



## Supporting Information

### **Chiral Primary Amine/Palladium Dual Catalysis for Asymmetric Allylic Alkylation of $\beta$ -Ketocarbonyl Compounds with Allylic Alcohols**

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## **Supporting Information**

**General information and materials**

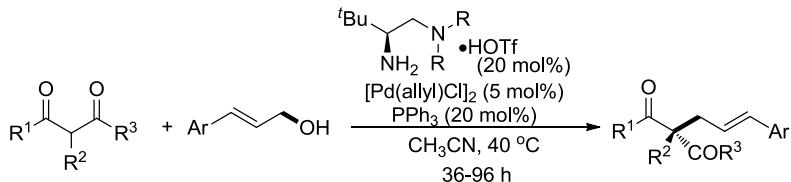
**Experimental section**

**NMR spectra**

**HPLC charts**

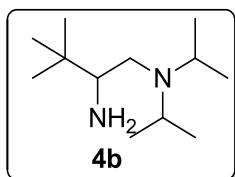
**General information:** All commercial reagents were used without further purification unless otherwise noted. Proton and carbon magnetic resonance spectra (<sup>1</sup>H NMR and <sup>13</sup>C NMR) were recorded on Bruker UltraShield 300 MHz, 400MHz or 500MHz spectrometer with solvent resonance as the internal standard (<sup>1</sup>H NMR: CDCl<sub>3</sub> at 7.26 ppm; <sup>13</sup>C NMR: CDCl<sub>3</sub> at 77.16 ppm). <sup>19</sup>F was recorded on Bruker Avance 500 MHz spectrometer. <sup>1</sup>H NMR data were reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet, td = triplet of doublet, dt = doublet of triplet, dd = doublet of doublet), coupling constants (Hz), and integration. Infrared Spectroscopy was conducted on Thermo Fisher Nicolet 6700. High resolution mass spectra were obtained using electrospray ionization (ESI), Atmospheric Pressure Chemical Ionization (APCI) and Electron Impact (EI) mass spectrometer. Silica gel (300 – 400 mesh) was used for column chromatography. The enantiomeric excesses were determined by HPLC analysis on Chiral Daicel Chiraldapak OD-H, OJ-H. Optical rotation were measured on a commercial polarimeter and reported as follows: [α]<sub>D</sub><sup>25</sup> (c = g/100 mL, solvent).

**Materials:** The corresponding β-Ketocarbonyl substrates **1a-o** were prepared according to reported procedures <sup>[1]</sup>. The allylic alcohols substrates **2a-m** were prepared by the hydrogenation of corresponding cinnamyl aldehydes use NaBH<sub>4</sub>.

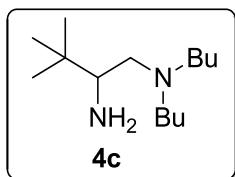


**General procedure:** To a flame-dried Schlenk tube equipped with a magnetic stir bar was added *tert*-butyl 2-methyl-3-oxobutanoate (**1a**, 0.15 mmol), cinnamyl alcohol (**2a**, 0.1 mmol), [Pd(allyl)Cl]<sub>2</sub> (5 mol%), PPh<sub>3</sub> (20 mol%) and primary amine (**4b** or **4f**, 20 mol%), the mixture was diluted with 0.5 mL of anhydrous CH<sub>3</sub>CN, then degassed for 3 times under standard freeze-thaw method. The reaction was conducted at 40 °C for 36 or 72 h, the solvent was removed and residue was purified by silica gel chromatography (5% EtOAc in Petroleum ether) to give **3aa** as a colorless oil. The enantiometric excess was determined by HPLC (OJ-H).

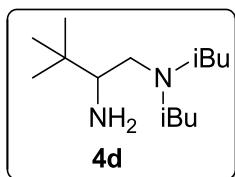
Chiral primary-tertiary amine catalyst **4a-f** were synthesized according to previous reports. [1,2]



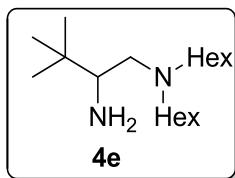
Colorless oil:  $^1\text{H}$  NMR (400 MHz, )  $\delta$  2.99 (dt,  $J = 13.2, 6.6$  Hz, 2H), 2.58-2.47 (m, 2H), 2.06-2.00 (m, 2H), 1.50 (br, s, 2H), 1.01 (d,  $J = 6.7$  Hz, 6H), 0.94 (d,  $J = 6.5$  Hz, 6H), 0.88 (s, 9H).  $^{13}\text{C}$  NMR (400 MHz, )  $\delta$  57.19, 47.72, 46.23, 33.14, 26.34, 22.78, 19.14. HRMS: HRMS (ESI) calcd for  $\text{C}_{12}\text{H}_{29}\text{N}_2$ : 201.2323, found 201.2325.



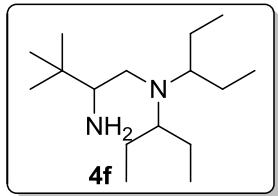
Colorless oil:  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  3.75 (t,  $J = 6.4$  Hz, 1H), 2.55-2.45 (m, 3H), 2.36-2.25 (m, 3H), 2.16-2.10 (m, 1H), 1.87-1.84 (m, 1H), 1.42-1.27 (m, 8H), 0.93-0.89 (m, 15H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  67.97, 57.31, 56.92, 54.42, 32.96, 29.58, 26.31, 25.61, 20.70, 14.12. HRMS: HRMS (ESI) calcd for  $\text{C}_{14}\text{H}_{33}\text{N}_2$ : 229.2635, found 229.2638.



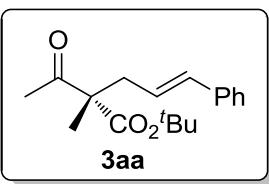
Colorless oil:  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  2.53 (dd,  $J = 10.3, 2.9$  Hz, 1H), 2.24-2.00 (m, 6H), 1.76-1.67(m, 2H), 1.56 (br, s, 2H), 0.93 (d,  $J = 6.5$  Hz, 6H), 0.89 (s, 9H), 0.85 (d,  $J = 6.7$  Hz, 6H).  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ )  $\delta$  64.68, 58.31, 57.21, 32.90, 26.37, 26.32, 21.07, 20.98. HRMS: (ESI) calcd for  $\text{C}_{14}\text{H}_{33}\text{N}_2$ : 229.2635, found 229.2638.



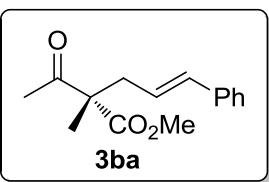
Colorless oil:  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  2.55-2.43 (m, 3H), 2.37-2.22 (m, 3H), 2.6-2.08 (m, 1H), 1.42-1.39 (m, 18H), 0.89-0.86 (m, 15H). HRMS: (ESI) calcd for  $\text{C}_{18}\text{H}_{41}\text{N}_2$ : 285.3262, found 285.3264.



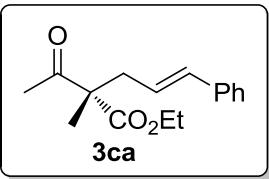
Colorless oil:  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$  5.80 (br s, 2H), 2.97-2.91 (m, 2H), 2.48-2.40 (m, 3H), 1.70-1.65 (m, 2H), 1.61-1.55 (m, 2H), 1.41-1.27 (m, 4H), 1.04 (s, 9H), 1.00 (t,  $J = 7.4$  Hz, 6H), 0.95 (t,  $J = 7.4$  Hz, 6H).  $^{13}\text{C}$  NMR (126 MHz,  $\text{CDCl}_3$ )  $\delta$  63.15, 57.32, 32.40, 25.94, 24.84, 24.33, 12.15, 11.92. HRMS: HRMS (ESI) calcd for  $\text{C}_{16}\text{H}_{37}\text{N}_2$ : 257.2948, found 257.2951.



**3aa:** prepared according to the general procedure above and obtained as colorless oil (method A: 92% yield, 98% *ee* method B: 94% yield, 93% *ee*).  $[\alpha]_D^{25} = -31.4$  ( $c=0.26$ , CHCl<sub>3</sub>, 98% *ee*). HPLC analysis: Daicel Chiralpak OJ-H, 5% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 7.9 min (major), 13.7 min (minor). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.32-7.26 (m, 4H), 7.22-7.19 (m, 1H), 6.43 (d,  $J = 15.7$  Hz, 1H), 6.10-6.02 (m, 1H), 2.78-2.58 (m, 2H), 2.18 (s, 3H), 1.45 (s, 10H), 1.34 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  205.44, 171.58, 137.14, 133.71, 128.52, 127.33, 126.17, 124.60, 81.95, 60.38, 38.62, 27.89, 26.27, 19.20. IR (thin film, cm<sup>-1</sup>) 3418, 2952, 1743, 1434, 1267, 968, 744, 693. HRMS (APCI) calcd for C<sub>18</sub>H<sub>24</sub>O<sub>3</sub>Na<sup>+</sup>: 311.1615, found 311.1617.

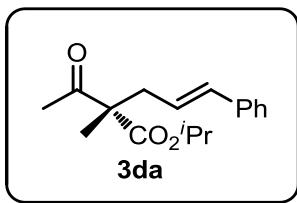


**3ba:** prepared according to the general procedure above and obtained as colorless oil (method A: 89% yield, 92% *ee* method B: 91% yield, 85% *ee*).  $[\alpha]_D^{25} = -22.2$  ( $c=0.21$ , CHCl<sub>3</sub>, 92% *ee*). HPLC analysis: Daicel Chiralpak OJ-H, 5% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 19.1 min (minar), 20.9 min (major). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.33-7.26 (m, 4H), 7.23-7.19 (m, 1H), 6.43 (d,  $J = 15.7$  Hz, 1H), 6.08-6.00 (m, 1H), 3.74 (s, 3H), 2.72 (ddd,  $J = 56.3, 14.1, 7.5$  Hz, 2H), 2.18 (s, 3H), 1.39 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  205.06, 173.04, 137.04, 134.03, 128.52, 127.44, 126.23, 124.19, 59.88, 52.50, 38.68, 26.39, 19.20. IR (thin film, cm<sup>-1</sup>) 3418, 2952, 1743, 1434, 1267, 968, 744, 693. HRMS (APCI) calcd for C<sub>15</sub>H<sub>19</sub>O<sub>3</sub><sup>+</sup>: 247.1327, found 247.1328.

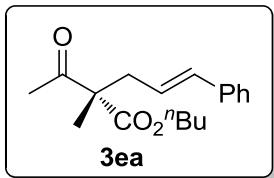


**3ca:** prepared according to the general procedure above and obtained as colorless oil (96% yield, 94% *ee*).  $[\alpha]_D^{25} = -27.0$  ( $c=0.18$ , CHCl<sub>3</sub>). HPLC analysis: Daicel Chiralpak OJ-H, 2% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 23.6 min (major), 29.5 min (minor). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.32-7.26 (m, 4H), 7.22-7.19 (m, 1H), 6.43 (d,  $J = 15.7$  Hz, 1H), 6.09-6.01 (m, 1H), 4.20 (q,  $J = 7.1$  Hz, 2H), 2.72 (ddd,  $J = 57.9, 14.1, 7.5$  Hz, 2H), 2.18 (s, 3H), 1.38 (s, 3H), 1.26 (t,  $J = 7.1$  Hz, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  205.16, 172.52, 137.07,

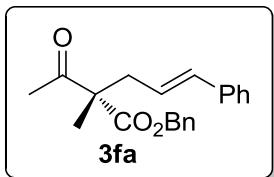
133.94, 128.52, 127.41, 126.21, 124.29, 61.43, 59.83, 38.64, 26.35, 19.19, 14.13. IR (thin film,  $\text{cm}^{-1}$ ) 3564, 2065, 1712, 1651, 1496, 1449, 1227, 1188, 1096, 968. HRMS (APCI) calcd for  $\text{C}_{16}\text{H}_{21}\text{O}_3\text{+}$ : 261.1483, found 261.1485.



**3da:** prepared according to the general procedure above and obtained as colorless oil (81% yield, 97% *ee*).  $[\alpha]_D^{25} = -38.0$  ( $c=0.24$ ,  $\text{CHCl}_3$ ). HPLC analysis: Daicel Chiralpak OJ-H, 2% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 16.6 min (major), 25.5 min (minor).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.32-7.28 (m, 4H), 7.23-7.19 (m, 1H), 6.43 (d,  $J = 15.7$  Hz, 1H), 6.09-6.01 (m, 1H), 5.07 (dt,  $J = 12.5, 6.3$  Hz, 1H), 2.71 (ddd,  $J = 59.1, 14.1, 7.5$  Hz, 2H), 2.18 (s, 3H), 1.37 (s, 3H), 1.24 (dd,  $J = 6.3, 2.9$  Hz, 6H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  205.21, 171.97, 137.08, 133.88, 128.51, 127.38, 126.19, 124.35, 68.97, 59.82, 38.58, 26.29, 21.65, 21.57, 19.17. IR (thin film,  $\text{cm}^{-1}$ ) 3444, 2981, 2936, 1711, 1644, 1100, 968, 744. HRMS (APCI) calcd for  $\text{C}_{17}\text{H}_{23}\text{O}_3\text{+}$ : 275.1638, found: 275.1641.

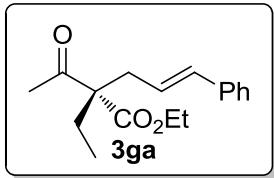


**3ea:** prepared according to the general procedure above and obtained as colorless oil (91% yield, 94% *ee*).  $[\alpha]_D^{25} = -30.1$  ( $c=0.19$ ,  $\text{CHCl}_3$ ). HPLC analysis: Daicel Chiralpak OJ-H, 5% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 11.4 min (major), 13.5 min (minor).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.32-7.26 (m, 4H), 7.22-7.19 (m, 1H), 6.43 (d,  $J = 15.7$  Hz, 1H), 6.09-6.01 (m, 1H), 4.14 (t,  $J = 6.6$  Hz, 2H), 2.72 (ddd,  $J = 56.7, 14.1, 7.5$  Hz, 2H), 2.18 (s, 3H), 1.64-1.57 (m, 2H), 1.40-1.33 (m, 4H), 0.91 (t,  $J = 7.4$  Hz, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  205.14, 172.62, 137.06, 133.94, 128.51, 127.41, 126.21, 124.29, 65.35, 59.89, 38.68, 30.55, 26.38, 19.22, 19.14, 13.63. IR (thin film,  $\text{cm}^{-1}$ ) 3587, 2978, 2934, 1734, 1711, 1456, 1152, 1119, 967, 846, 741, 693. HRMS (APCI) calcd for  $\text{C}_{18}\text{H}_{24}\text{O}_3\text{Na+}$ : 311.1615, found 311.1618.

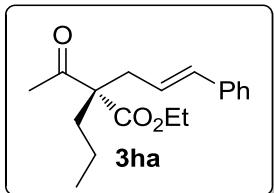


**3fa:** prepared according to the general procedure above and obtained as colorless oil (96% yield, 93% *ee*).  $[\alpha]_D^{25} = -29.4$  ( $c=0.14$ ,  $\text{CHCl}_3$ ). HPLC analysis: Daicel Chiralpak OD-H, 1% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 18.5 min (minor), 20.2 min (major).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$

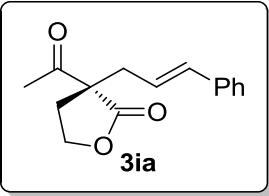
7.33 (s, 5H), 7.29-7.25 (m, 4H), 7.23-7.20 (m, 1H), 6.39 (d,  $J$  = 15.7 Hz, 1H), 6.02-5.94 (m, 1H), 5.18 (d,  $J$  = 2.3 Hz, 2H), 2.84-2.61 (m, 2H), 2.11 (s, 3H), 1.39 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  204.98, 172.32, 136.98, 135.27, 134.04, 128.65, 128.49, 127.42, 126.24, 124.09, 67.19, 59.95, 38.63, 26.36, 19.19. IR (thin film,  $\text{cm}^{-1}$ ) 3500, 2064, 1713, 1634, 1458, 1265, 1114, 968. HRMS (APCI) calcd for  $\text{C}_{21}\text{H}_{23}\text{O}_3+$ : 323.1639, found 323.1641.



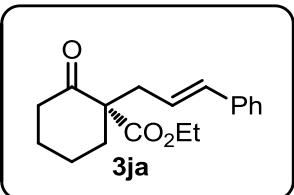
**3ga:** prepared according to the general procedure above and obtained as colorless oil (method A: 45% yield, 90% *ee*; method B: 52% yield, 83% *ee*).  $[\alpha]_D^{25}=-8.6$  ( $c=0.10$ ,  $\text{CHCl}_3$ , 90% *ee*). HPLC analysis: Daicel Chiraldpak OJ-H, 2% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 16.7 min (major), 18.3 min (minor).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.32-7.26 (m, 4H), 7.22-7.19 (m, 1H), 6.43 (d,  $J$  = 15.7 Hz, 1H), 5.97 (dt,  $J$  = 15.5, 7.6 Hz, 1H), 4.21 (q,  $J$  = 7.1 Hz, 2H), 2.75 (qdd,  $J$  = 14.6, 7.6, 1.2 Hz, 2H), 2.16 (s, 3H), 1.97 (ddt,  $J$  = 22.0, 14.5, 7.4 Hz, 2H), 1.26 (t,  $J$  = 7.1 Hz, 3H), 0.83 (t,  $J$  = 7.6 Hz, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  204.89, 172.06, 137.08, 133.58, 128.51, 127.38, 126.19, 124.16, 64.10, 61.30, 34.63, 26.91, 24.64, 14.16, 8.20. IR (thin film,  $\text{cm}^{-1}$ ) 3565, 2064, 1645, 1651, 1449, 1227, 1188, 1096, 968. HRMS (APCI) calcd for  $\text{C}_{17}\text{H}_{23}\text{O}_3+$ : 275.1639, found 275.1641.



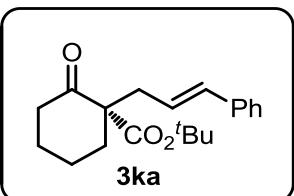
**3ha:** prepared according to the general procedure above and obtained as colorless oil (method A: 57% yield, 74% *ee*; method B: 53% yield, 80% *ee*).  $[\alpha]_D^{25}=-8.3$  ( $c=0.16$ ,  $\text{CHCl}_3$ , 80% *ee*). HPLC analysis: Daicel Chiraldpak OJ-H, 2% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 12.0 min (minor), 13.5 min (major).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.31-7.28 (m, 4H), 7.22-7.21 (m, 1H), 6.42 (d,  $J$  = 15.7 Hz, 1H), 6.01-5.96 (m, 1H), 4.20 (q,  $J$  = 6.9 Hz, 2H), 2.82-2.69 (m, 2H), 2.16 (s, 3H), 1.92-1.84 (m, 2H), 1.27-1.17 (m, 5H), 0.93 (t,  $J$  = 7.3 Hz, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  204.94, 172.11, 137.10, 133.56, 128.51, 127.38, 126.19, 124.25, 63.81, 61.30, 35.29, 34.01, 26.92, 17.20, 14.52, 14.16. IR (thin film,  $\text{cm}^{-1}$ ) 3397, 3026, 2961, 2933, 2873, 1712, 1242, 1214, 966, 743. HRMS (APCI) calcd for  $\text{C}_{18}\text{H}_{25}\text{O}_3+$ : 289.1795, found 289.1798.



**3ia:** prepared according to the general procedure above and obtained as colorless oil (method A: 44% yield, 85% *ee*).  $[\alpha]_D^{25}=25.2$  ( $c=0.09$ , CHCl<sub>3</sub>, 85% *ee*). HPLC analysis: Daicel Chiraldpak OD-H, 3% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 27.1 min (minor), 28.7 min (major). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.34-7.29 (m, 4H), 7.26-7.23 (m, 1H), 6.52 (d,  $J = 15.7$  Hz, 1H), 6.01-5.93 (m, 1H), 4.32-4.16 (m, 2H), 2.89-2.84 (m, 3H), 2.39 (s, 3H), 2.22-2.14 (m, 1H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  202.13, 175.21, 136.35, 135.15, 128.65, 127.94, 126.35, 122.32, 66.39, 61.31, 38.25, 28.79, 25.83. IR (thin film, cm<sup>-1</sup>) 3497, 1773, 1763, 1685, 1636, 1220, 1179, 756, 698. HRMS (APCI) calcd for C<sub>15</sub>H<sub>16</sub>O<sub>3</sub>Na<sup>+</sup>: 267.0989, found 267.0991.

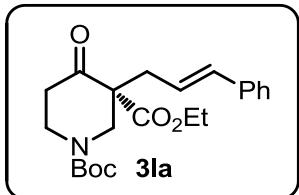


**3ja:** prepared according to the general procedure above and obtained as colorless oil (method A: 93% yield, 95% *ee*; method B: 92% yield, 91% *ee*).  $[\alpha]_D^{25}=-57.4$  ( $c=0.20$ , CHCl<sub>3</sub>, 95% *ee*). HPLC analysis: Daicel Chiraldpak OJ-H, 2% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 14.4 min (minor), 19.7 min (major). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.33-7.25 (m, 5H), 7.21-7.17 (m, 1H), 6.37 (d,  $J = 15.8$  Hz, 1H), 6.21-6.13 (m, 1H), 4.17 (q,  $J = 7.1$  Hz, 2H), 2.74-2.46 (m, 5H), 2.03-2.02 (m, 1H), 1.76-1.63 (m, 4H), 1.56-1.49 (m, 1H), 1.21 (t,  $J = 7.1$  Hz, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  207.71, 171.59, 137.26, 133.22, 128.47, 127.22, 126.18, 125.18, 61.38, 61.32, 41.21, 38.65, 36.07, 27.55, 22.57, 14.21. IR (thin film, cm<sup>-1</sup>) 3364, 2936, 1712, 1448, 1495, 1191, 1134, 1095, 1019, 967, 742, 693. HRMS (APCI) calcd for C<sub>18</sub>H<sub>23</sub>O<sub>3</sub><sup>+</sup>: 287.1639, found 287.1641.

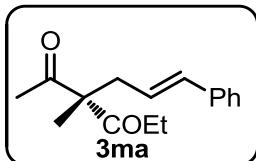


**3ka:** prepared according to the general procedure above and obtained as colorless oil (method A: 99% yield, 96% *ee*; method B: 99% yield, 96% *ee*).  $[\alpha]_D^{25}=-83.2$  ( $c=0.30$ , CHCl<sub>3</sub>, 96% *ee*). HPLC analysis: Daicel Chiraldpak OD-H, 1% *iso*-propanol/hexane,

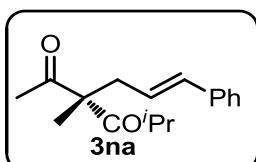
flow rate = 1.0 mL/min,  $\lambda=238$  nm, retention time: 6.7 min (minor) 11.3 min (major).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.33-7.25 (m, 4H), 7.21-7.19 (m, 1H), 6.37 (d,  $J = 15.8$  Hz, 1H), 6.24-6.16 (m, 1H), 2.74-2.42 (m, 5H), 2.05-2.01 (m, 1H), 1.75-1.48 (m, 4H), 1.41 (s, 9H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  207.93, 170.64, 137.36, 133.06, 128.46, 127.13, 126.16, 125.48, 82.09, 61.76, 41.24, 38.83, 36.37, 27.97, 27.63, 22.66. IR (thin film,  $\text{cm}^{-1}$ ) 3025, 2936, 2864, 1711, 1157, 1114, 967, 771, 693. HRMS (APCI) calcd for  $\text{C}_{20}\text{H}_{26}\text{O}_3\text{Na}^+$ : 337.1771, found: 337.1774.



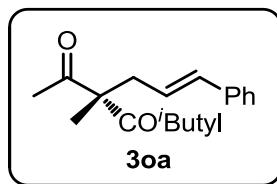
**3la:** prepared according to the general procedure above and obtained as light yellow oil (method A: 34% yield, 97% ee, method B: 72% yield, 92% ee).  $[\alpha]_D^{25} = -40.6$  ( $c=0.12$ ,  $\text{CHCl}_3$ , 97% ee) HPLC analysis: Daicel Chiralpak OJ-H\*2, 20% *iso*-propanol/hexane, flow rate = 0.5 mL/min,  $\lambda=254$  nm, retention time: 33.8 min(major) 38.9 min (minor).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.31-7.28 (m, 4H), 7.22-7.19 (m, 1H), 6.43 (d,  $J = 15.8$  Hz, 1H), 6.25-6.09 (m, 1H), 4.56 (br, 1H), 4.20-4.15 (m, 3H), 3.33-3.17 (m, 2H), 2.74-2.46 (m, 4H), 1.48 (s, 9H), 1.23 (t,  $J = 7.1$  Hz, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  204.76, 154.24, 136.96, 134.12, 128.51, 127.45, 126.25, 123.95, 80.59, 61.72, 61.49, 40.00, 35.57, 28.29, 14.14. IR (thin film,  $\text{cm}^{-1}$ ) 3362, 2976, 2923, 2853, 1697, 1423, 1360, 1243, 1161, 971, 859, 694. HRMS (EI) calcd for  $\text{C}_{22}\text{H}_{29}\text{NO}_5$ : 387.2046 found 387.2052.



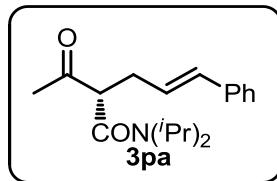
**3ma:** prepared according to the general procedure above and obtained as colorless oil (method A: 60% yield, 91% ee).  $[\alpha]_D^{25}=14.0$  ( $c=0.11$ ,  $\text{CHCl}_3$ ) HPLC analysis: Daicel Chiralpak OJ-H, 10% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 16.1 min(major) 19.9 min (minor).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.31-7.28 (m, 4H), 7.23-7.19 (m, 1H), 6.43 (d,  $J = 15.7$  Hz, 1H), 6.00-5.92 (m, 1H), 2.75 (d,  $J = 7.5$  Hz, 2H), 2.44 (q,  $J = 7.2$  Hz, 2H), 2.12 (s, 3H), 1.38 (s, 3H), 1.05 (t,  $J = 7.2$  Hz, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  209.49, 206.89, 136.94, 133.97, 128.54, 127.48, 126.20, 124.17, 66.48, 38.19, 32.29, 26.79, 18.32, 7.99. IR(thin film,  $\text{cm}^{-1}$ ) 3565, 2064, 1688, 1646, 1558, 1488, 1265, 967. HRMS (APCI) calcd for  $\text{C}_{16}\text{H}_{21}\text{O}_2^+$ : 245.1536, found 245.1536.



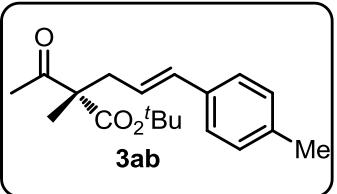
**3na:** prepared according to the general procedure above and obtained as colorless oil (method A: 91% yield, 91% *ee*).  $[\alpha]_D^{25}=19.5$  ( $c=0.21$ , CHCl<sub>3</sub>). HPLC analysis: Daicel Chiralpak OJ-H, 10% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 11.3 min (major), 15.4 min (minor). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.30-7.26 (m, 4H), 7.23-7.20 (m, 1H), 6.44 (d,  $J = 15.7$  Hz, 1H), 6.00-5.92 (m, 1H), 2.96-2.70 (m, 3H), 2.14 (s, 3H), 1.41 (s, 3H), 1.06 (t,  $J = 6.8$  Hz, 6H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  213.52, 206.75, 136.97, 133.99, 128.54, 127.46, 126.19, 124.28, 67.17, 38.12, 36.62, 27.15, 20.18, 19.96, 18.12. IR (thin film, cm<sup>-1</sup>) 3564, 2972, 2931, 2874, 2065, 1694, 1495, 1380, 967, 749. HRMS (APCI) calcd for C17H23O2 $+$ : 259.1691, found 259.1692.



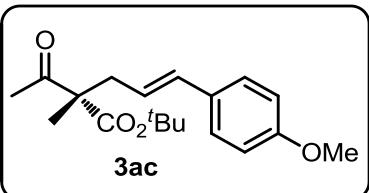
**3oa:** prepared according to the general procedure above and obtained as colorless oil (method A: 61% yield, 94% *ee*; method B: 86% yield, 87% *ee*).  $[\alpha]_D^{25}=1.9$  ( $c=0.12$ , CHCl<sub>3</sub>, 94% ee). HPLC analysis: Daicel Chiralpak OJ-H, 10% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 9.9 min (major) 11.9 min (minor). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.31-7.28 (m, 4H), 7.23-7.19 (m, 1H), 6.43 (d,  $J = 15.7$  Hz, 1H), 6.00-5.92 (m, 1H), 2.76-2.73 (m, 2H), 2.31-2.29 (m, 2H), 2.22-2.15 (m, 1H), 2.12 (s, 3H), 1.36 (s, 3H), 0.89 (dd,  $J = 6.6, 2.8$  Hz, 6H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  208.10, 206.80, 136.96, 133.99, 128.53, 127.46, 126.19, 124.17, 66.76, 47.72, 38.07, 26.87, 23.72, 22.46, 18.20. IR (thin film, cm<sup>-1</sup>) 2959, 2926, 2871, 1714, 1703, 1361, 965, 741, 692. HRMS (APCI) calcd for C18H25O2 $+$ : 273.1847, found 273.1849.



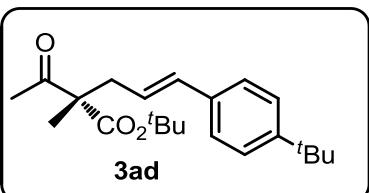
**3pa:** prepared according to the general procedure above and obtained as yellow solid (B: 90% yield, 65% *ee*).  $[\alpha]_D^{25}=6.0$  ( $c=0.11$ , CHCl<sub>3</sub>, 65% ee). HPLC analysis: Daicel Chiralpak OJ-H, 5% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 20.9 min (minor) 23.2 min (major). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.31-7.27 (m, 4H), 7.21-7.18 (m, 1H), 6.45 (d,  $J = 15.8$  Hz, 1H), 6.17-6.09 (m, 1H), 4.11 (dt,  $J = 13.2, 6.5$  Hz, 1H), 3.66 (t,  $J = 7.2$  Hz, 1H), 3.45 (s, 1H), 2.86-2.71 (m, 2H), 2.18 (s, 3H), 1.40 (dd,  $J = 10.1, 6.8$  Hz, 6H), 1.16 (dd,  $J = 13.1, 6.6$  Hz, 6H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  204.57, 167.44, 137.12, 132.38, 128.52, 127.29, 126.39, 126.09, 59.28, 49.12, 46.38, 32.71, 27.15, 21.00, 20.80, 20.60, 20.29. IR (thin film, cm<sup>-1</sup>) 3359, 2964, 2922, 2851, 1720, 1631, 1511, 1249, 1034, 969, 801, 758. HRMS (APCI) calcd for C19H28O2N $+$ : 302.2111, found 302.2114.



**3ab:** prepared according to the general procedure above and obtained as colorless oil (method A: 74% yield, 97% *ee*; method B: 64% yield, 93% *ee*).  $[\alpha]_D^{25} = -35.3$  (*c*=0.16, CHCl<sub>3</sub>, 97% *ee*). HPLC analysis: Daicel Chiraldpak OJ-H, 5% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda$ =254 nm, retention time: 7.4 min (major), 9.5 min (minor). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.23 (d, *J* = 8.1 Hz, 2H), 7.12 (d, *J* = 8.0 Hz, 2H), 6.42 (d, *J* = 15.7 Hz, 1H), 6.06-5.99 (m, 1H), 2.69 (ddd, *J* = 58.3, 14.1, 7.5 Hz, 2H), 2.34 (s, 3H), 2.20 (s, 3H), 1.47 (s, 9H), 1.35 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  205.50, 171.63, 137.10, 134.38, 133.58, 129.20, 126.08, 123.47, 81.89, 60.41, 38.64, 27.89, 26.27, 21.15, 19.19. IR (thin film, cm<sup>-1</sup>) 3435, 2978, 2936, 1711, 1217, 1153, 1120, 968, 771. HRMS (APCI) calcd for C<sub>19</sub>H<sub>26</sub>O<sub>3</sub>Na<sup>+</sup>: 325.1772, found 325.1774.

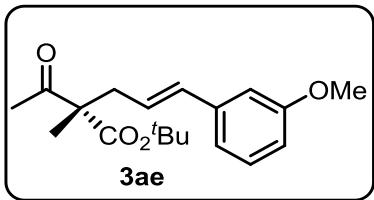


**3ac:** prepared according to the general procedure above and obtained as colorless oil (method A: 96% yield, 96% *ee*; method B: 96% yield, 93% *ee*).  $[\alpha]_D^{25} = -34.2$  (*c*=0.20, CHCl<sub>3</sub>, 96% *ee*). HPLC analysis: Daicel Chiraldpak OJ-H, 5% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda$ =254 nm, retention time: 12.5 min (major), 17.7 min (minor). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.26-7.23 (m, 2H), 6.83-6.81 (m, 2H), 6.36 (d, *J* = 15.7 Hz, 1H), 5.94-5.87 (m, 1H), 3.79 (s, 3H), 2.65 (ddd, *J* = 58.3, 14.1, 7.5 Hz, 2H), 2.17 (s, 3H), 1.44 (s, 9H), 1.32 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  205.53, 171.65, 159.02, 133.09, 130.01, 127.30, 122.26, 113.93, 81.87, 60.44, 55.28, 38.63, 27.89, 26.29, 19.18. IR (thin film, cm<sup>-1</sup>) 3439, 2978, 2934, 1711, 1511, 1248, 1136, 969, 842. HRMS (APCI) calcd for C<sub>19</sub>H<sub>26</sub>O<sub>4</sub>Na<sup>+</sup>: 341.1720, found 341.1723.

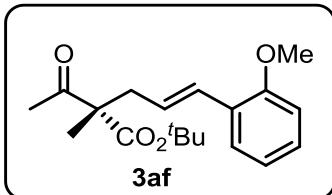


**3ad:** prepared according to the general procedure above and obtained as colorless oil (method A: 61% yield, 97% *ee*; method B: 99% yield, 92% *ee*).  $[\alpha]_D^{25} = -31.5$  (*c*= 0.29, CHCl<sub>3</sub>, 97% *ee*). HPLC analysis: Daicel Chiraldpak OJ-H, 1% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda$ =254 nm, retention time: 9.2 min (minor), 10.8 min (major). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.31 (d, *J* = 8.3 Hz, 2H), 7.25 (d, *J* = 7.7 Hz, 2H), 6.41

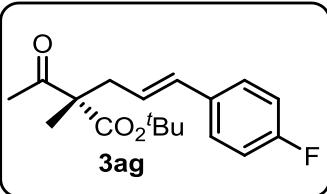
(d,  $J = 15.7$  Hz, 1H), 6.05-5.99 (m, 1H), 2.67 (ddd,  $J = 53.9, 14.1, 7.5$  Hz, 2H), 2.18 (s, 3H), 1.46 (s, 9H), 1.32 (s, 3H), 1.30 (s, 9H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  205.50, 171.63, 150.40, 134.39, 133.50, 125.90, 125.43, 123.70, 81.88, 60.40, 38.62, 34.54, 31.30, 27.90, 26.28, 19.12. IR (thin film,  $\text{cm}^{-1}$ ) 3361, 2978, 2917, 2848, 1711, 1598, 1155, 964, 772. HRMS (APCI) calcd for  $\text{C}_{22}\text{H}_{32}\text{O}_3\text{Na}^+$ : 367.2241, found 367.2243.



