Electronic Supplementary Material (ESI) for ChemComm.


# Supporting Information

## $I_2$-Promoted formal [3+2] cycloaddition of α-methylenyl isocyanides with methyl ketones: a route to 2,5-disubstituted oxazoles

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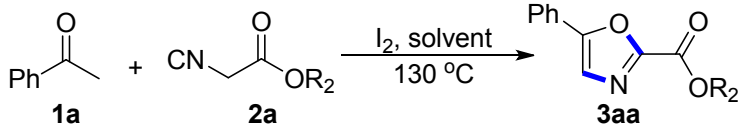
## 1. General

All substrates and reagents were commercially available and used without further purification. TLC analysis was performed using pre-coated glass plates. Column chromatography was performed using silica gel (200–300 mesh). IR spectra were recorded on a Perkin-Elmer PE-983 infrared spectrometer as KBr pellets with absorption in $cm^{-1}$. $^1H$ spectra were recorded in $CDCl_3$ on 300/600 MHz NMR spectrometers and resonances (δ) are given in parts per million relative to tetramethylsilane. Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet), coupling constants (Hz) and integration. $^{13}C$ spectra were recorded in $CDCl_3$ on 75/100/150 MHz NMR spectrometers and resonances (δ) are given in ppm. HRMS were obtained on a Bruker 7-tesla FT-ICR MS equipped with an electrospray source. The X-ray crystal-structure determinations of **3ga** were obtained on a Bruker SMART APEX CCD system. Melting points were determined using XT-4 apparatus and not corrected.

## 2. General procedure for the synthesis of 3 (3aa as an example)

To a solution of acetophenone **1a** (1.0 mmol) and iodine (1.6 mmol) in DMSO (3 mL) was added ethyl 2-isocyanoacetate **2a** (2.0 mmol). Then the mixture was stirred at 130 ℃ till almost completed conversion of the substrates by TLC analysis. the mixture was quenched with water (50 mL), extracted with EtOAc (3 × 50 mL). The combined organic layers were washed with brine, dried over anhydrous $Na_2SO_4$ and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (eluent: petroleum ether/EtOAc) to afford the product 3aa.

