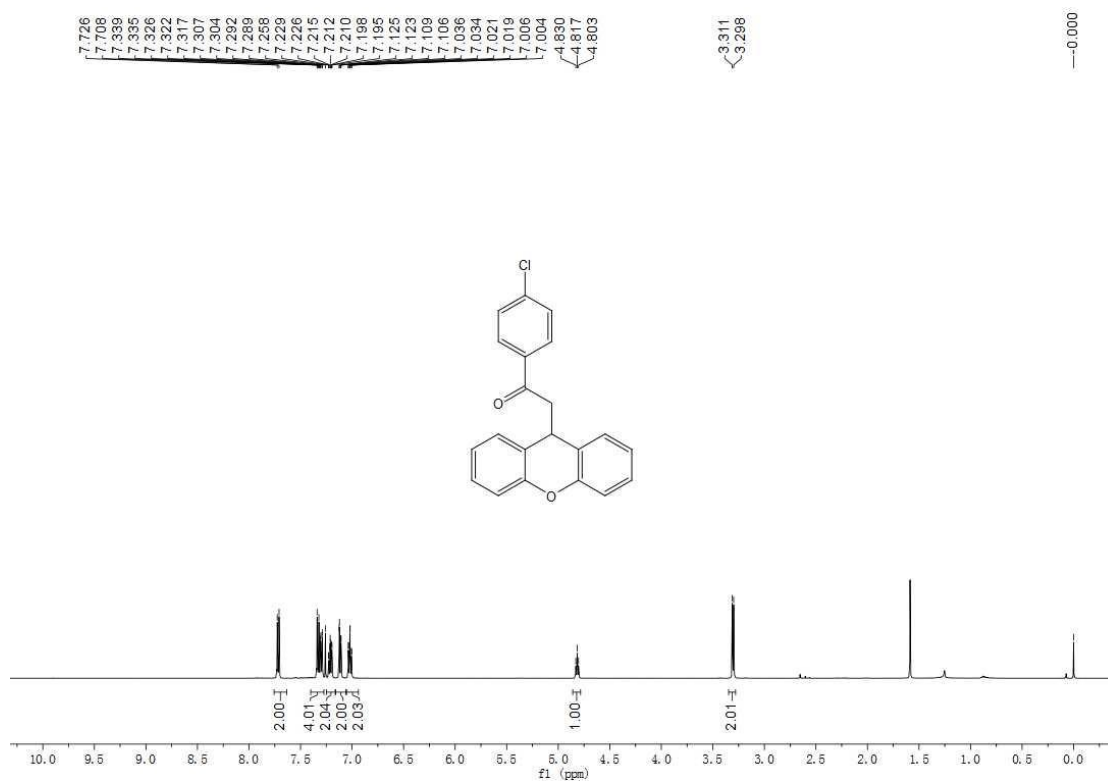
6-(9H-Xanthen-9-yl)cyclohex-2-en-1-one (3aq)



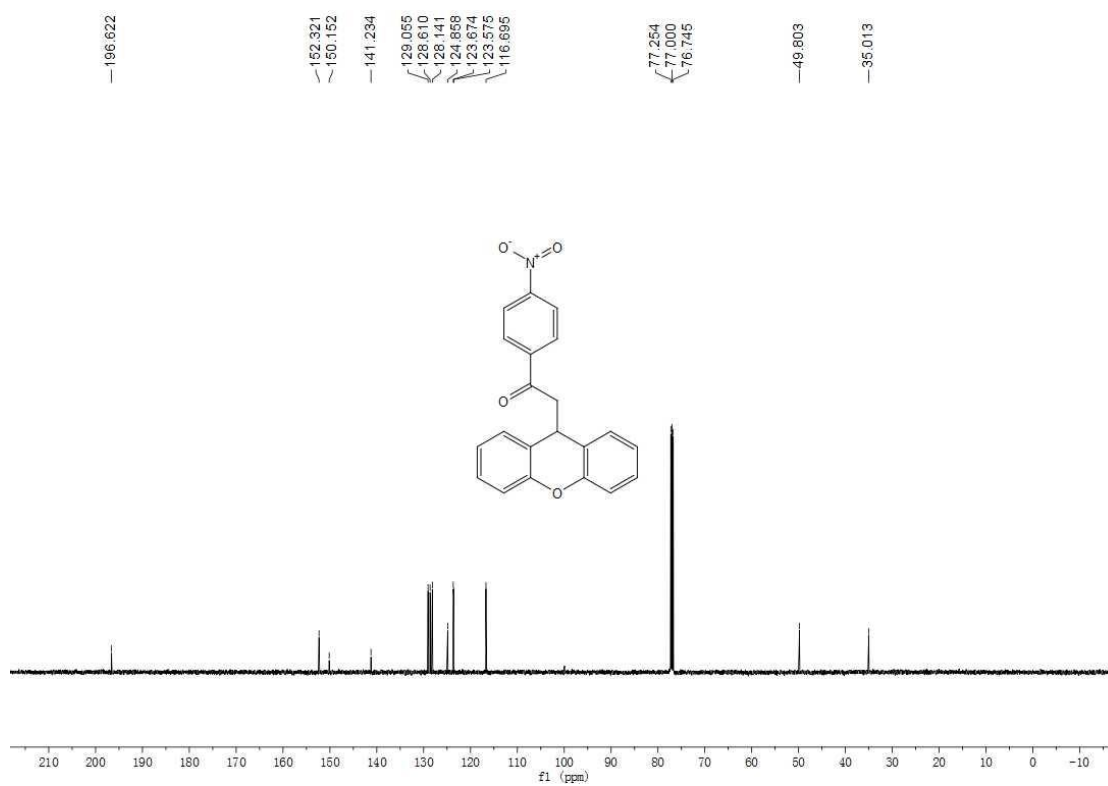
1-(*p*-Tolyl)-2-(9*H*-xanthen-9-yl)ethan-1-one (3ar)



1-(4-Chlorophenyl)-2-(9H-xanthen-9-yl)ethan-1-one (3as)



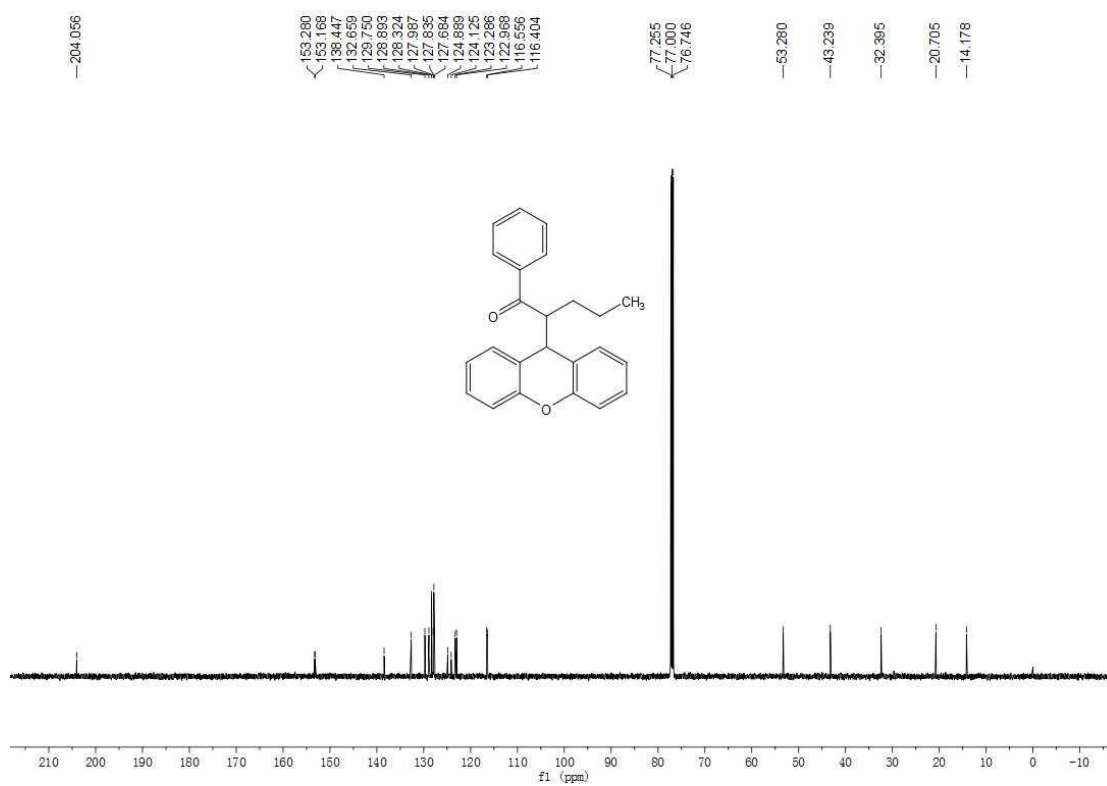
1-(4-Nitrophenyl)-2-(9H-xanthen-9-yl)ethan-1-one (3at)



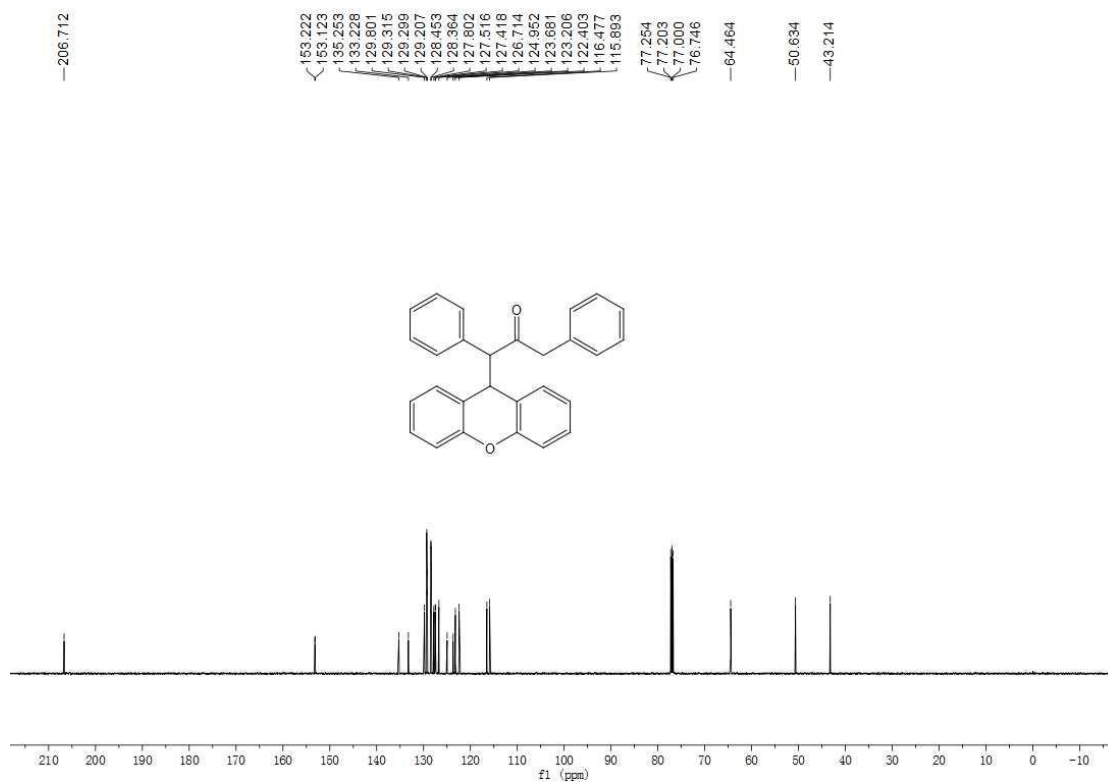
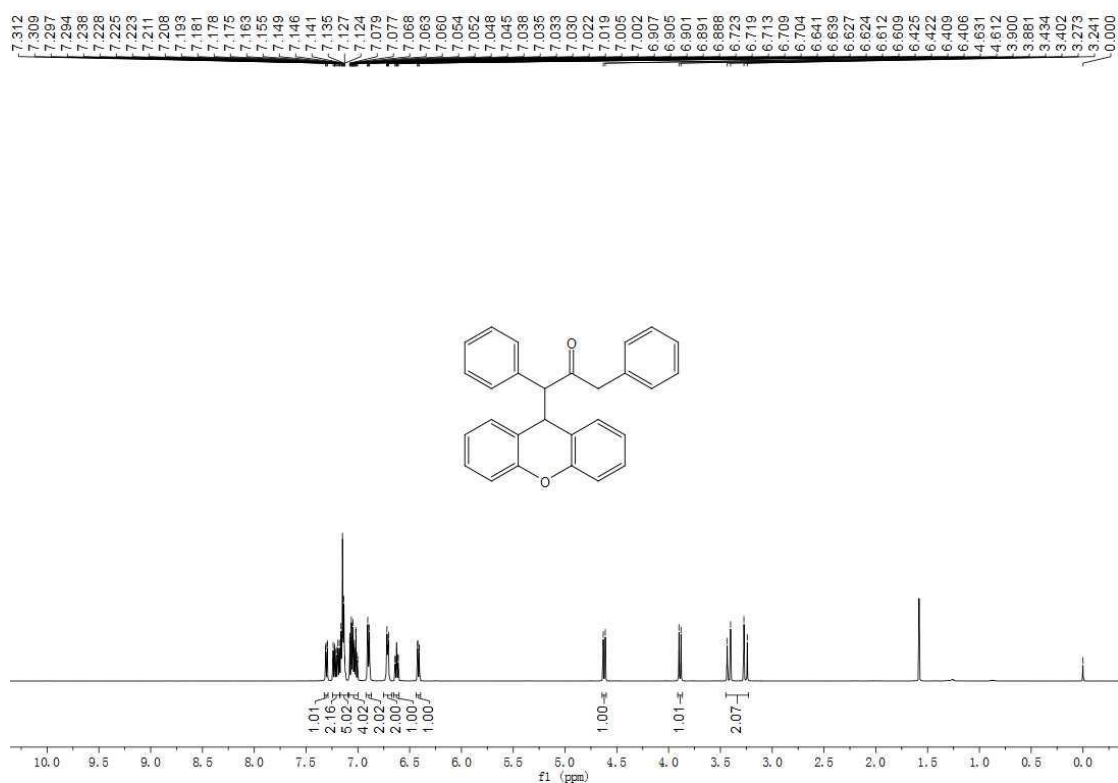
Chemical structure: CC(C(=O)c1ccccc1)C2c3ccccc3Oc4ccccc24

¹H NMR spectrum (CDCl₃) showing peaks from 0.00 to 7.64 ppm. Integration values are provided below the peaks.