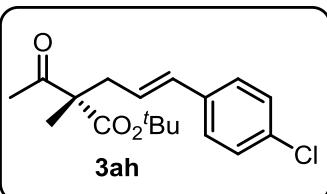
**3ae:** prepared according to the general procedure above and obtained as colorless oil (method A: 71% yield, 98% *ee*; method B: 92% yield, 93% *ee*).  $[\alpha]_D^{25}=-31.4$  ( $c=0.33$ ,  $\text{CHCl}_3$ , 98% ee). HPLC analysis: Daicel Chiralpak OJ-H, 5% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 9.9 min (major), 14.2 min (minor).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.20 (t,  $J = 7.9$  Hz, 1H), 6.91 (d,  $J = 7.7$  Hz, 1H), 6.85-6.84 (m, 1H), 6.77-6.75 (m, 1H), 6.40 (d,  $J = 15.7$  Hz, 1H), 6.10-6.02 (m, 1H), 3.80 (s, 3H), 2.67 (ddd,  $J = 60.2, 14.1, 7.5$  Hz, 2H), 2.18 (s, 3H), 1.45 (s, 9H), 1.33 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  205.38, 171.55, 159.79, 138.61, 133.61, 129.48, 124.97, 118.85, 112.92, 111.60, 81.95, 60.36, 55.20, 38.60, 27.88, 26.25, 19.22. IR (thin film,  $\text{cm}^{-1}$ ) 2965, 2869, 1712, 1285, 1153, 968, 844, 692. HRMS (APCI) calcd for  $\text{C}_{19}\text{H}_{26}\text{O}_4\text{Na}^+$ : 341.1720, found 341.1722.



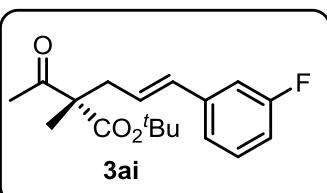
**3af:** prepared according to the general procedure above and obtained as colorless oil (method A: 92% yield, 98% *ee*; method B: 96% yield, 90% *ee*).  $[\alpha]_D^{25}=-32.1$  ( $c=0.25$ ,  $\text{CHCl}_3$ , 98% ee). HPLC analysis: Daicel Chiralpak OJ-H, 2% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 11.7 min (major), 15.8 min (minor).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.37-7.35 (m, 1H), 7.21-7.17 (m, 1H), 6.91-6.83 (m, 2H), 6.76 (d,  $J = 15.8$  Hz, 1H), 6.08-6.00 (m, 1H), 3.82 (s, 3H), 2.70 (ddd,  $J = 58.2, 14.1, 7.5$  Hz, 2H), 2.18 (s, 3H), 1.45 (s, 9H), 1.34 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  205.56, 171.66, 156.43, 128.55, 128.34, 126.71, 126.28, 125.04, 120.61, 110.79, 81.83, 60.47, 55.39, 39.00, 27.86, 26.26, 19.14. IR (thin film,  $\text{cm}^{-1}$ ) 2977, 2934, 1711, 1511, 1248, 969, 842. HRMS (APCI) calcd for  $\text{C}_{19}\text{H}_{26}\text{O}_4\text{Na}^+$ : 341.1720, found 341.1723.



**3ag:** prepared according to the general procedure above and obtained as colorless oil (method A: 91% yield, 97% *ee*; method B: 89% yield, 93% *ee*).  $[\alpha]_D^{25} = -34.1$  (*c*=0.24, CHCl<sub>3</sub>, 97% *ee*). HPLC analysis: Daicel Chiralpak OJ-H, 5% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda$ =254 nm, retention time: 7.1 min (major), 9.8 min (minor). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.28-7.25 (m, 2H), 6.99-6.94 (m, 2H), 6.38 (d, *J* = 15.7 Hz, 1H), 6.01-5.93 (m, 1H), 2.66 (ddd, *J* = 60.5, 14.2, 7.5 Hz, 2H), 2.17 (s, 3H), 1.44 (s, 9H), 1.33 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  205.35, 171.54, 163.39, 160.94, 133.29, 132.47, 127.66, 127.58, 124.38, 115.49, 115.28, 81.97, 60.34, 38.55, 27.88, 26.25, 19.21. <sup>19</sup>F NMR (471 MHz, CDCl<sub>3</sub>)  $\delta$  -114.94. IR (thin film, cm<sup>-1</sup>) 3361, 2979, 2933, 1711, 1508, 1157, 970, 844, 769. HRMS (APCI) calcd for C<sub>18</sub>H<sub>23</sub>O<sub>3</sub>FNa<sup>+</sup>: 329.1521, found 329.1523.

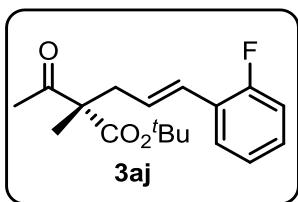


**3ah:** prepared according to the general procedure above and obtained as colorless oil (method A: 91% yield, 97% *ee*; method B: 75% yield, 94% *ee*).  $[\alpha]_D^{25} = -31.4$  (*c*=0.26, CHCl<sub>3</sub>, 97% *ee*). HPLC analysis: Daicel Chiralpak OJ-H, 5% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda$ =254 nm, retention time: 6.9 min (major), 8.1 min (minor). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.26-7.21 (m, 4H), 6.37 (d, *J* = 15.7 Hz, 1H), 6.08-6.01 (m, 1H), 2.66 (ddd, *J* = 62.5, 14.2, 7.5 Hz, 2H), 2.17 (s, 3H), 1.44 (s, 9H), 1.33 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  205.10, 171.48, 135.63, 132.93, 132.43, 128.66, 127.36, 125.47, 82.02, 60.31, 38.59, 27.88, 26.24, 19.25. IR (thin film, cm<sup>-1</sup>) 3565, 2978, 2064, 1688, 1489, 1368, 1260, 1153, 1119, 1012, 969. HRMS (APCI) calcd for C<sub>18</sub>H<sub>23</sub>O<sub>3</sub>ClNa<sup>+</sup>: 345.1229, found 345.1228.

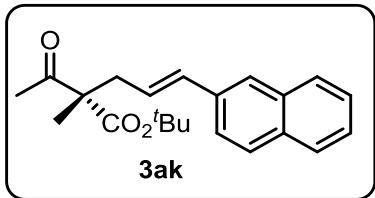


**3ai:** prepared according to the general procedure above and obtained as colorless oil (method A: 87% yield, 98% *ee*; method B: 91% yield, 93% *ee*).  $[\alpha]_D^{25} = -25.6$  (*c*=0.29, CHCl<sub>3</sub>, 98% *ee*). HPLC analysis: Daicel Chiralpak OJ-H, 2% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda$ =254 nm, retention time: 8.6 min (major), 15.2 min (minor). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.25-7.21 (m, 1H), 7.07-7.05 (m, 1H), 7.02-6.98 (m,

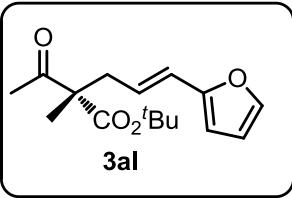
1H), 6.89 (td,  $J$  = 8.3, 2.0 Hz, 1H), 6.39 (d,  $J$  = 15.7 Hz, 1H), 6.12-6.04 (m, 1H), 2.67 (ddd,  $J$  = 62.8, 14.2, 7.5 Hz, 2H), 2.18 (s, 3H), 1.44 (s, 9H), 1.33 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  205.25, 171.46, 164.31, 161.87, 139.52, 139.44, 132.61, 132.58, 129.98, 129.90, 126.24, 122.03, 122.01, 114.22, 114.01, 112.72, 112.50, 82.05, 60.29, 38.51, 27.88, 26.22, 19.23.  $^{19}\text{F}$  NMR (471 MHz,  $\text{CDCl}_3$ )  $\delta$  -113.67. IR (thin film,  $\text{cm}^{-1}$ ) 3742, 2952, 1743, 1713, 1448, 1434, 1267, 1118, 968, 744, 693. HRMS (APCI) calcd for  $\text{C}_{18}\text{H}_{23}\text{O}_3\text{FNa}^+$ : 329.1522, found 329.1523.



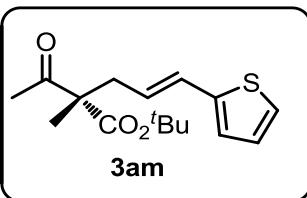
**3aj:** prepared according to the general procedure above and obtained as colorless oil (method A: 72% yield, 98% *ee*; method B: 34% yield, 92% *ee*).  $[\alpha]_D^{25}=-31.8$  ( $c=0.14$ ,  $\text{CHCl}_3$ , 98% *ee*). HPLC analysis: Daicel Chiralpak OJ-H, 2% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 7.2 min (major), 11.6 min (minor).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.38 (t,  $J$  = 7.6 Hz, 1H), 7.17 (m, 1H), 7.03 (m, 2H), 6.59 (d,  $J$  = 15.9 Hz, 1H), 6.19-6.11 (m, 1H), 2.70 (ddd,  $J$  = 64.3, 14.1, 7.6 Hz, 2H), 2.18 (s, 3H), 1.45 (s, 9H), 1.34 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  205.31, 171.47, 128.60, 128.52, 127.37, 127.28, 127.24, 126.05, 124.05, 124.02, 115.75, 115.53, 82.02, 60.34, 38.98, 27.86, 26.22, 19.19.  $^{19}\text{F}$  NMR (471 MHz,  $\text{CDCl}_3$ )  $\delta$  -118.59. IR (thin film,  $\text{cm}^{-1}$ ) 3359, 2979, 2931, 1712, 1449, 1151, 1116, 948, 756. HRMS (APCI) calcd for  $\text{C}_{18}\text{H}_{23}\text{O}_3\text{FNa}^+$ : 329.1522, found 329.1523.



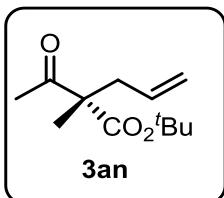
**3ak:** prepared according to the general procedure above and obtained as light yellow solid (method A: 87% yield, 98% *ee*; method B: 95% yield, 93% *ee*).  $[\alpha]_D^{25}=-31.7$  ( $c=0.29$ ,  $\text{CHCl}_3$ , 98% *ee*). HPLC analysis: Daicel Chiralpak OJ-H, 5% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 16.9 min (major), 22.4 min (minor).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.76 (t,  $J$  = 9.5 Hz, 3H), 7.65 (s, 1H), 7.53 (dd,  $J$  = 8.5, 1.3 Hz, 1H), 7.46-7.39 (m, 2H), 6.59 (d,  $J$  = 15.7 Hz, 1H), 6.24-6.16 (m, 1H), 2.74 (ddd,  $J$  = 61.7, 14.2, 7.5 Hz, 2H), 2.20 (s, 3H), 1.45 (s, 9H), 1.37 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  205.47, 171.60, 134.60, 133.79, 133.62, 132.89, 128.16, 127.93, 127.66, 126.23, 125.87, 125.74, 125.07, 123.54, 82.01, 60.44, 38.80, 27.91, 26.32, 19.31. IR (thin film,  $\text{cm}^{-1}$ ) 3564, 2079, 1709, 1634, 1368, 1255, 1153, 1117. HRMS (APCI) calcd for  $\text{C}_{22}\text{H}_{26}\text{O}_3\text{Na}^+$ : 361.1771, found 361.1774.



**3al:** prepared according to the general procedure above and obtained as light yellow oil (method A: 42% yield, 97% *ee*; method B: 92% yield, 90% *ee*).  $[\alpha]_D^{25} = -26.6$  ( $c=0.19$ , CHCl<sub>3</sub>, 90% *ee*). HPLC analysis: Daicel Chiraldpak OJ-H, 2% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 10.7 min (major), 12.3 min (minor). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$  7.38 (t,  $J = 8.0$  Hz 1H), 7.17 (t,  $J = 8.0$  Hz, 1H), 7.08-6.98 (m, 2H), 6.49 (d,  $J = 15.5$  Hz, 1H), 6.19-6.11 (m, 1H), 2.65 (ddd,  $J = 22.0, 14.2, 7.3$  Hz, 2H), 2.18 (s, 3H), 1.45 (s, 9H), 1.34 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  205.31, 171.47, 128.60, 128.52, 127.37, 127.28, 127.24, 126.05, 124.05, 124.02, 115.75, 115.53, 82.02, 60.34, 38.98, 27.86, 26.22, 19.19. IR (thin film, cm<sup>-1</sup>) 3437, 2978, 2934, 1712, 1369, 1256, 1152, 967, 845, 753. HRMS (EI) calcd for C<sub>16</sub>H<sub>22</sub>O<sub>4</sub>: 278.1518, found 278.1522.



**3am:** prepared according to the general procedure above and obtained as light yellow oil (method B: 59% yield, 91% *ee*).  $[\alpha]_D^{25} = -26.2$  ( $c=0.16$ , CHCl<sub>3</sub>). HPLC analysis: Daicel Chiraldpak OJ-H, 2% *iso*-propanol/hexane, flow rate = 1.0 mL/min,  $\lambda=254$  nm, retention time: 12.8 min (major), 16.1 min (minor). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  7.10 (d,  $J = 5.0$  Hz, 1H), 6.92 (dd,  $J = 5.0, 3.6$  Hz, 1H), 6.87 (d,  $J = 3.3$  Hz, 1H), 6.54 (d,  $J = 15.5$  Hz, 1H), 5.93-5.86 (m, 1H), 2.63 (ddd,  $J = 22.0, 14.2, 7.3$  Hz, 2H), 2.17 (s, 3H), 1.45 (s, 9H), 1.33 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  205.37, 171.47, 142.23, 127.24, 126.77, 125.00, 124.46, 123.79, 82.04, 60.36, 38.51, 27.87, 26.27, 19.26. IR (thin film, cm<sup>-1</sup>) 3408, 2977, 2932, 1712, 1152, 771. HRMS (EI) calcd for C<sub>16</sub>H<sub>22</sub>O<sub>3</sub>S: 294.1290 found 294.1295.



**3an:** prepared according to the general procedure above and obtained as colorless oil

(Method B: 51% yield).  $[\alpha]_D^{25} = -28.3$  ( $c=0.12$ , CHCl<sub>3</sub>) The ee was determined after one step transformation of the desired product **3an** to **3aa** via cross olefin metathesis reaction (general procedure: **3an** (10.8 mg, 0.051 mmol) and Grubbs 2<sup>nd</sup> catalyst (10 mol%, 4.2mg) was dissolved in 1 mL CH<sub>2</sub>Cl<sub>2</sub> and added to a flame-dried Schlenk tube equipped with a magnetic stir bar, then styrene (6.1 mg, 0.06 mmol) was added and the reaction was conducted at room temperature for 4 h, the solvent was removed and residue was purified by silica gel chromatography to afford **3aa** (81% yield), the ee was determined by HPLC as 86% ee) <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ 5.70-5.62 (m, 1H), 5.11-5.08 (m, 2H), 2.53 (ddd,  $J = 63.8, 14.2, 7.4$  Hz, 2H), 2.15 (s, 3H), 1.45 (s, 9H), 1.28 (s, 3H). <sup>13</sup>C NMR (126 MHz, CDCl<sub>3</sub>) δ 205.37, 171.59, 132.84, 118.80, 81.85, 59.94, 39.30, 27.85, 26.18, 18.83. IR (thin film, cm<sup>-1</sup>) 3510, 2065, 1635, 1369, 1250, 1142, 656. HRMS has been reported in previous literature [3].

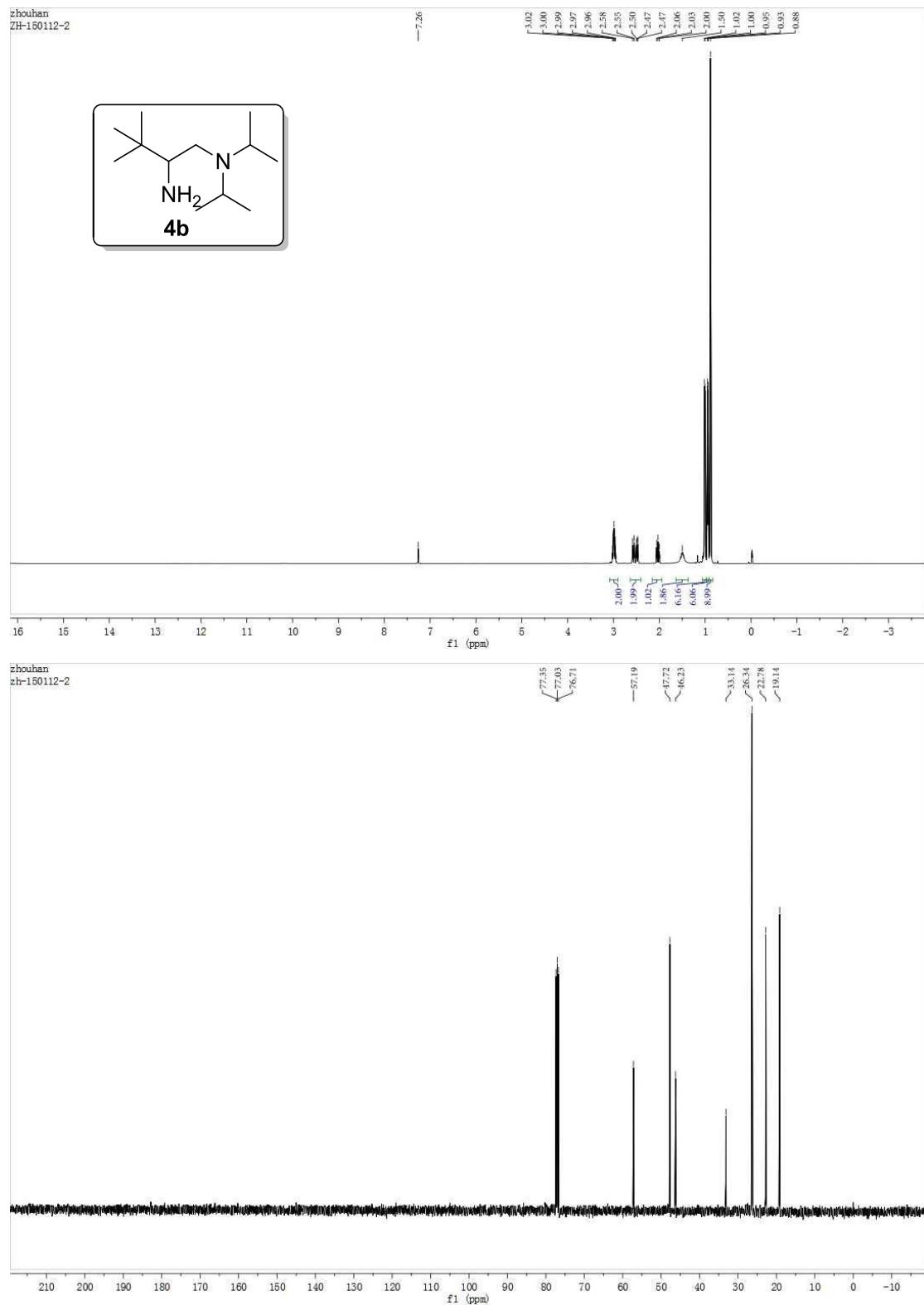
### General procedure for the gram scale experiments:

Gram scale experiments with **1a** and **1j**: To a flame-dried Schlenk tube equipped with a magnetic stir bar was added *substrates 1a or 1j* (1.5 mmol), allylic alcohol (1.0 mmol), [Pd(allyl)Cl]<sub>2</sub> (2.5 mol%), PPh<sub>3</sub> (10 mol%) and primary amine (**4b**, 10 mol%), the mixture was diluted with 4.5 mL of anhydrous CH<sub>3</sub>CN, then degassed for 3 times under standard freeze-thaw method. The reaction was conducted at 40 °C for several days, the solvent was removed and residue was purified by silica gel chromatography (5% EtOAc in Petroleum ether) to afford **3ah** (method B: 3 d, 216 mg, 67% yield, 93% ee) and **3ja** (method A: 5 d, 208 mg, 73% yield, 95% ee; method B: 3 d, 223 mg, 78% yield, 91% ee). The enantiometric excess was determined by HPLC (OJ-H).

### Reference:

- [1] C. Xu, L. Zhang, S. Luo, *Angew. Chem. Int. Ed.*, **2014**, *53*, 4149.
- [2] J. T. Reeves, Z. Tan, M. A. Herbage, Z. S. Han, M. A. Marsini, Z. Li, G. LI, Y. Xu, K. R. Fandrick N. C. Gonnella, S. Campbell, S. Ma, N. Grinberg, H. Lee, B. Z. Lu, C. H. Senanayake, *J. Am. Chem. Soc.* **2013**, *135*, 5565.
- [3] K. Nagata, D. Sano, Y. Shimizu, M. Miyazaki, T. Kanemitsu, T. Itoh, *Tetrahedron: Asymmetry*. **2009**, *20*, 2530.

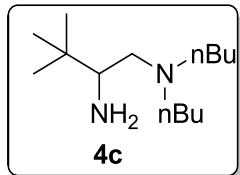
## NMR spectra:



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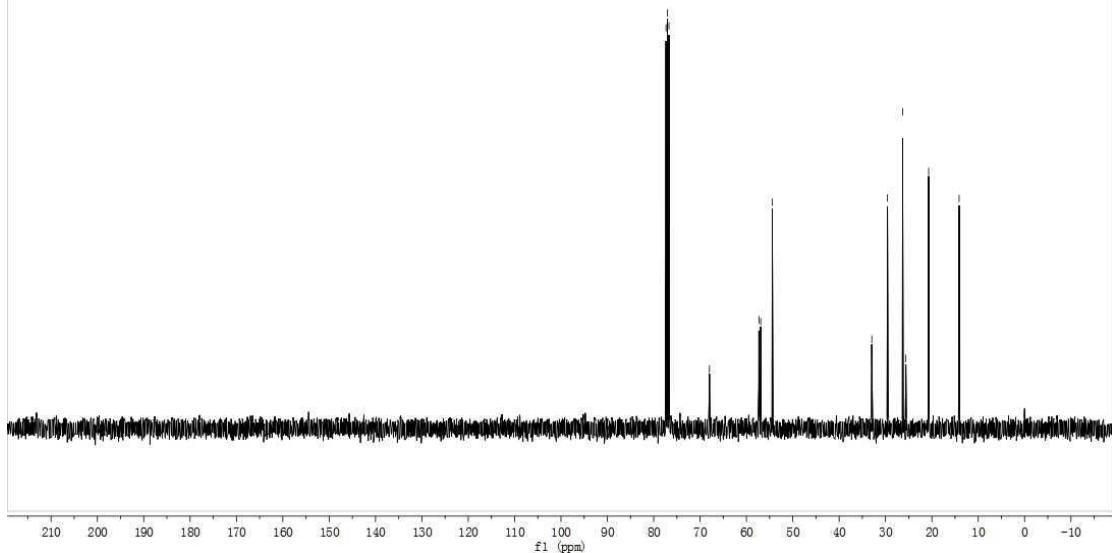
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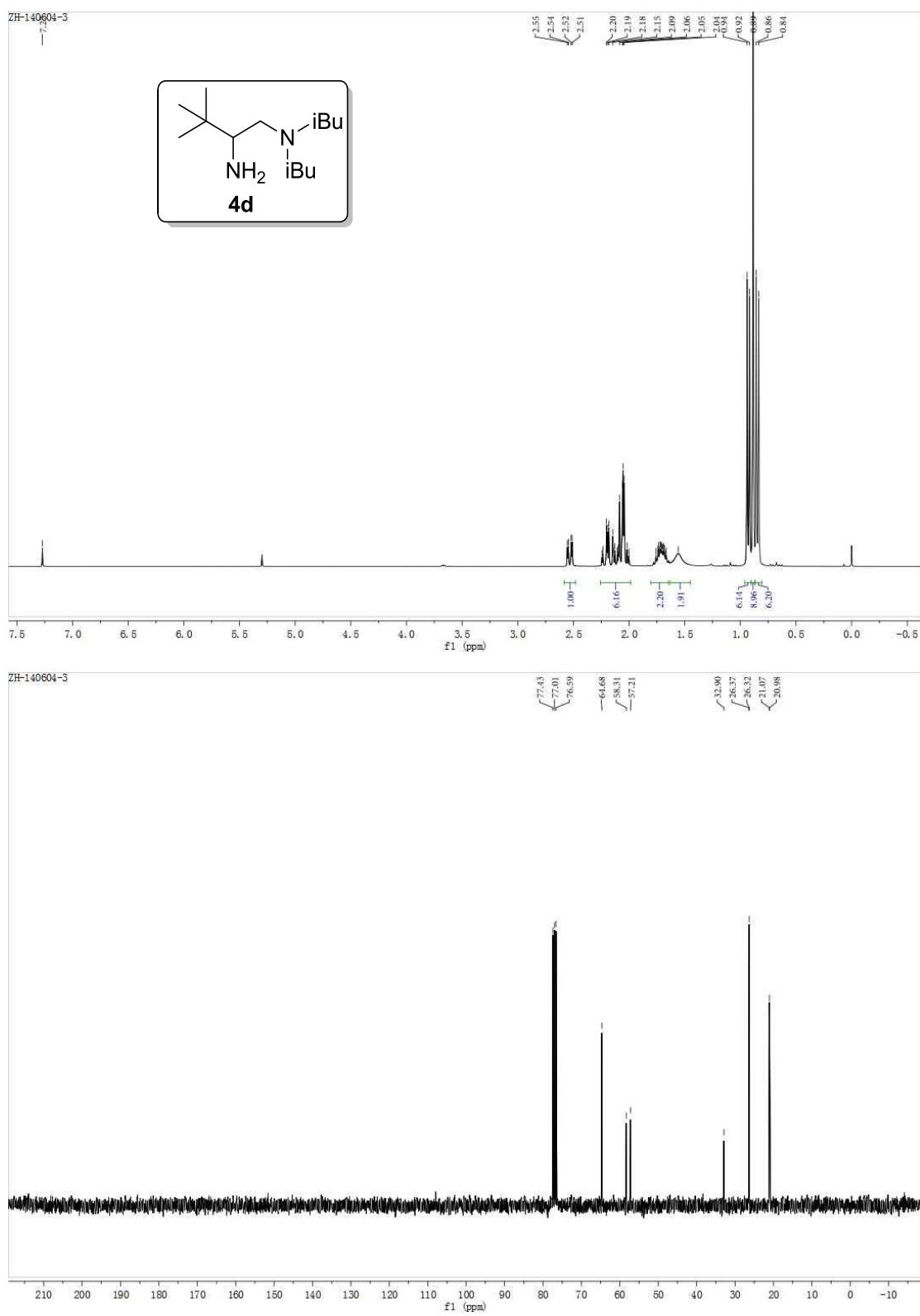


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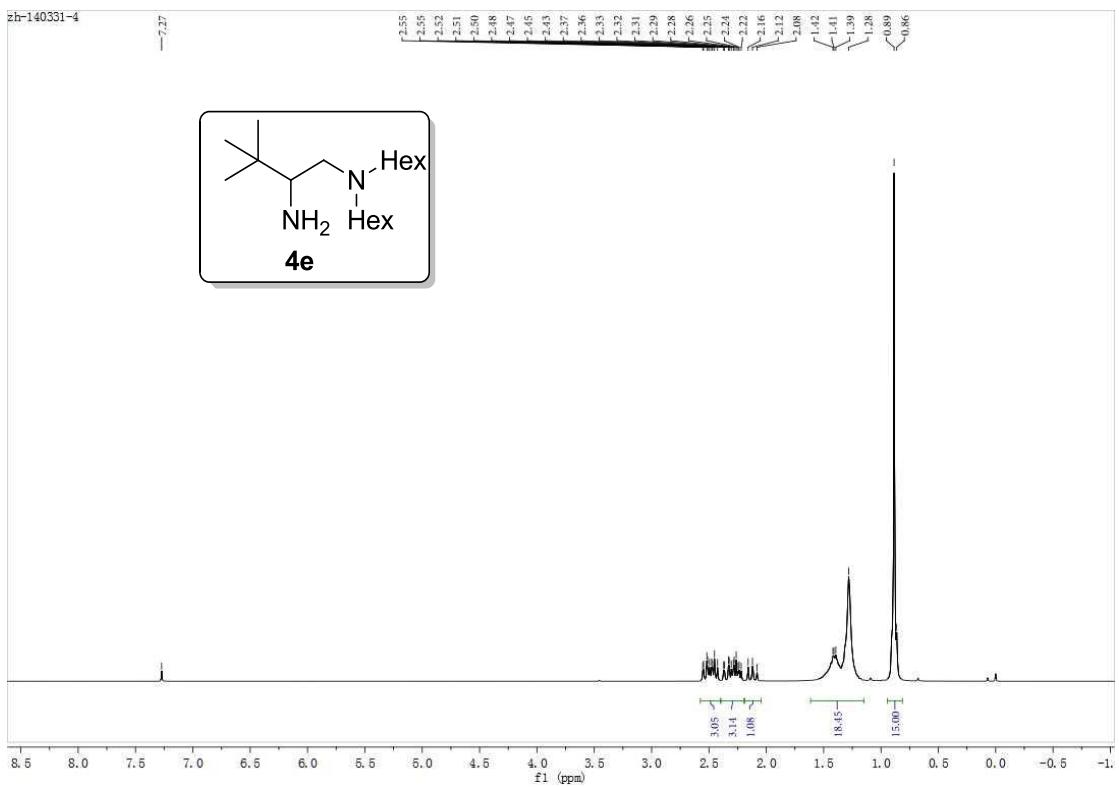
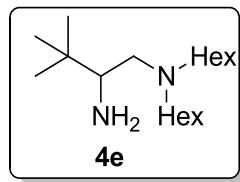
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14.12





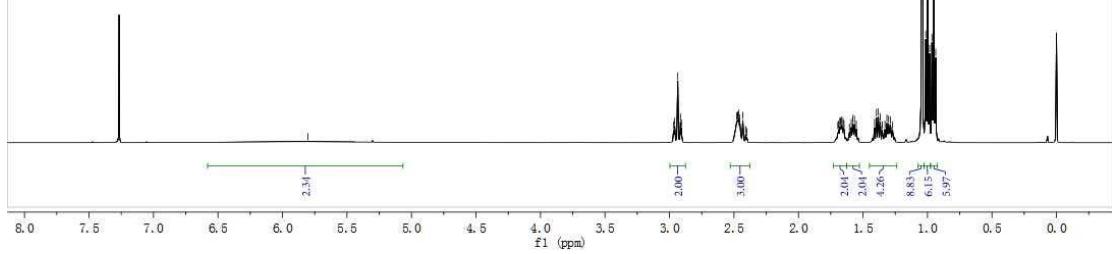
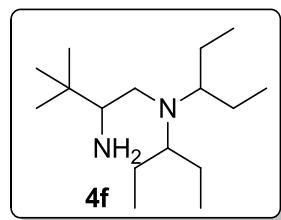
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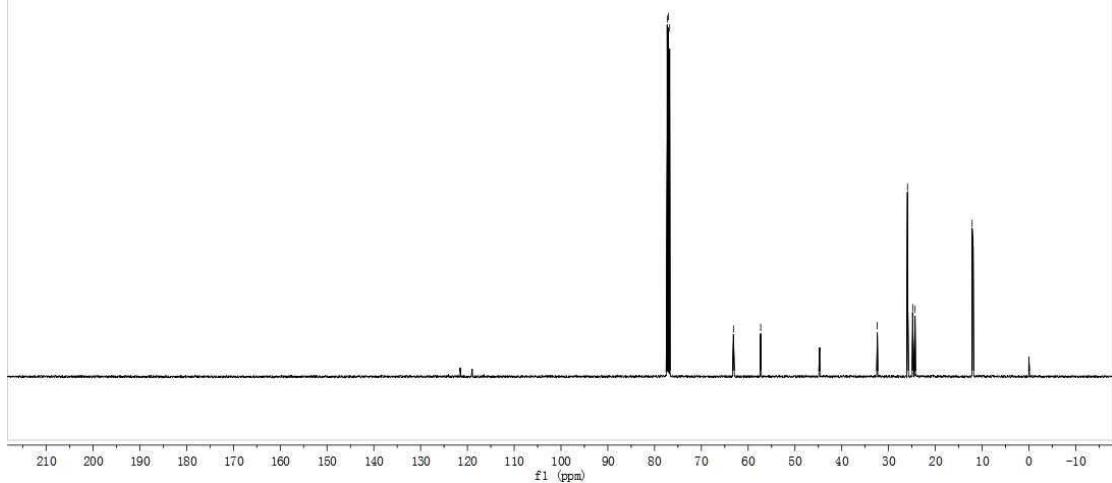
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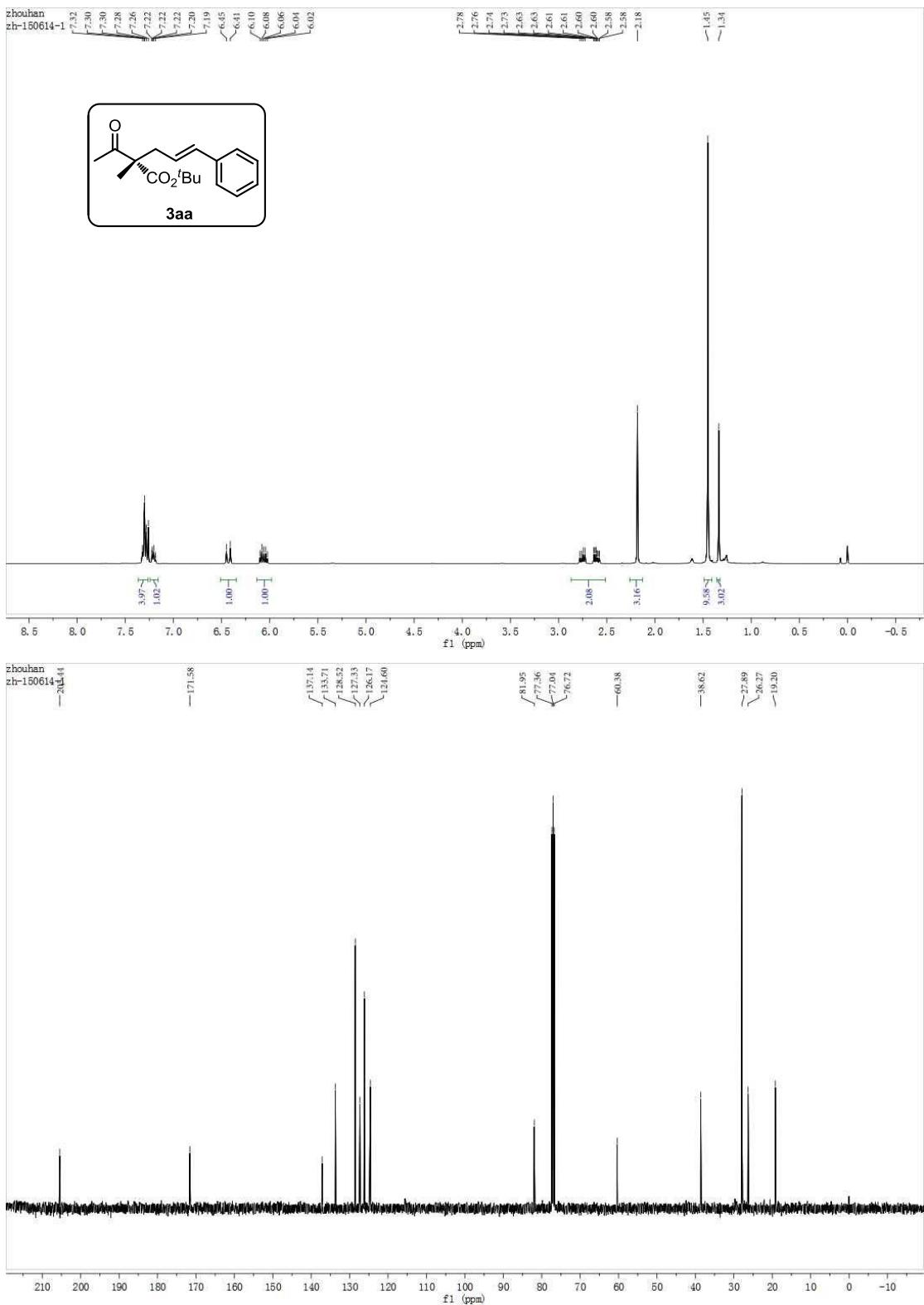
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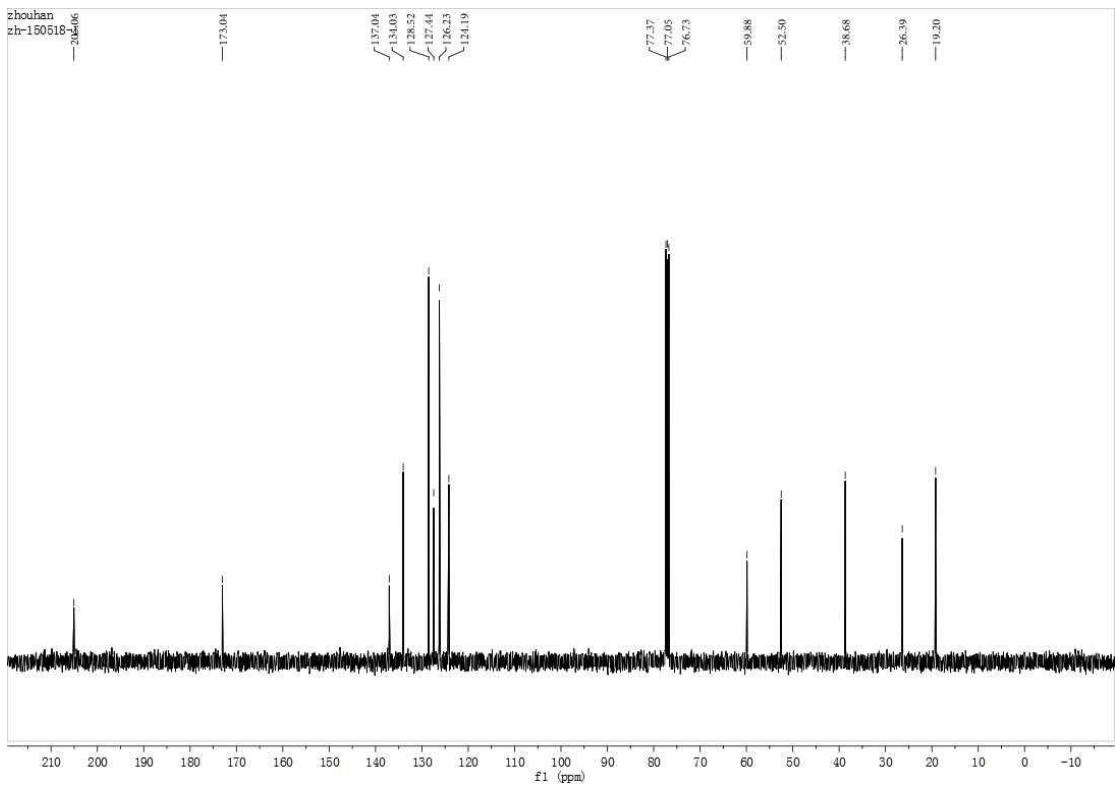
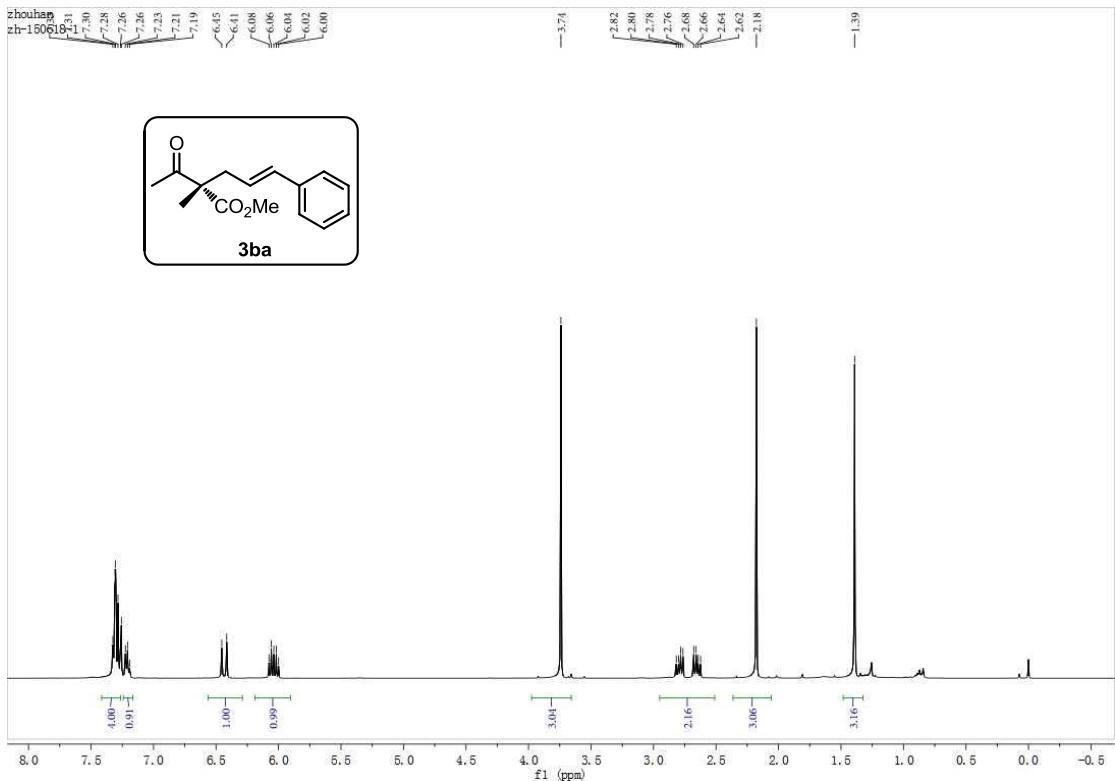