## 3. Optimization of the Reaction Conditions[a]



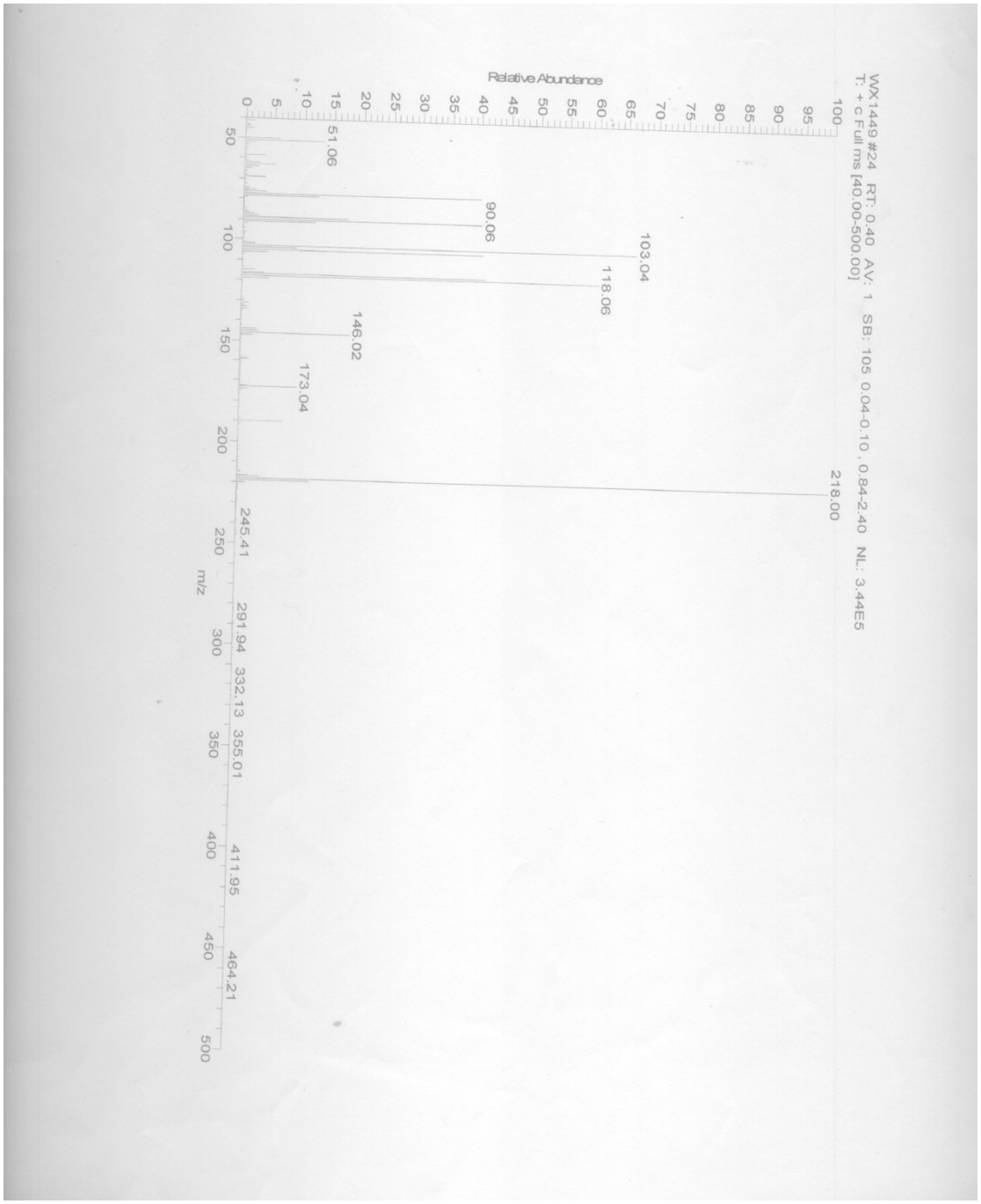

**1a** **2a** **3aa**

| Entry | Solvent | yield (%)[b] |
|---|---|---|
| 1 | DMF | 0 |
| 2 | toluene | 0 |
| 3[c] | DMSO | 0 |

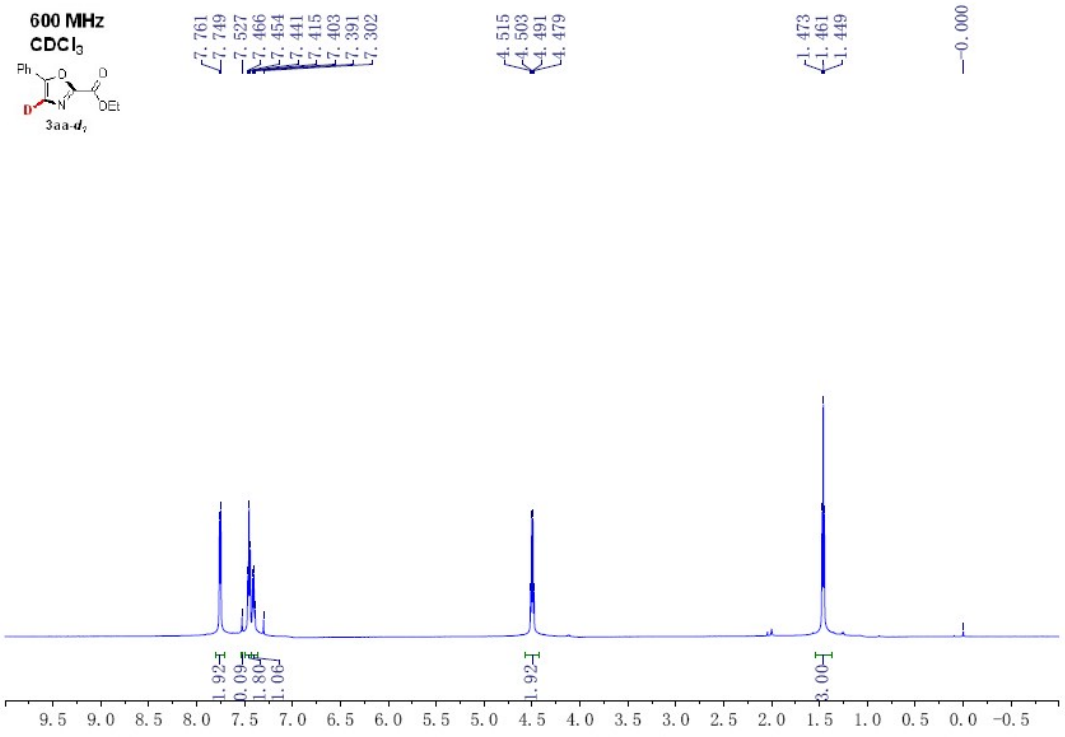
[a]Reaction conditions: **1a** (1.0 mmol), **2a** and $I_2$ were heated in 3 mL of DMSO. [b]Isolated yield. [c]$Ag_2O$ was used instead of $I_2$.