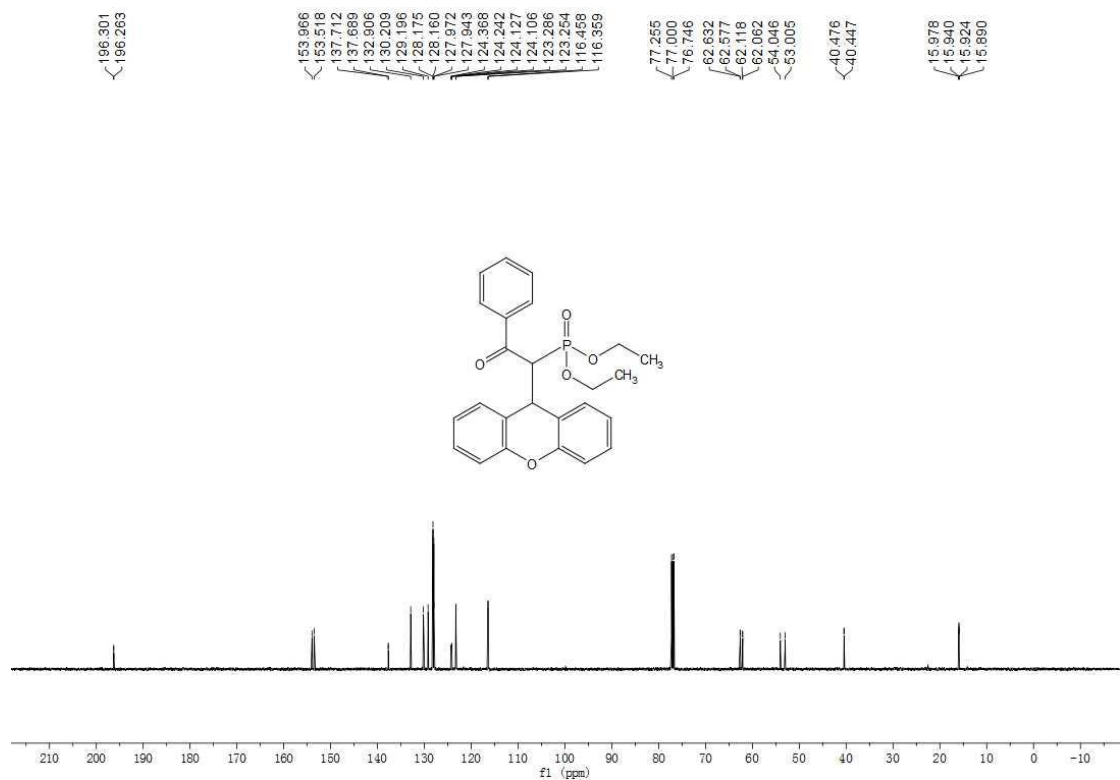
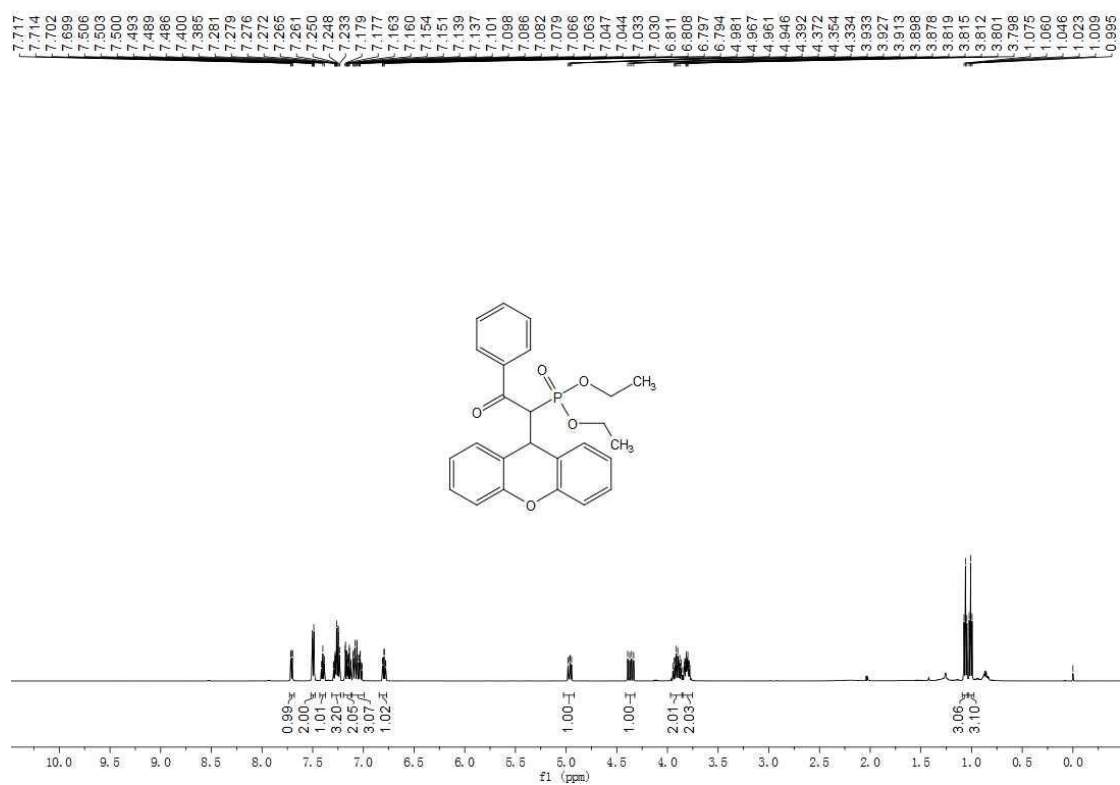
Chemical Shift (ppm)	Integration
7.640	2.01
7.636	1.03
7.624	2.00
7.611	2.00
7.595	1.00
7.465	1.00
7.440	1.00
7.438	2.18
7.426	2.18
7.423	1.01
7.325	1.01
7.322	1.01
7.310	1.01
7.298	1.01
7.294	1.01
7.277	1.01
7.274	1.01
7.262	1.01
7.258	1.01
7.246	1.01
7.243	1.01
7.192	1.01
7.190	1.01
7.176	1.01
7.145	1.01
7.142	1.01
7.128	1.01
7.125	1.01
7.113	1.01
7.110	1.01
7.098	1.01
7.084	1.01
7.078	1.01
7.072	1.01
7.067	1.01
7.064	1.01
6.850	1.01
6.851	1.01
6.847	1.01
6.843	1.01
6.840	1.01
6.837	1.01
6.831	1.01
6.826	1.01
4.272	1.00
4.271	1.00
3.671	1.00
3.664	1.00
3.654	1.00
3.647	1.00
3.643	1.00
3.638	1.00
3.635	1.00
3.632	1.00
3.629	1.00
3.626	1.00
3.623	1.00
3.620	1.00
3.617	1.00
3.614	1.00
3.611	1.00
3.608	1.00
3.605	1.00
3.602	1.00
3.599	1.00
3.596	1.00
3.593	1.00
3.590	1.00
3.587	1.00
3.584	1.00
3.581	1.00
3.578	1.00
3.575	1.00
3.572	1.00
3.569	1.00
3.566	1.00
3.563	1.00
3.560	1.00
3.557	1.00
3.554	1.00
3.551	1.00
3.548	1.00
3.545	1.00
3.542	1.00
3.539	1.00
3.536	1.00
3.533	1.00
3.530	1.00
3.527	1.00
3.524	1.00
3.521	1.00
3.518	1.00
3.515	1.00
3.512	1.00
3.509	1.00
3.506	1.00
3.503	1.00
3.500	1.00
3.497	1.00
3.494	1.00
3.491	1.00
3.488	1.00
3.485	1.00
3.482	1.00
3.479	1.00
3.476	1.00
3.473	1.00
3.470	1.00
3.467	1.00
3.464	1.00
3.461	1.00
3.458	1.00
3.455	1.00
3.452	1.00
3.449	1.00
3.446	1.00
3.443	1.00
3.440	1.00
3.437	1.00
3.434	1.00
3.431	1.00
3.428	1.00
3.425	1.00
3.422	1.00
3.419	1.00
3.416	1.00
3.413	1.00
3.410	1.00
3.407	1.00
3.404	1.00
3.401	1.00
3.398	1.00
3.395	1.00
3.392	1.00
3.389	1.00
3.386	1.00
3.383	1.00
3.380	1.00
3.377	1.00
3.374	1.00
3.371	1.00
3.368	1.00
3.365	1.00
3.362	1.00
3.359	1.00
3.356	1.00
3.353	1.00
3.350	1.00
3.347	1.00
3.344	1.00
3.341	1.00
3.338	1.00
3.335	1.00
3.332	1.00
3.329	1.00
3.326	1.00
3.323	1.00
3.320	1.00
3.317	1.00
3.314	1.00
3.311	1.00
3.308	1.00
3.305	1.00
3.302	1.00
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3.296	1.00
3.293	1.00
3.290	1.00
3.287	1.00
3.284	



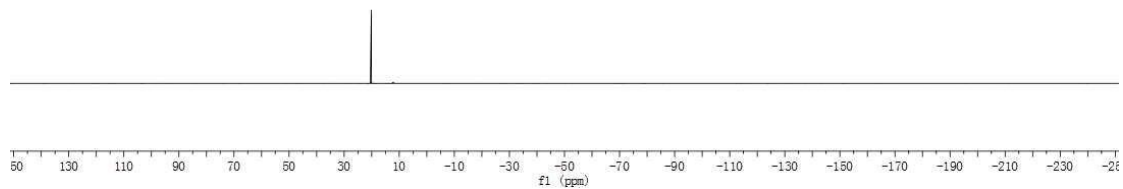
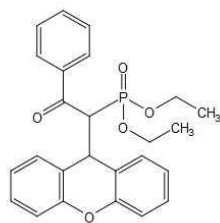
1,3-Diphenyl-1-(9H-xanthen-9-yl)propan-2-one (3av)



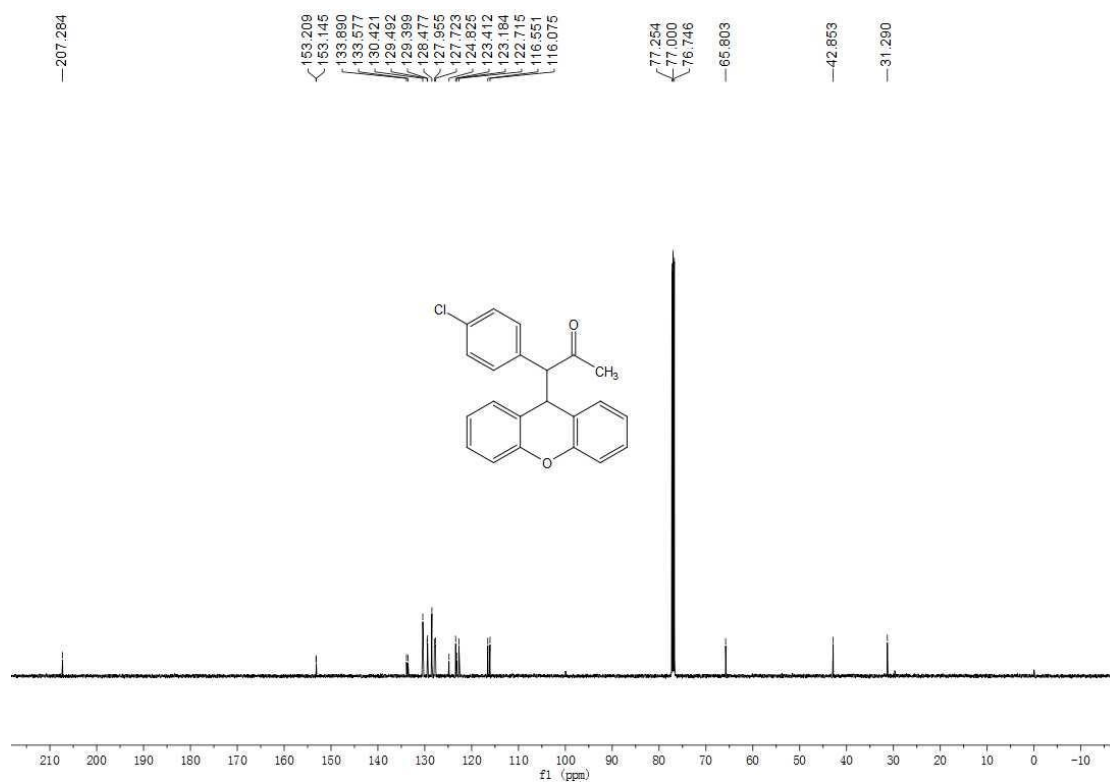
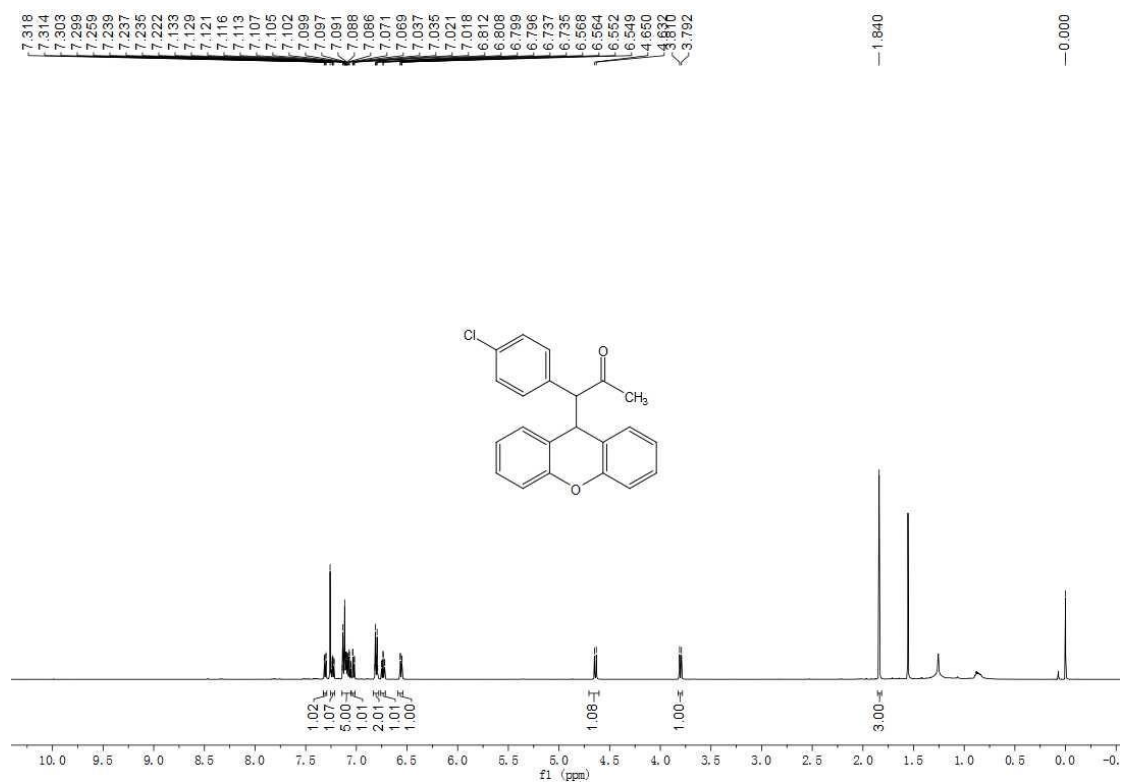
Diethyl (2-oxo-2-phenyl-1-(9H-xanthen-9-yl)ethyl)phosphonate (3aw)