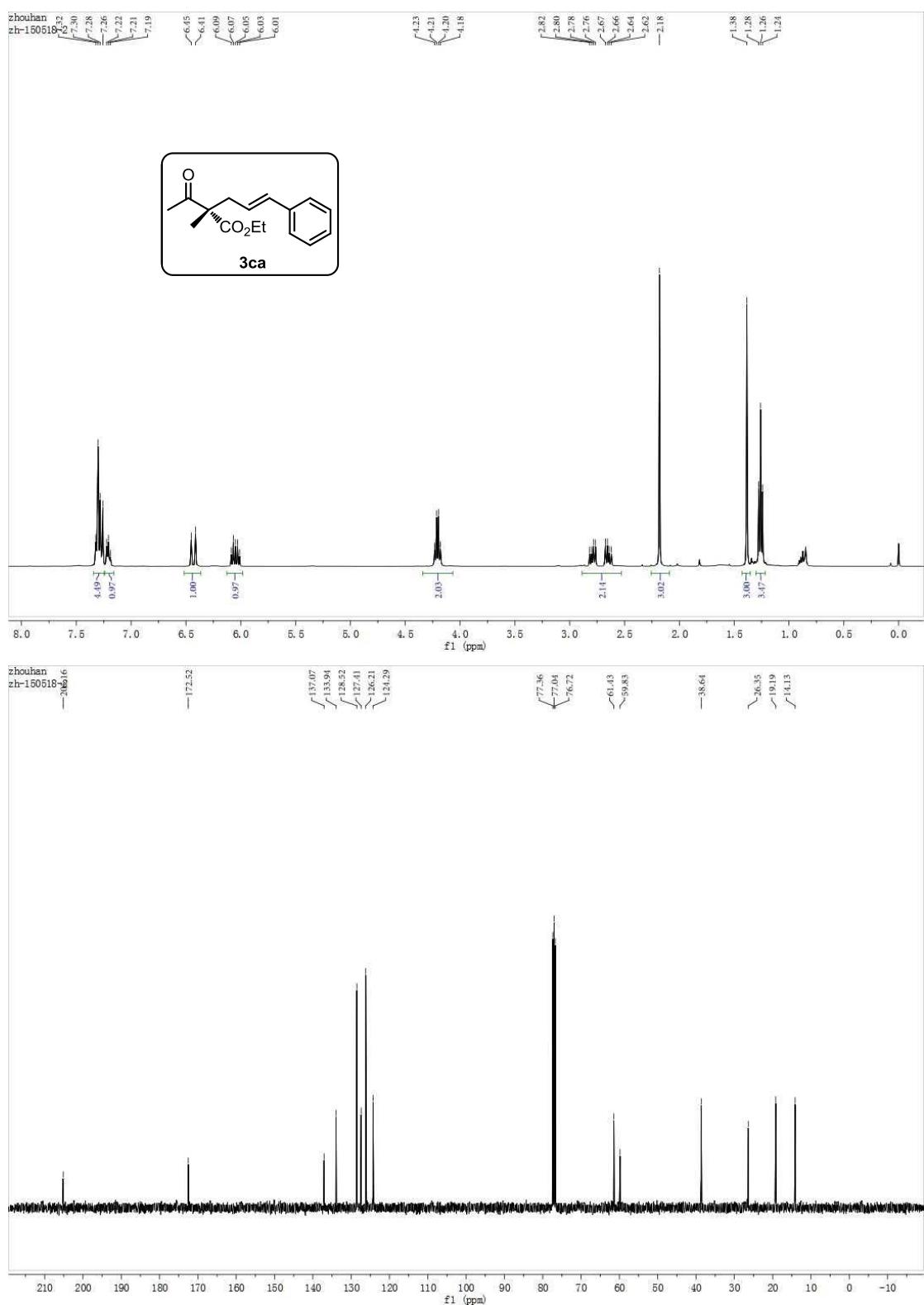
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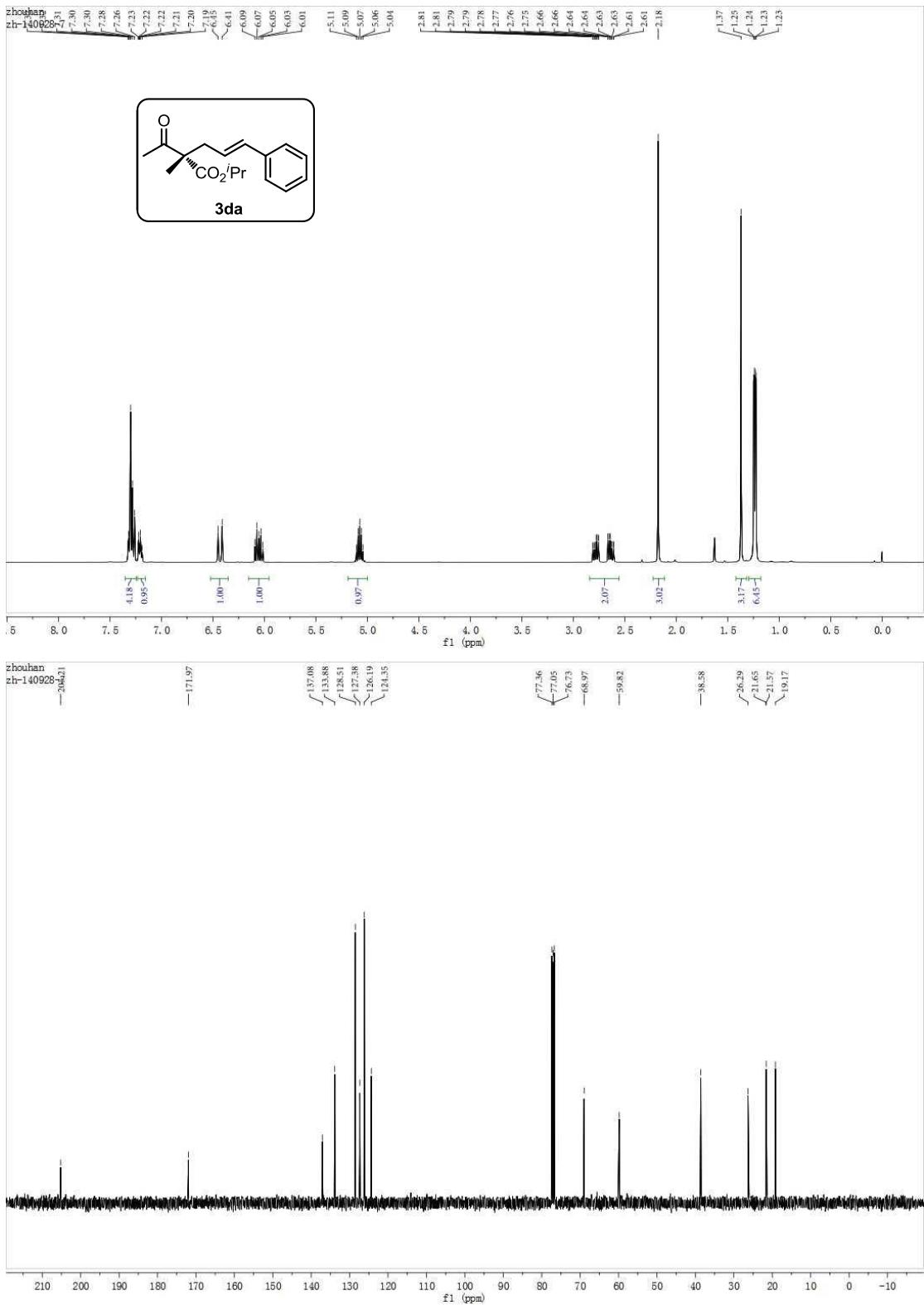
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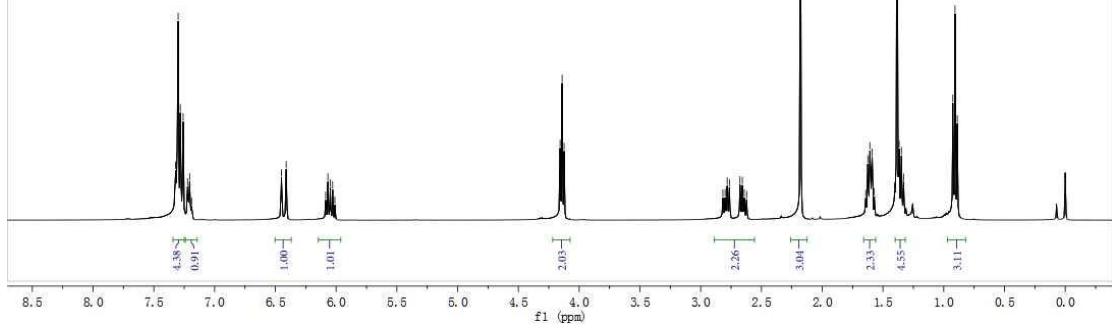
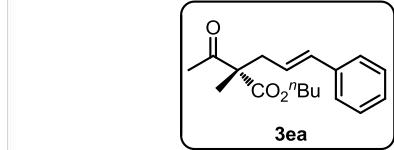




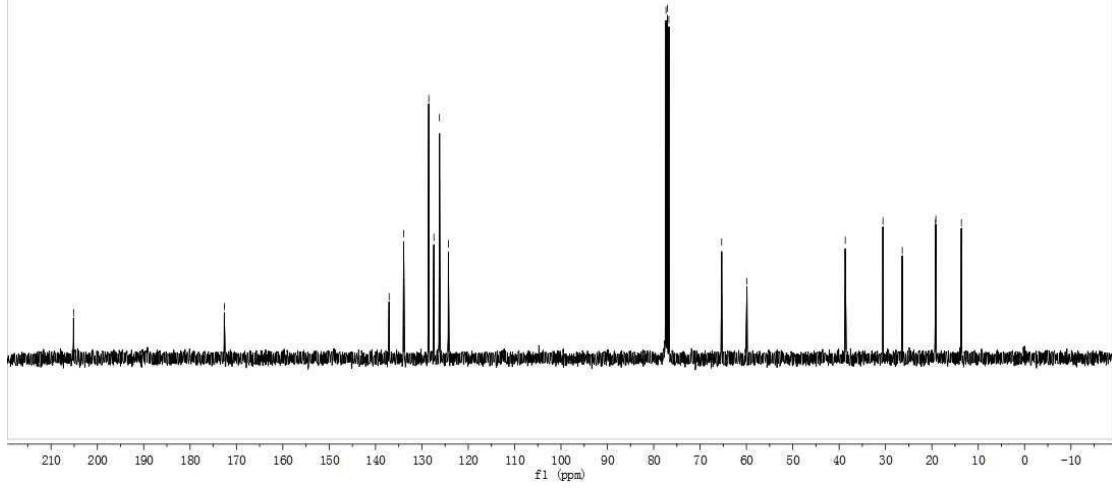


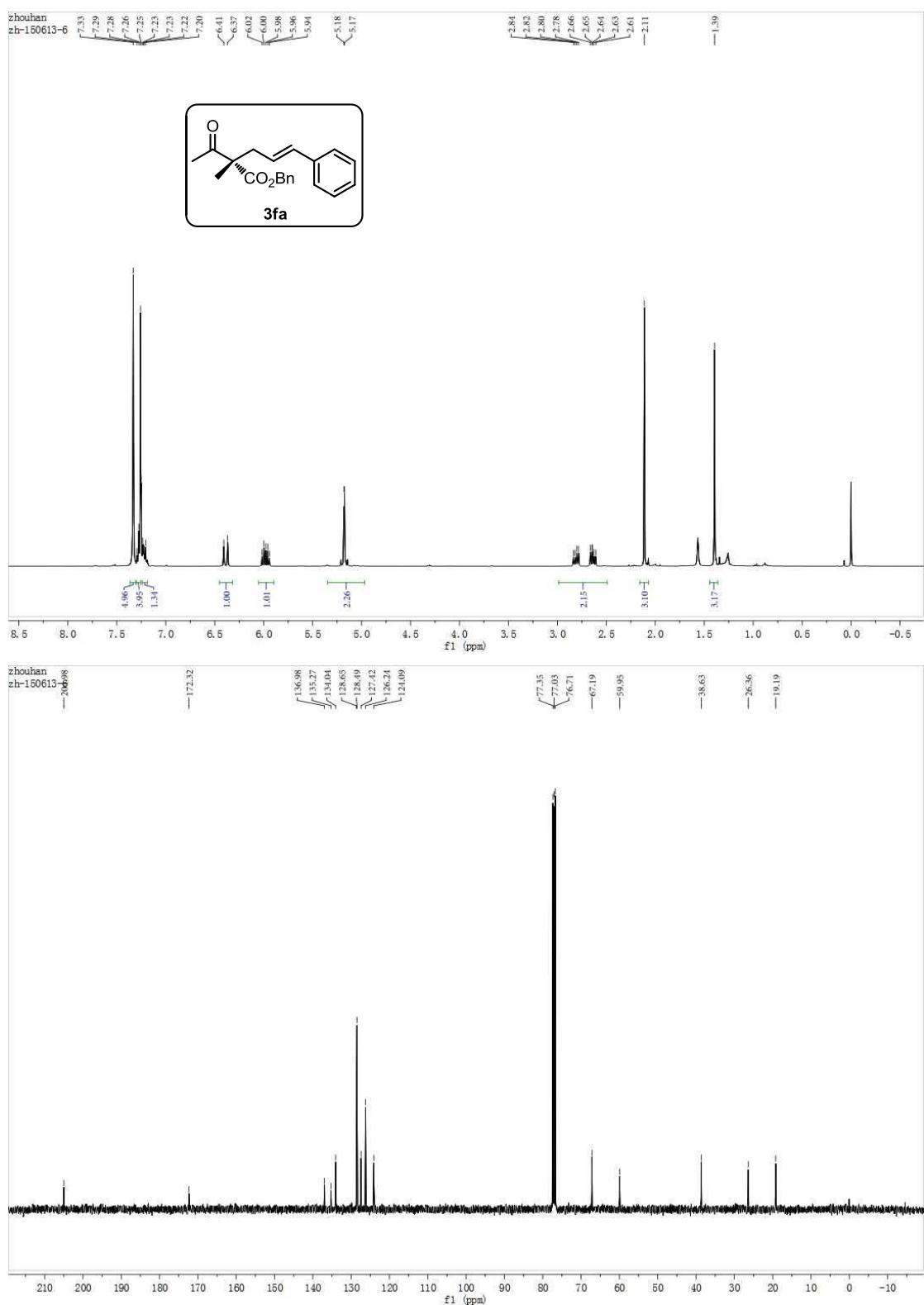


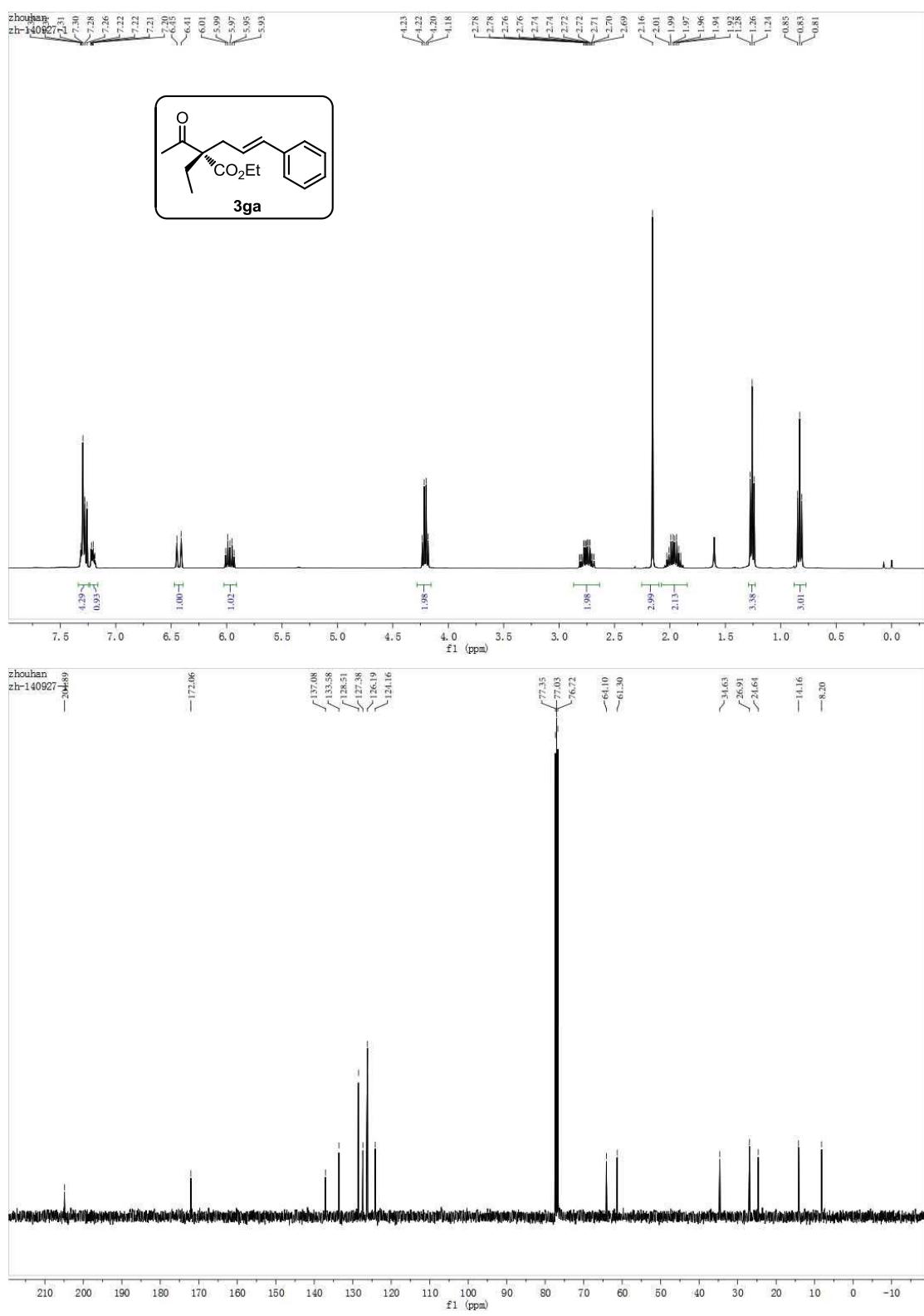
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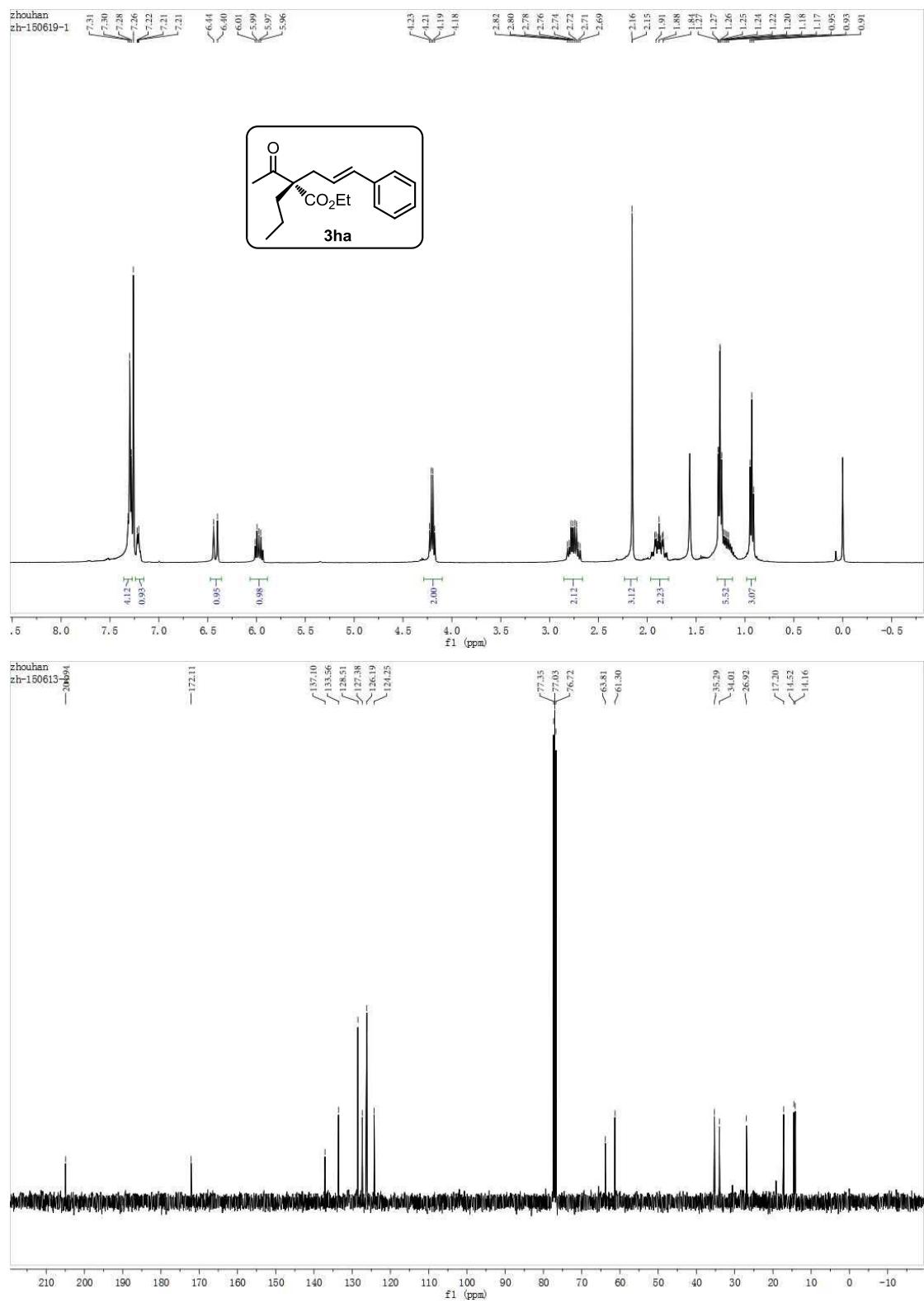


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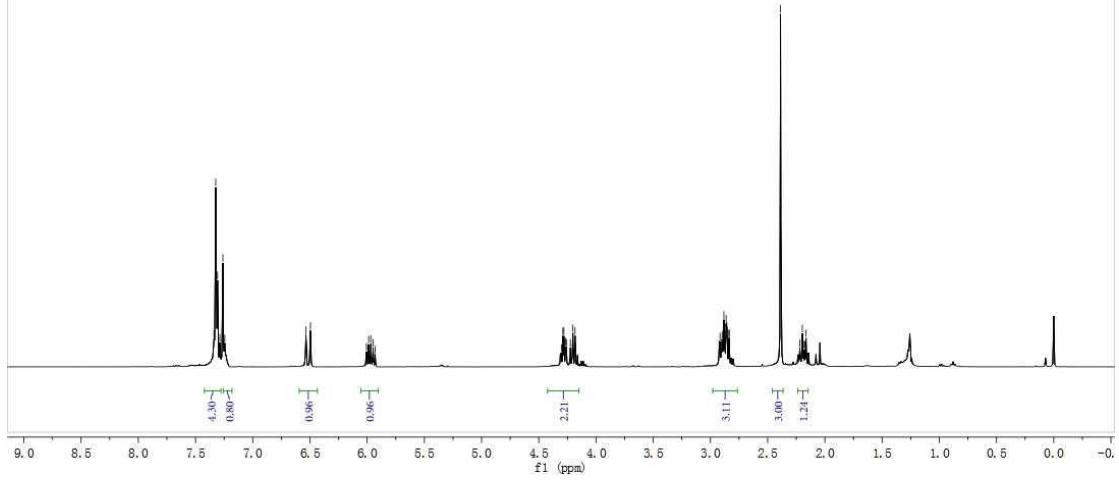
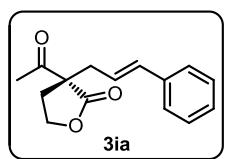






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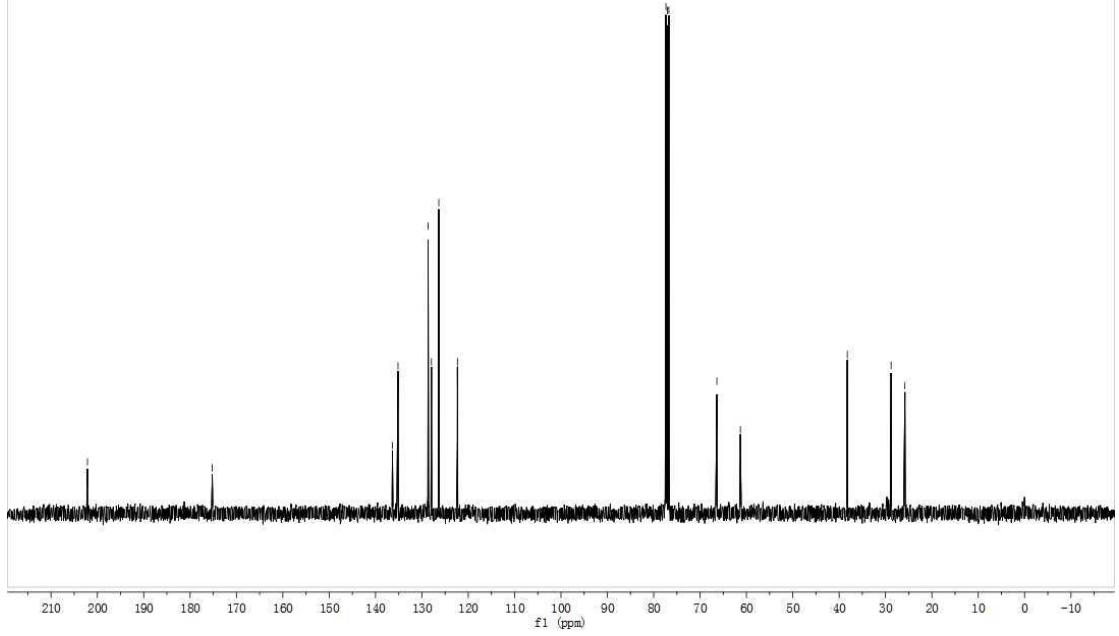
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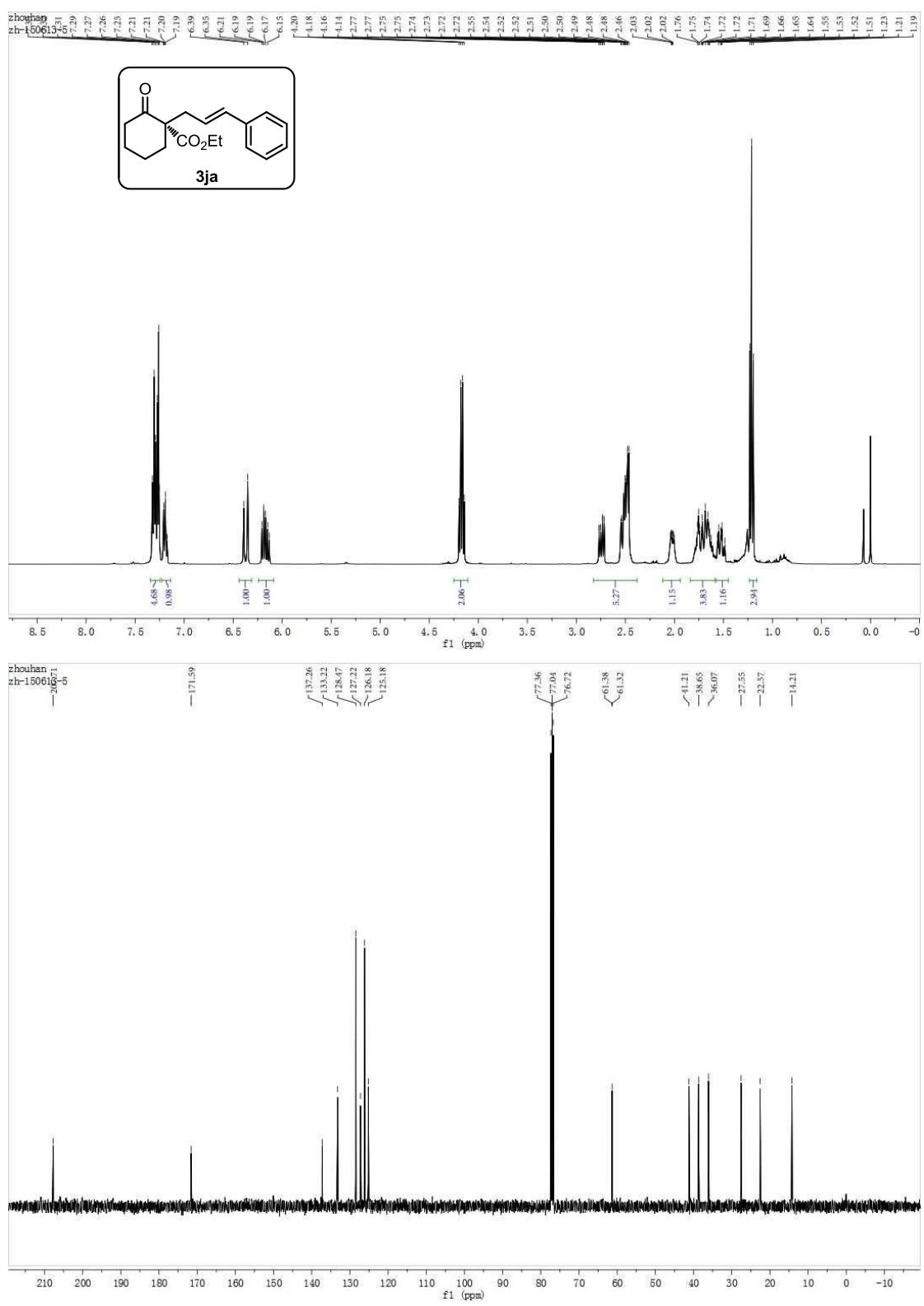