A brief screening of the reaction media proved that DMSO was the best choice with respect to yields. Moreover, molecular iodine was the best medium.

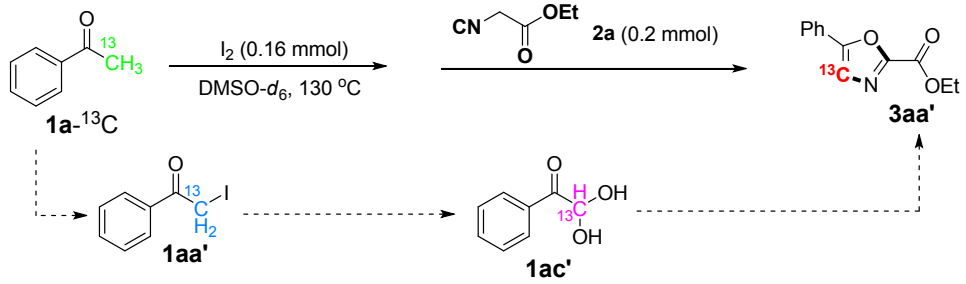
## 4. Mass spectrum of 3aa' and $^1H$ NMR of 3aa-$d_1$




The molecular weight of **3aa'** detected by MS. MS (EI): m/z 219.19 (M-1, 3.71%), 218.00 (M, 100%), 219.06 (M+1, 12.03%). This result indicated that methyl ketones provided two carbons of the oxazoles ring.