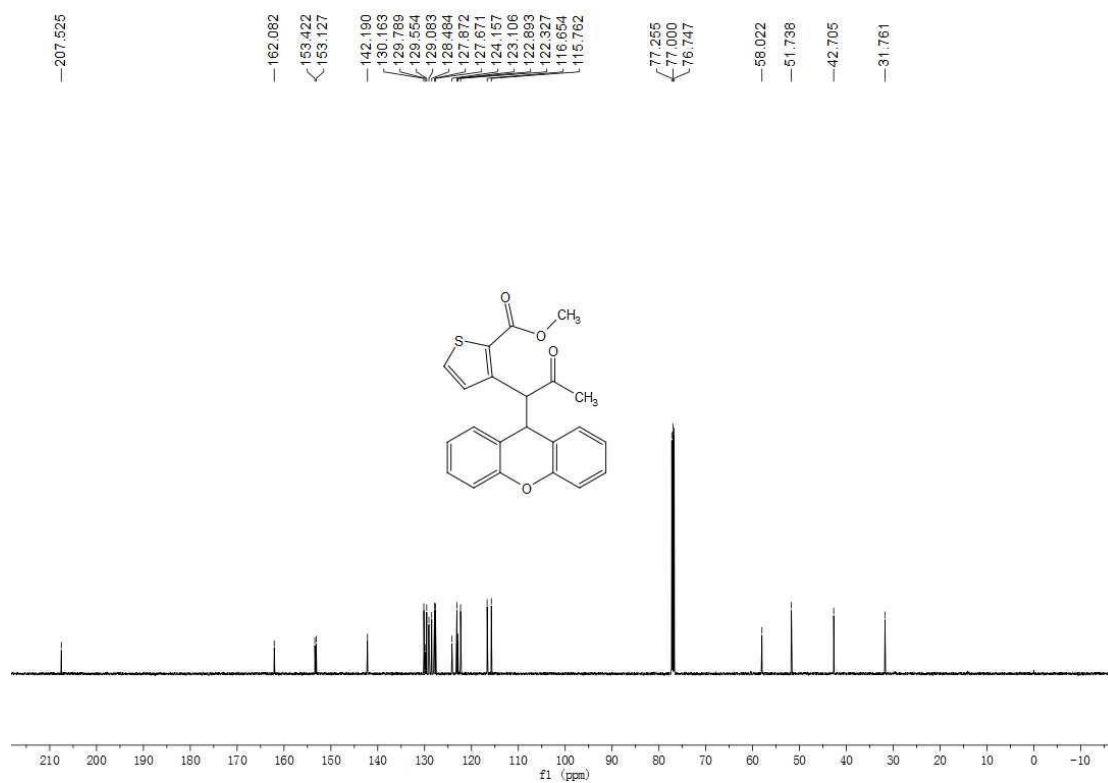
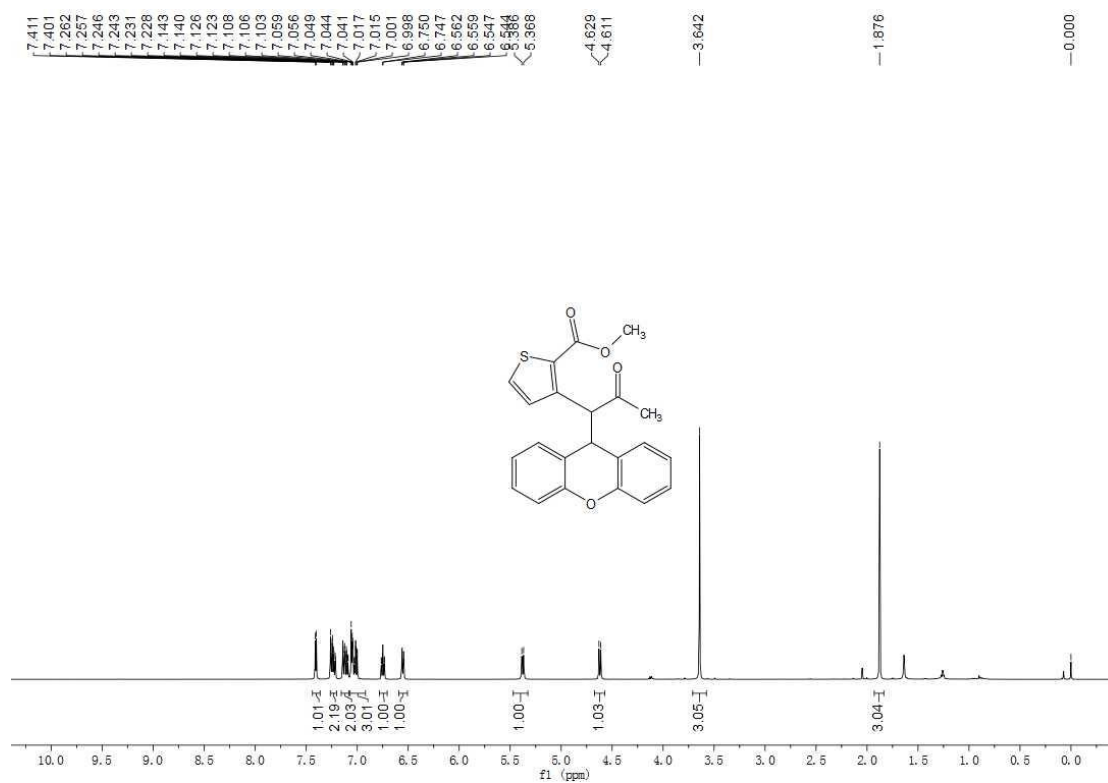
-20.162



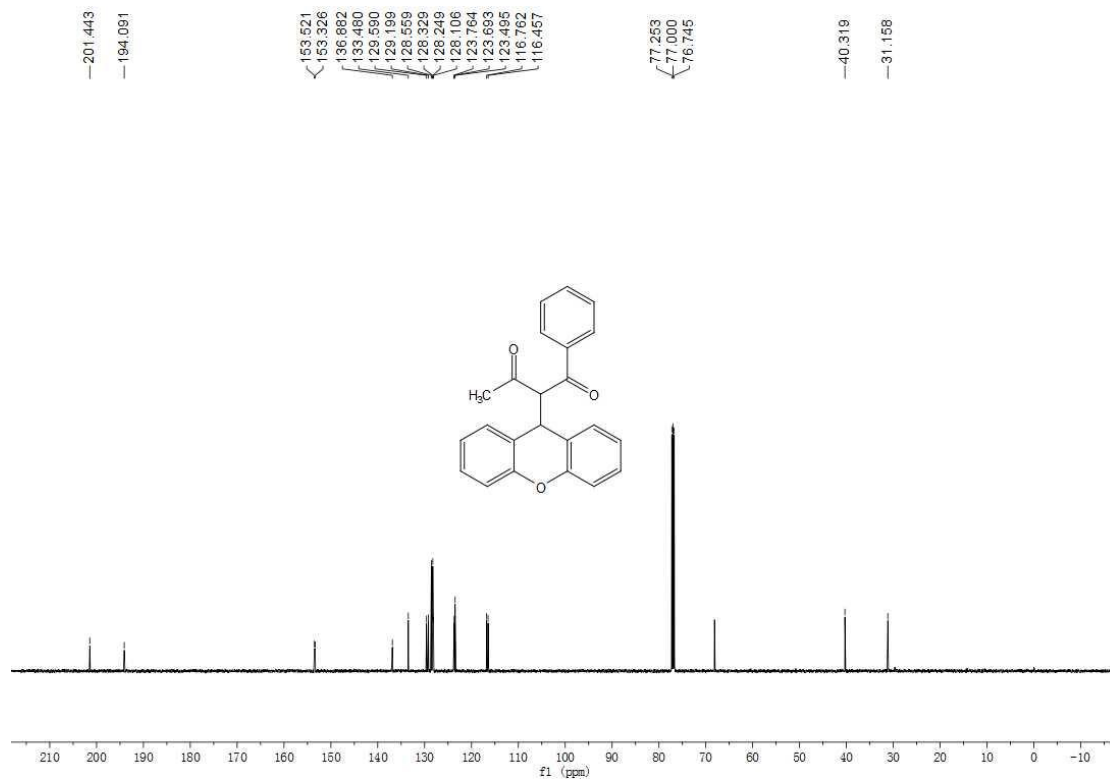
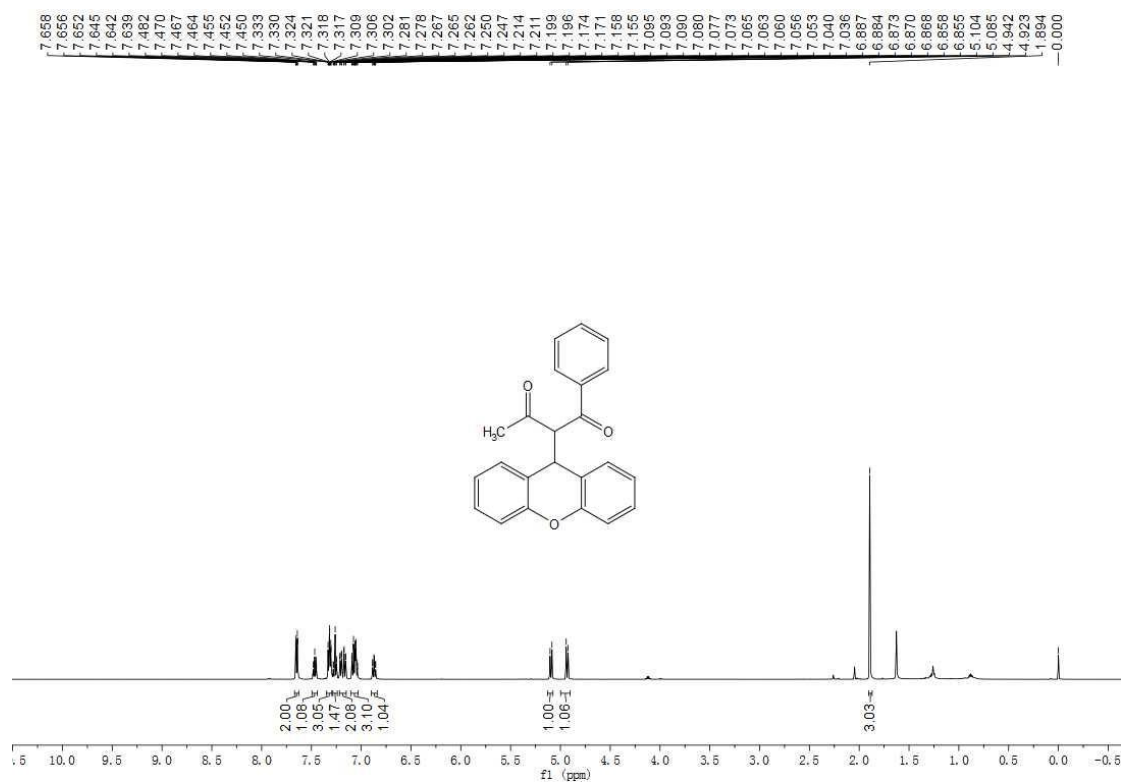
1-(4-Chlorophenyl)-1-(9H-xanthen-9-yl)propan-2-one (3ax)



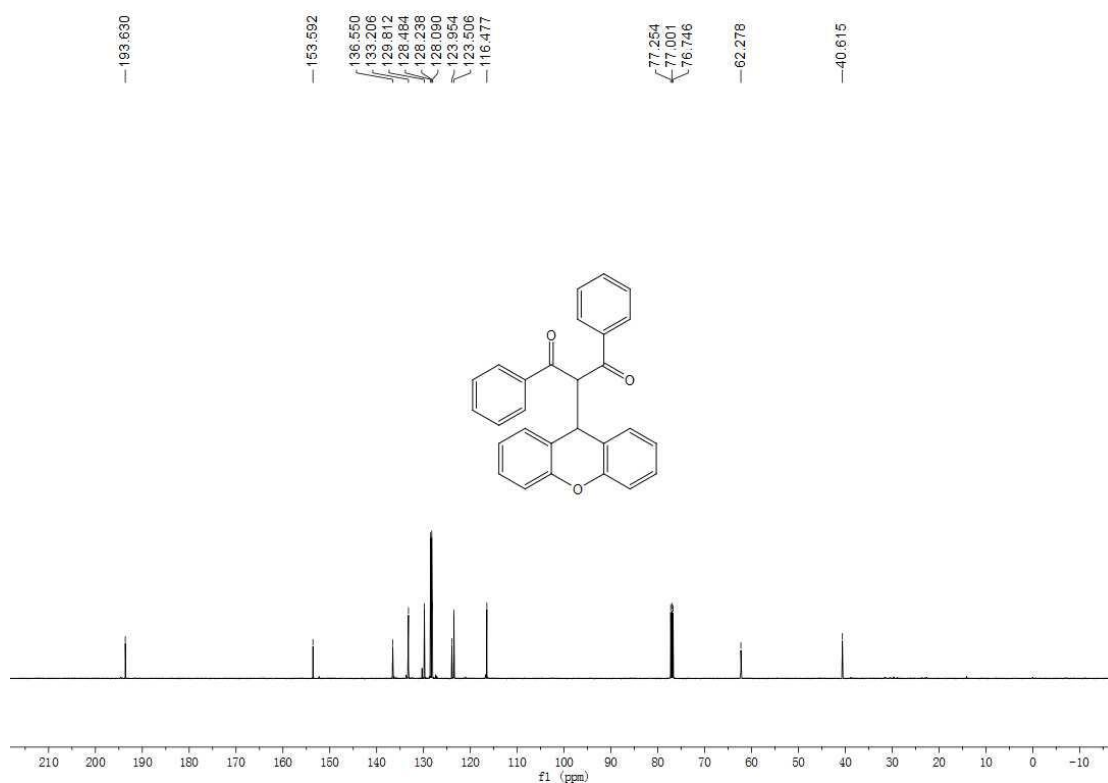
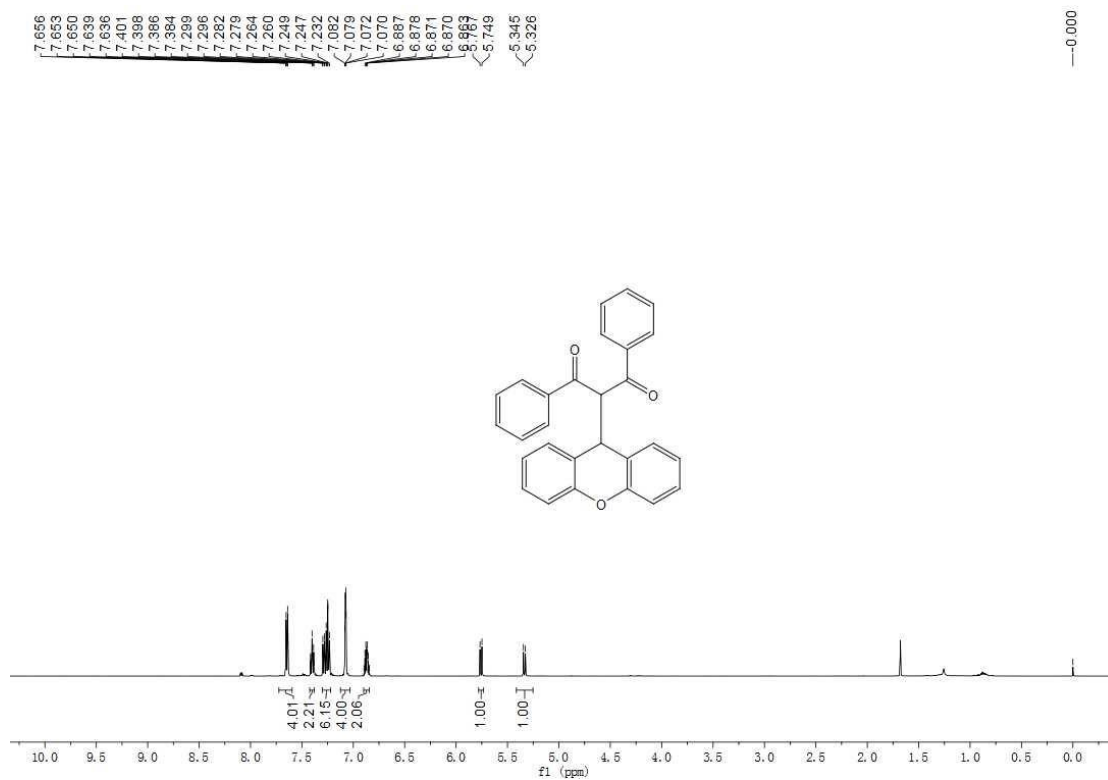
Methyl 3-(2-oxo-1-(9H-xanthen-9-yl)propyl)thiophene-2-carboxylate (3ay)