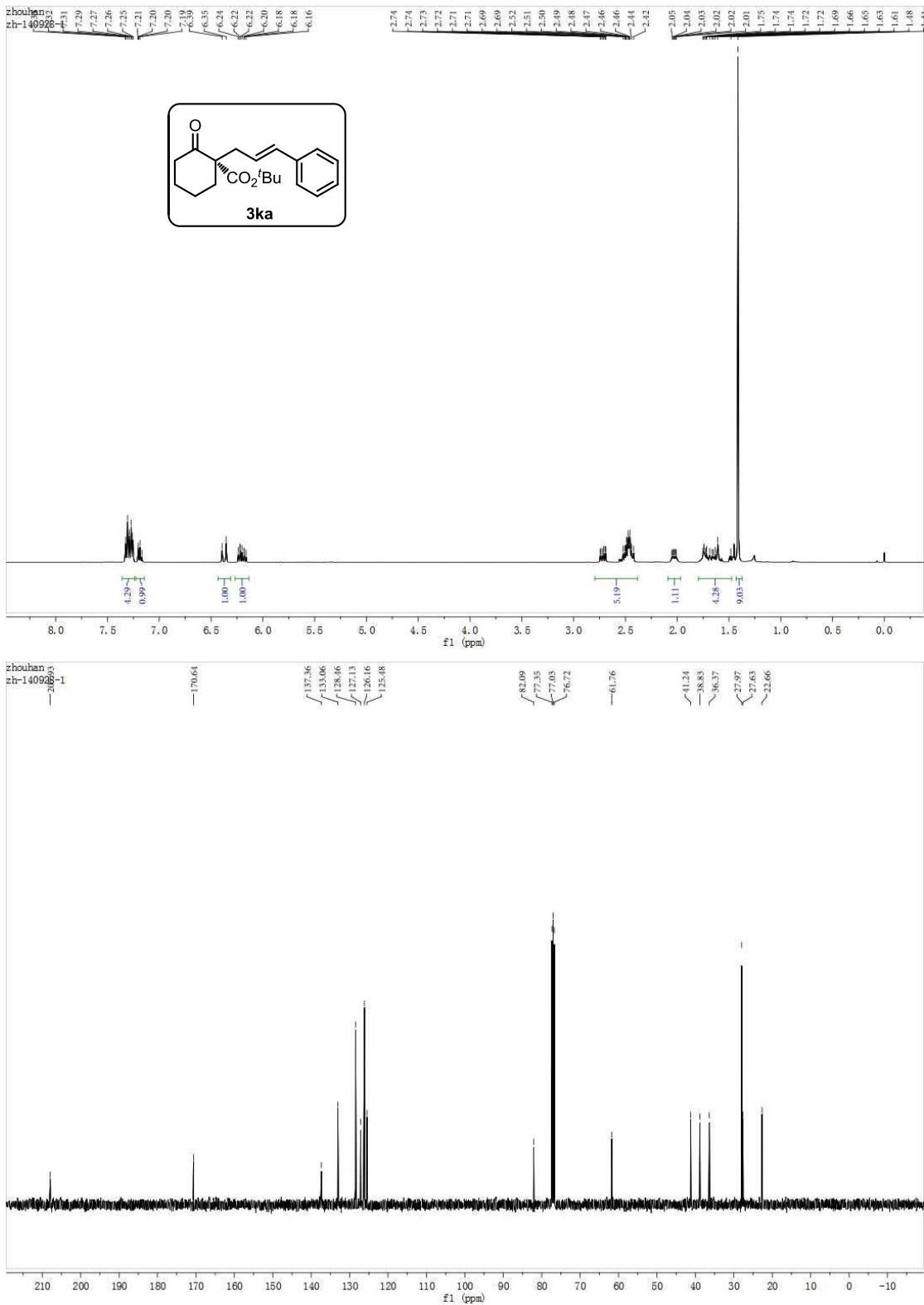
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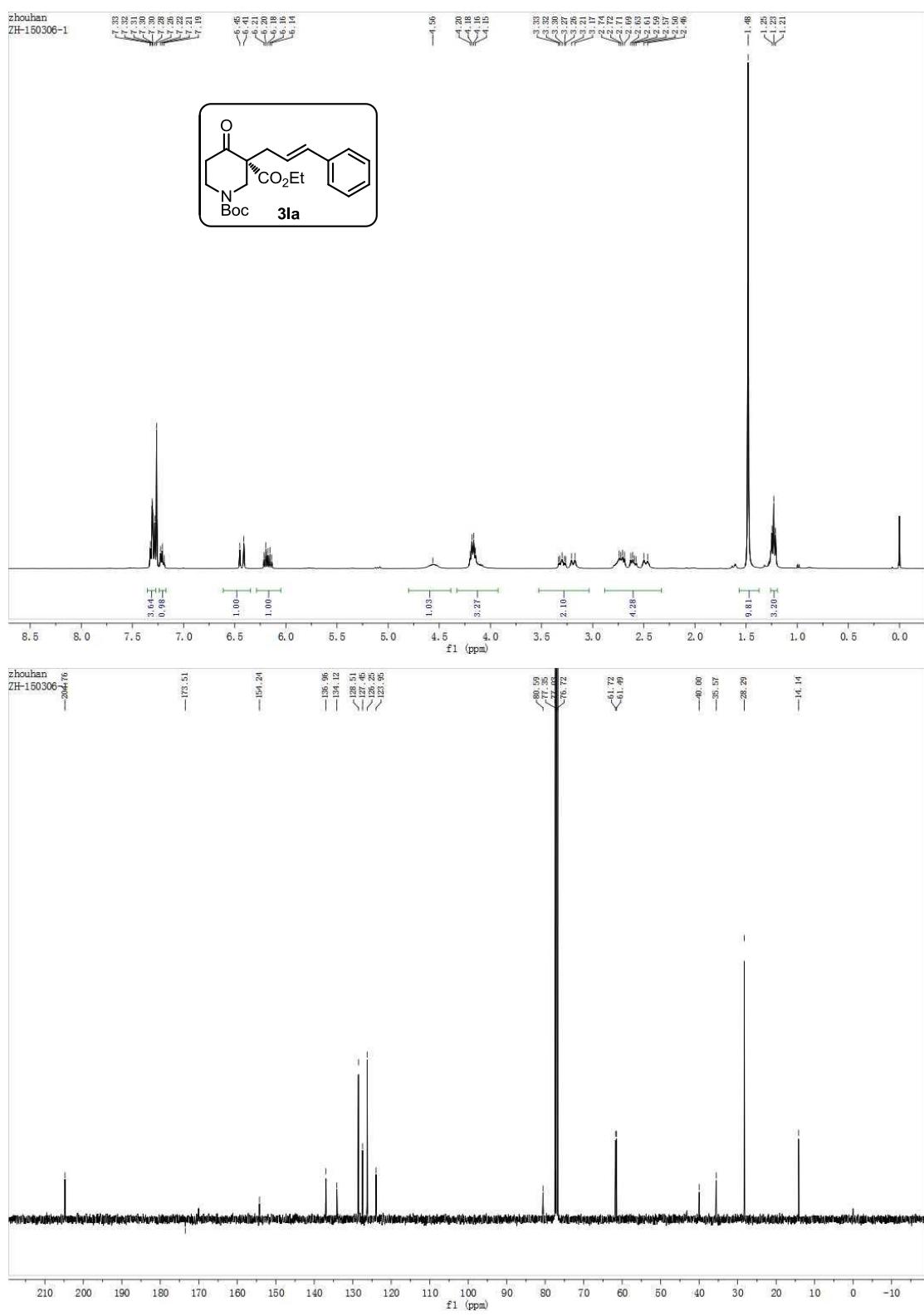
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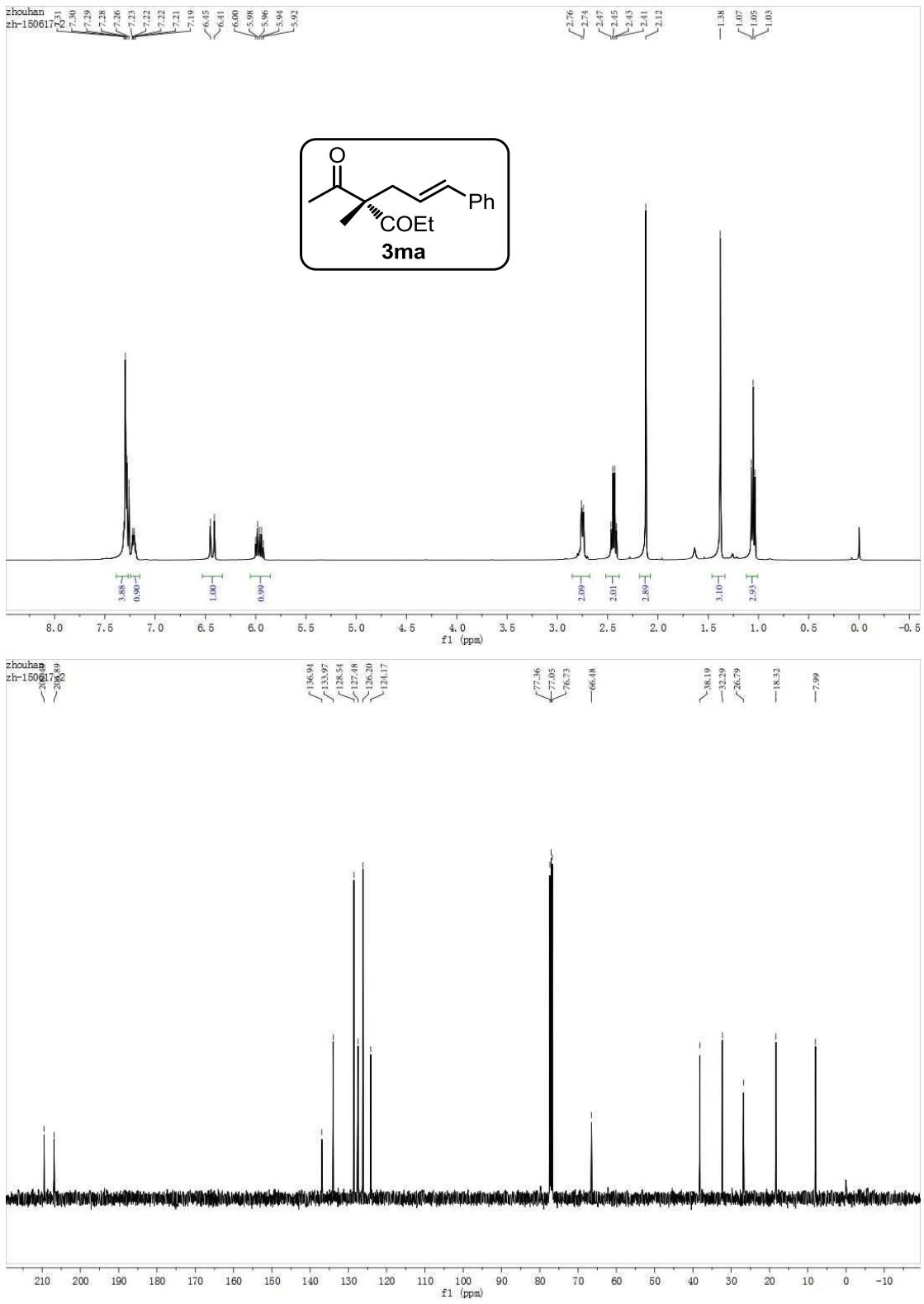
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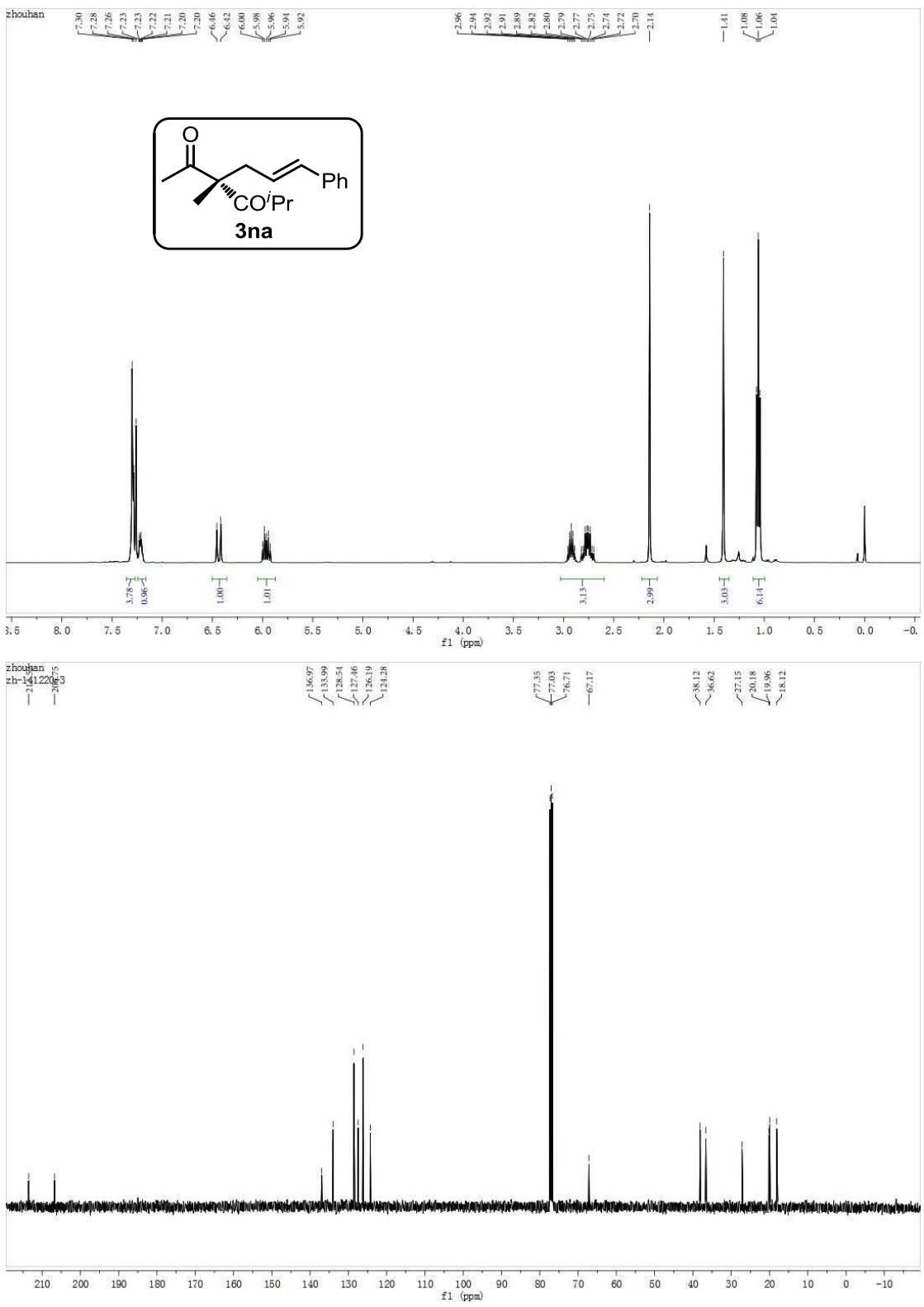


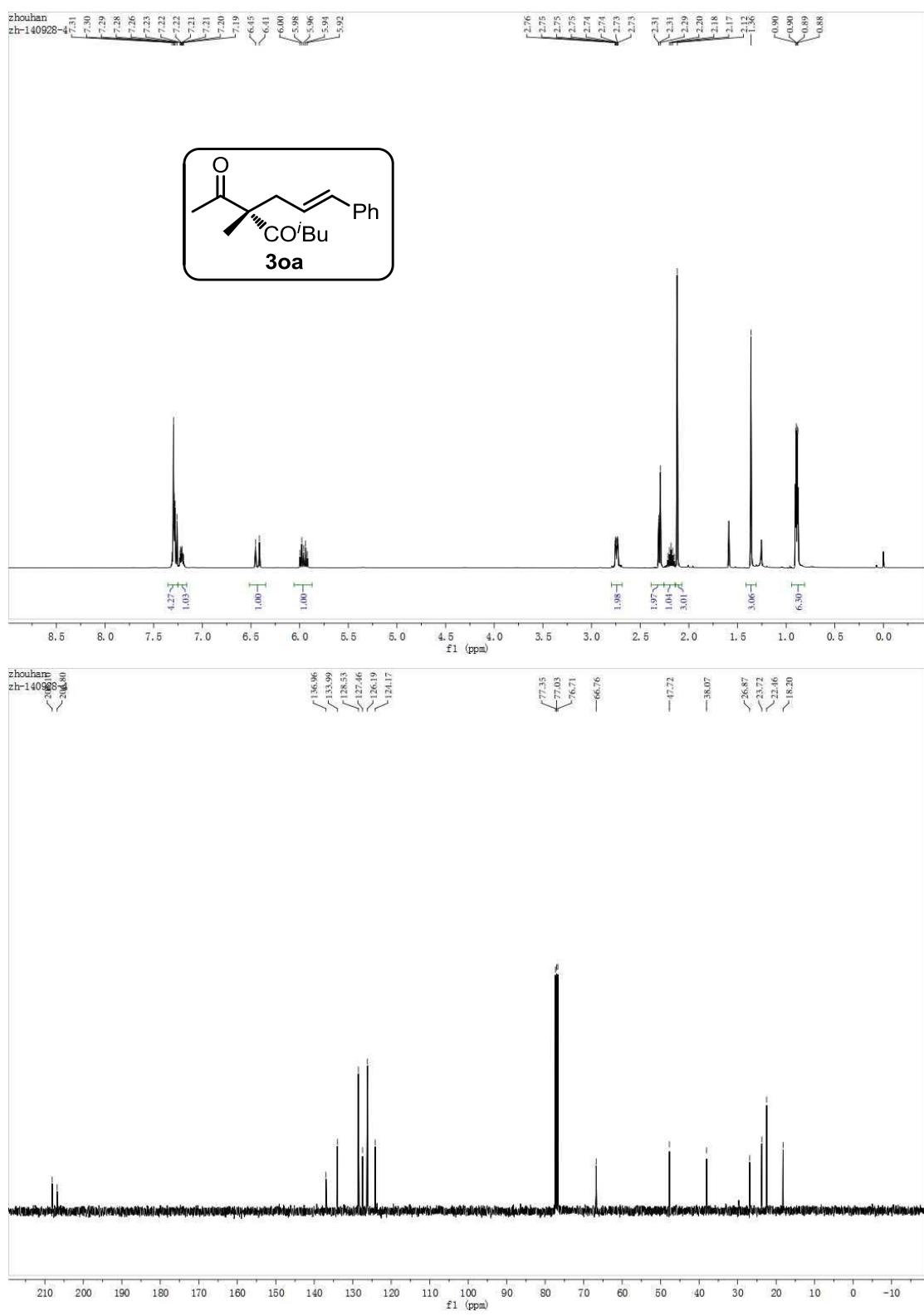




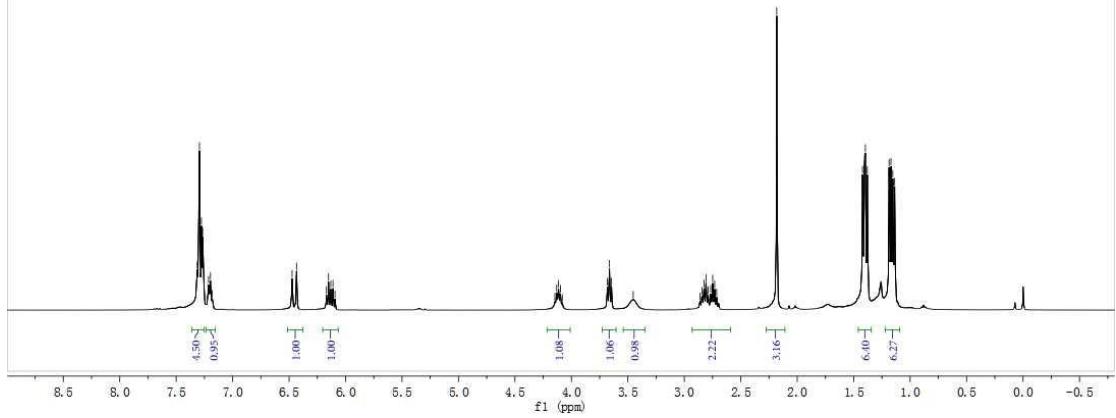
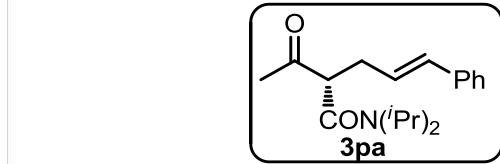




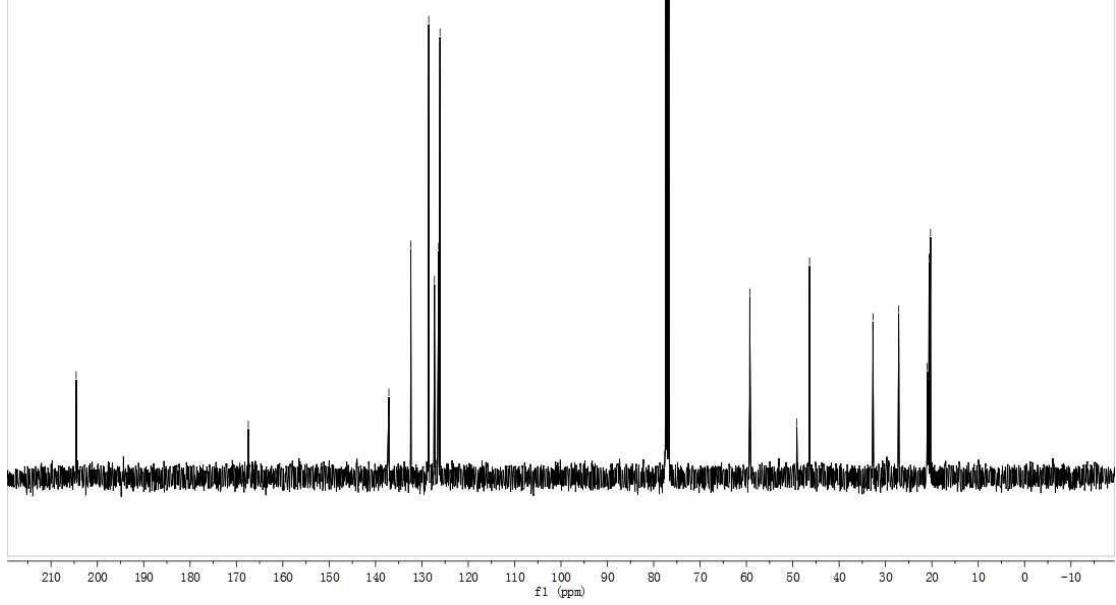




zhouhan  
zh-150623-1

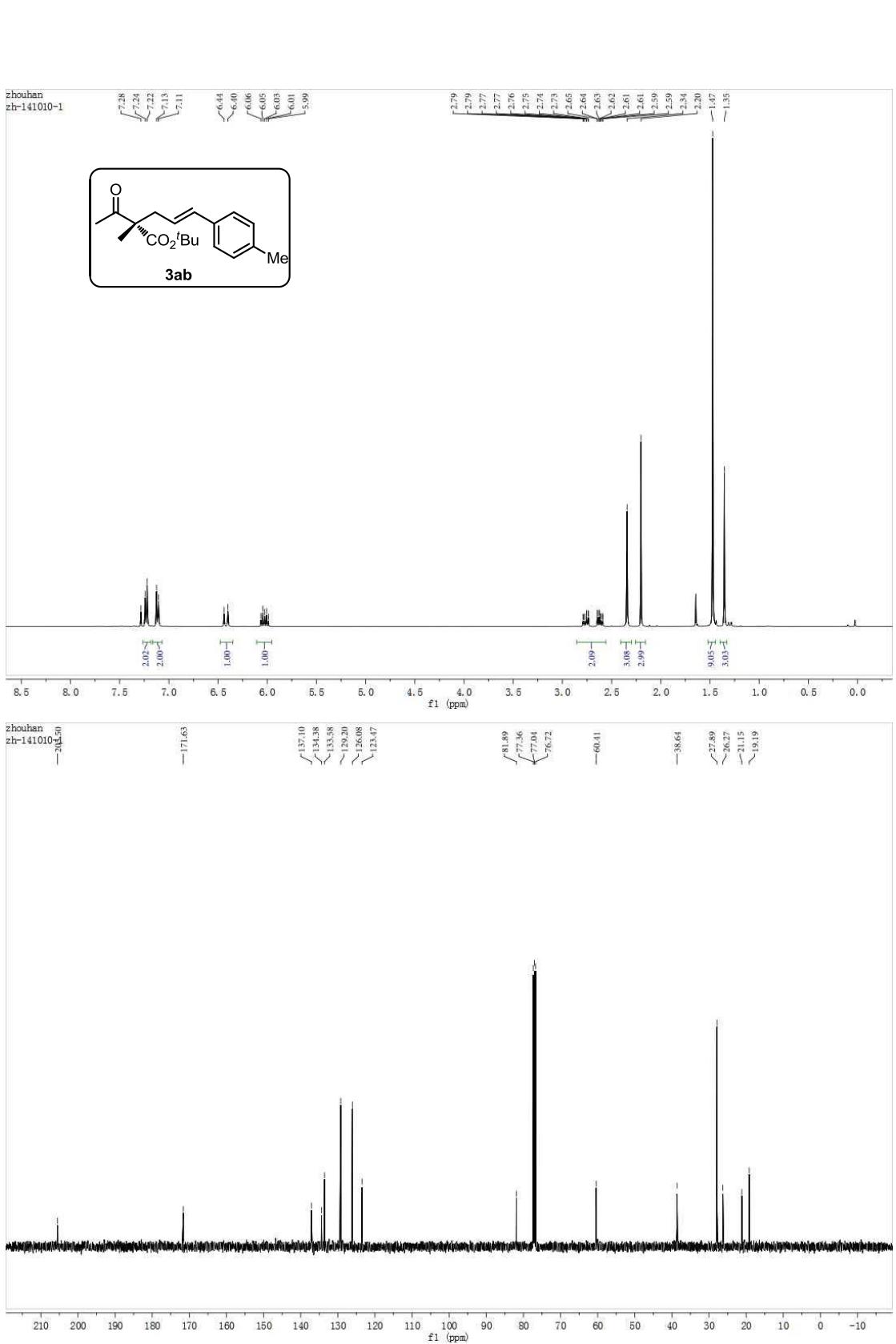
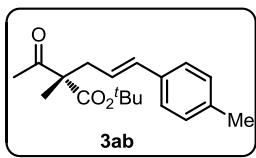


zhouhan  
zh-150623-2044:57

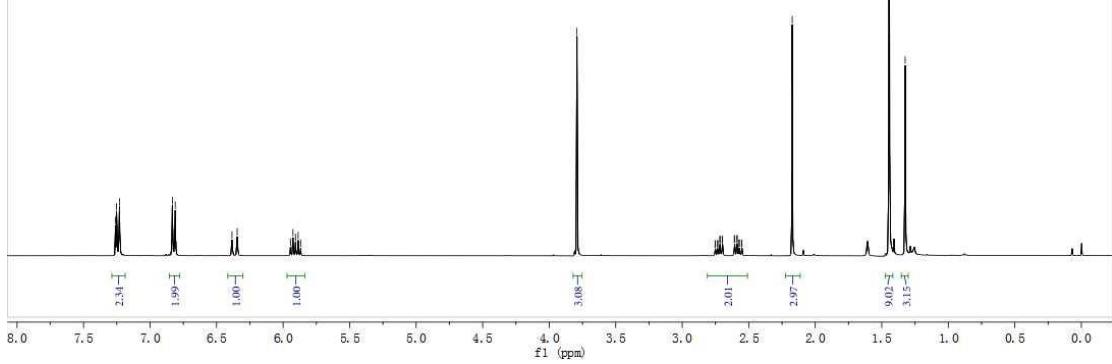
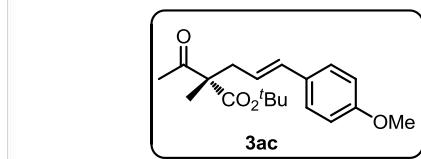


zhouhan  
zh-141010-1

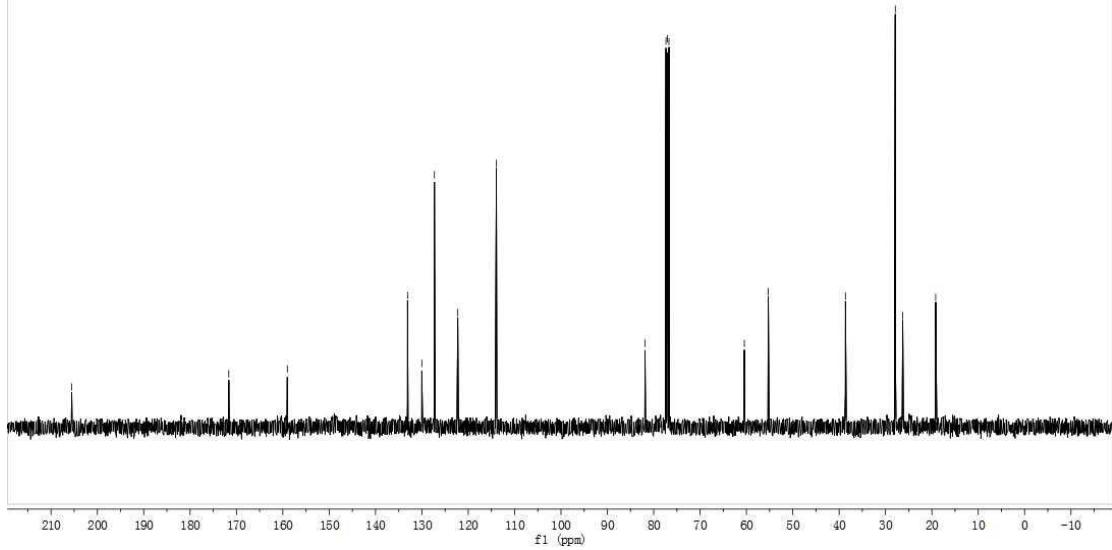
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7.24  
7.22  
7.13  
7.11  
6.44  
6.40  
6.06  
6.03  
6.01  
5.99



zhouhan  
zh-140928-



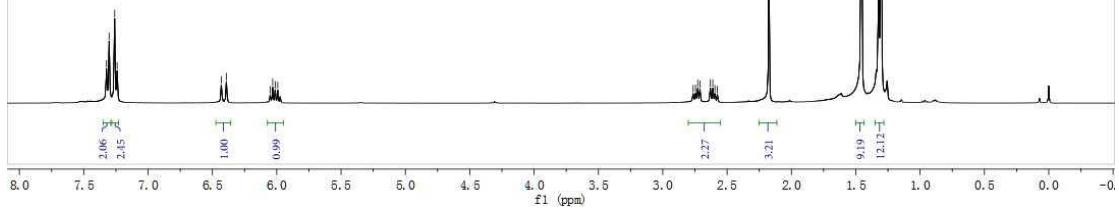
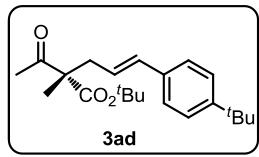
zhouhan  
zh-140928-153



zhouhan  
zh-150613-3

7.32  
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7.26  
7.24  
6.43  
6.39  
6.05  
6.03  
6.01  
5.99

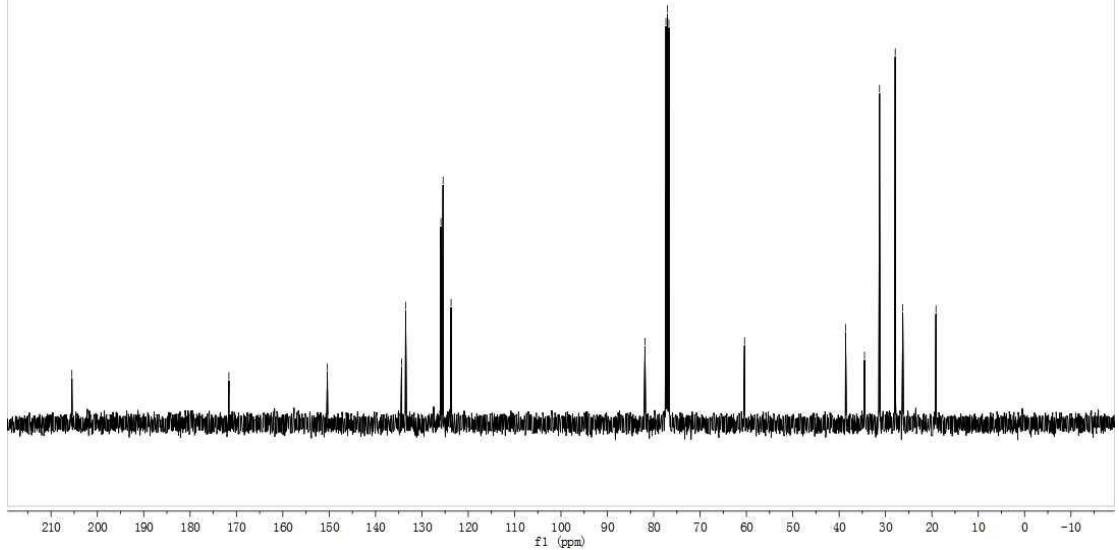
2.76  
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2.73  
2.71  
2.63  
2.61  
2.59  
2.58  
2.38  
2.18