## 5. $^{13}$C NMR spectroscopy monitored



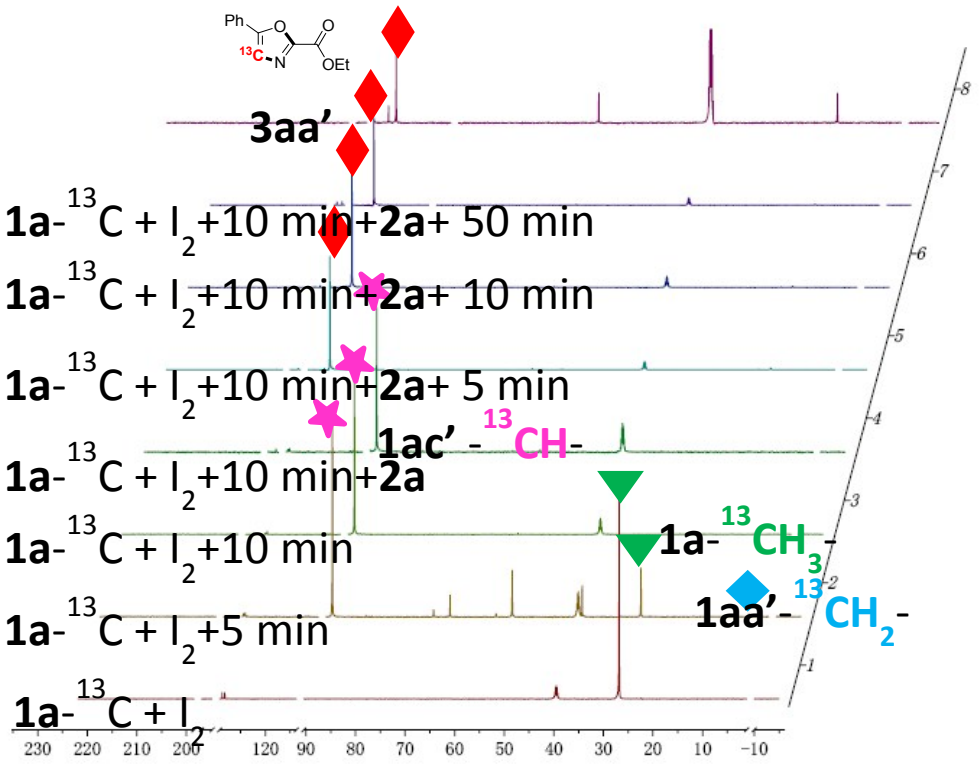
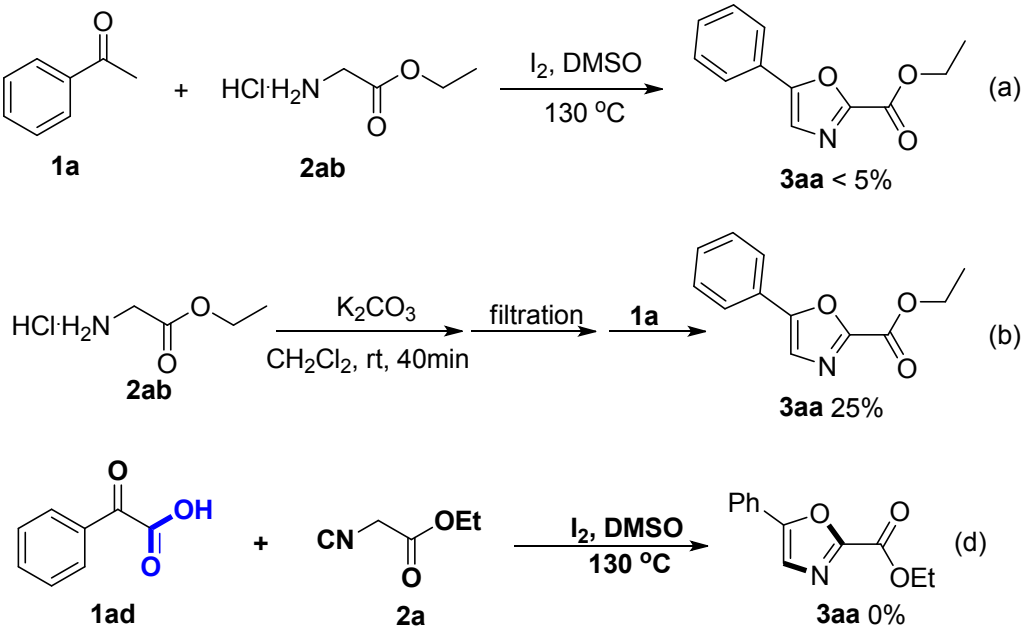



Figure 1. Progress of the reaction of **1a** (0.1 mmol), **2a** (0.2 mmol) with $I_2$ (0.16 mmol) at 130 °C by $^{13}C$ NMR (150 MHz, DMSO-$d_6$, 298 ± 0.5 K)

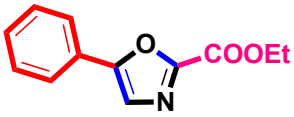
The reaction of **1a**-$^{13}C$ (0.1 mmol) with **2a** (0.2 mmol) in the presence of $I_2$ (0.16 mmol) in DMSO-$d_6$ was monitored by $^{13}C$ NMR spectroscopy to develop a deeper understanding of the reaction mechanism (Figure 1).[1] The results of this study also revealed that phenacyl iodine (**1aa'**) and phenylglyoxal (**1ac'**) were important intermediates in the overall transformation. Moreover, this experimental result also indicated that methyl ketones provided two carbons of the oxazoles ring.