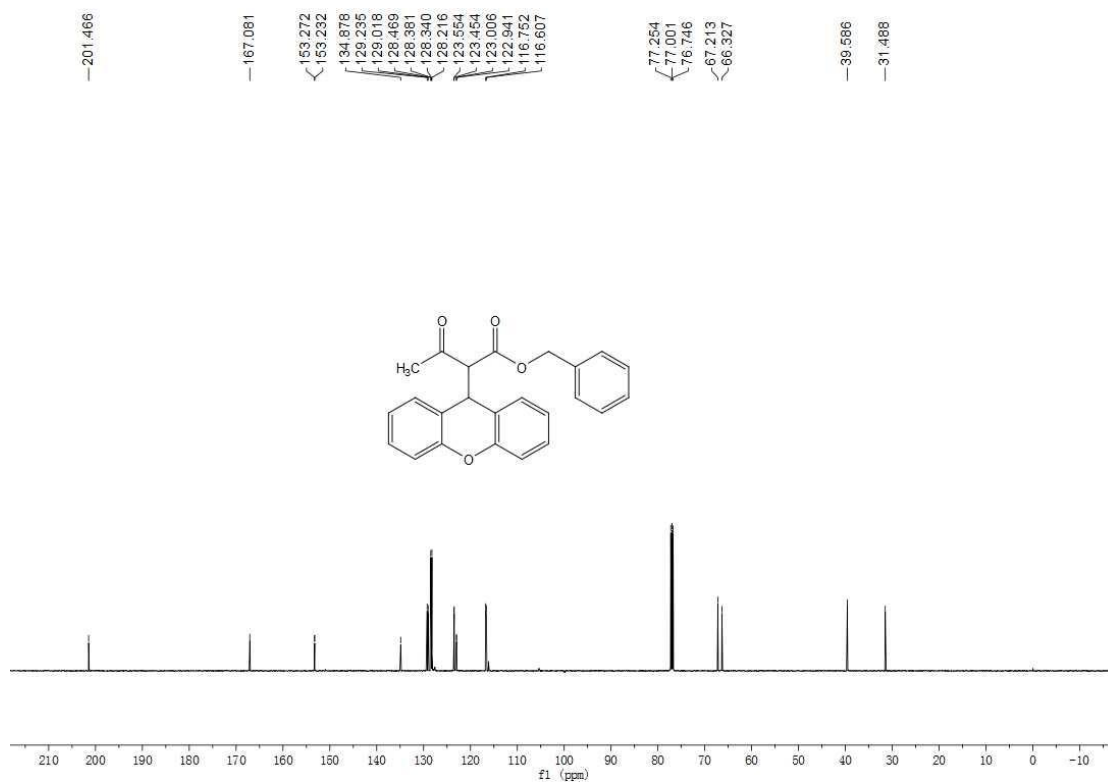
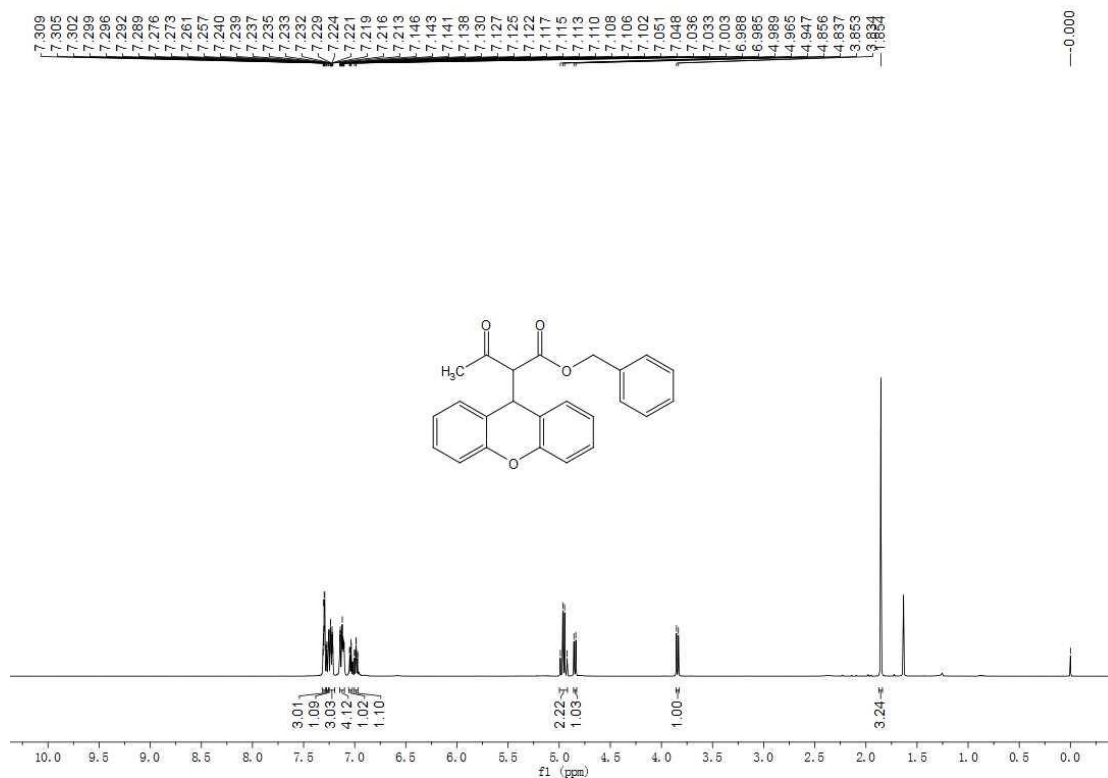
1-Phenyl-2-(9H-xanthen-9-yl)butane-1,3-dione (3az)



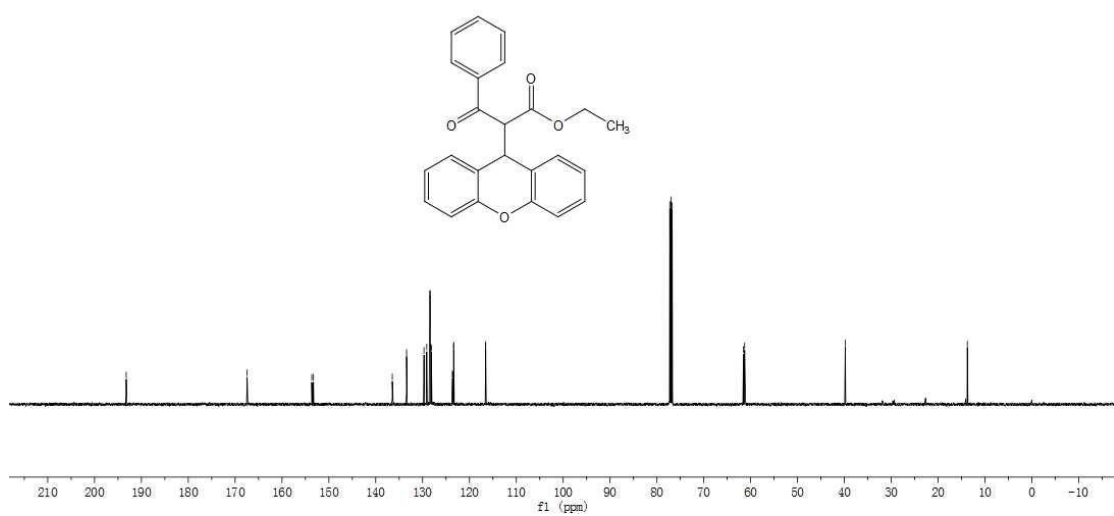
1,3-Diphenyl-2-(9H-xanthen-9-yl)propane-1,3-dione (3aA)



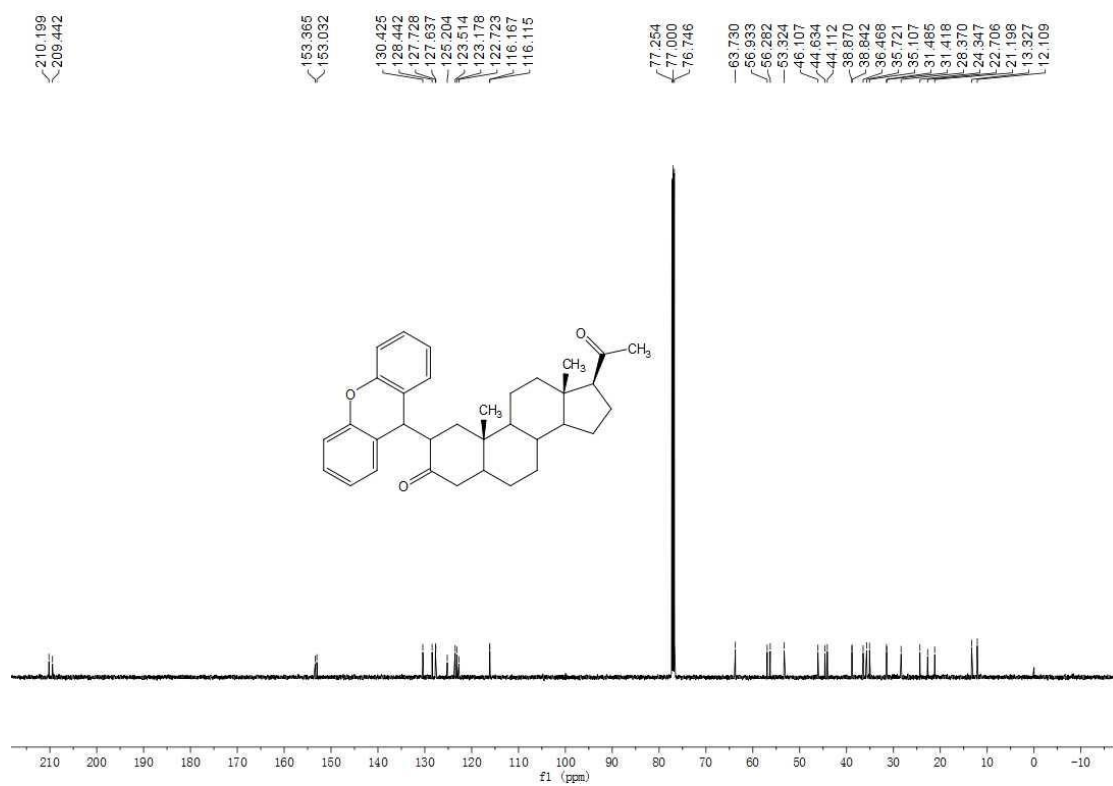
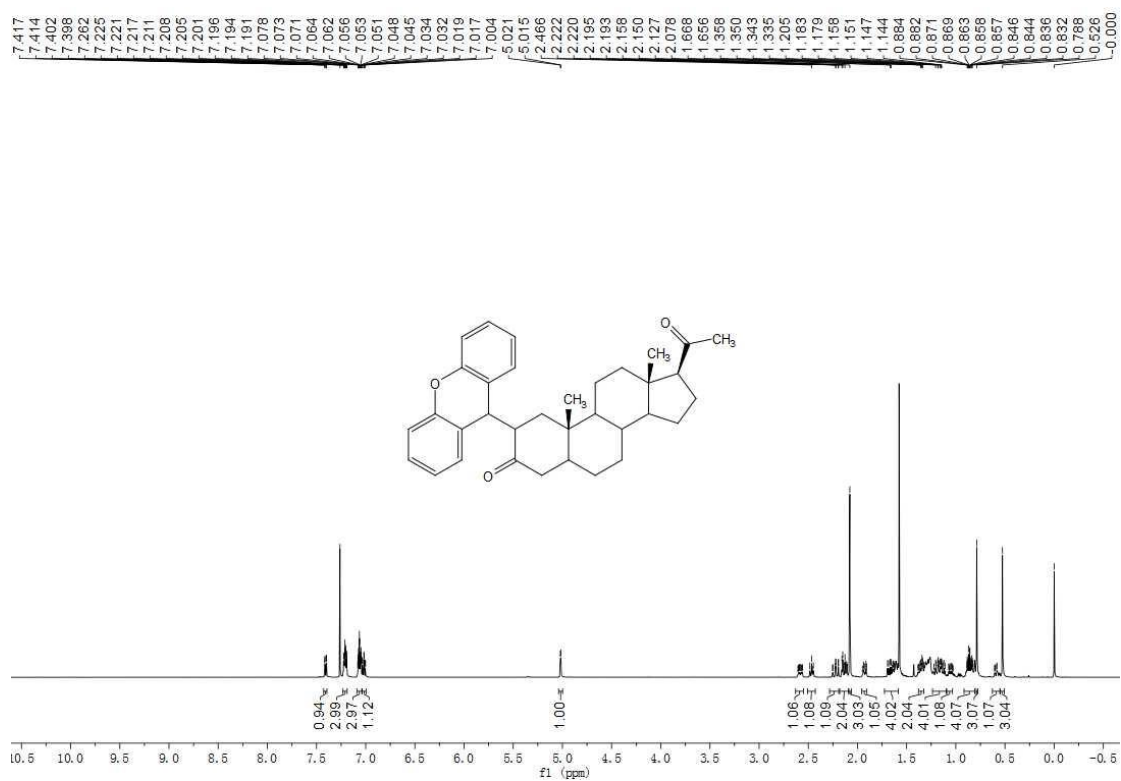
Benzyl 3-oxo-2-(9H-xanthen-9-yl)butanoate (3aB)