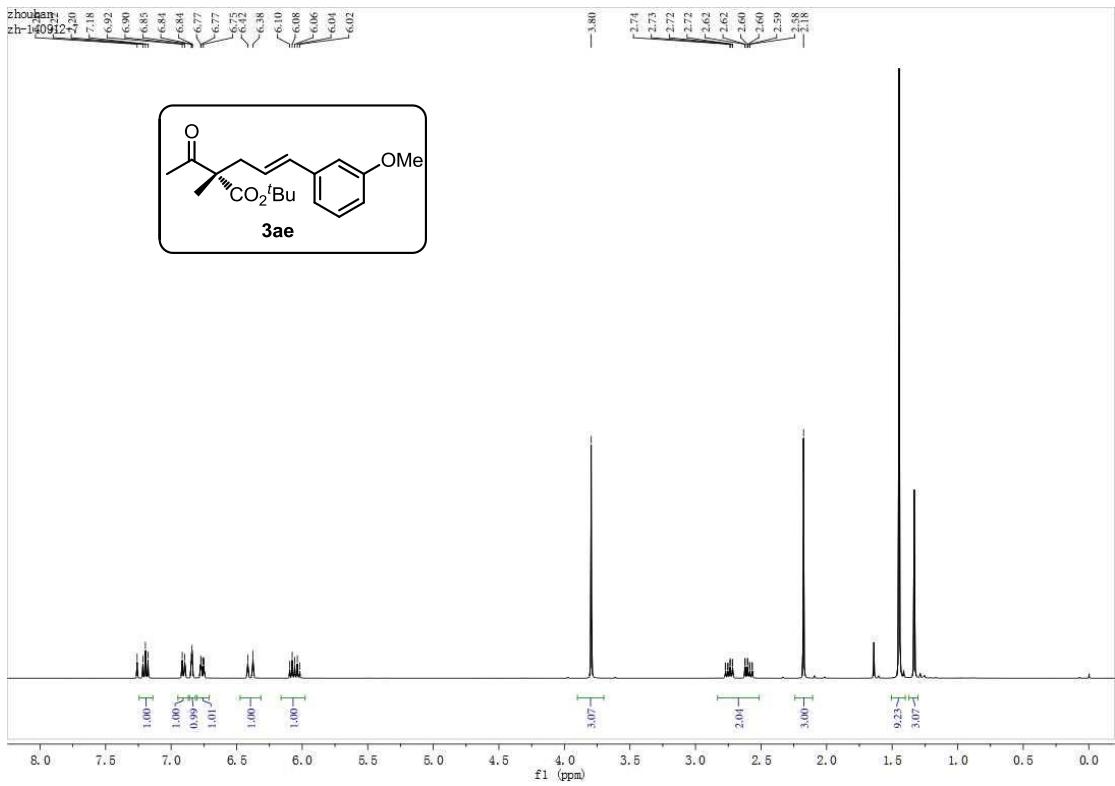


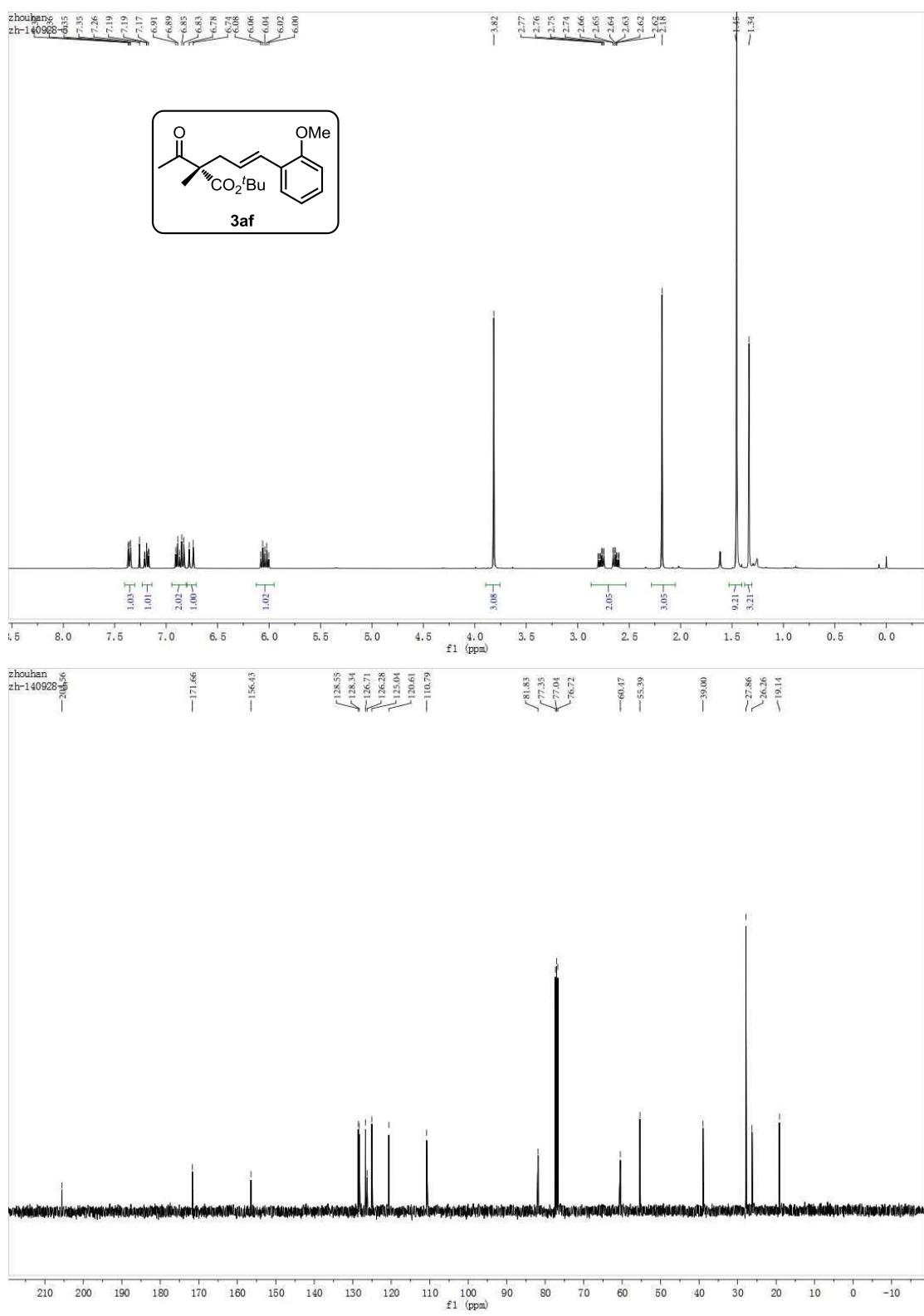
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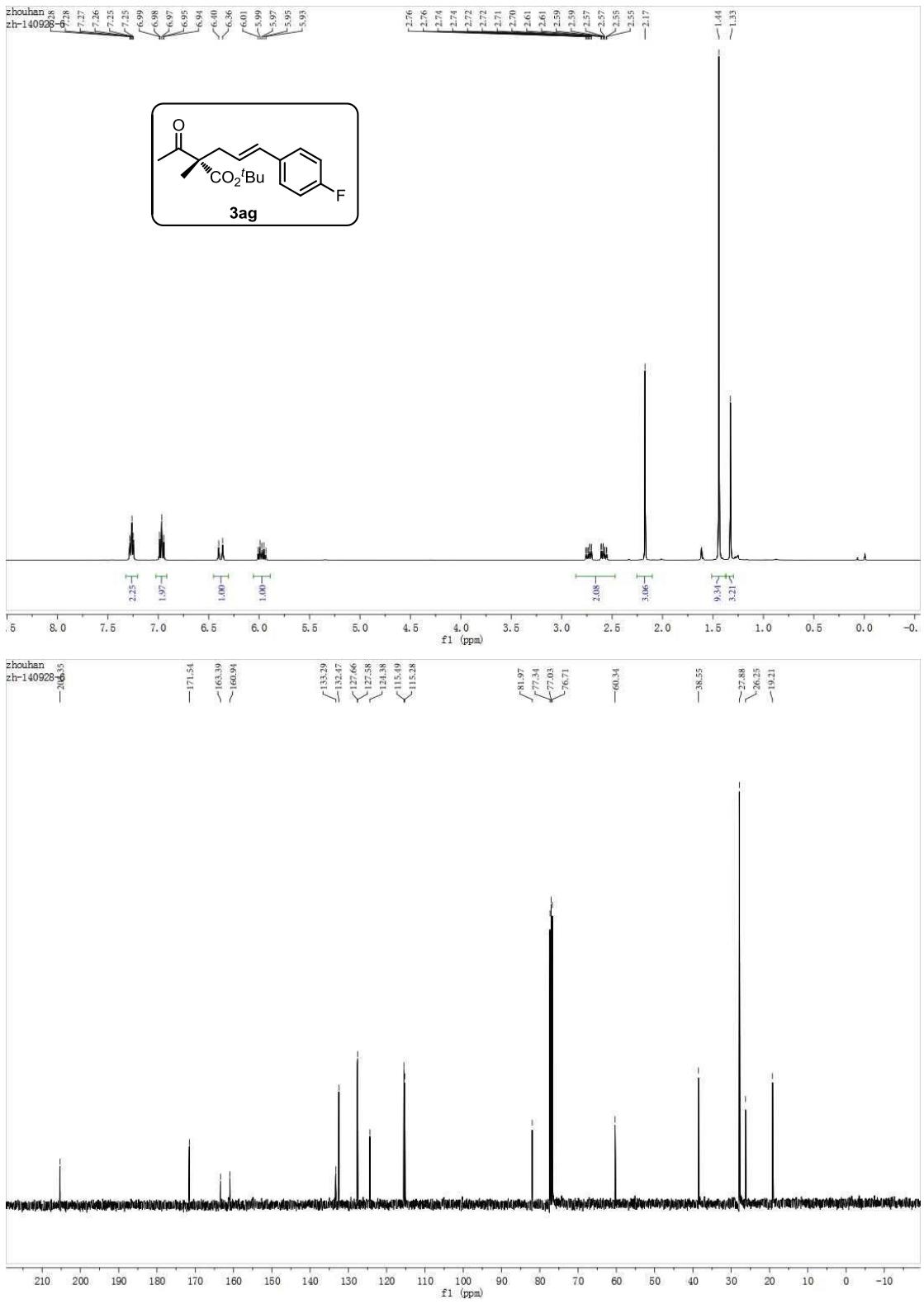
—171.63  
—150.40  
—134.39  
—133.50  
—125.90  
—125.43  
—123.70

—81.48  
—77.36  
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—34.54  
—31.30  
—27.90  
—26.38  
—19.12

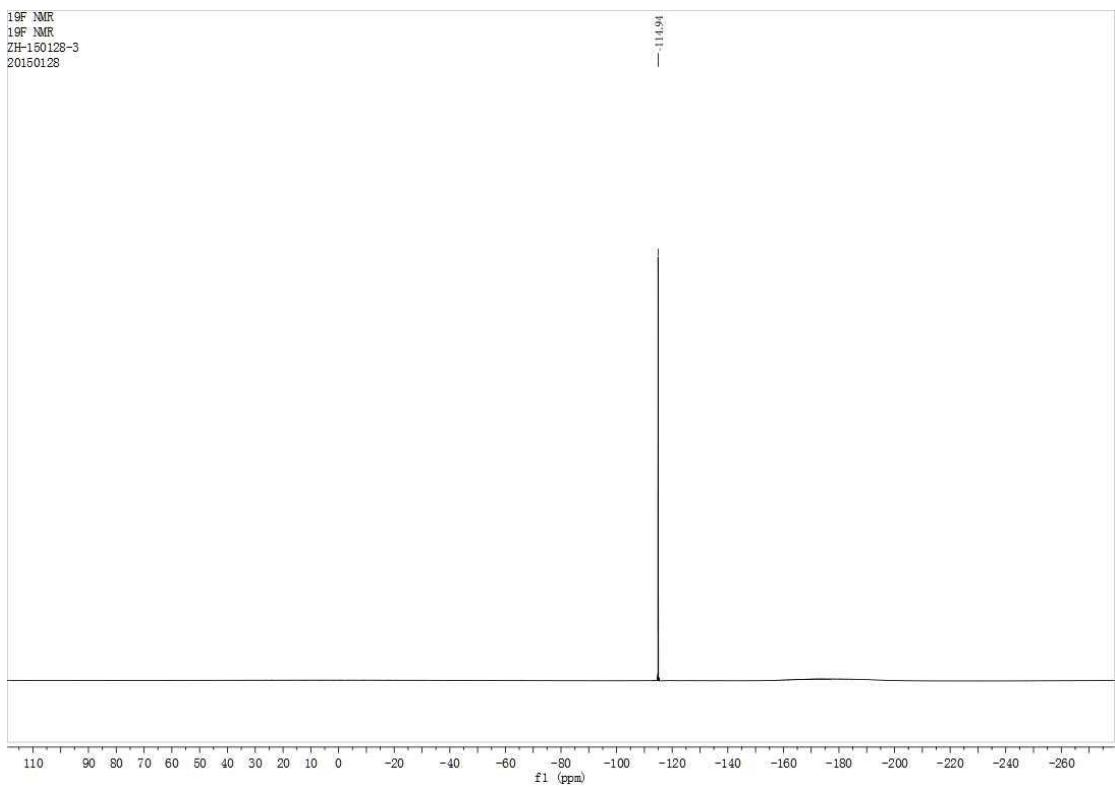


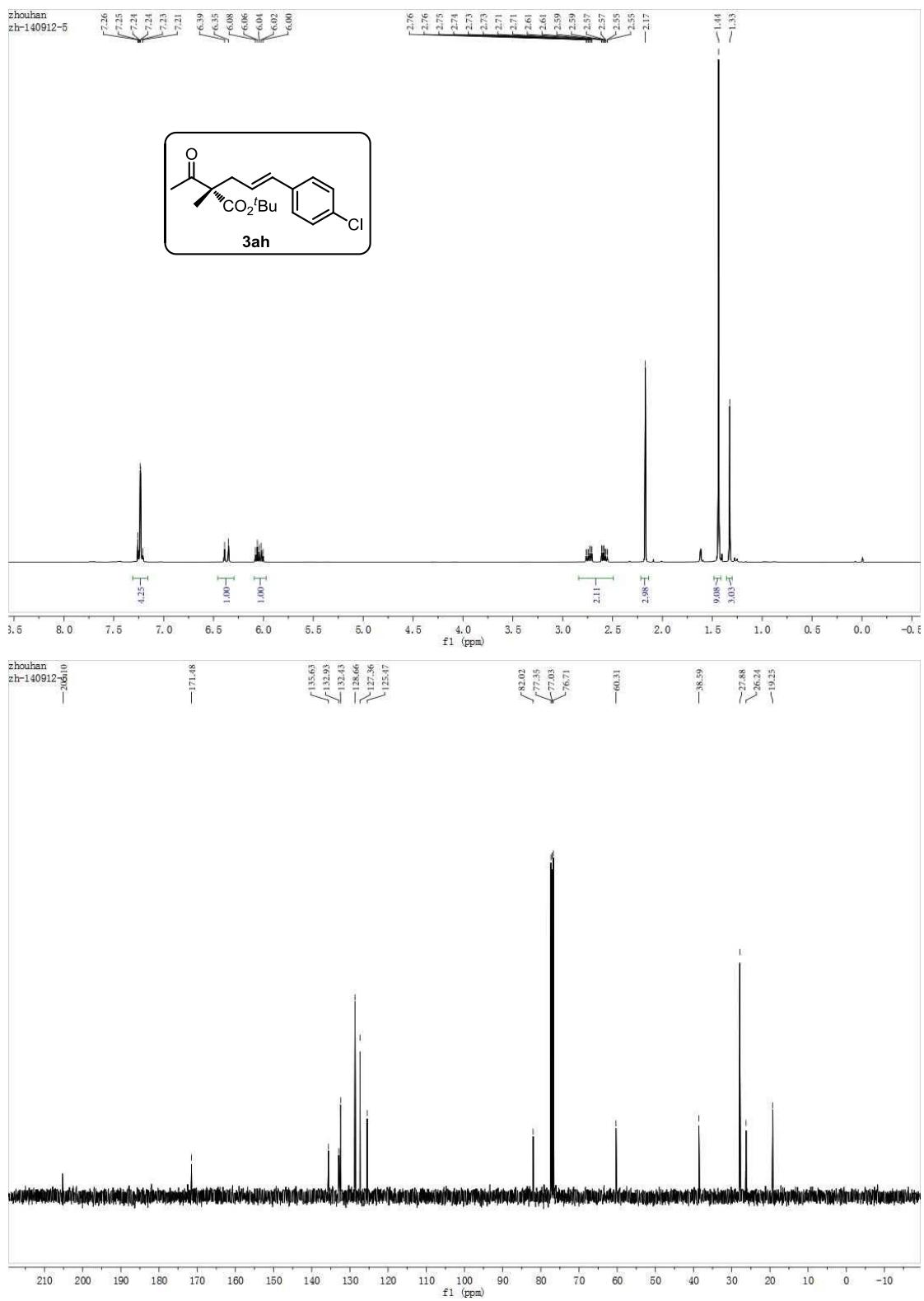


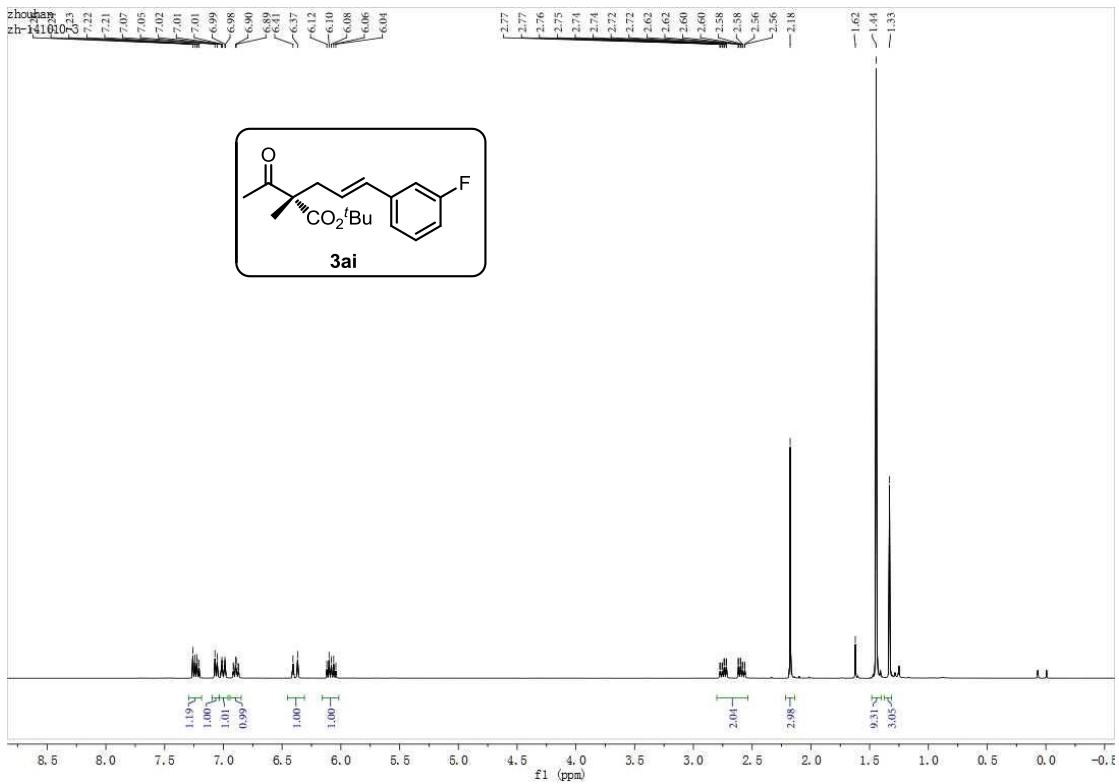




19F NMR  
19F NMR  
ZH-150128-3  
20150128

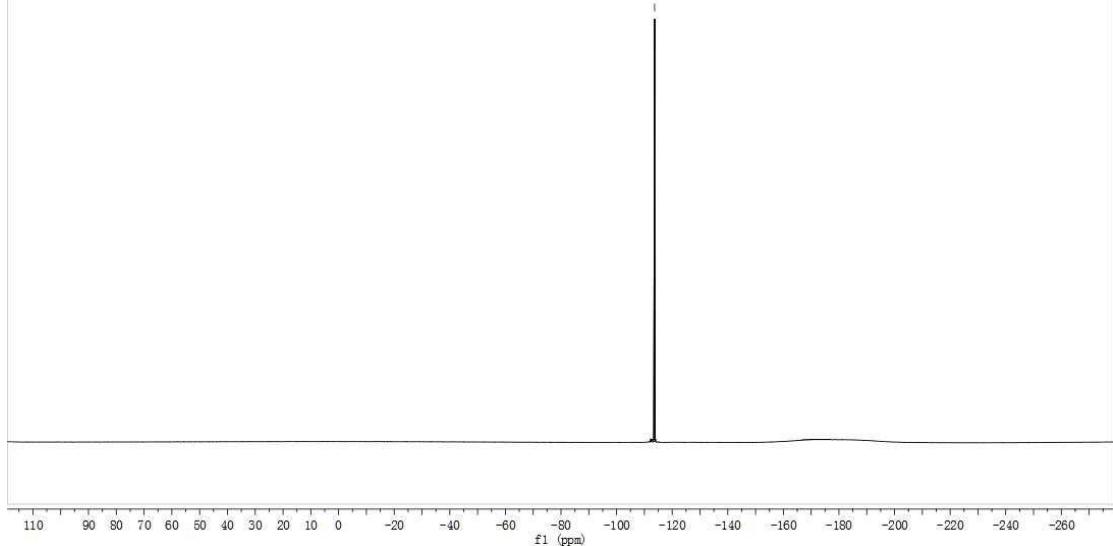


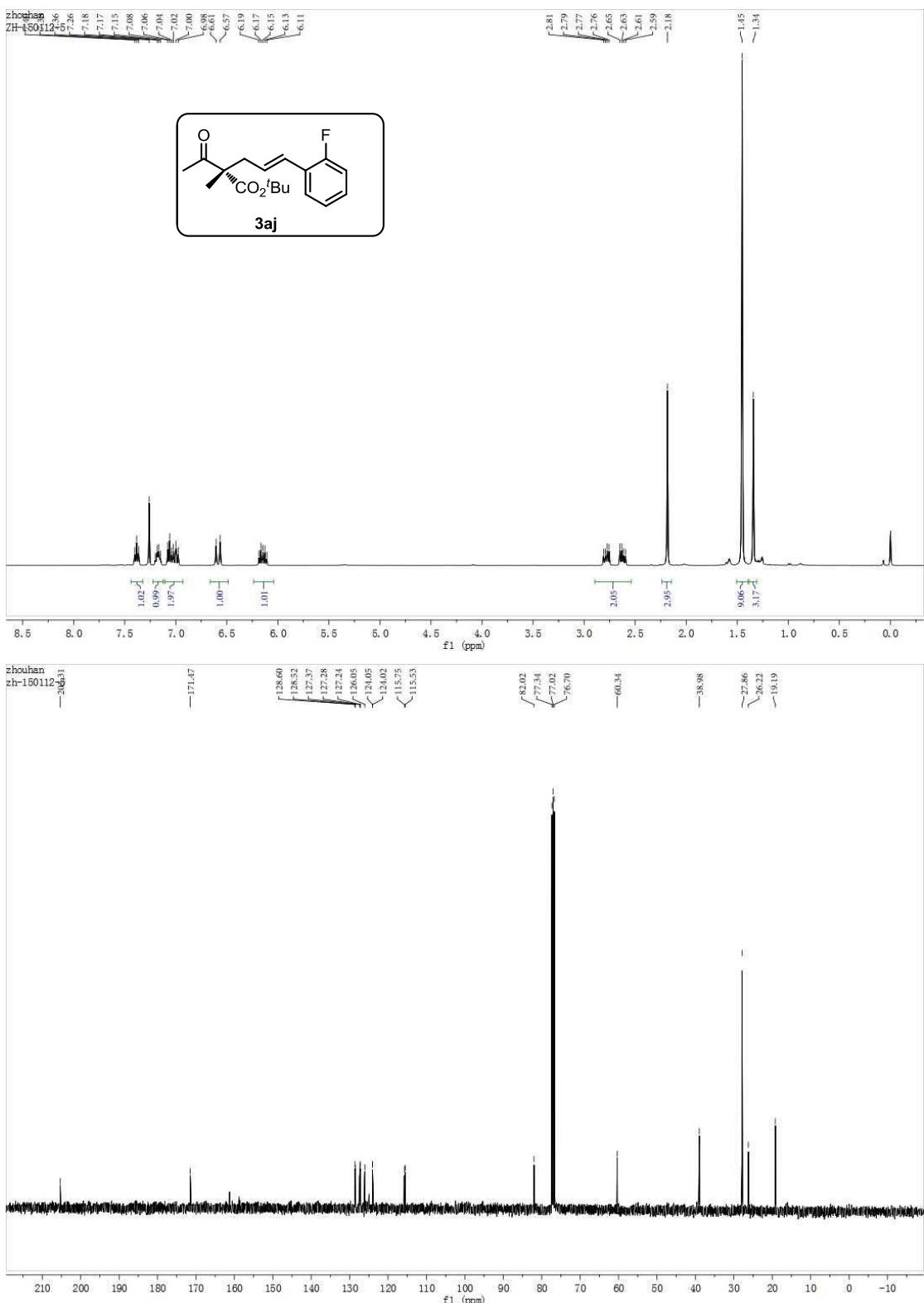




<sup>19</sup>F NMR  
<sup>19</sup>F NMR  
ZH-150128-2  
20150128

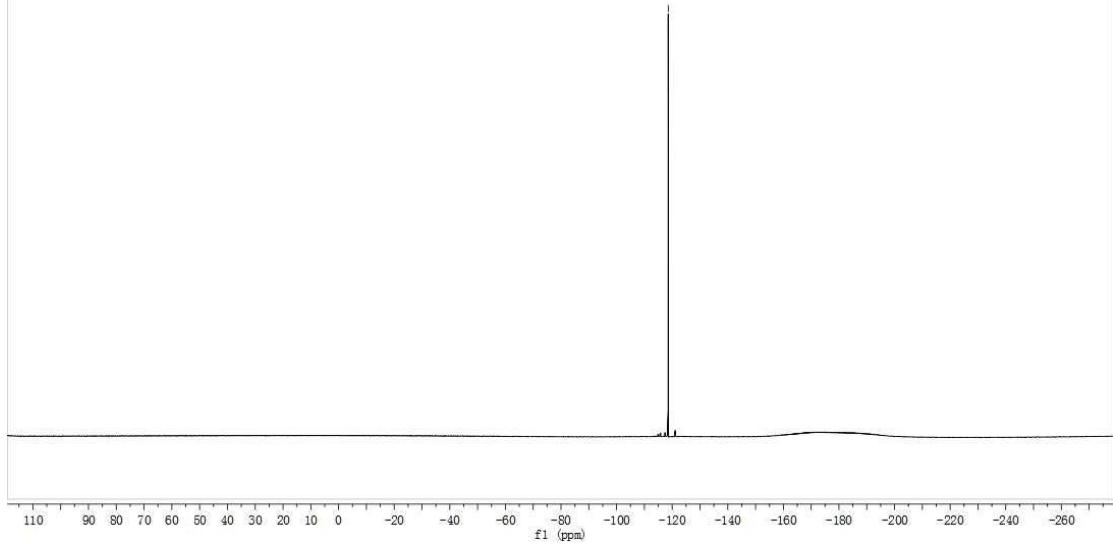
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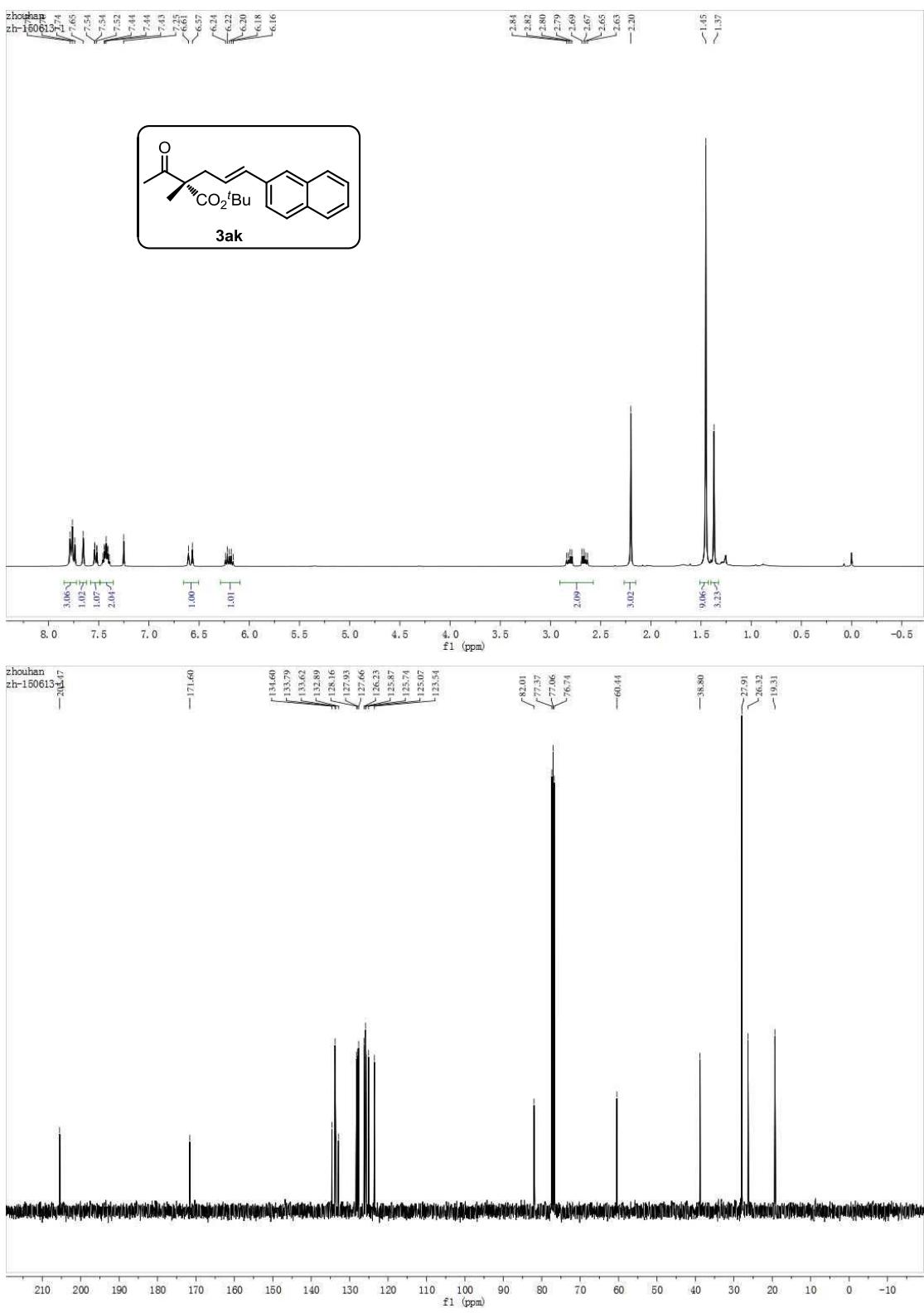


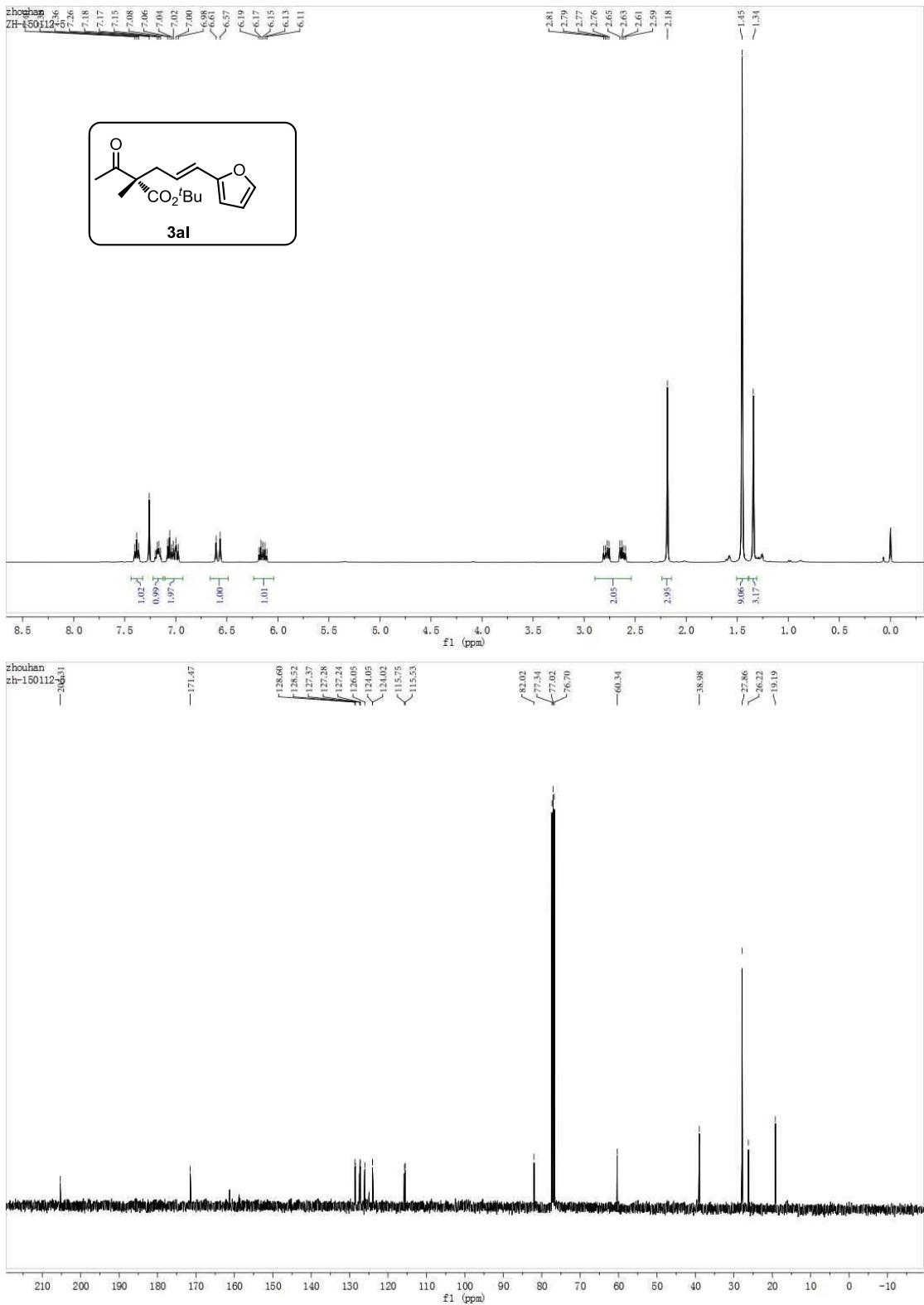


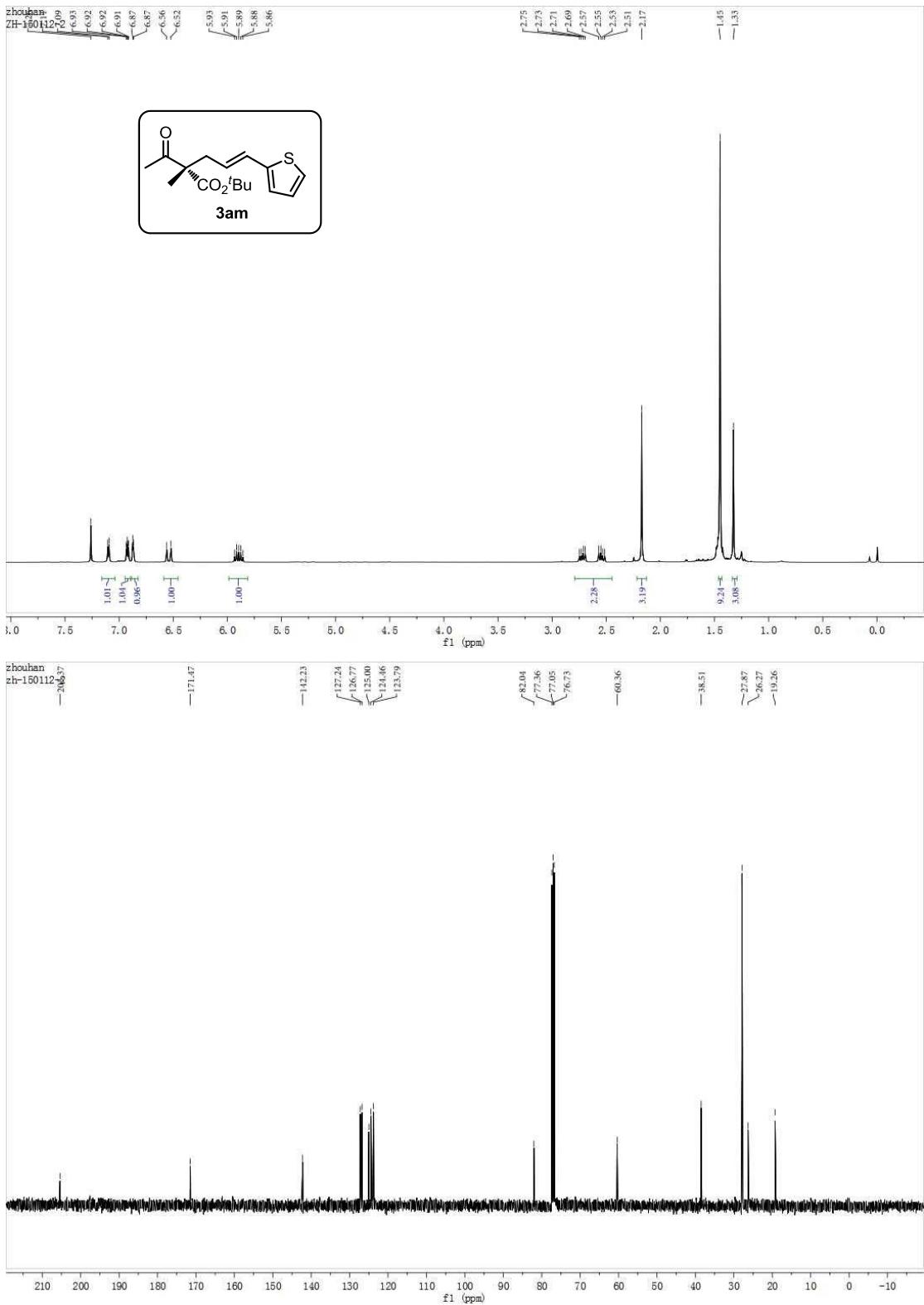
<sup>19</sup>F NMR  
<sup>19</sup>F NMR  
ZH-150128-1  
20150128