**6. Control Experiments**



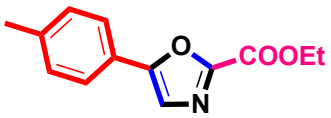
To gain insight into the mechanism of the reaction, the following experiments were performed. Ethyl 2-aminoacetate hydrochloride **2ab** reacted with aryl methyl ketone **1a** to afford the product **3aa** in lower yield. Then, in order to improve the yield, the substrate **2ab** was reacted with $K_2CO_3$ in order to remove the hydrochloric acid and subsequently react with acetophenone **1a** could provide desired product **3aa** in 25% yield. These results clearly confirm the intermediacy of ethyl 2-aminoacetate **2aa** in the transformation. Moreover, 2-oxo-2-phenylacetic acid **1ad** was reacted with **2a** under the standard conditions, but target product **3aa** was not obtained. This result indicates that **1ad** is not the intermediate to construct 2,5-disubstituted oxazoles in this transformation.

**7. Characterization data for compounds 3**



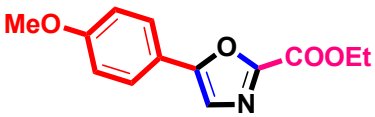

**ethyl 5-phenyloxazole-2-carboxylate (3aa):**

Yield 75%; 162.9 mg; yellow solid; mp 52–55℃; IR (KBr): 1276, 1447, 1382, 1181, 1126, 764, 690 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.76 (d, $J$ = 7.2 Hz, 2H), 7.52 (s, 1H), 7.46 (t, $J$ = 7.8 Hz, 2H), 7.41 (t, $J$ = 7.2 Hz, 1H), 4.54-7.46 (m, 2H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (100 MHz, $CDCl_3$) $\delta$ (ppm) 155.6, 154.2, 151.5, 129.7, 129.0, 126.6, 125.0, 123.8, 62.5, 14.1; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{12}H_{11}NNaO_3$: 240.0631; found: 240.0635.




**ethyl 5-(p-tolyl)oxazole-2-carboxylate (3ba):**

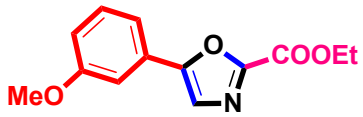
Yield 74%; 171.25 mg; light yellow solid; mp 90–93 ℃; IR (KBr): 1737, 1526, 1490, 1381, 1175, 1129, 819 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.65 (d, $J$ = 7.8 Hz, 2H), 7.47 (s, 1H), 7.26 (d, $J$ = 8.4 Hz, 2H), 4.55-4.46 (m, 2H), 2.40 (s, 3H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 155.7, 154.5, 151.3, 140.1, 129.7, 125.0, 123.9, 123.2, 62.5, 21.4, 14.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{13}H_{13}NNaO_3$: 254.0788; found: 254.0785.




**ethyl 5-(4-methoxyphenyl)oxazole-2-carboxylate (3ca):**

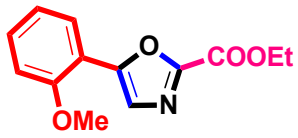
Yield 79%; 195.3 mg; light yellow solid; mp 70–73 ℃; IR (KBr): 1729, 1612, 1488, 1264, 1179, 1152, 1122, 1020 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.70 (d, $J$ = 8.4 Hz, 2H), 7.41 (s, 1H), 6.98 (d, $J$ = 9.0 Hz, 2H), 4.53-4.44 (m, 2H), 3.86 (s, 3H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 160.8, 155.8, 154.5,

151.0, 126.7, 122.4, 119.4, 114.5, 62.5, 55.4, 14.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{13}H_{13}NNaO_4$: 270.0737; found: 270.0740.