7.756	7.753	7.750	7.747	7.744	7.741	7.738	7.735	7.732	7.729	7.726	7.723	7.720	7.717	7.714	7.711	7.708	7.705	7.702	7.699	7.696	7.693	7.690	7.687	7.684	7.681	7.678	7.675	7.672	7.669	7.666	7.663	7.660	7.657	7.654	7.651	7.648	7.645	7.642	7.639	7.636	7.633	7.630	7.627	7.624	7.621	7.618	7.615	7.612	7.609	7.606	7.603	7.600	7.597	7.594	7.591	7.588	7.585	7.582	7.579	7.576	7.573	7.570	7.567	7.564	7.561	7.558	7.555	7.552	7.549	7.546	7.543	7.540	7.537	7.534	7.531	7.528	7.525	7.522	7.519	7.516	7.513	7.510	7.507	7.504	7.501	7.498	7.495	7.492	7.489	7.486	7.483	7.480	7.477	7.474	7.471	7.468	7.465	7.462	7.459	7.456	7.453	7.450	7.447	7.444	7.441	7.438	7.435	7.432	7.429	7.426	7.423	7.420	7.417	7.414	7.411	7.408	7.405	7.402	7.399	7.396	7.393	7.390	7.387	7.384	7.381	7.378	7.375	7.372	7.369	7.366	7.363	7.360	7.357	7.354	7.351	7.348	7.345	7.342	7.339	7.336	7.333	7.330	7.327	7.324	7.321	7.318	7.315	7.312	7.309	7.306	7.303	7.300	7.297	7.294	7.291	7.288	7.285	7.282	7.279	7.276	7.273	7.270	7.267	7.264	7.261	7.258	7.255	7.252	7.249	7.246	7.243	7.240	7.237	7.234	7.231	7.228	7.225	7.222	7.219	7.216	7.213	7.210	7.207	7.204	7.201	7.198	7.195	7.192	7.189	7.186	7.183	7.180	7.177	7.174	7.171	7.168	7.165	7.162	7.159	7.156	7.153	7.150	7.147	7.144	7.141	7.138	7.135	7.132	7.129	7.126	7.123	7.120	7.117	7.114	7.111	7.108	7.105	7.102	7.099	7.096	7.093	7.090	7.087	7.084	7.081	7.078	7.075	7.072	7.069	7.066	7.063	7.060	7.057	7.054	7.051	7.048	7.045	7.042	7.039	7.036	7.033	7.030	7.027	7.024	7.021	7.018	7.015	7.012	7.009	7.006	7.003	7.000	6.997	6.994	6.991	6.988	6.985	6.982	6.979	6.976	6.973	6.970	6.967	6.964	6.961	6.958	6.955	6.952	6.949	6.946	6.943	6.940	6.937	6.934	6.931	6.928	6.925	6.922	6.919	6.916	6.913	6.910	6.907	6.904	6.901	6.898	6.895	6.892	6.889	6.886	6.883	6.880	6.877	6.874	6.871	6.868	6.865	6.862	6.859	6.856	6.853	6.850	6.847	6.844	6.841	6.838	6.835	6.832	6.829	6.826	6.823	6.820	6.817	6.814	6.811	6.808	6.805	6.802	6.799	6.796	6.793	6.790	6.787	6.784	6.781	6.778	6.775	6.772	6.769	6.766	6.763	6.760	6.757	6.754	6.751	6.748	6.745	6.742	6.739	6.736	6.733	6.730	6.727	6.724	6.721	6.718	6.715	6.712	6.709	6.706	6.703	6.700	6.697	6.694	6.691	6.688	6.685	6.682	6.679	6.676	6.673	6.670	6.667	6.664	6.661	6.658	6.655	6.652	6.649	6.646	6.643	6.640	6.637	6.634	6.631	6.628	6.625	6.622	6.619	6.616	6.613	6.610	6.607	6.604	6.601	6.598	6.595	6.592	6.589	6.586	6.583	6.580	6.577	6.574	6.571	6.568	6.565	6.562	6.559	6.556	6.553	6.550	6.547	6.544	6.541	6.538	6.535	6.532</
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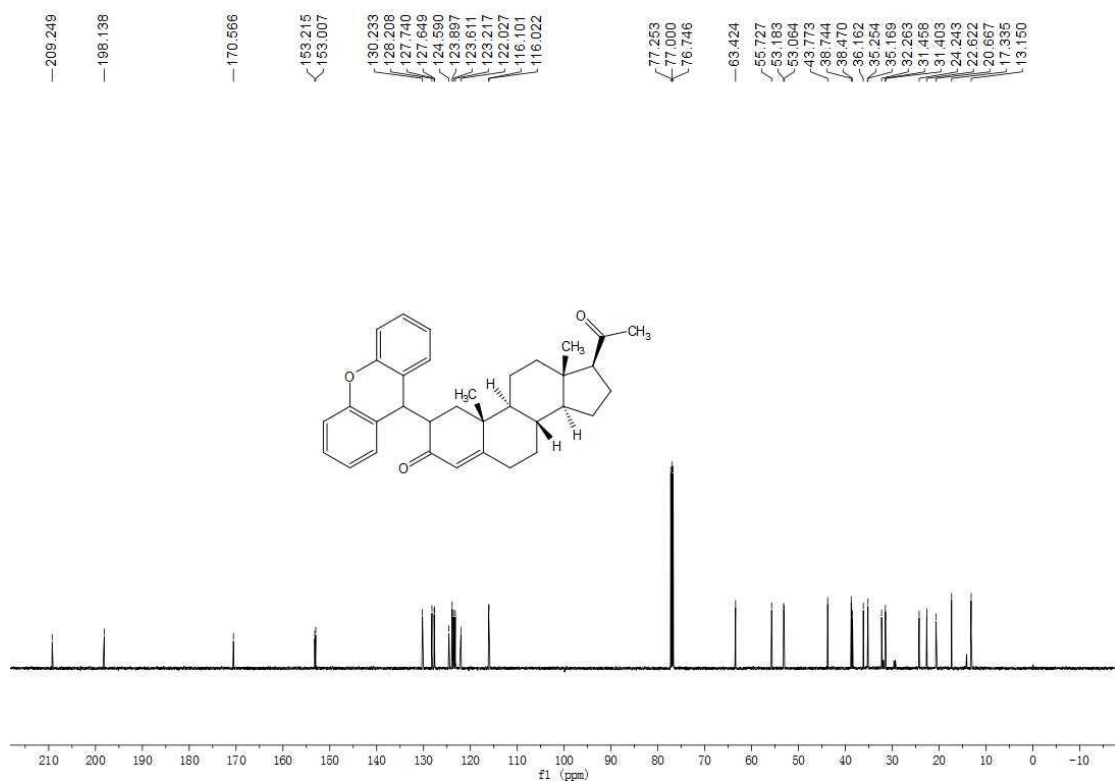
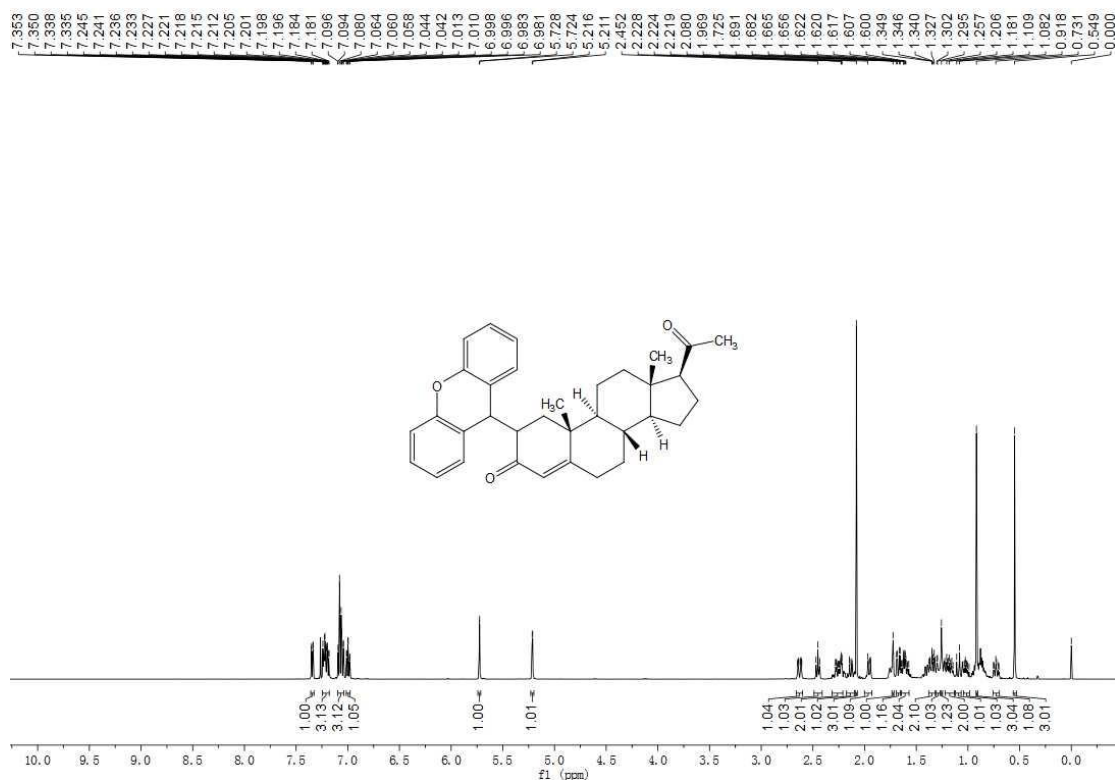
Rac-(10*R*,13*R*,17*R*)-17-acetyl-10,13-dimethyl-2-(9*H*-xanthen-9-yl)hexadecahydro-3*H*-cyclopenta[*a*]phenanthren-3-one (3aD)



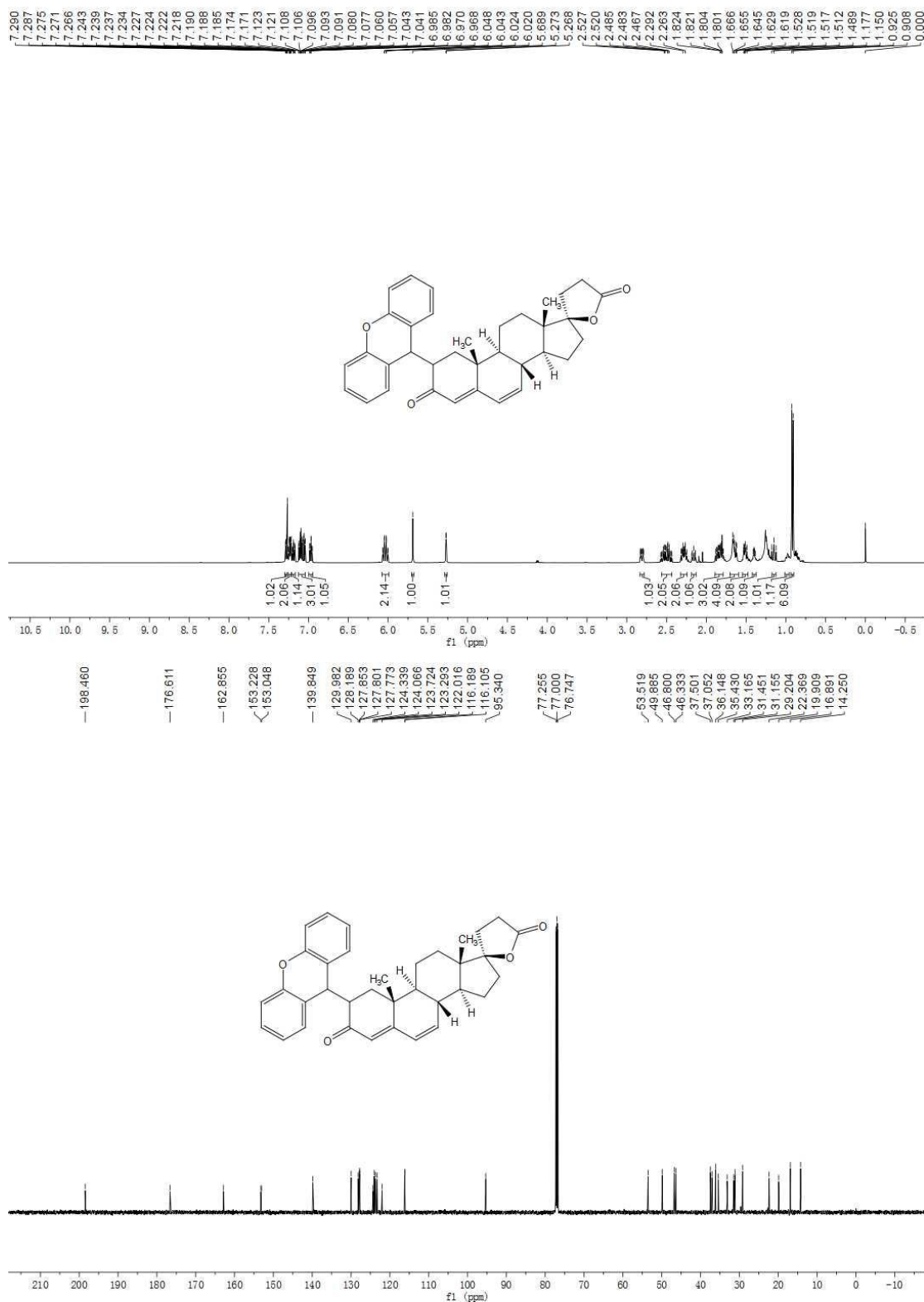
(8*S*,9*S*,10*R*,13*S*,14*S*,17*S*)-17-Acetyl-10,13-dimethyl-2-(9*H*-xanthen-9-yl)-1,2,6,7,8,

9,10,11,12,13,14,15,16,17-tetradecahydro-3*H*-cyclopenta[*a*]phenanthren-3-one

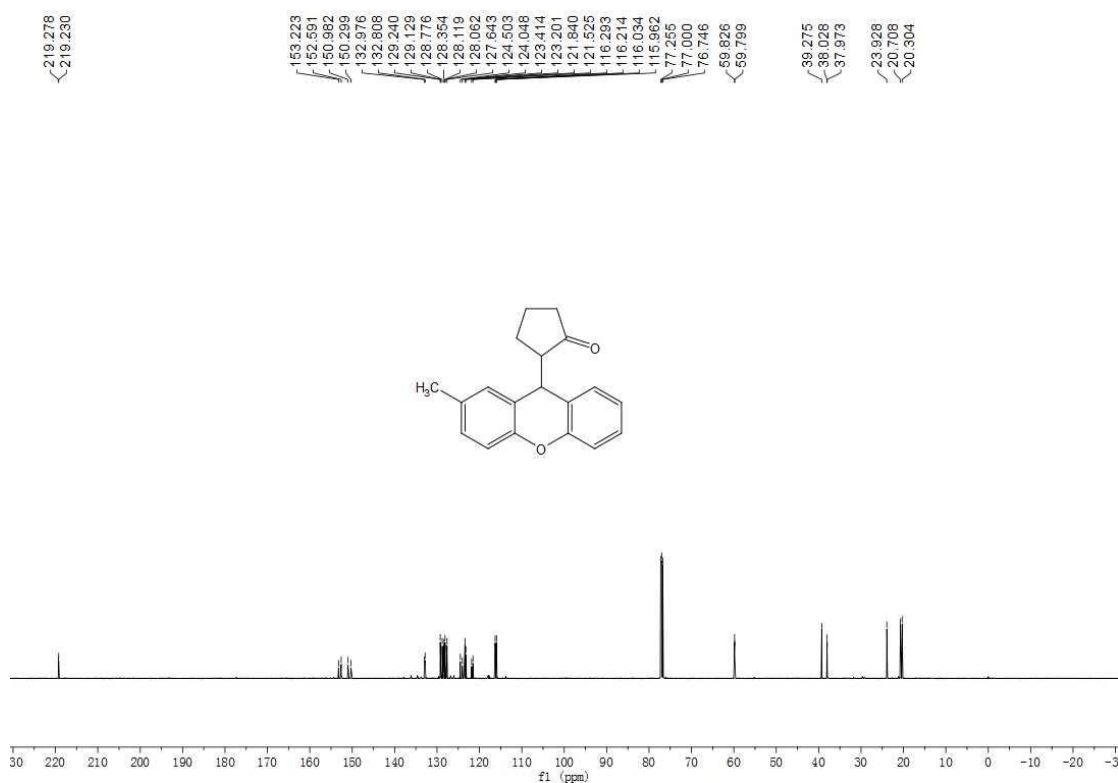
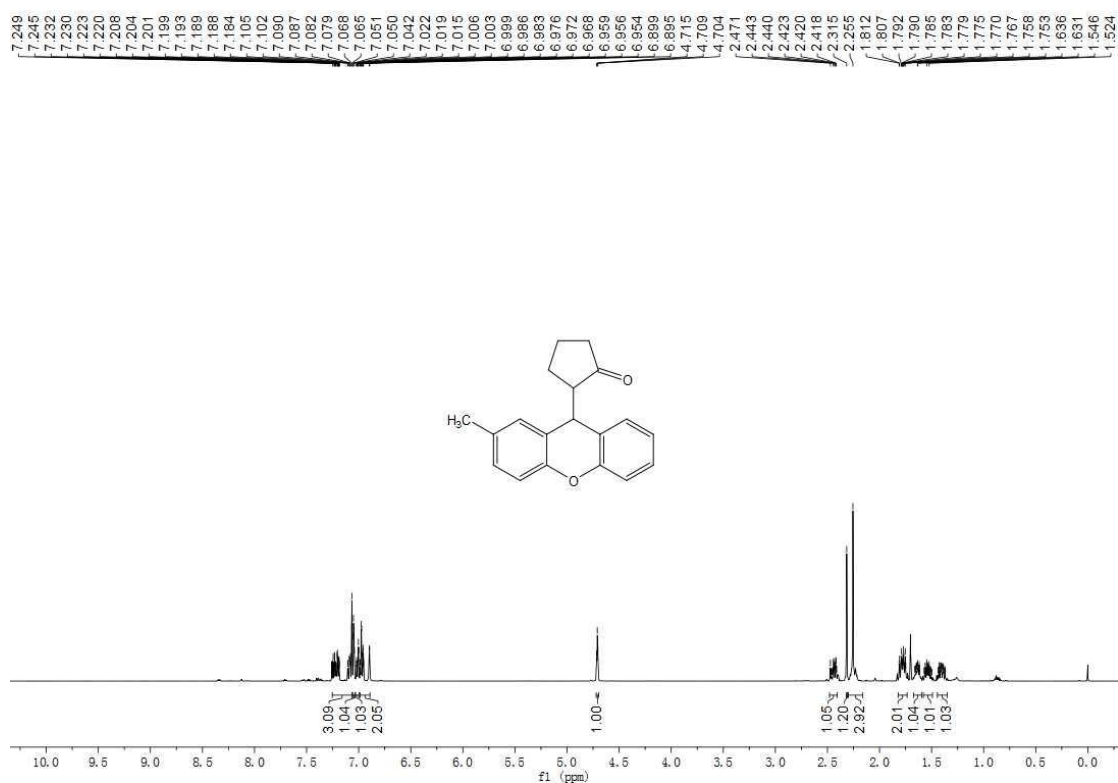
(3aE)