<sup>29</sup>S  
—  
—118S

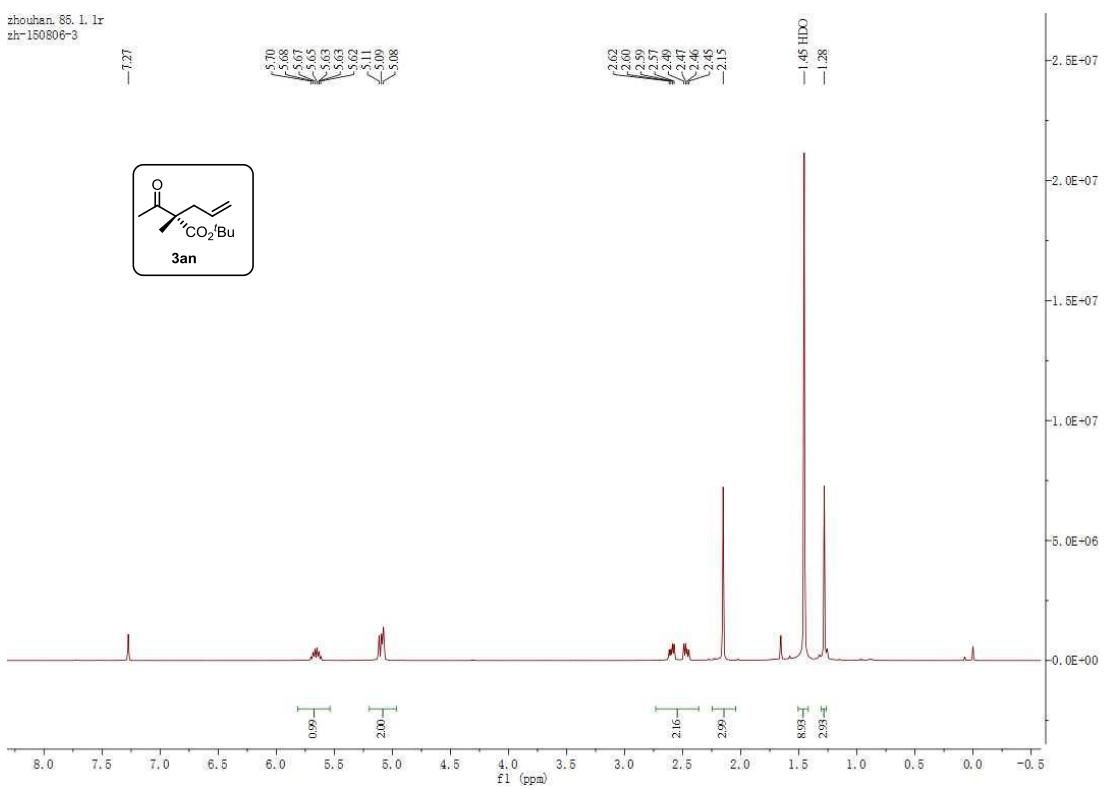




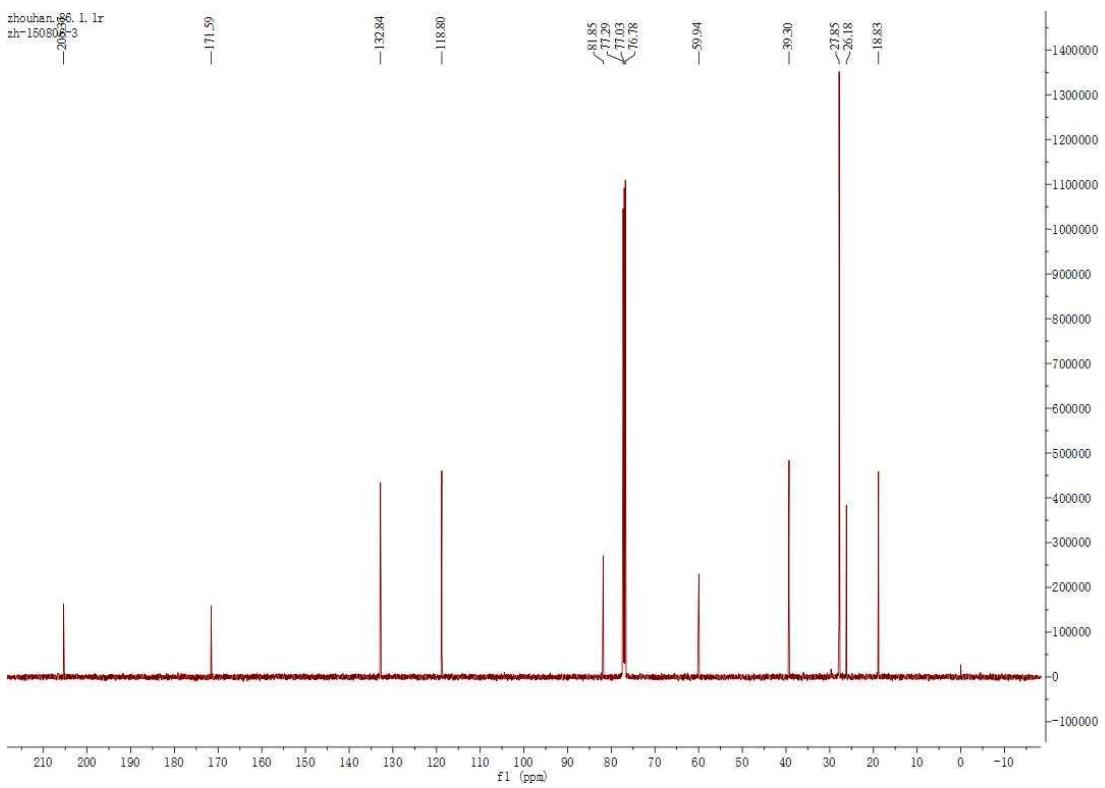




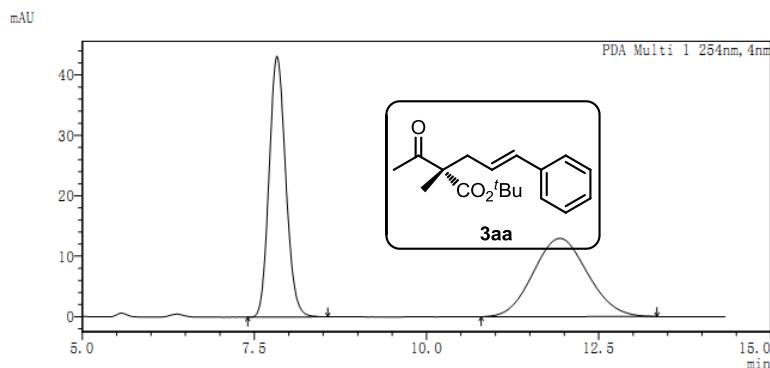
zhouhan.85.1.1r  
zh-150806-3



zhouhan.86.1.1r  
zh-150806-3



## HPLC Charts:

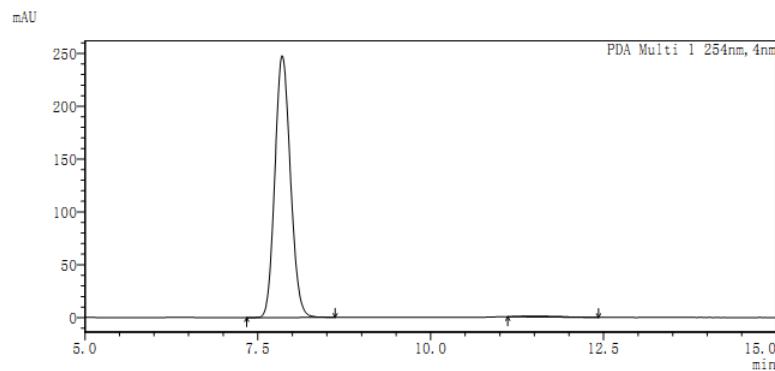


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.829	43195	725284	50.468
2	11.941	12965	711824	49.532

## Method A:

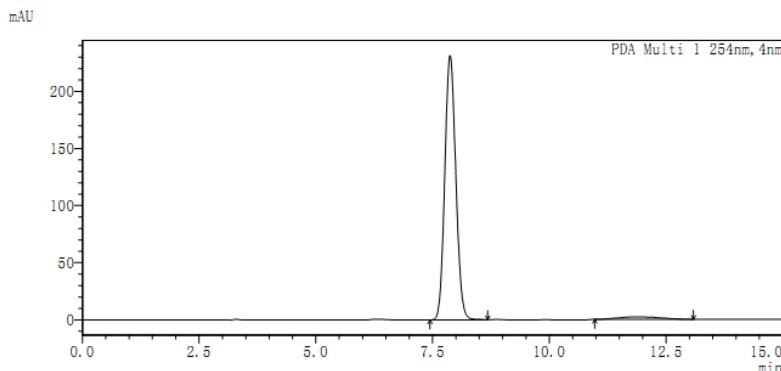


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.854	247784	3877061	99.135
2	11.485	778	33845	0.865

## Method B:

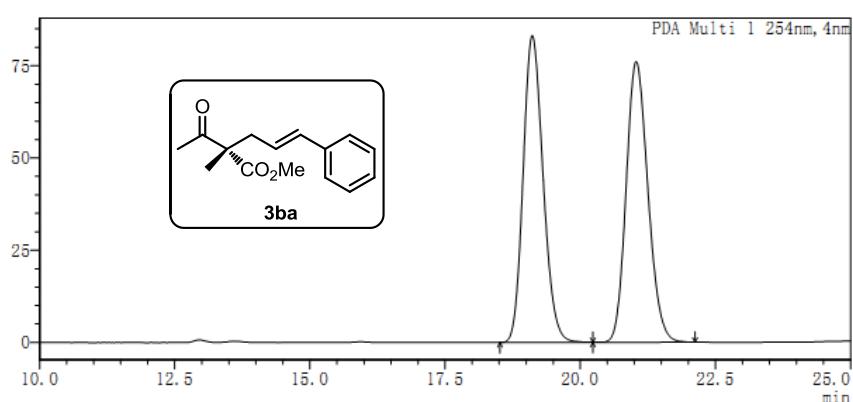


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.874	231449	3796060	96.469
2	11.872	2188	138948	3.531

mAU

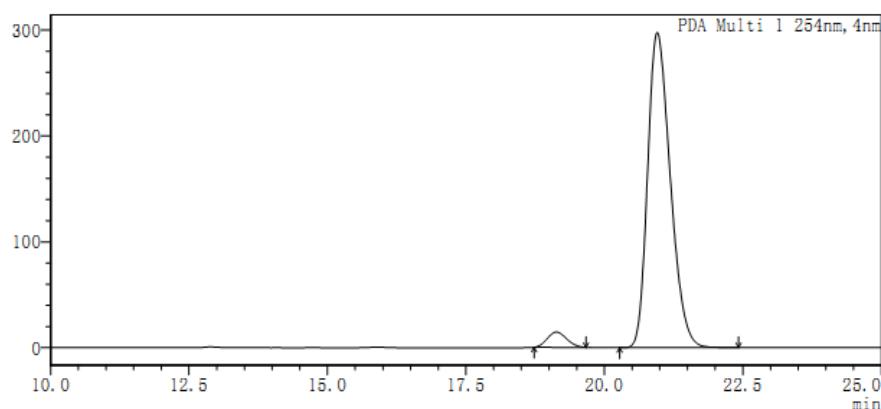


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	19.113	83263	2136351	50.024
2	21.035	76160	2134334	49.976

mAU

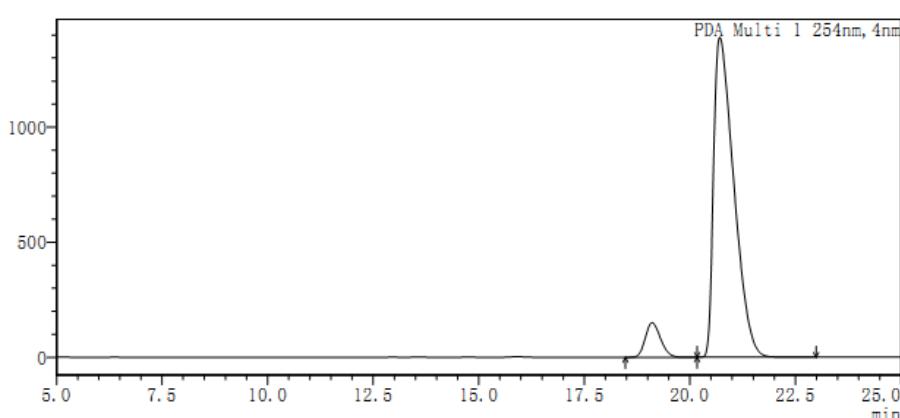


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	19.132	14423	352368	3.991
2	20.955	297503	8477000	96.009

mAU

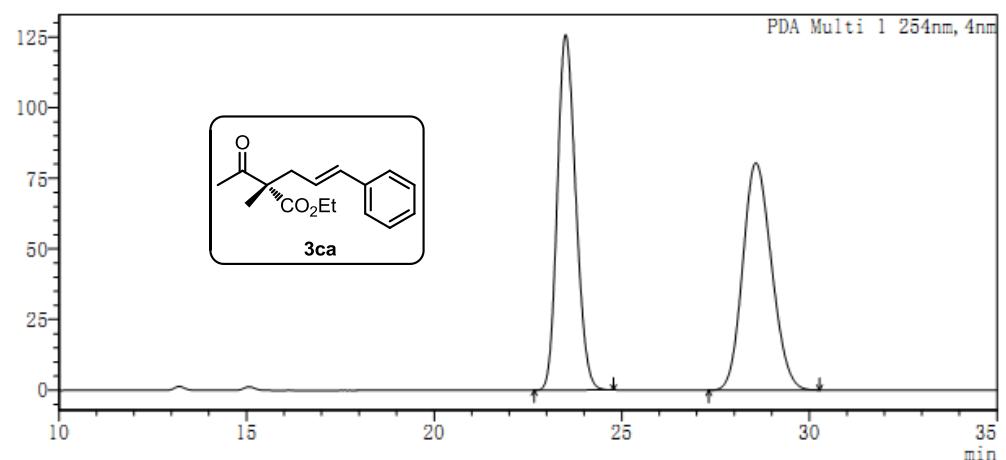


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	19.106	150578	3812620	7.606
2	20.709	1389703	46311967	92.394

mAU

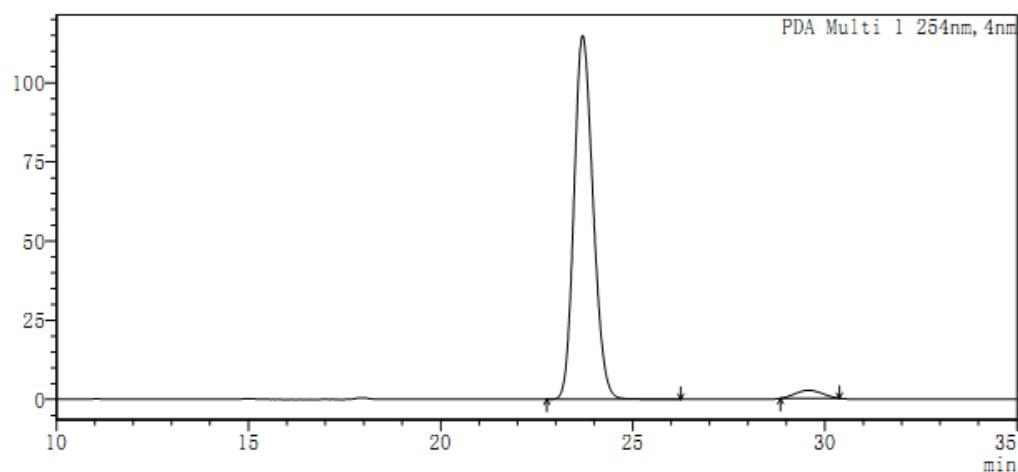


<Peak Results>

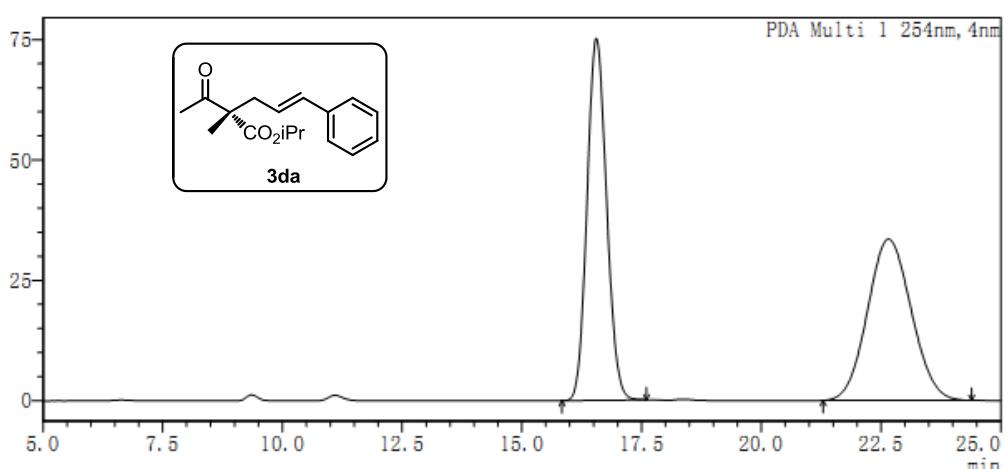
PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	23.697	114858	3959799	96.982
2	29.578	2528	123213	3.018

mAU



mAU

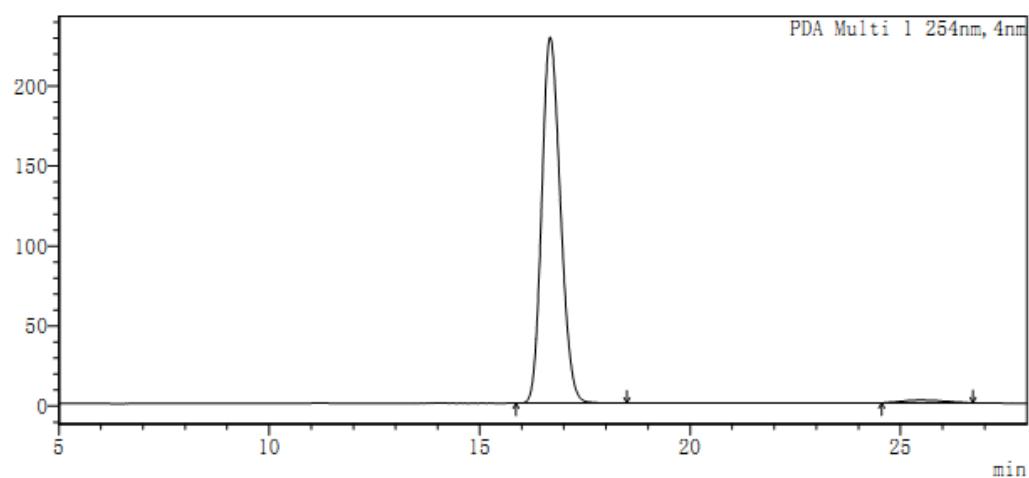


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	16.555	75221	2132772	49.998
2	22.650	33512	2132936	50.002

mAU

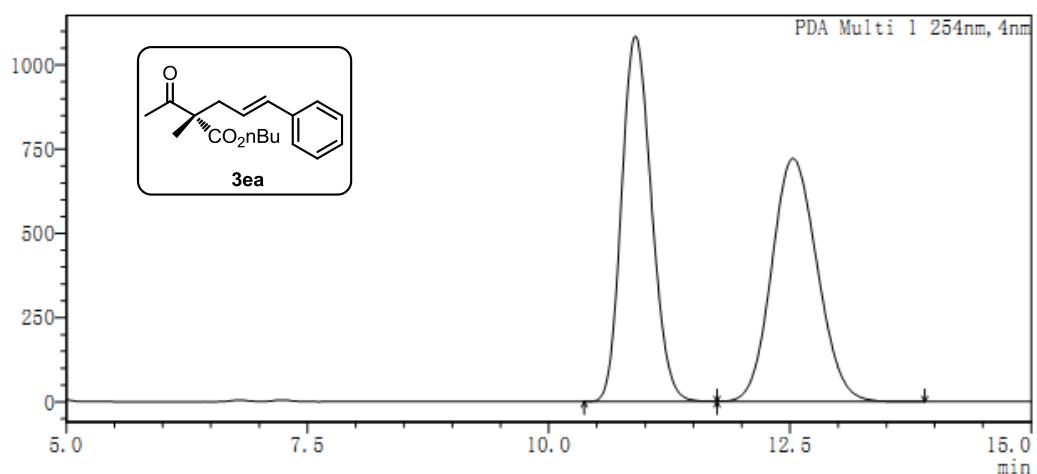


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	16.674	228765	7056789	98.411
2	25.508	1629	113910	1.589

mAU

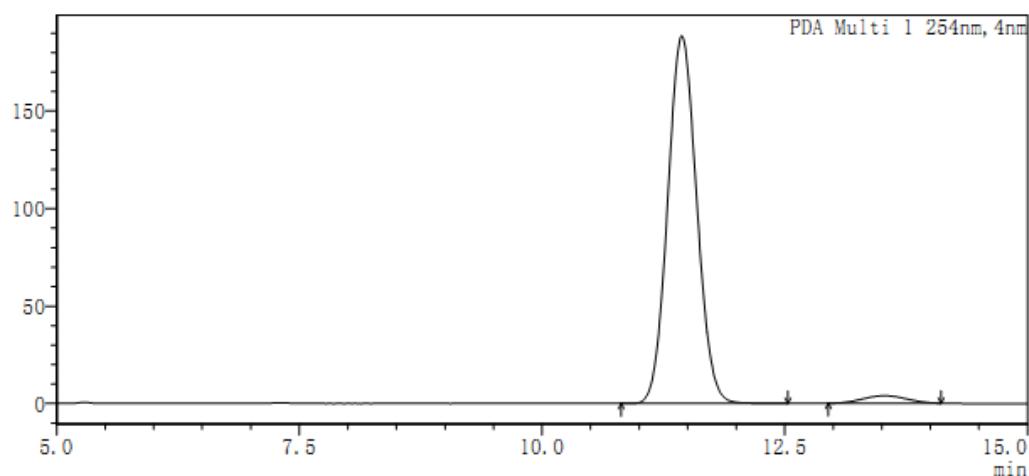


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	10.898	1084823	23390379	49.621
2	12.531	721992	23747720	50.379

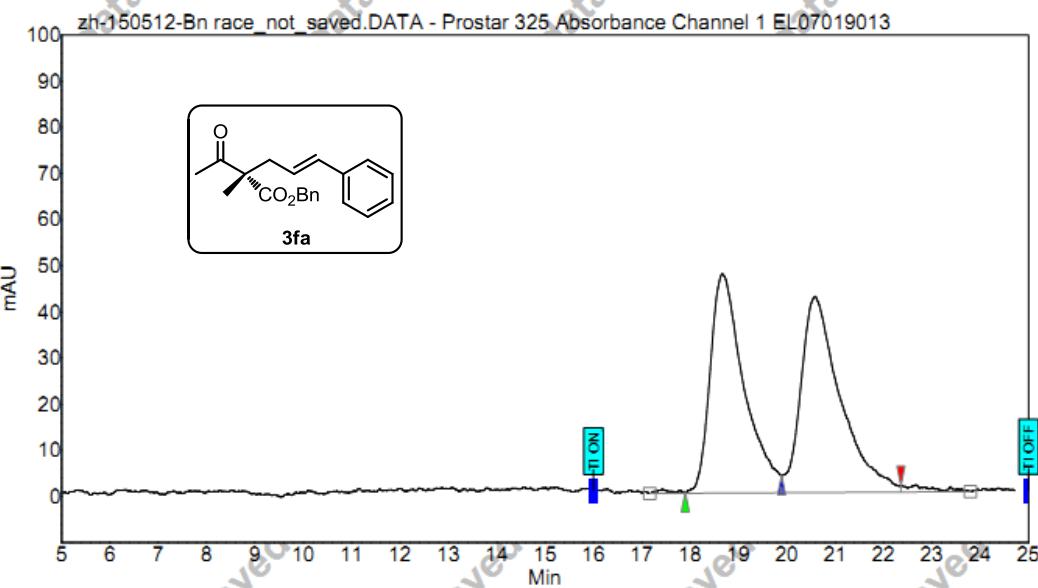
mAU



<Peak Results>

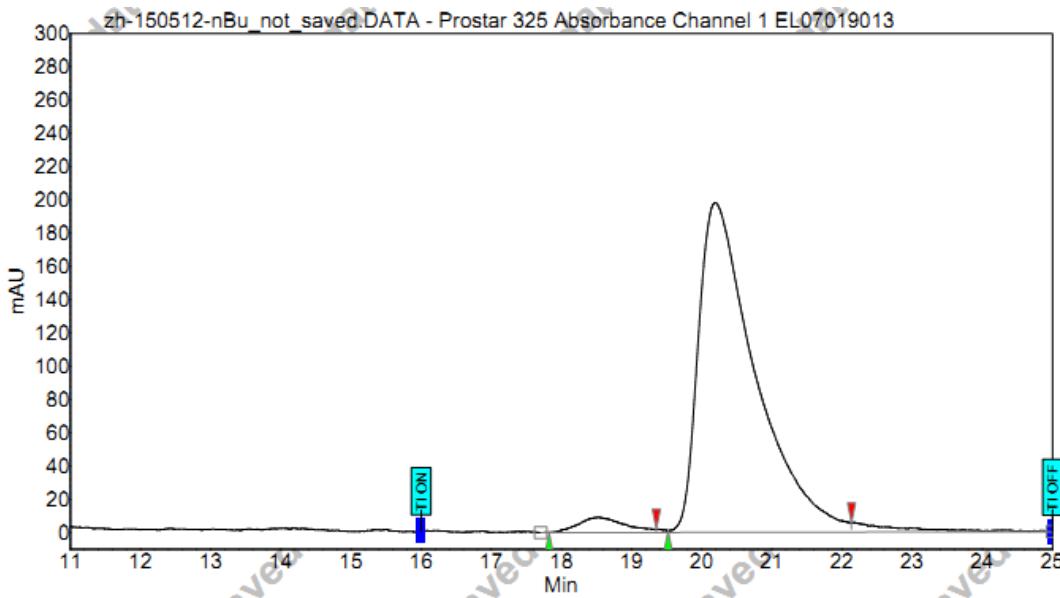
PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	11.439	188510	3922418	96.894
2	13.532	3948	125742	3.106



#### Peak results :

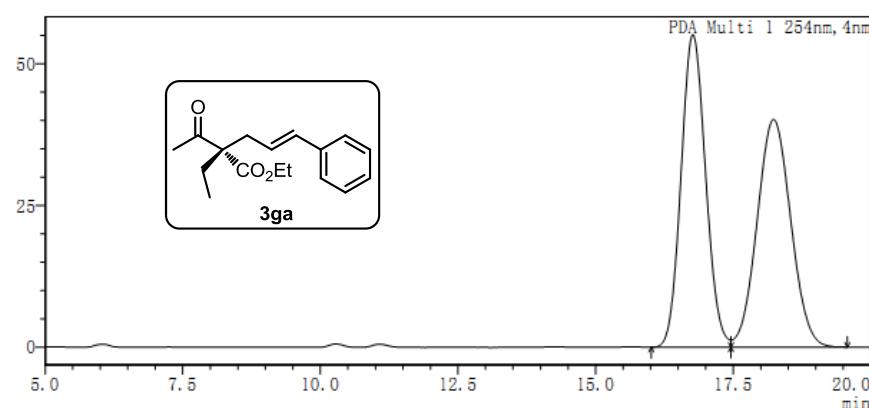
Index	Name	Time [Min]	Quantity [% Area]	Height [mAU]	Area [mAU.Min]	Area % [%]
1	UNKNOWN	18.66	48.88	47.5	38.4	48.883
2	UNKNOWN	20.58	51.12	42.5	40.2	51.117
Total			100.00	90.0	78.6	100.000



#### Peak results :

Index	Name	Time [Min]	Quantity [% Area]	Height [mAU]	Area [mAU.Min]	Area % [%]
1	UNKNOWN	18.53	3.64	9.1	7.0	3.639
2	UNKNOWN	20.19	96.36	198.1	185.4	96.361
Total			100.00	207.3	192.4	100.000

mAU

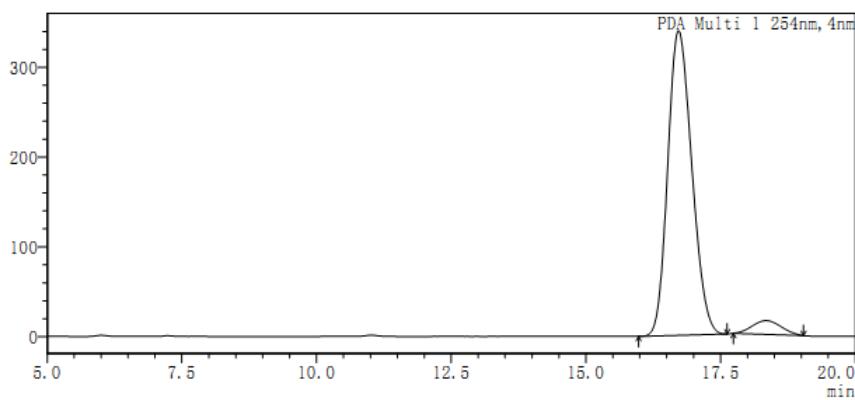


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	16.767	55201	1712242	49.982
2	18.233	40218	1713471	50.018

mAU

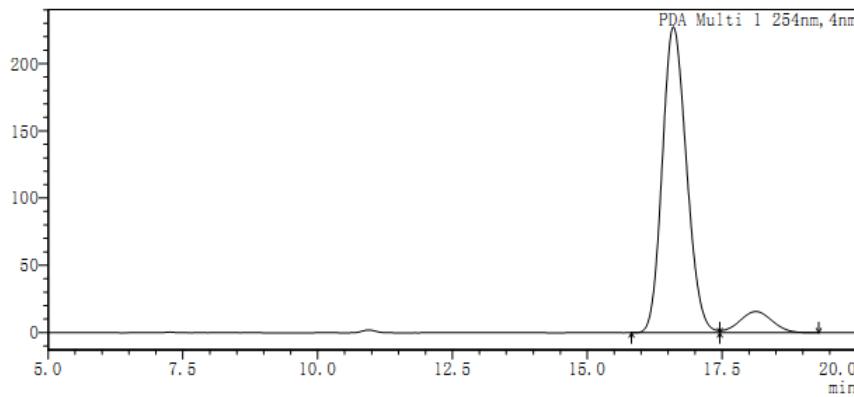


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	16.720	339300	10550410	94.877
2	18.341	15235	569682	5.123

mAU

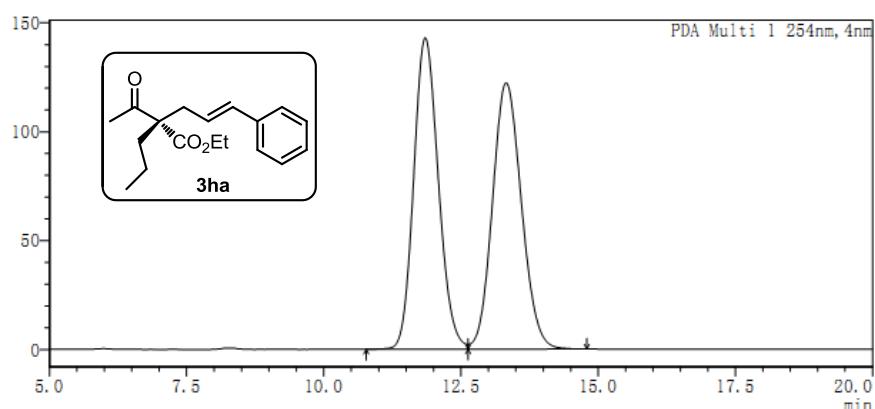


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	16.598	227649	7128808	91.401
2	18.128	15824	670708	8.599

mAU

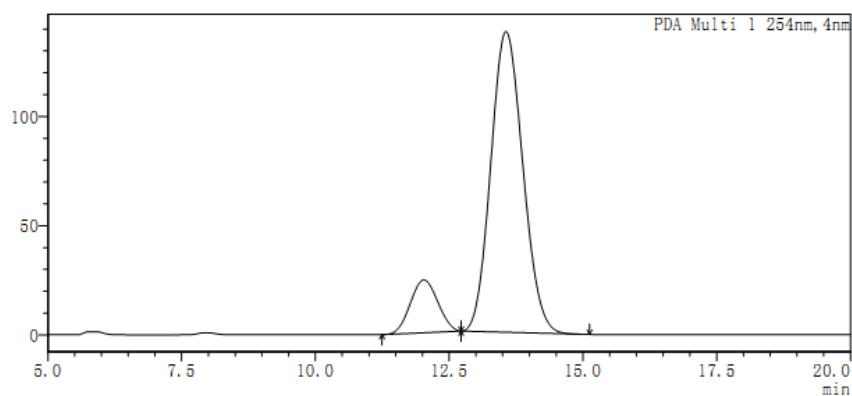


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	11.848	143062	4471242	49.890
2	13.323	122380	4490954	50.110

mAU

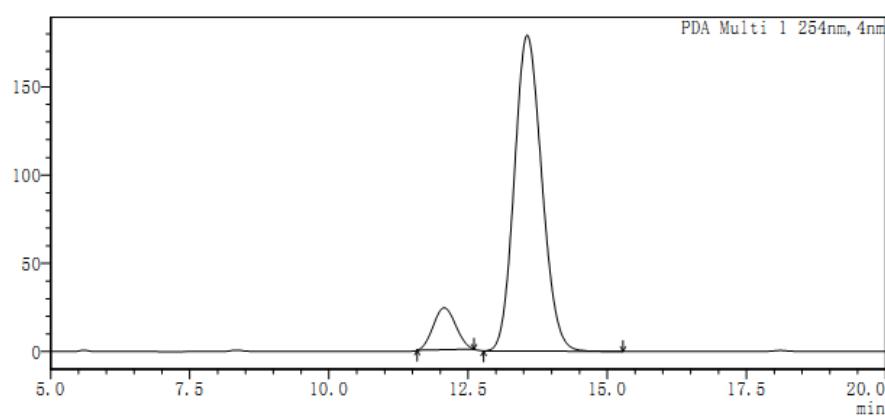


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	12.026	24203	863219	13.074
2	13.562	137675	5739134	86.926

mAU

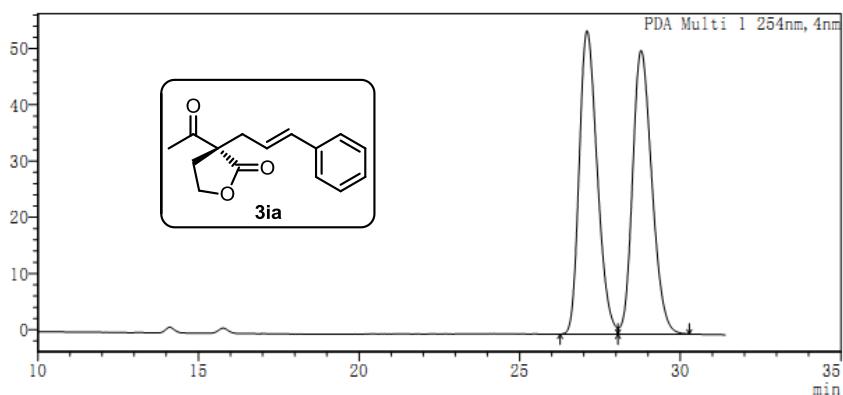


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	12.071	23794	672185	9.853
2	13.562	178975	6150167	90.147