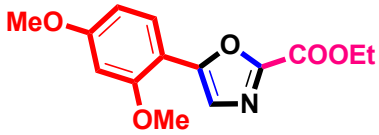

**ethyl 5-(3-methoxyphenyl)oxazole-2-carboxylate (3da):**

Yield 80%; 197.8 mg; light yellow solid; mp 60–63 ℃; IR (KBr): 1731, 1638, 1620, 1231, 1182, 1125, 623 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.52 (s, 1H), 7.39-7.31 (m, 2H), 7.27 (s, 1H), 6.95 (d, $J$ = 7.2 Hz, 1H), 4.56-4.43 (m, 2H), 3.87 (s, 3H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 160.0, 155.6, 154.1, 151.5, 130.1, 127.8, 124.1, 117.5, 115.6, 110.2, 62.5, 55.4, 14.1; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{13}H_{13}NNaO_4$: 270.0737; found: 270.0734.



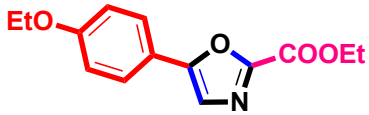

**ethyl 5-(2-methoxyphenyl)oxazole-2-carboxylate (3ea):**

Yield 83%; 205.2 mg; yellow solid; mp 103–106 ℃; IR (KBr): 1733, 1512, 1378, 1306, 1264, 1177, 1128, 757 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.93 (d, $J$ = 7.8 Hz, 1H), 7.71 (s, 1H), 7.37 (t, $J$ = 7.2 Hz, 1H), 7.07 (t, $J$ = 7.8 Hz, 1H), 6.99 (d, $J$ = 8.4 Hz, 1H), 4.56-4.44 (m, 2H), 3.98 (s, 3H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 156.2, 155.8, 150.9, 150.4, 130.5, 127.8, 126.8, 120.9, 115.8, 110.9, 62.4, 55.4, 14.1; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{13}H_{13}NNaO_4$: 270.0737; found: 270.0742.



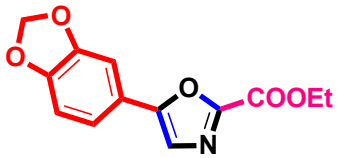

**ethyl 5-(2,4-dimethoxyphenyl)oxazole-2-carboxylate (3fa):**

Yield 81%; 224.6 mg; yellow solid; mp 65–67 ℃; IR (KBr): 2293, 2852, 1729, 1613, 1463, 1269, 1216, 1178, 1021 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.85 (d, $J$ = 8.4 Hz, 1H), 7.58 (s, 1H), 6.60 (d, $J$ = 8.4 Hz, 1H), 6.54 (s, 1H), 4.51-4.44 (m, 2H), 3.96 (s, 4H), 3.86 (s, 4H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 162.2, 158.0, 156.2, 151.6, 150.2, 128.2, 126.3, 109.4, 105.5, 98.7, 62.6, 55.83, 55.78, 14.5; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{14}H_{15}NNaO_5$: 300.0842; found: 300.0841.




**ethyl 5-(4-ethoxyphenyl)oxazole-2-carboxylate (3ga):**

Yield 71%; 185.5 mg; light yellow solid; mp 100–103 °C; IR (KBr): 1730, 1616, 1492, 1246, 1182, 1154, 1124, 694 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.68 (d, $J$ = 8.4 Hz, 2H), 7.40 (s, 1H), 6.96 (d, $J$ = 8.4 Hz, 2H), 4.53-4.55 (m, 2H), 4.12-4.00 (m, 2H), 1.51-1.40 (m, 6H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 160.2, 155.7, 154.5, 151.0, 126.7, 122.4, 119.1, 114.9, 63.6, 62.4, 14.7, 14.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{14}H_{15}NNaO_4$: 284.0893; found: 284.0899.