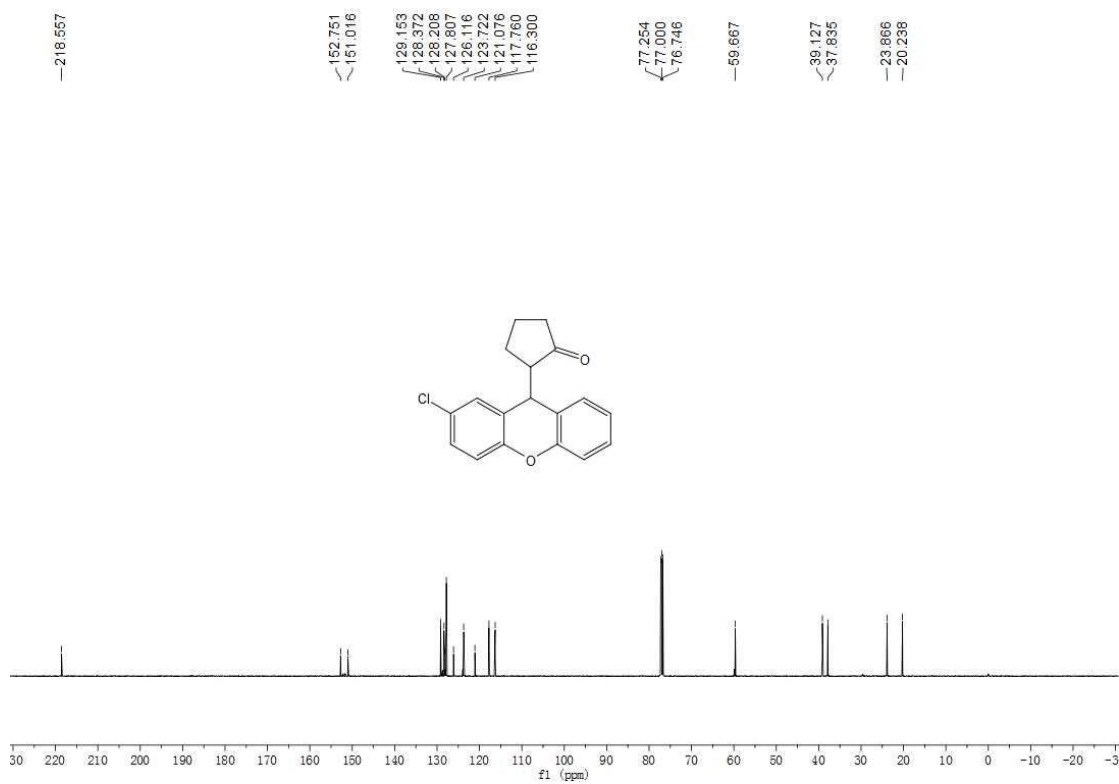
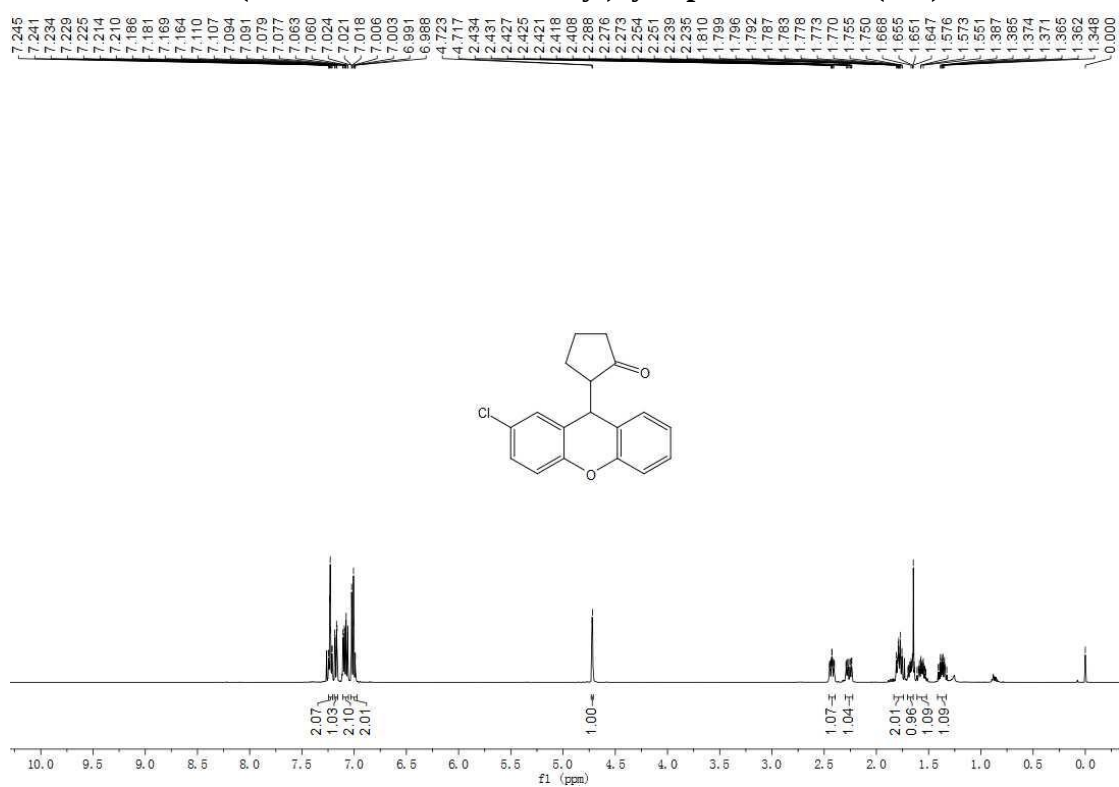
(8R,9S,10R,13S,14S,17R)-10,13-Dimethyl-2-(9H-xanthen-9-yl)-1,3',4',8,9,10,11,12,13,14,15,16-dodecahydro-5'H-spiro[cyclopenta[a]phenanthrene-17,2'-furan]-3,5'-(2H)-dione (3aF)



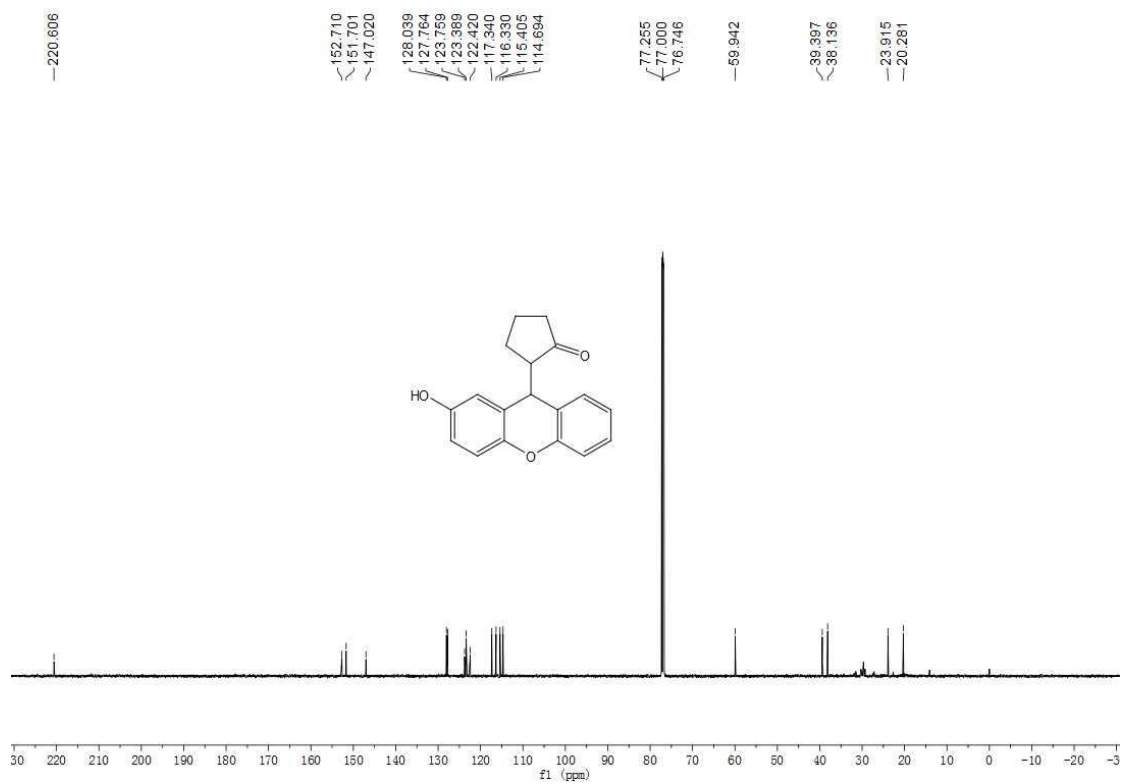
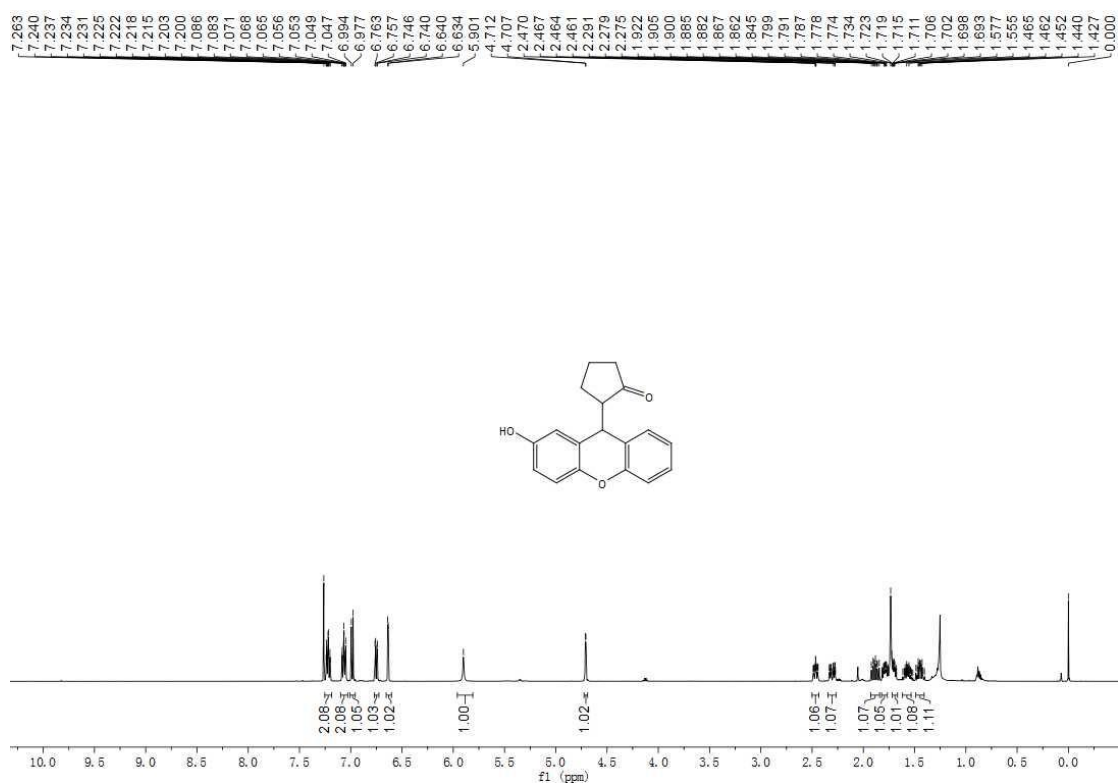
2-(2-Methyl-9H-xanthen-9-yl)cyclopentan-1-one (3ba)



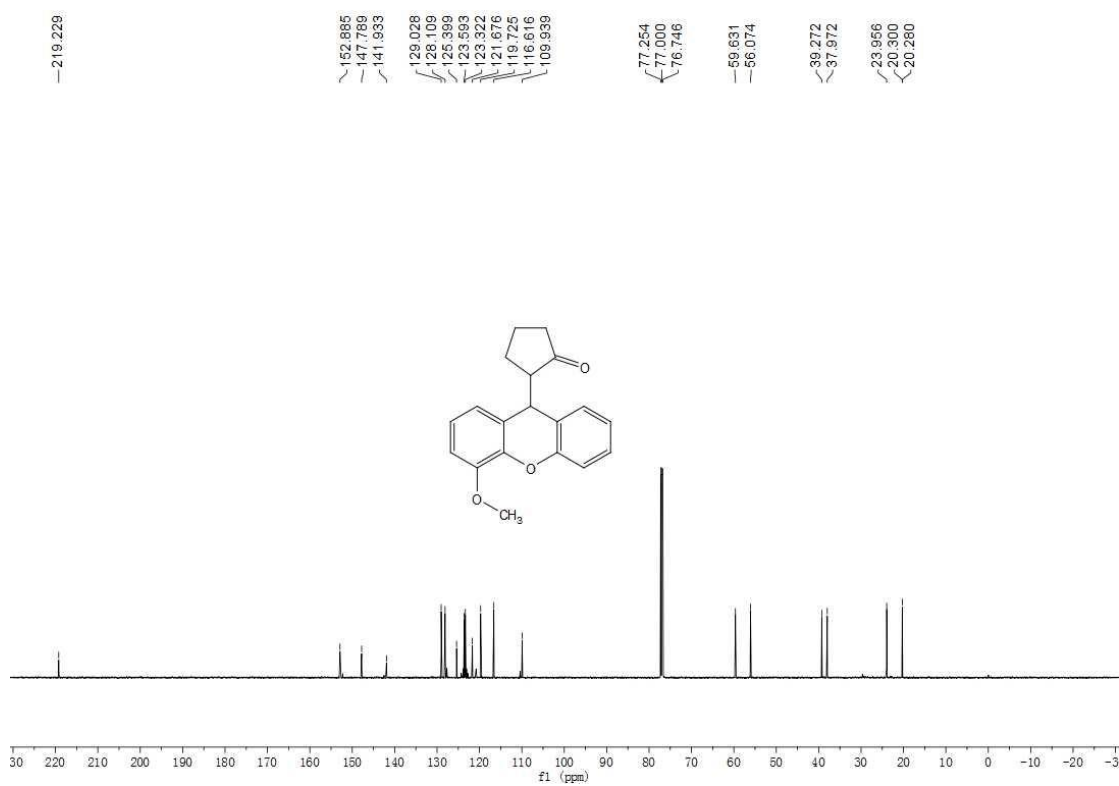
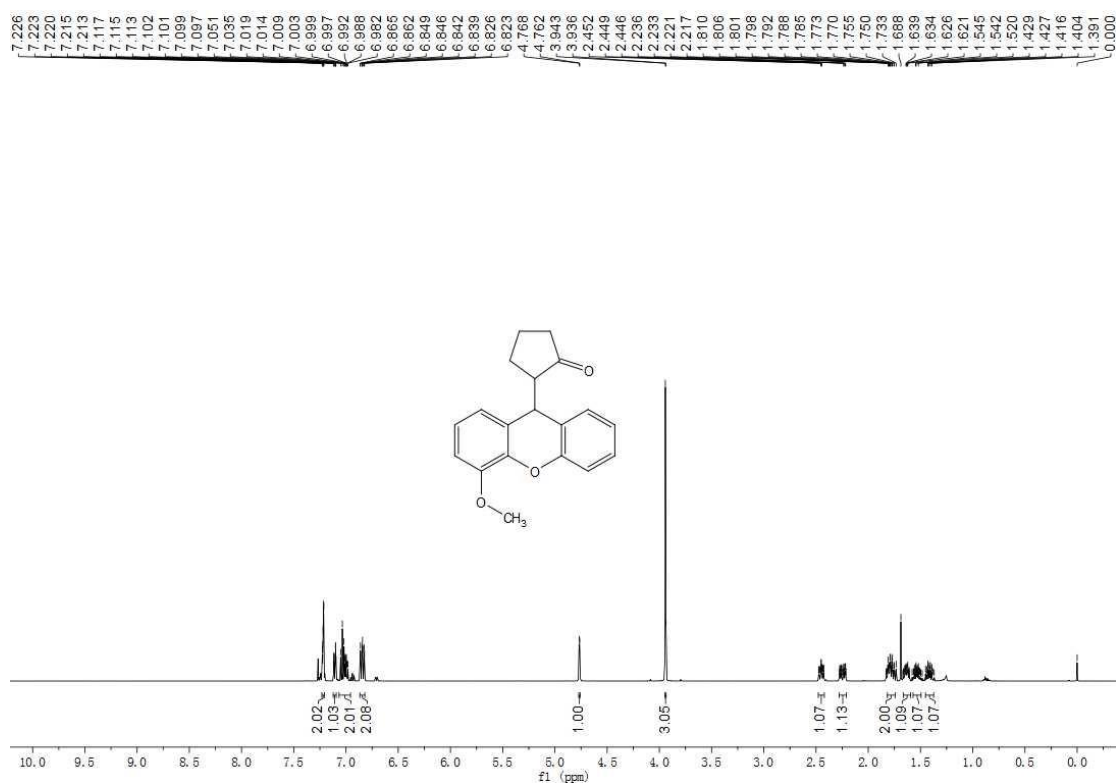
2-(2-Chloro-9H-xanthen-9-yl)cyclopentan-1-one (3ca)