mAU

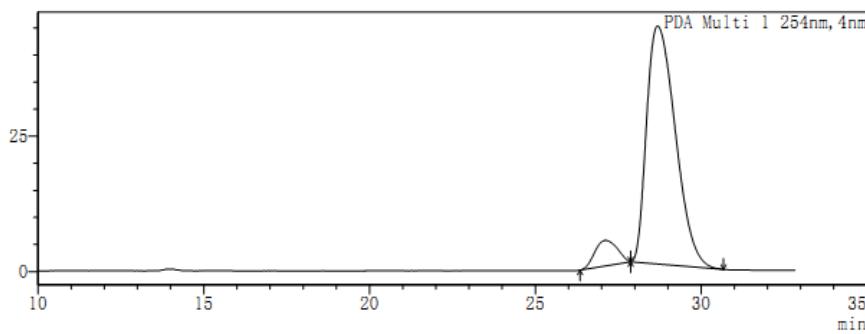


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	27.099	53927	2098932	49.908
2	28.780	50454	2106633	50.092

mAU

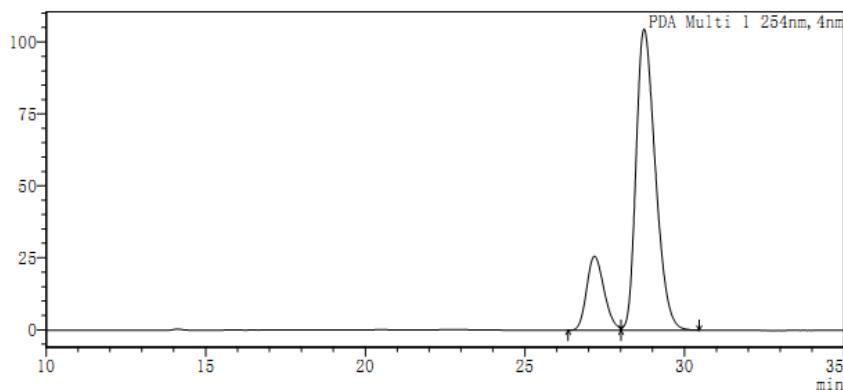


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	27.127	4681	220732	7.684
2	28.691	43979	2651916	92.316

mAU

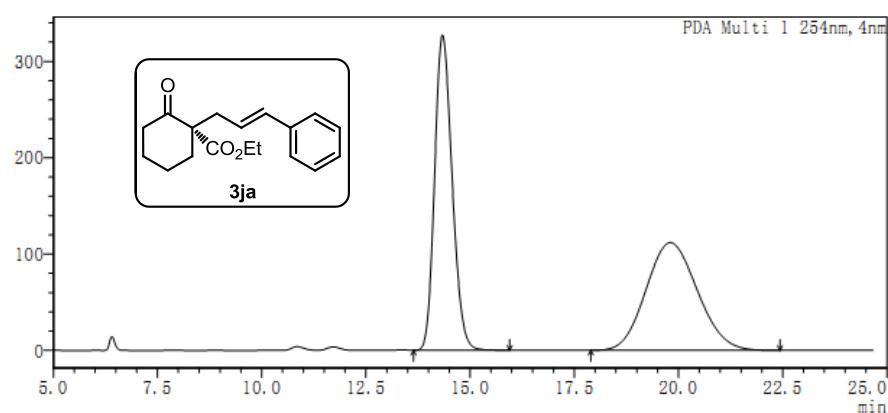


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	27.181	25767	979107	18.215
2	28.735	104718	4396216	81.785

mAU

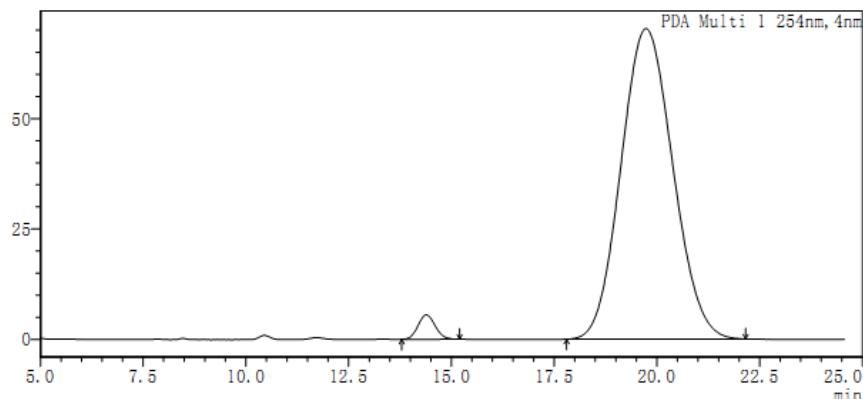


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	14.337	327347	9590908	49.969
2	19.804	111813	9602974	50.031

mAU

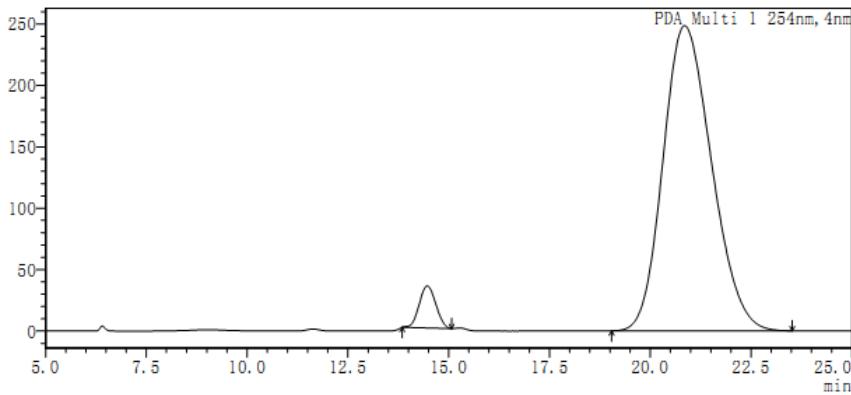


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	14.392	5539	161478	2.548
2	19.735	70341	6176913	97.452

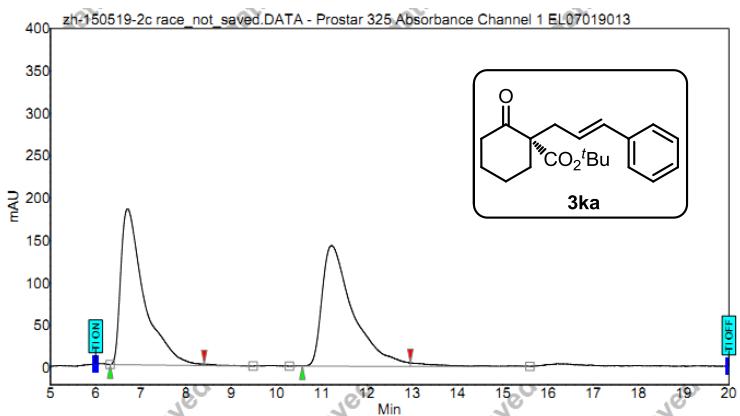
mAU



<Peak Results>

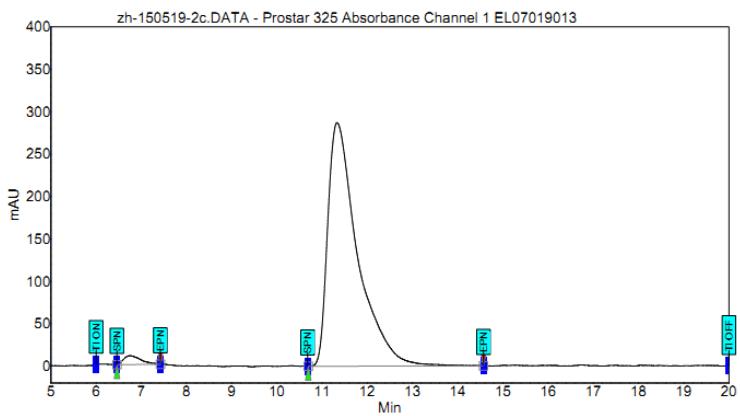
PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	14.467	34271	982687	4.503
2	20.852	248599	20838991	95.497



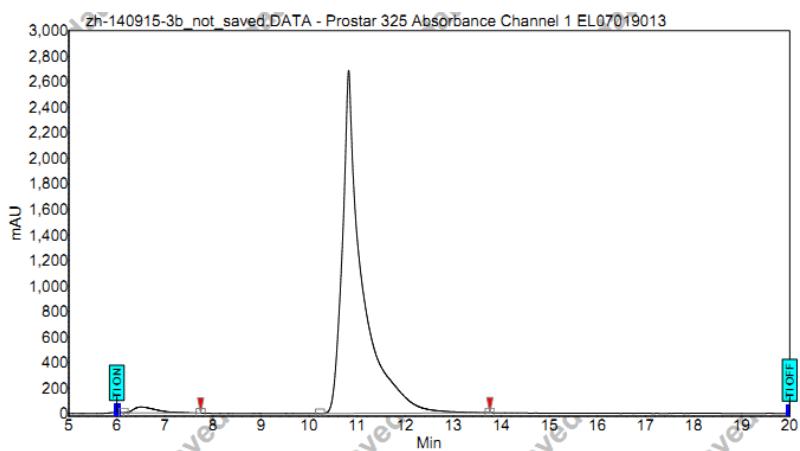
**Peak results :**

Index	Name	Time [Min]	Quantity [% Area]	Height [mAU]	Area [mAU Min]	Area % [%]
1	UNKNOWN	6.70	49.39	183.8	109.7	49.394
2	UNKNOWN	11.22	50.61	142.2	112.4	50.606
Total			100.00	326.0	222.1	100.000



**Peak results :**

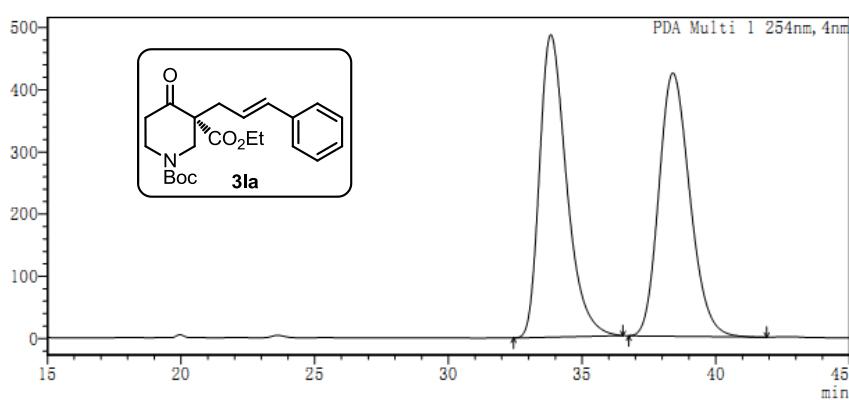
Index	Name	Time [Min]	Quantity [% Area]	Height [mAU]	Area [mAU Min]	Area % [%]
1	UNKNOWN	6.74	2.07	10.5	4.6	2.069
2	UNKNOWN	11.33	97.93	287.2	219.0	97.931
Total			100.00	297.6	223.6	100.000



**Peak results :**

Index	Name	Time [Min]	Quantity [% Area]	Height [mAU]	Area [mAU Min]	Area % [%]
1	UNKNOWN	6.50	2.03	46.0	26.4	2.033
2	UNKNOWN	10.82	97.97	2687.9	1271.7	97.967
Total			100.00	2733.9	1298.0	100.000

mAU

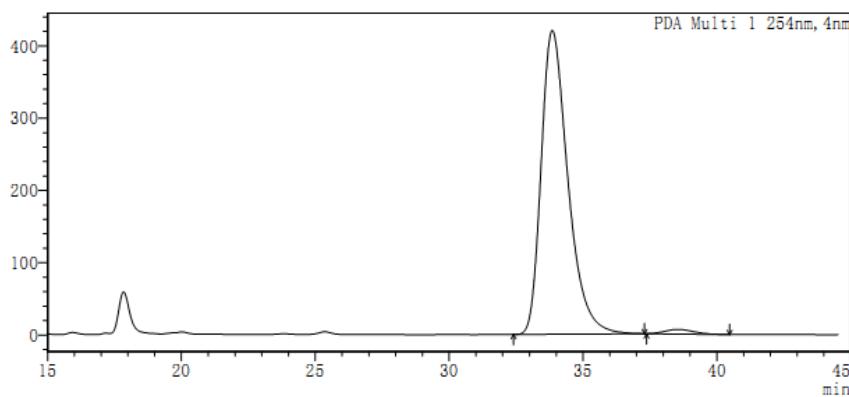


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	33.833	486541	34209377	50.073
2	38.399	423481	34108950	49.927

mAU

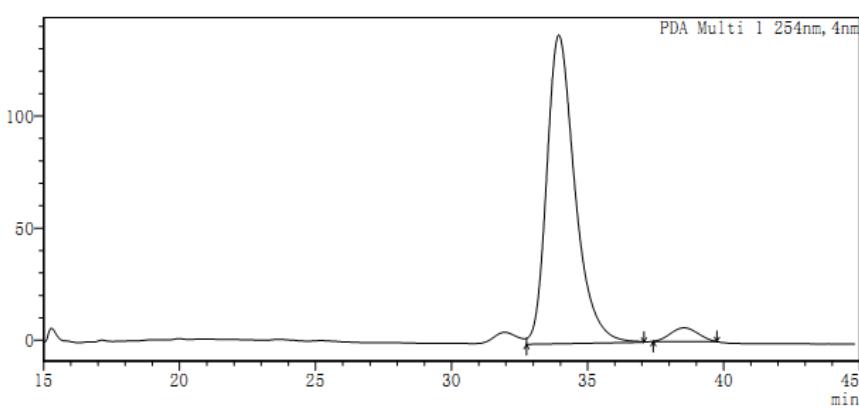


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	33.853	420418	29234157	98.424
2	38.540	6296	468051	1.576

mAU

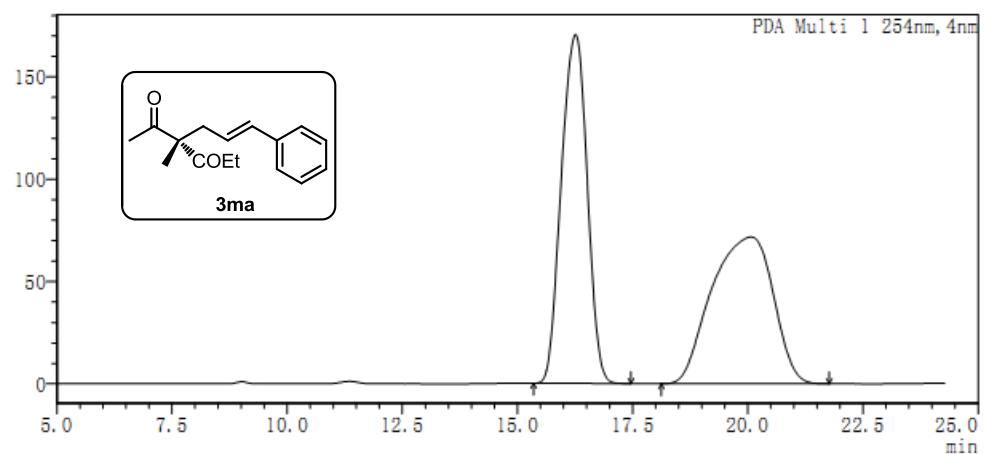


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	33.942	137731	9931768	95.863
2	38.536	6113	428566	4.137

mAU

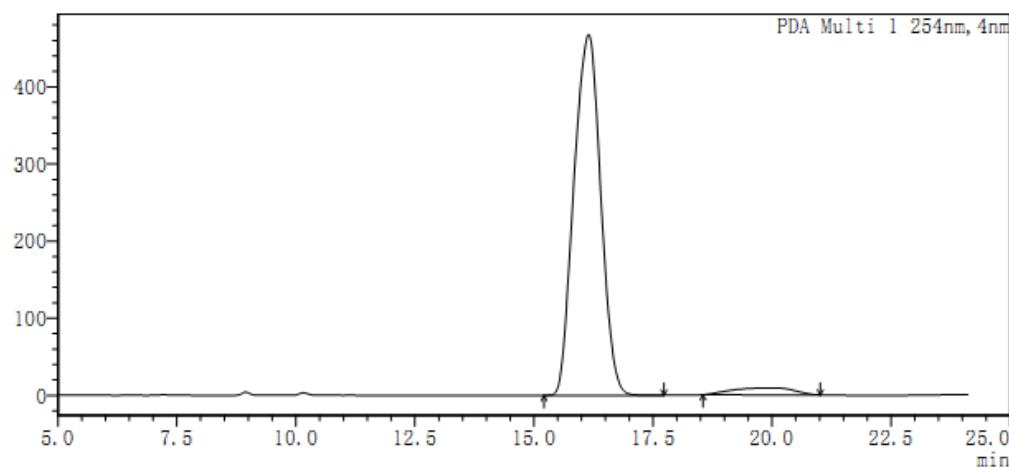


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	16.280	170515	6664223	49.945
2	20.068	71803	6678955	50.055

mAU

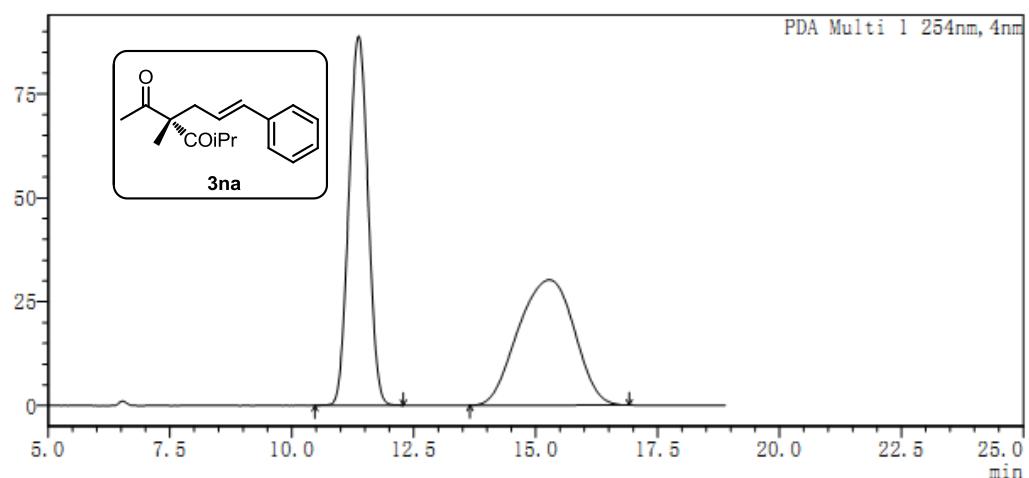


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	16.148	467559	18285832	95.739
2	19.965	9167	813917	4.261

mAU

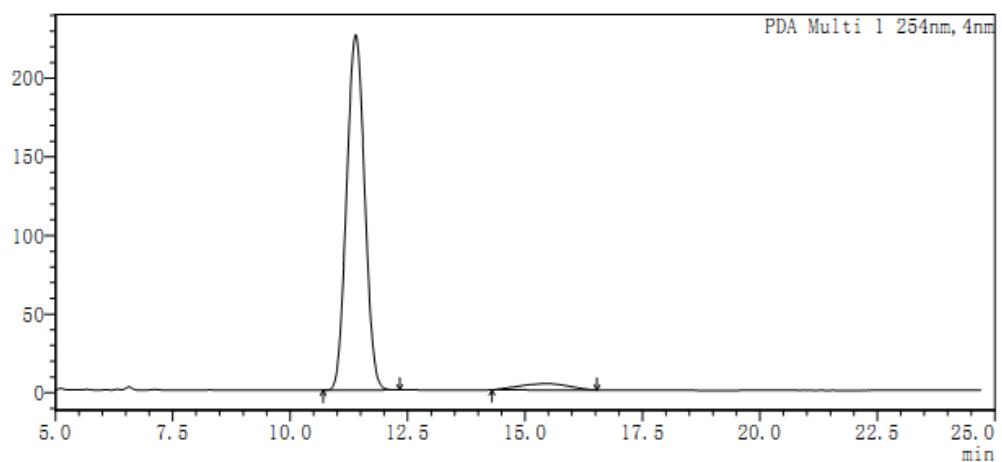


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	11.369	88882	2438330	50.111
2	15.281	30178	2427562	49.889

mAU

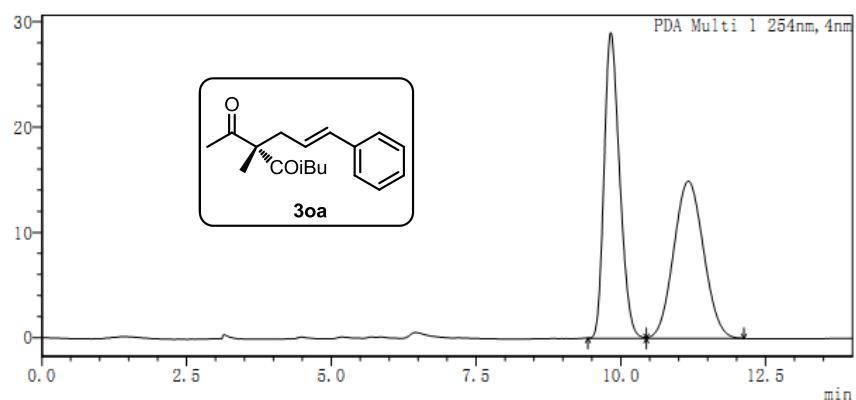


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	11.394	226095	6035796	95.482
2	15.426	3856	285574	4.518

mAU

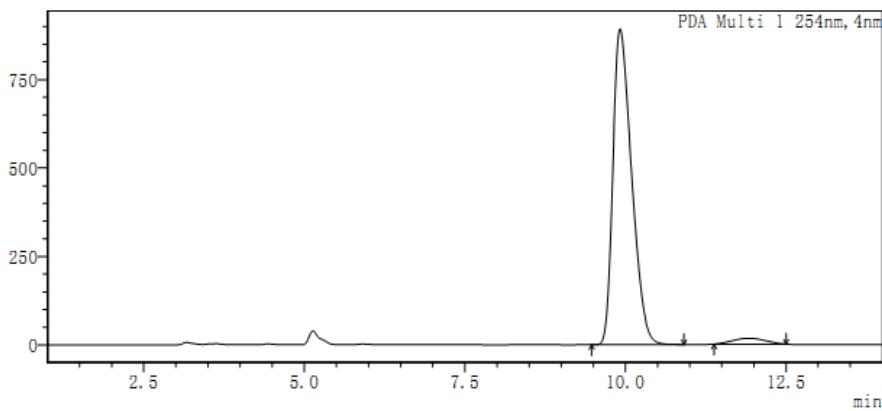


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	9.827	29027	540405	50.124
2	11.165	14933	537740	49.876

mAU

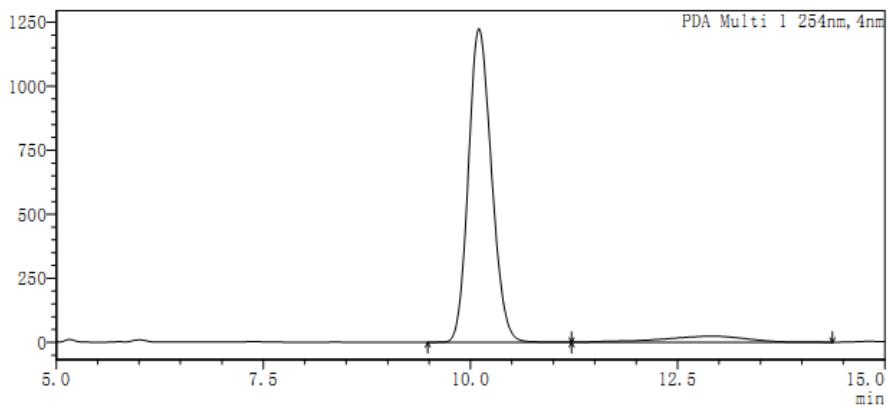


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	9.917	893289	18145259	96.917
2	11.919	16264	577232	3.083

mAU

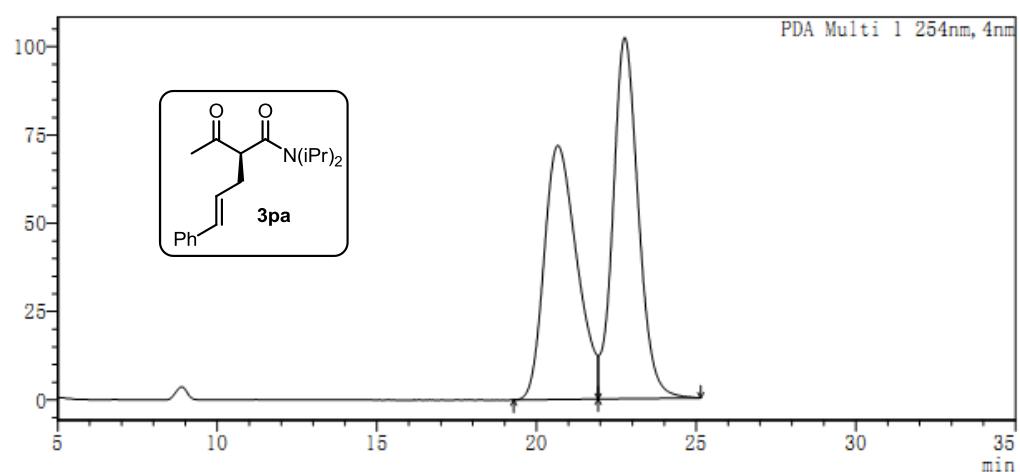


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	10.102	1225526	23780140	93.261
2	12.908	23329	1718382	6.739

mAU

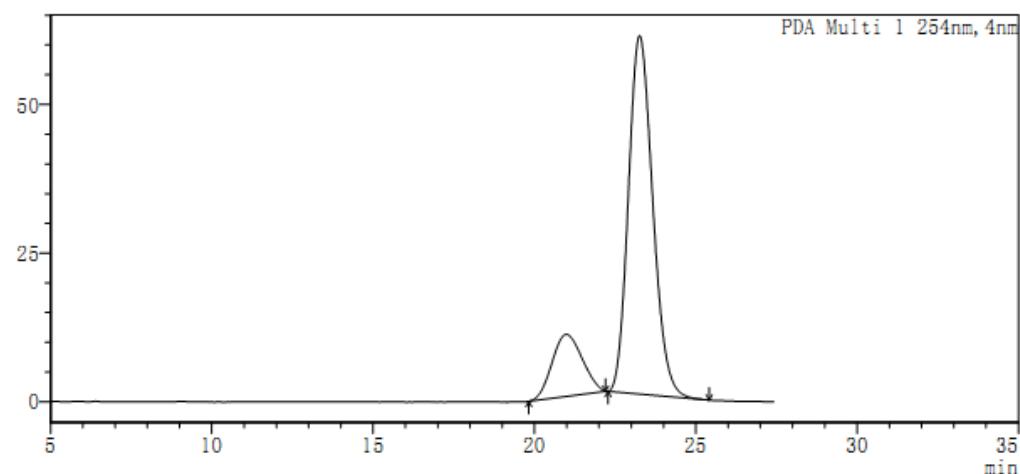


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	20.669	71921	5124977	47.593
2	22.762	102280	5643384	52.407

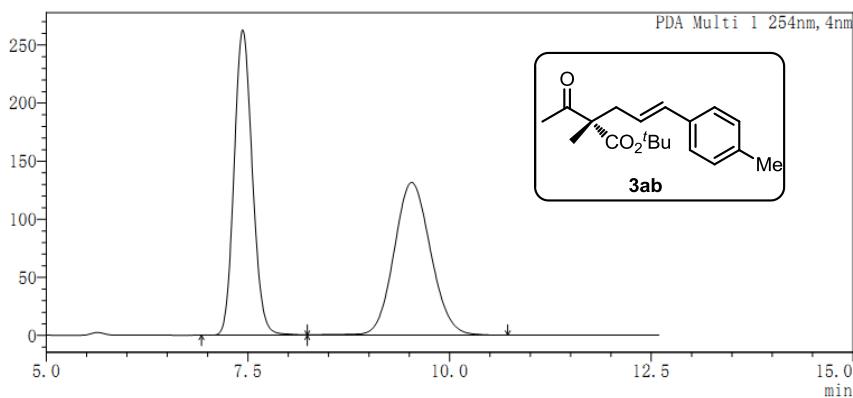
mAU



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PDA Ch1 254nm

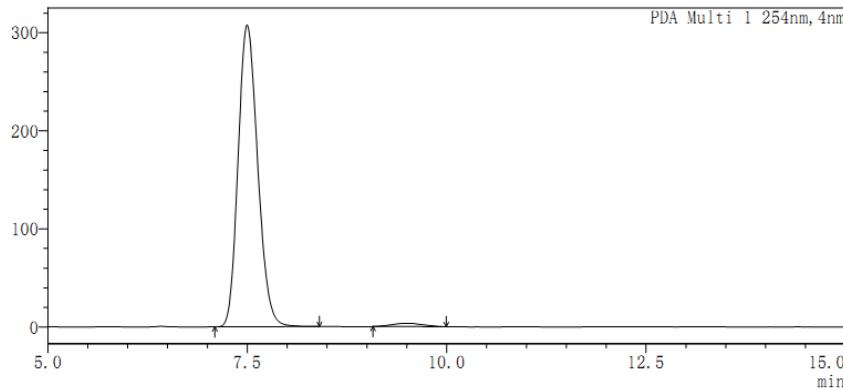
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	20.987	10450	679652	17.720
2	23.259	60283	3155858	82.280



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.435	263081	4132367	49.871
2	9.529	131483	4153722	50.129

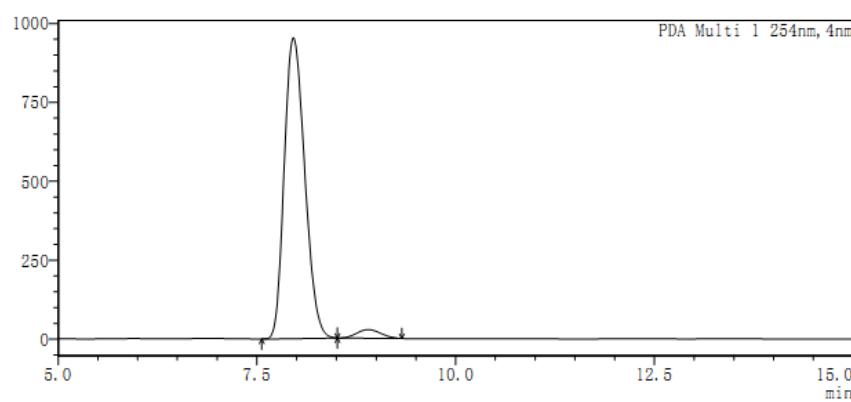


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.497	307817	5254177	98.315
2	9.501	3345	90074	1.685

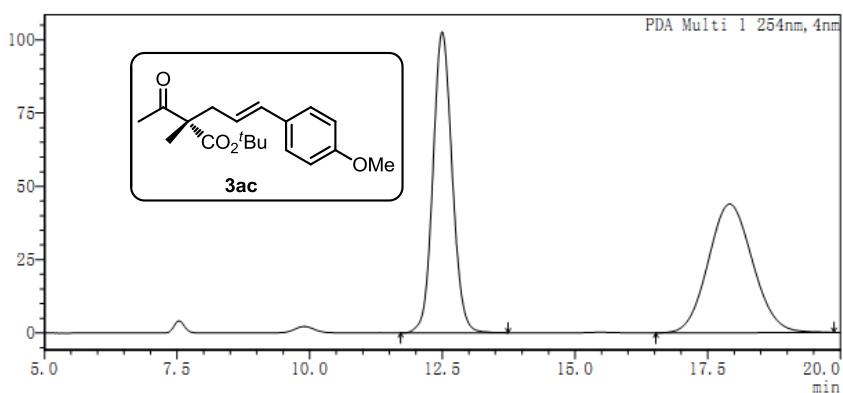
mAU



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PDA Ch1 254nm

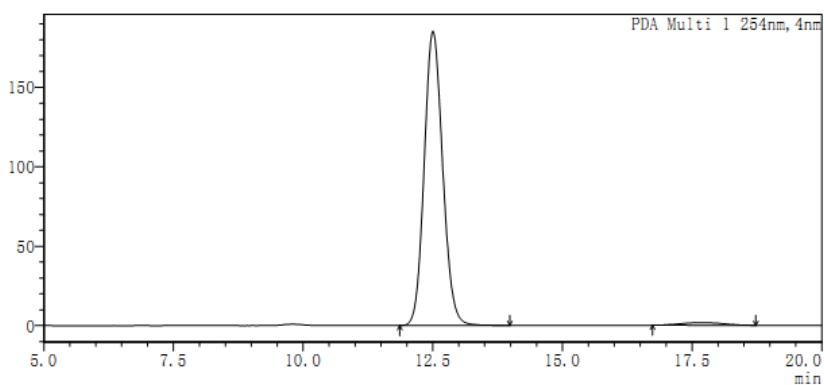
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.960	953874	17092669	96.750
2	8.900	27400	574139	3.250



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	12.495	102726	2588906	50.273
2	17.913	43917	2560771	49.727

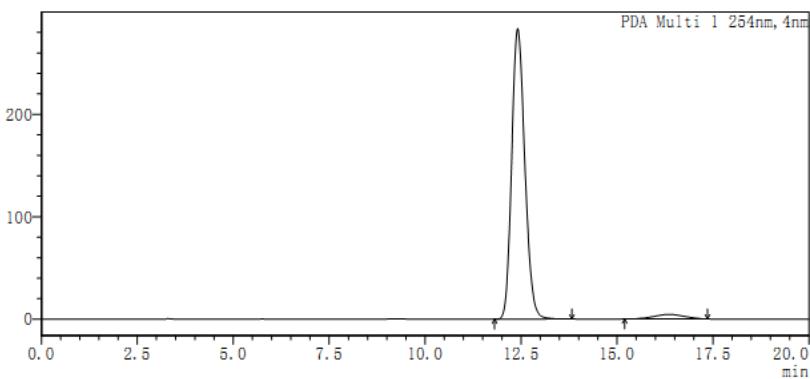


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	12.502	185442	4598497	97.909
2	17.694	1702	98230	2.091

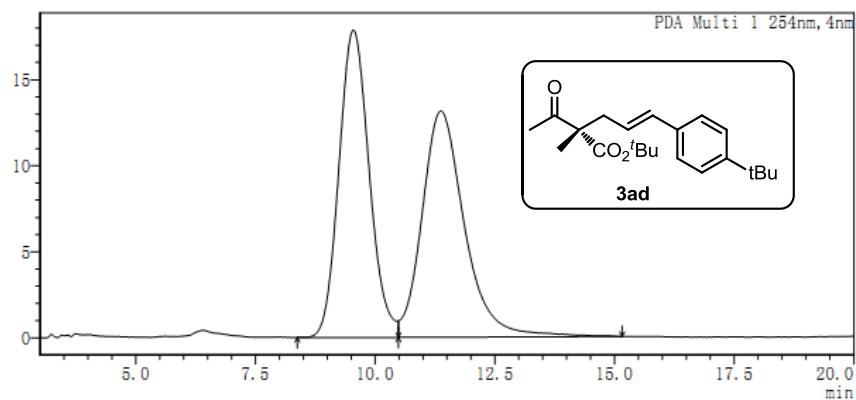
mAU



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PDA Ch1 254nm

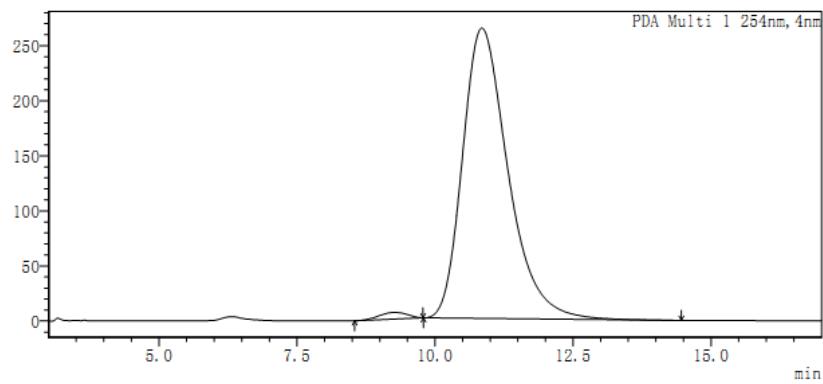
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	12.411	283808	6758128	96.507
2	16.362	4365	244581	3.493