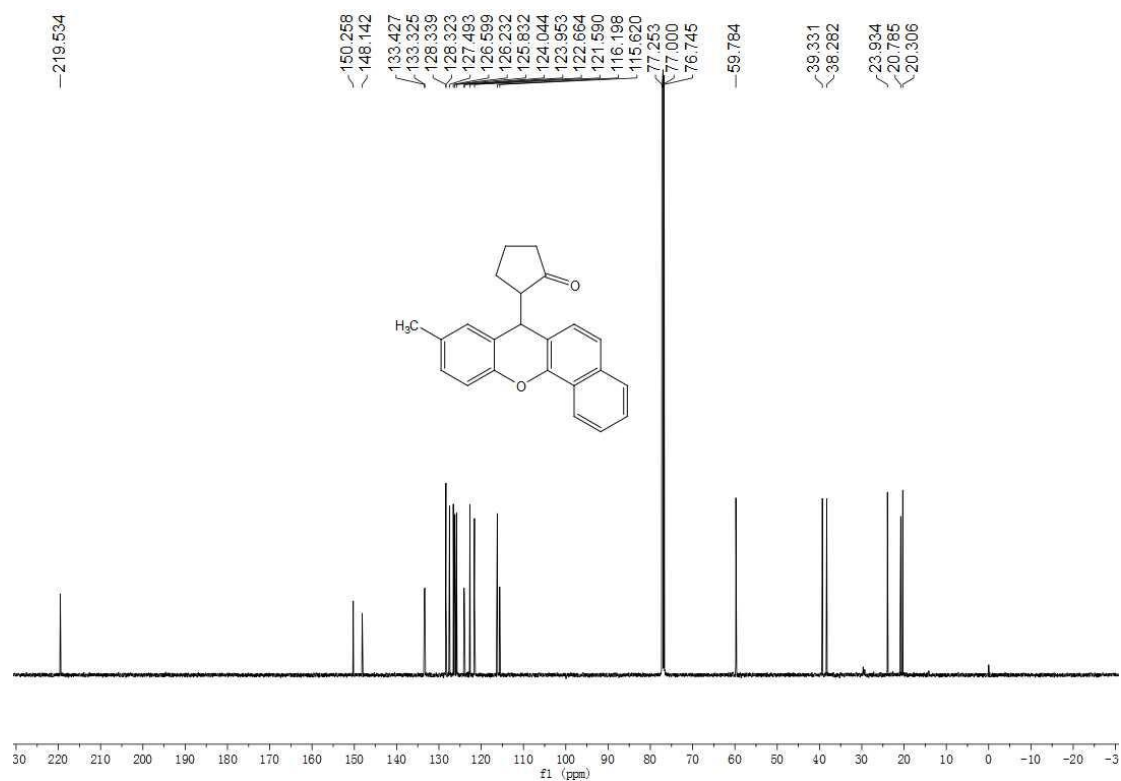
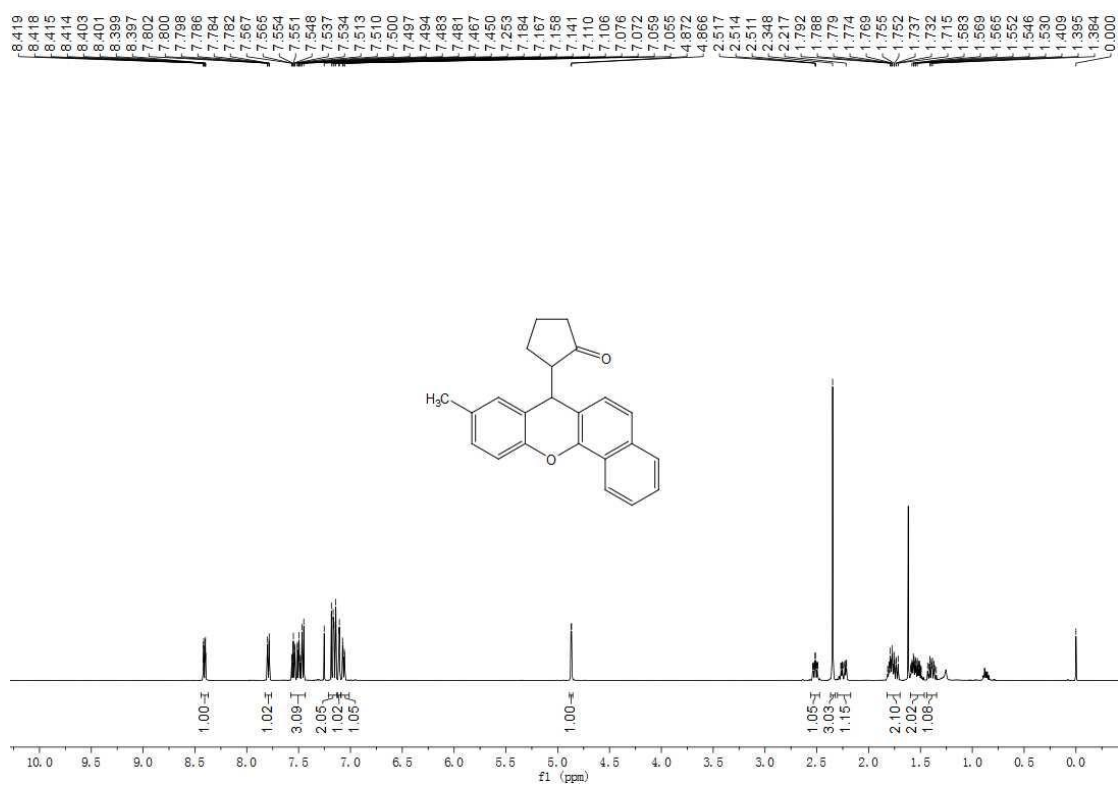
2-(2-Hydroxy-9H-xanthen-9-yl)cyclopentan-1-one (3da)



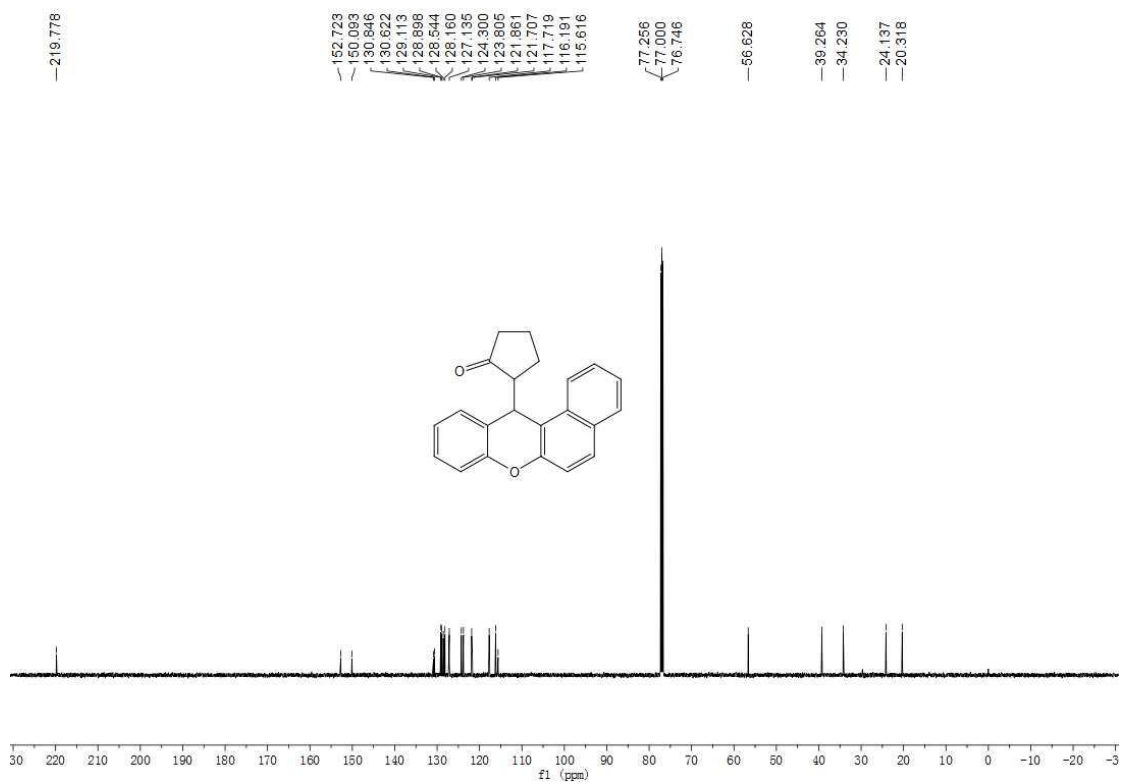
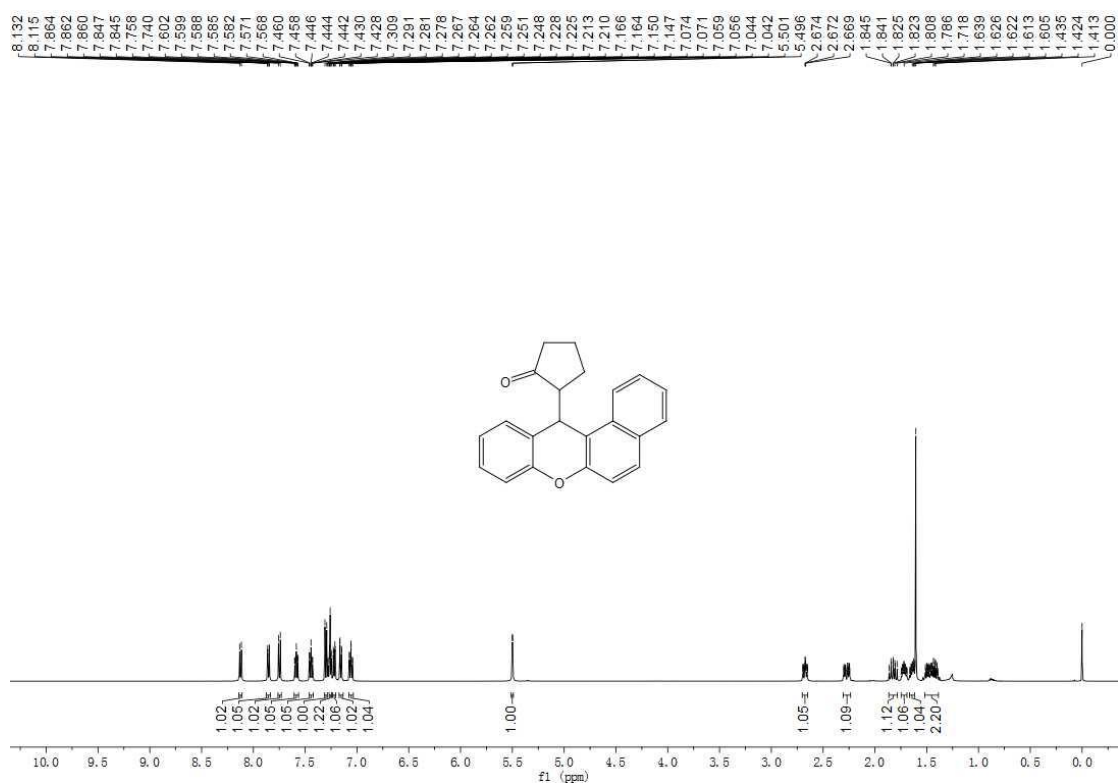
2-(4-Methoxy-9H-xanthen-9-yl)cyclopentan-1-one (3ea)