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	9.544	17865	785612	49.262
2	11.371	13147	809136	50.738

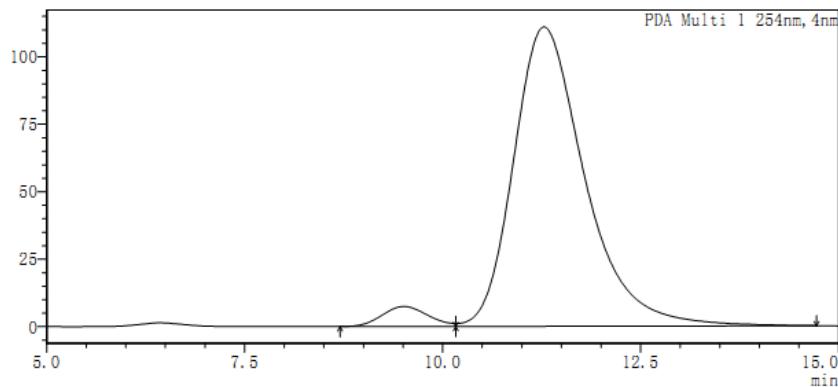


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	9.266	6122	216373	1.413
2	10.848	263669	15100361	98.587

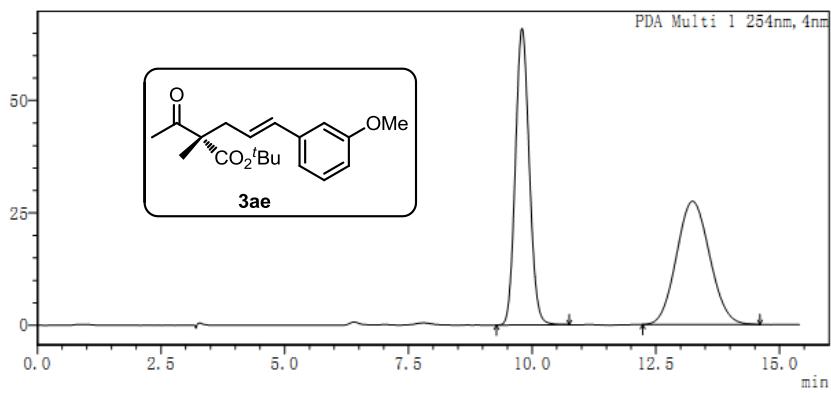
mAU



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PDA Ch1 254nm

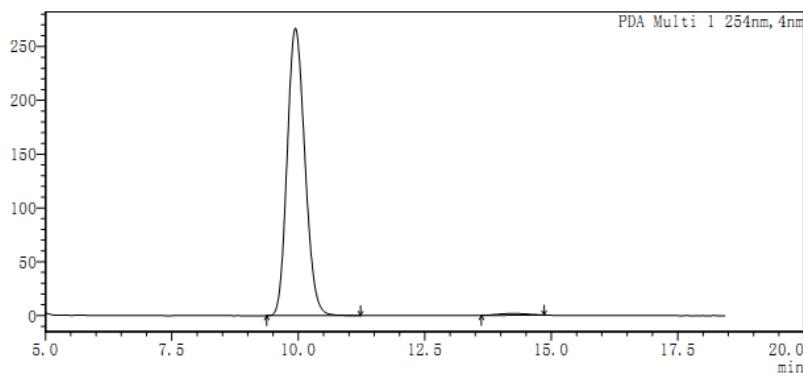
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	9.509	7429	299334	4.130
2	11.280	110887	6949017	95.870



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	9.796	66000	1289152	50.178
2	13.244	27413	1279995	49.822

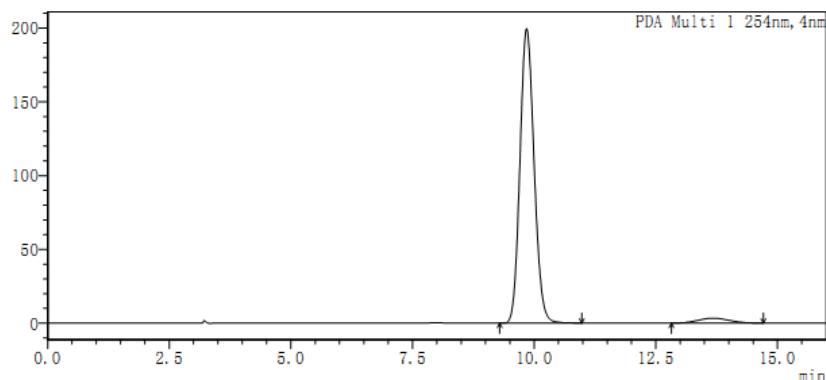


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	9.942	267149	6505446	98.994
2	14.248	1623	66079	1.006

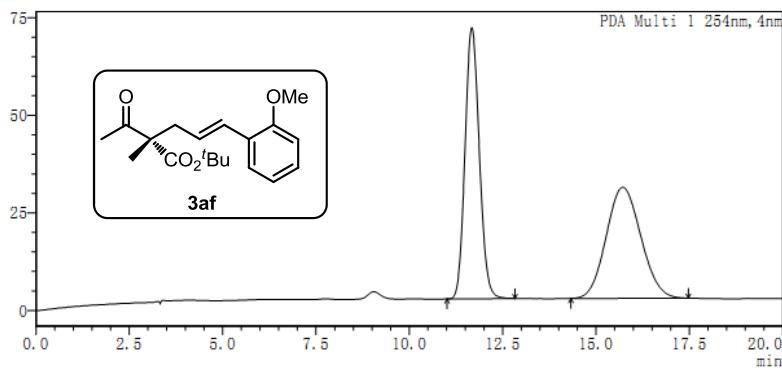
mAU



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	9.845	199744	4044589	96.328
2	13.673	3372	154166	3.672

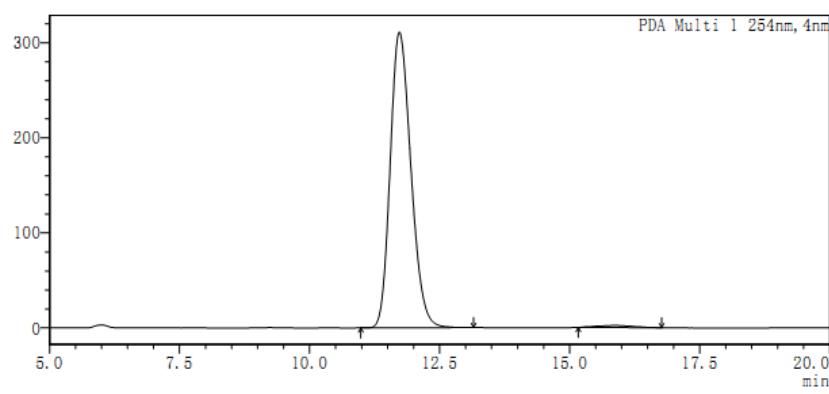


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	11.673	69481	1850490	50.127
2	15.715	28464	1841136	49.873

mAU

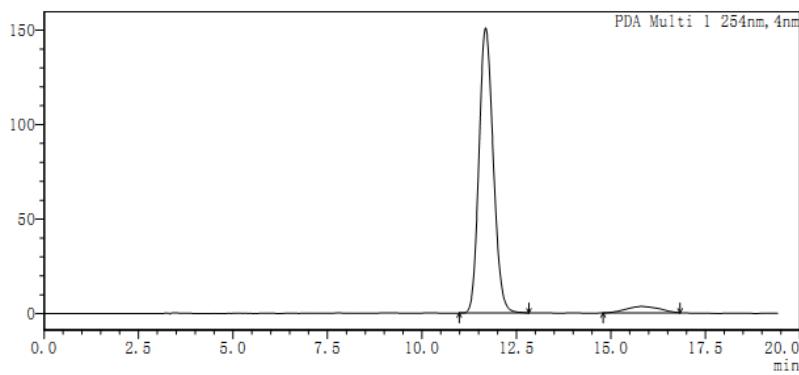


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	11.727	311066	8616456	98.821
2	15.843	1971	102803	1.179

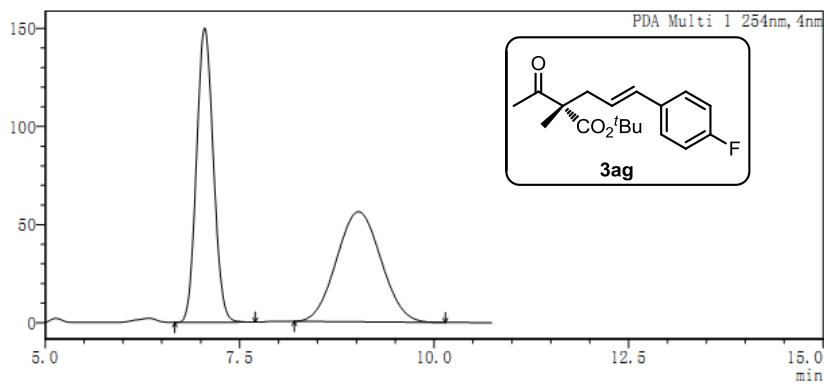
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PDA Ch1 254nm

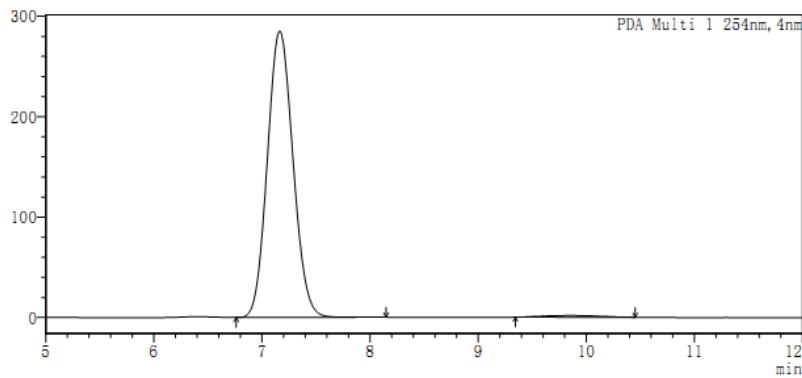
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	11.684	150857	3961985	95.052
2	15.820	3324	206224	4.948



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.050	150130	2263866	50.286
2	9.028	56119	2238132	49.714

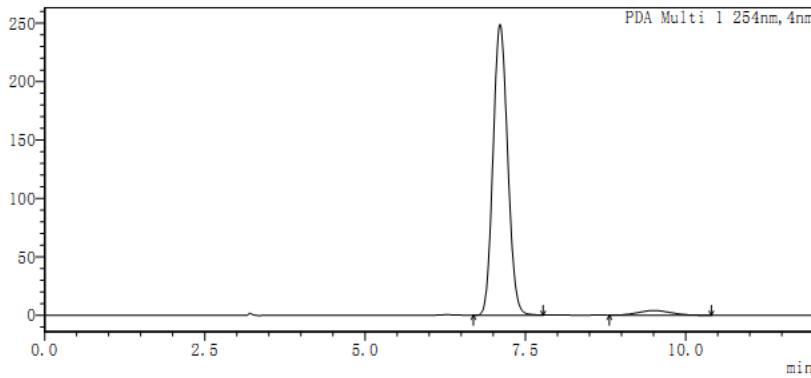


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.164	285192	4711674	98.695
2	9.853	1690	62294	1.305

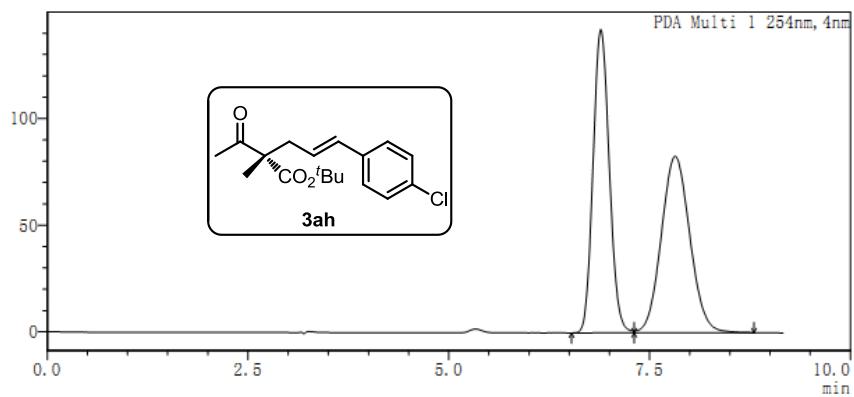
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PDA Ch1 254nm

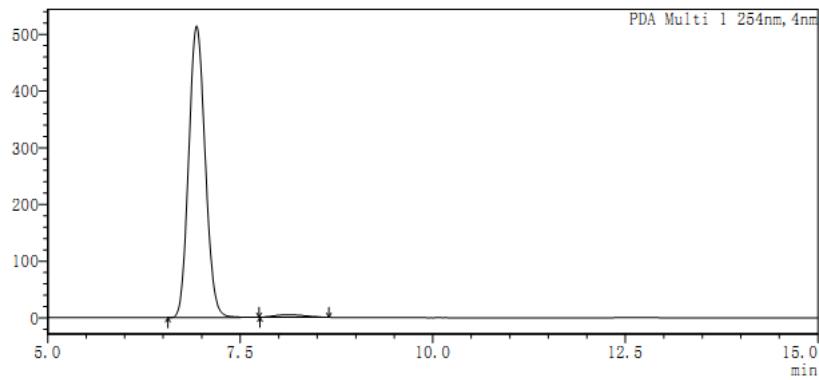
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.105	249110	3948429	96.473
2	9.510	4030	144345	3.527



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	6.893	142266	2003536	49.452
2	7.819	82717	2047945	50.548

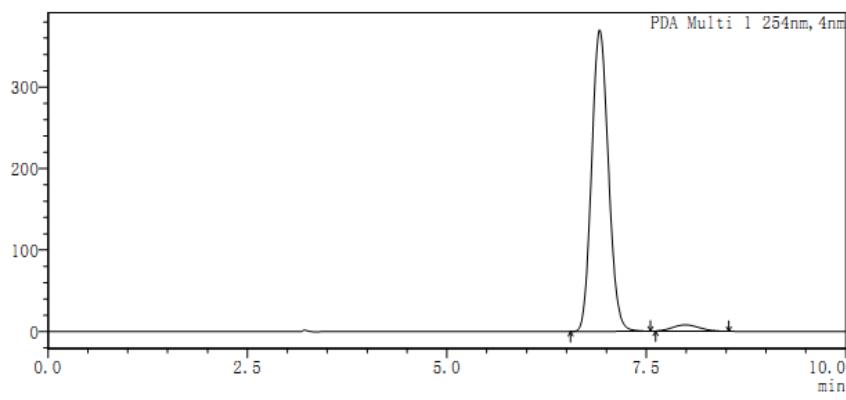


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	6.933	514460	7649142	98.373
2	8.129	4482	126516	1.627

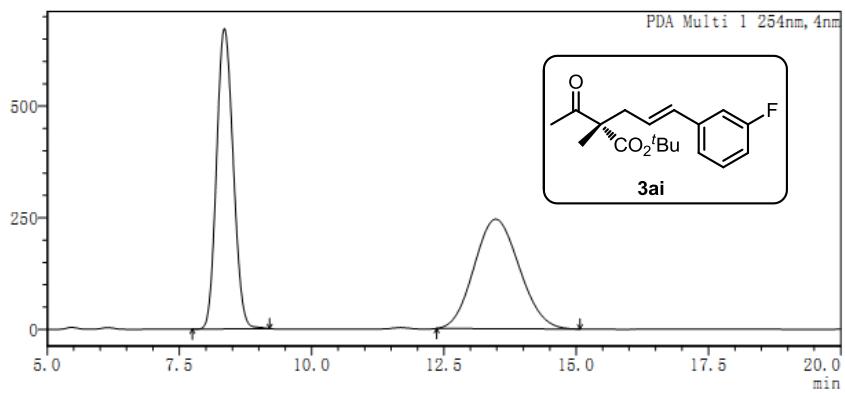
mAU



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PDA Ch1 254nm

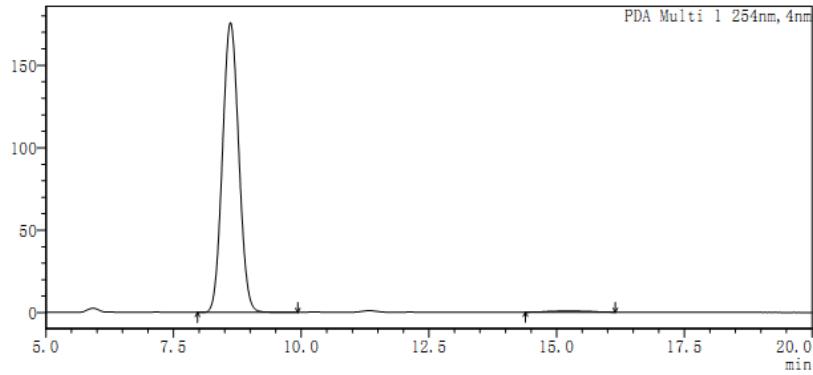
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	6.915	370133	5408946	96.803
2	7.989	7620	178572	3.197



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	8.350	672437	14719460	50.206
2	13.478	245201	14598824	49.794

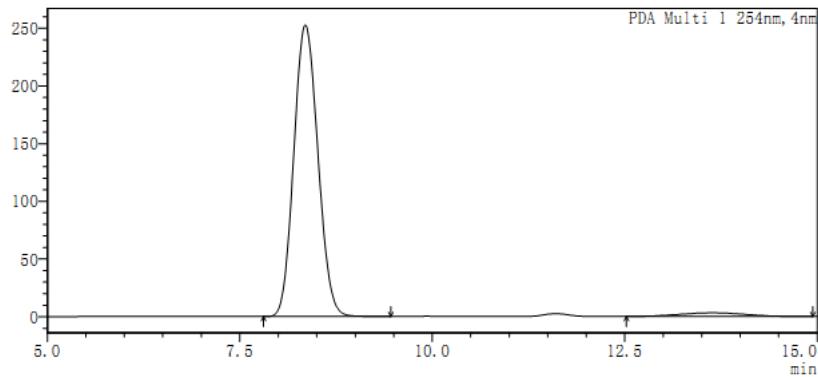


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	8.614	175731	3900592	98.810
2	15.263	830	46990	1.190

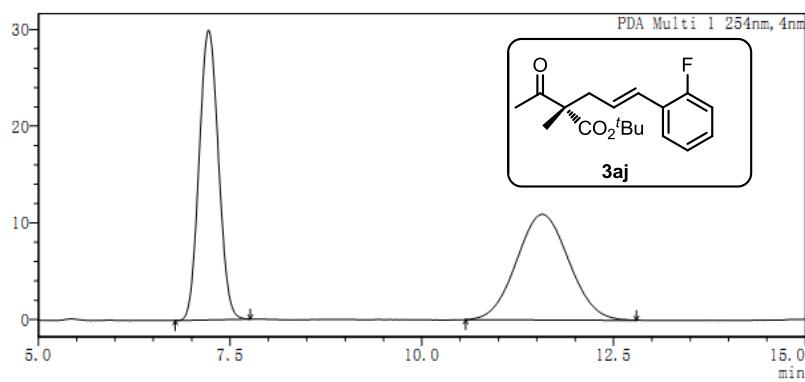
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PDA Ch1 254nm

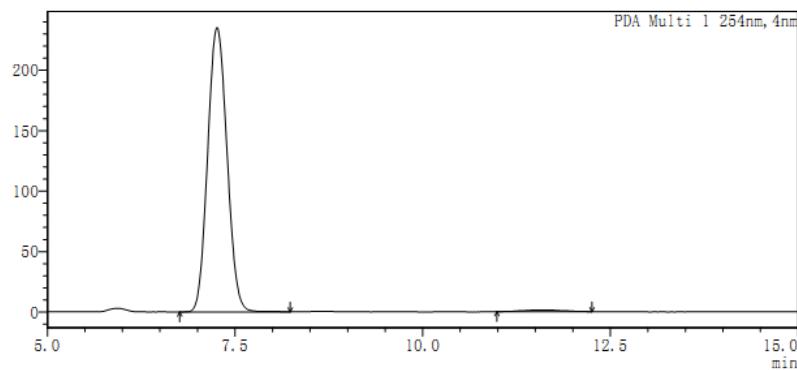
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	8.351	252757	5503805	96.410
2	13.645	3341	204919	3.590



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.220	29970	524100	50.216
2	11.574	10925	519599	49.784

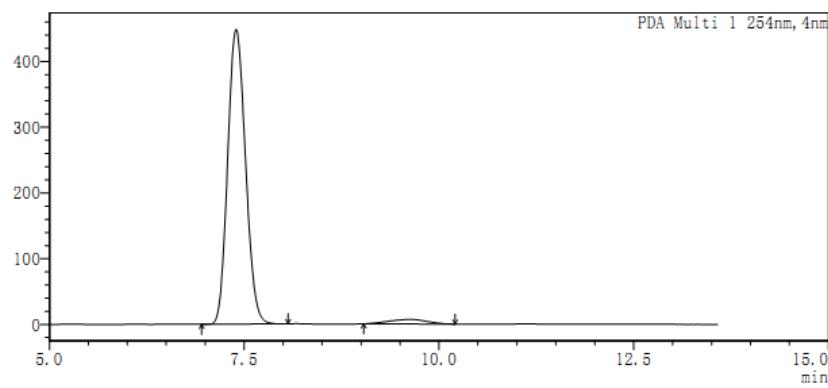


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.260	235126	4217916	98.743
2	11.587	1329	53706	1.257

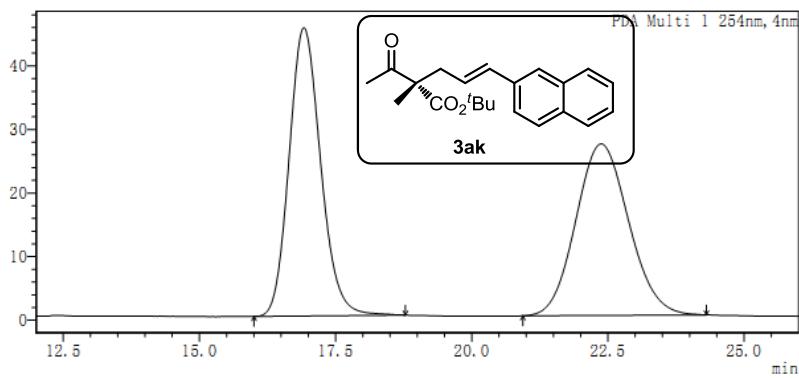
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PDA Ch1 254nm

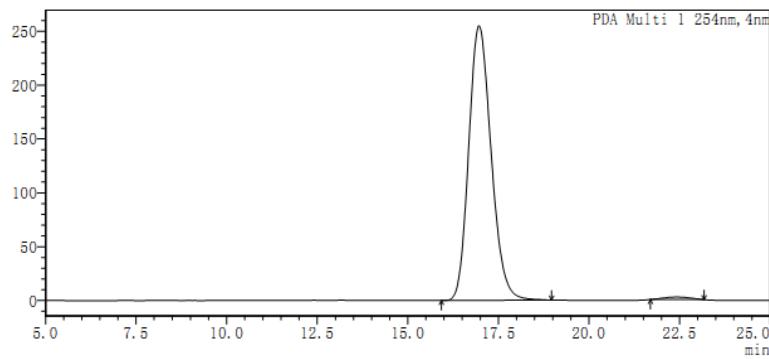
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.397	447963	7128859	96.830
2	9.635	6799	233379	3.170



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	16.918	45320	1826800	50.162
2	22.377	26953	1815032	49.838

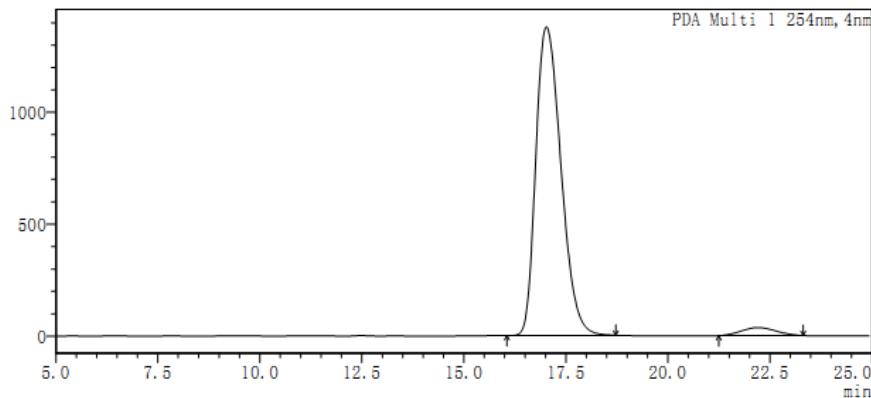


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	16.964	255071	10982961	98.900
2	22.434	2405	122167	1.100

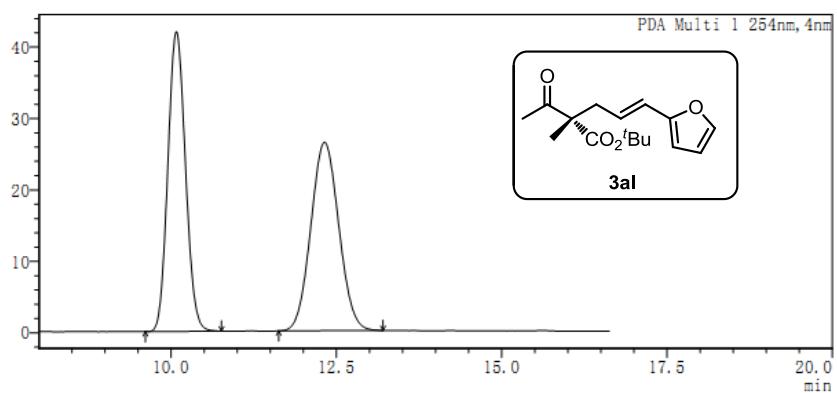
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PDA Ch1 254nm

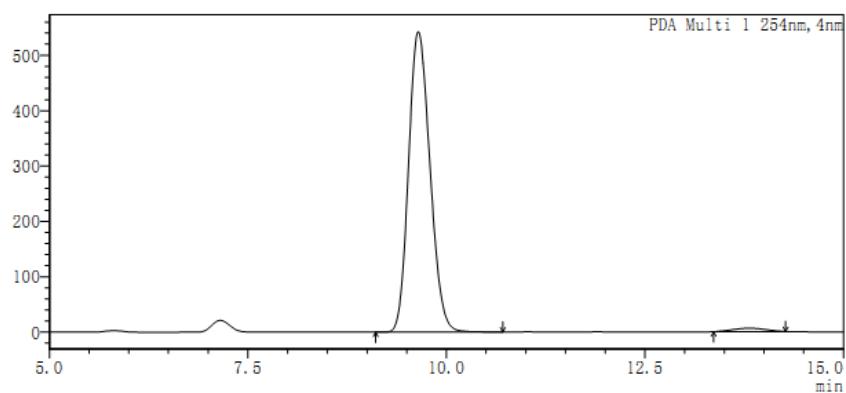
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	17.024	1377867	59072936	96.549
2	22.212	35633	2111778	3.451



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	10.078	41997	777581	50.028
2	12.320	26393	776711	49.972

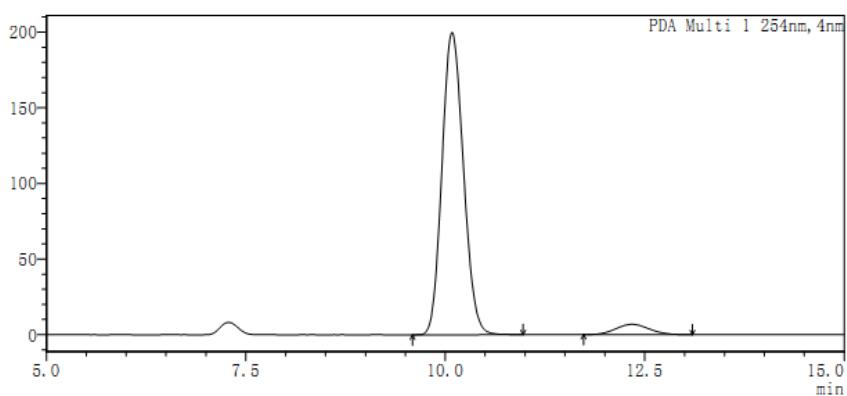


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	9.646	542663	10202372	98.305
2	13.813	6136	175953	1.695

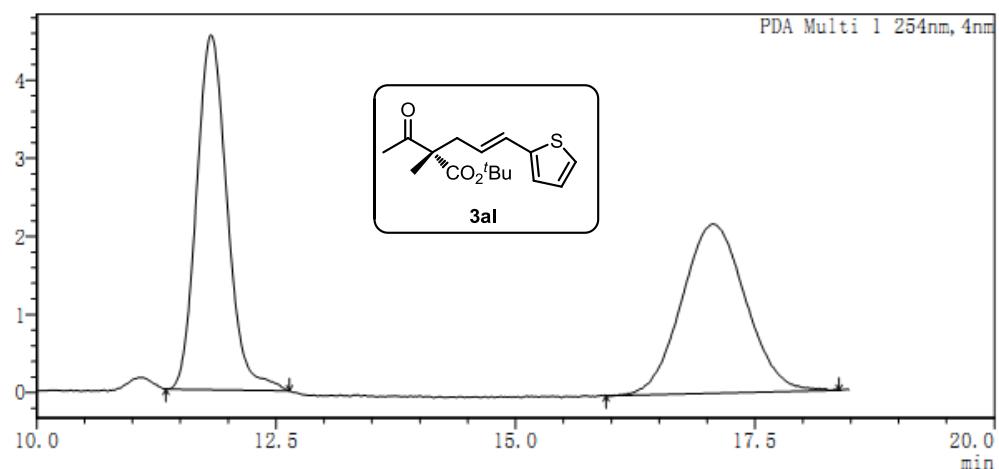
mAU



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PDA Ch1 254nm

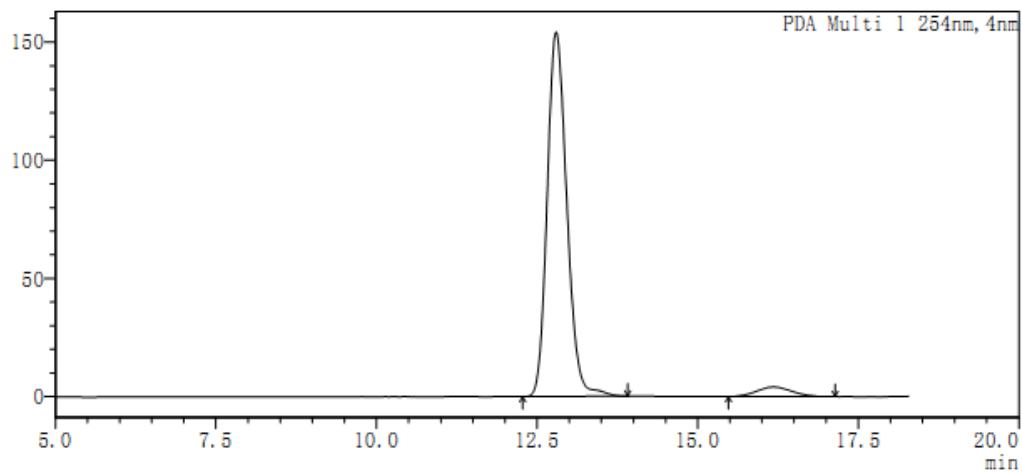
Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	10.085	199820	3737071	94.885
2	12.342	6820	201438	5.115



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	11.820	4546	101140	50.159
2	17.058	2169	100498	49.841

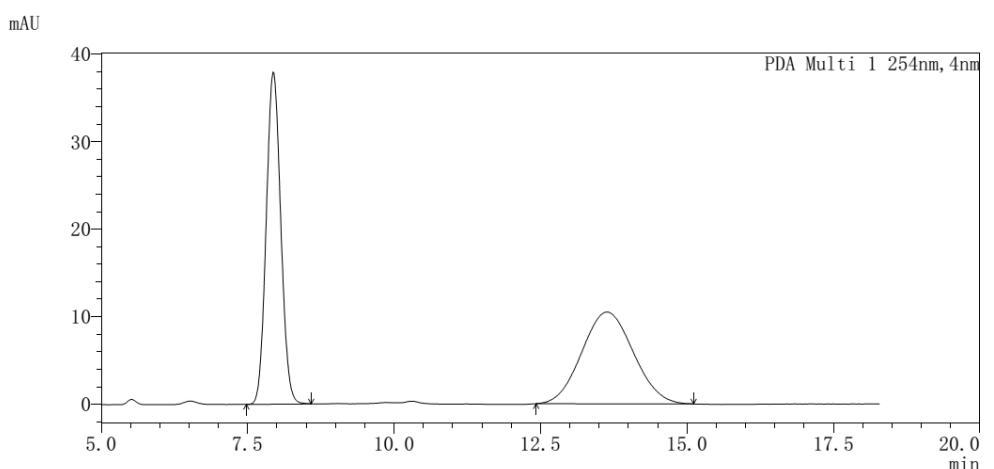


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	12.795	154138	3278256	95.490
2	16.179	4041	154822	4.510

4-H alcohol

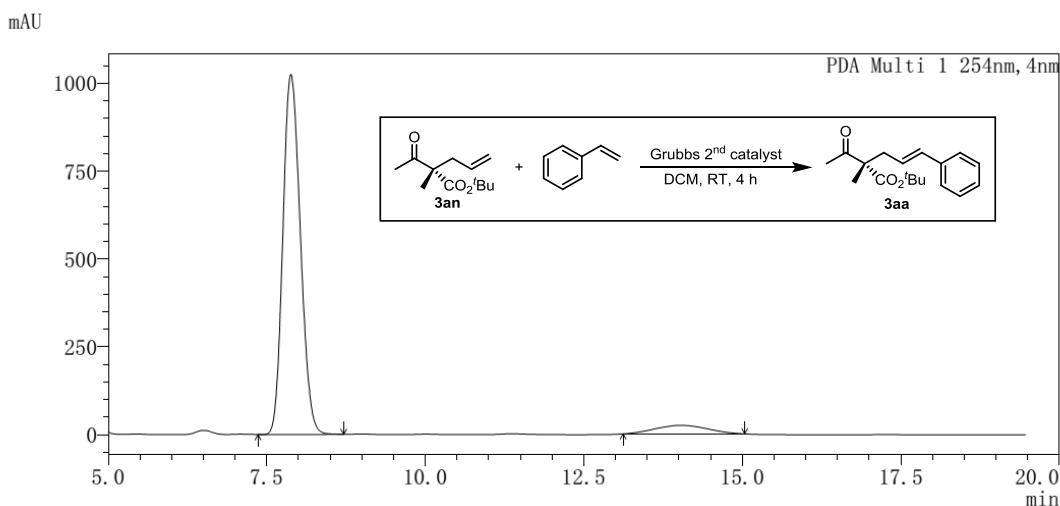


<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.938	37952	655072	50.468
2	13.626	10476	642932	49.532

zh-150806 propenol



<Peak Results>

PDA Ch1 254nm

Index	Time/min	Height/mAU	Quantity/Area	Area %/%
1	7.880	1025733	19692178	93.275
2	14.025	24655	1419761	6.725