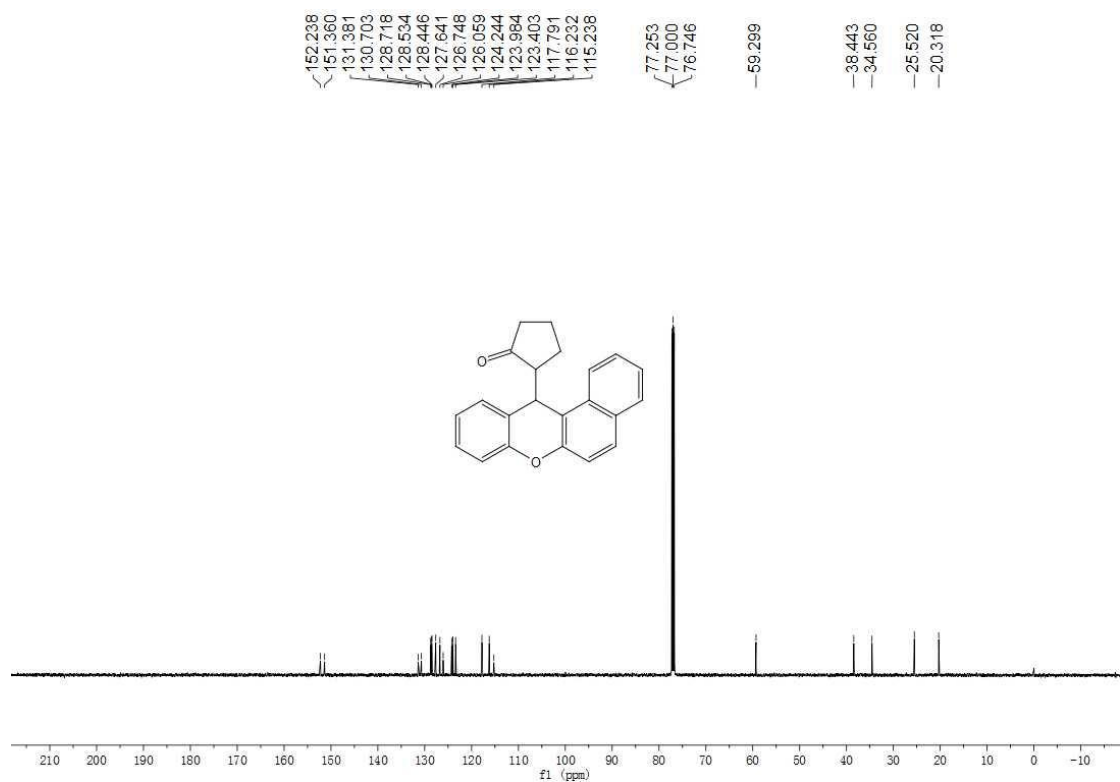
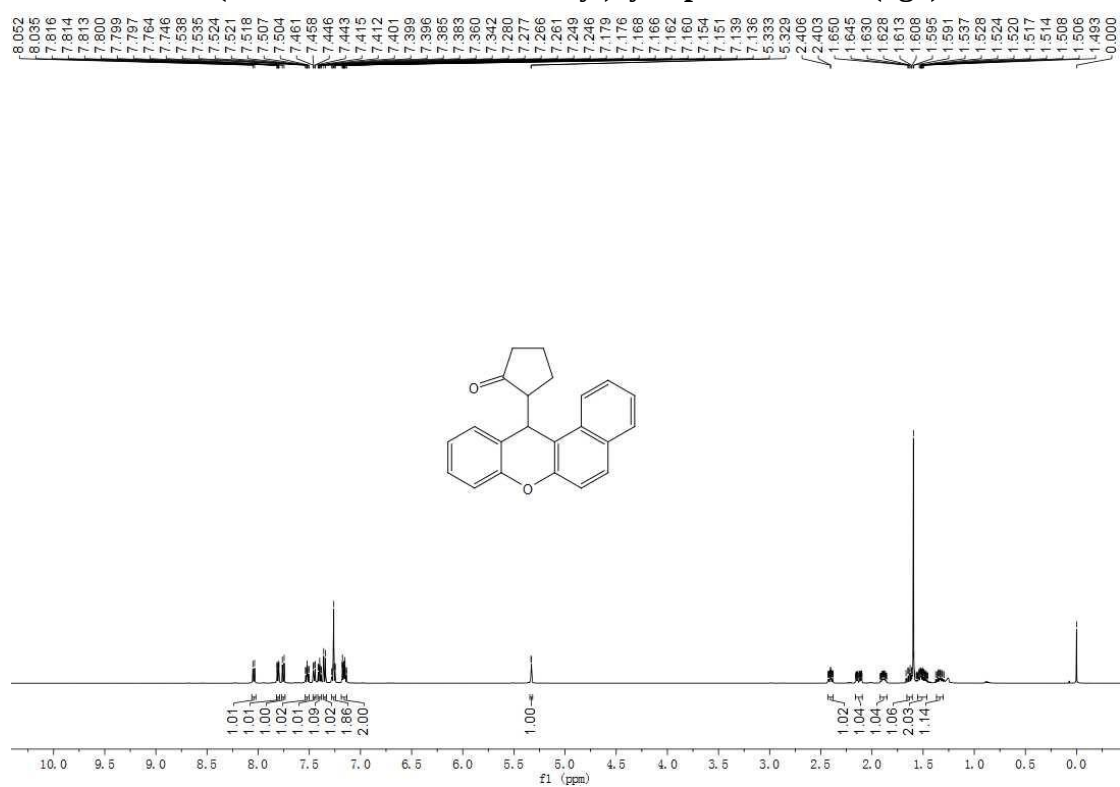
2-(9-Methyl-7H-benzo[c]xanthen-7-yl)cyclopentan-1-one (3fa)



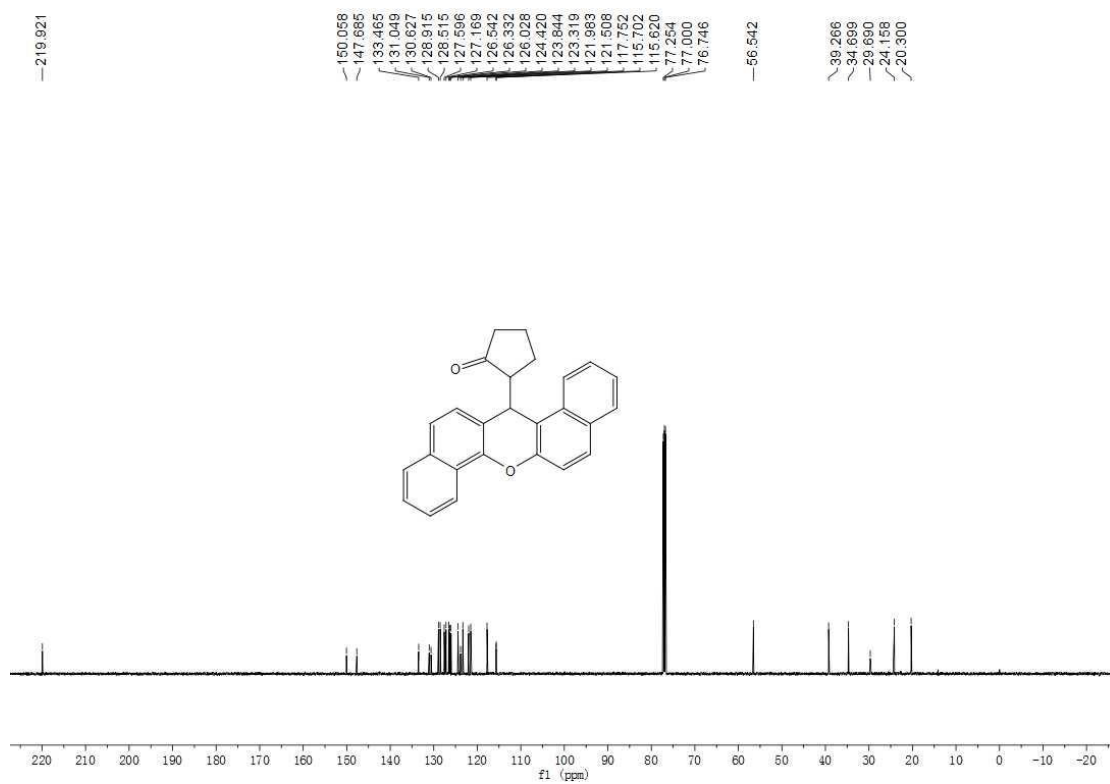
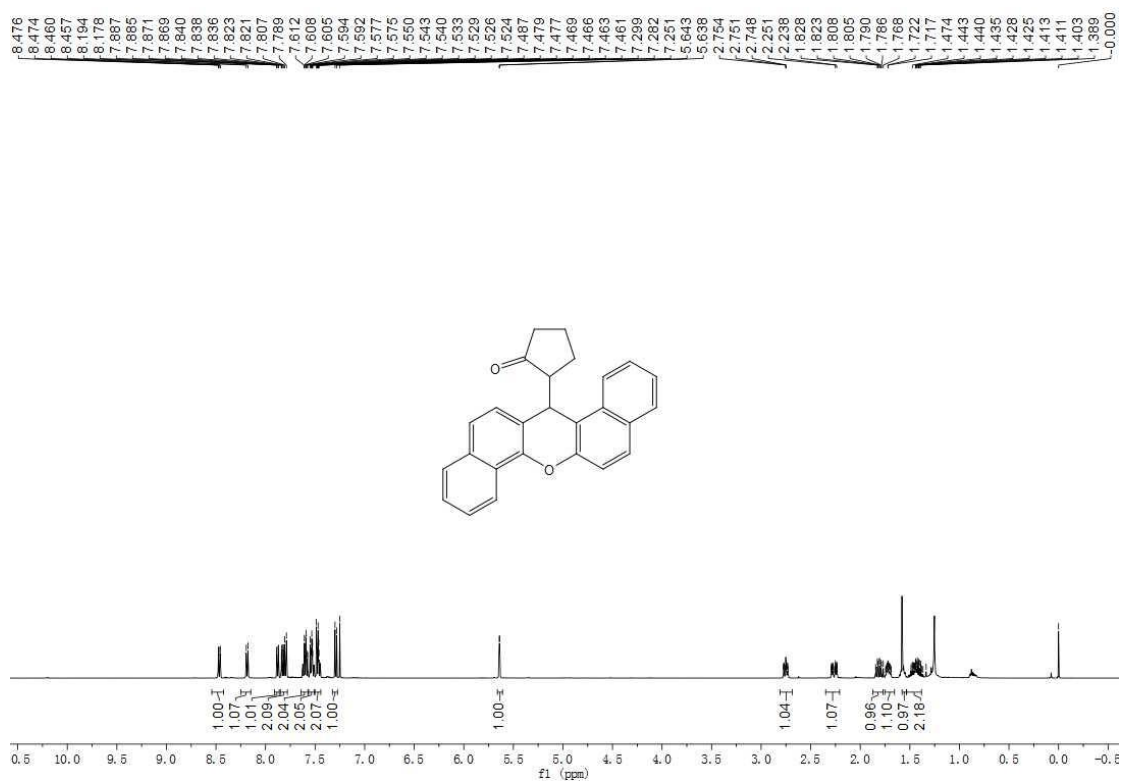
2-(12H-Benzo[a]xanthen-12-yl)cyclopentan-1-one (3ga)



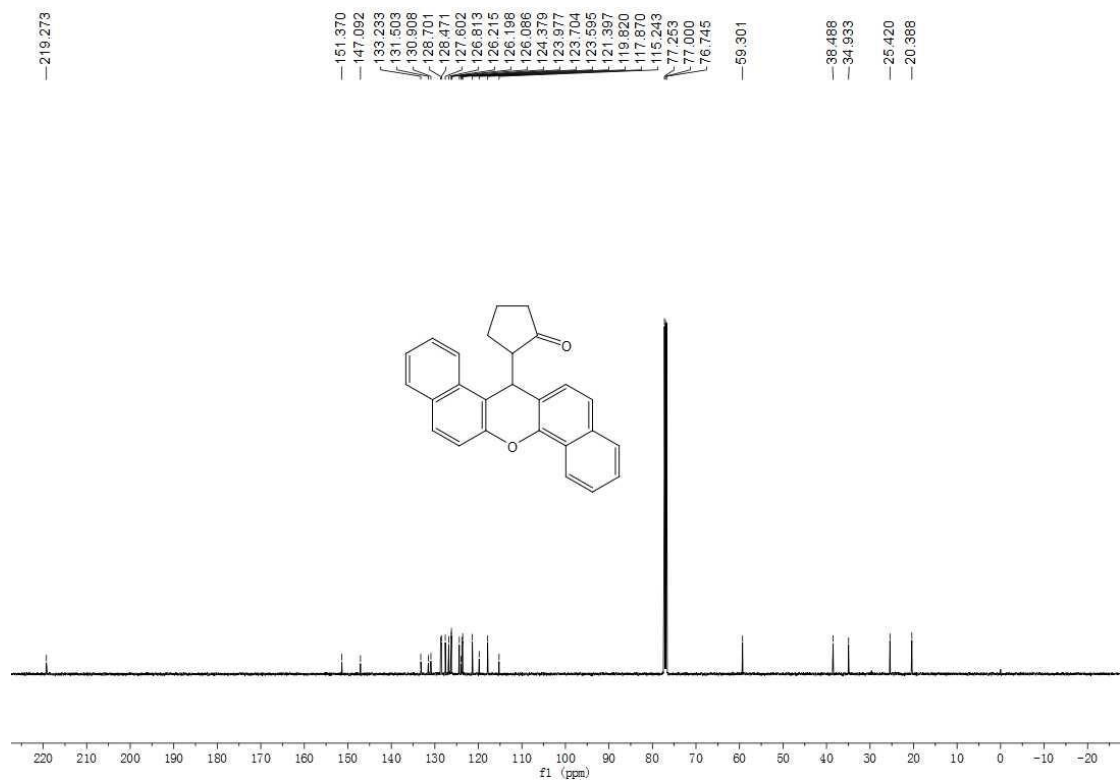
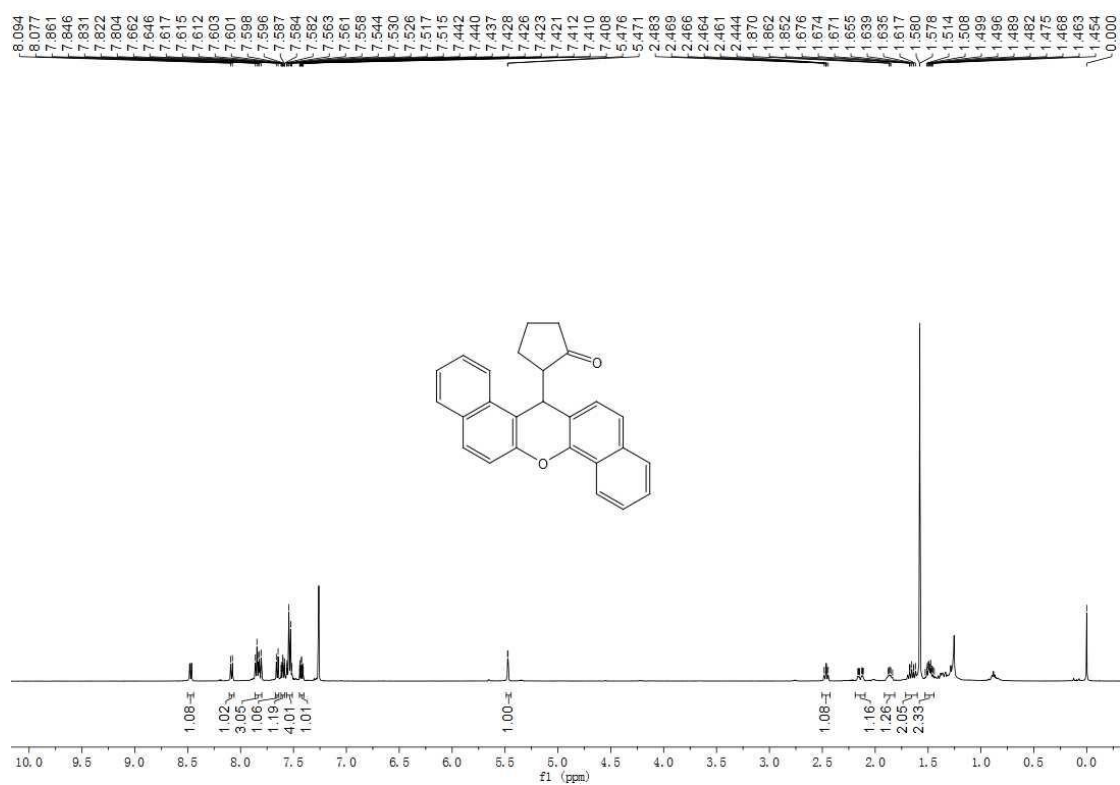
2-(12*H*-Benzo[*a*]xanthen-12-yl)cyclopentan-1-one (3ga)



2-(14*H*-Dibenzo[*a,h*]xanthen-14-yl)cyclopentan-1-one (3ha)



2-(14*H*-Dibenzo[*a,h*]xanthen-14-yl)cyclopentan-1-one (3ha)



2-(2-Fluoro-9H-xanthen-9-yl)-1,3-diphenylpropane-1,3-dione (3ia)