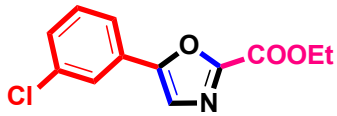



**ethyl 5-(benzo[*d*][1,3]dioxol-5-yl)oxazole-2-carboxylate (3ha):**

Yield 69%; 180.2 mg; light yellow solid; mp 127–130 ℃; IR (KBr): 1719, 1473, 1446, 1331, 1234, 1177, 1041 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.38 (s, 1H), 7.27 (d, $J$ = 8.4 Hz, 1H), 7.19 (s, 1H), 6.88 (d, $J$ = 7.8 Hz, 1H), 6.03 (s, 2H), 4.53-4.45 (m, 2H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 155.6, 154.1, 151.0, 148.9, 148.2, 122.7, 120.6, 119.6, 108.8, 105.3, 101.5, 62.4, 14.1; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{13}H_{11}NNaO_5$: 284.0529; found: 284.0532.


**ethyl 5-(4-chlorophenyl)oxazole-2-carboxylate (3ia):**

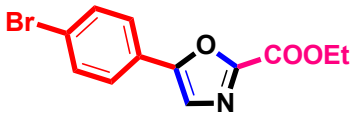
Yield 75%; 188.8 mg; light yellow solid; mp 99–102 ℃; IR (KBr): 1726, 1477, 1411, 1184, 1127, 1090, 833 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.70 (d, $J$ = 8.4 Hz, 2H), 7.52 (s, 1H), 7.44 (d, $J$ = 8.4 Hz, 2H), 4.54-4.44 (m, 2H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 155.5, 153.2, 151.7, 135.7, 129.3, 126.3, 125.1, 124.1, 62.7, 14.1; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{12}H_{10}ClNNaO_3$: 274.0241; found: 274.0247.




**ethyl 5-(3-chlorophenyl)oxazole-2-carboxylate (3ja):**

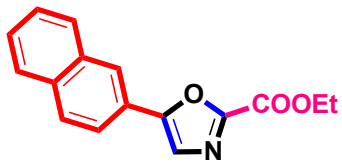
Yield 70%; 176.2 mg; light yellow solid; mp 122–125 ℃; IR (KBr): 1723, 1646, 1620, 1187, 1151, 1130, 1118 $cm^{-1}$; $^1H$ NMR (300 MHz, $CDCl_3$): $\delta$ (ppm) 7.76 (s, 1H), 7.68-7.62 (m, 1H), 7.55 (s, 1H), 7.43–7.37 (m, 2H), 4.57-4.44 (m, 2H), 1.47 (t, $J$ = 7.2 Hz,

3H); $^{13}$C NMR (75 MHz, $CDCl_3$) $\delta$ (ppm) 155.6, 152.8, 152.0, 135.3, 130.4, 129.8, 128.3, 125.1, 124.7, 123.2, 62.8, 14.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{12}H_{10}ClNNaO_3$: 274.0241; found: 274.0244.



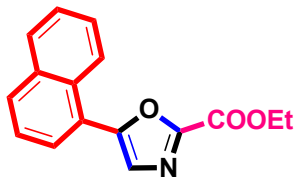

**ethyl 5-(4-bromophenyl)oxazole-2-carboxylate (3ka):**

Yield 78%; 231.0 mg; light yellow solid; mp 101–104 ℃; IR (KBr): 1724, 1475, 1408, 1279, 1182, 834 $cm^{-1}$; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.63 (d, $J$ = 8.4 Hz, 2H), 7.59 (d, $J$ = 8.4 Hz, 2H), 7.54 (s, 1H), 4.54-4.46 (m, 2H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}$C NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 155.5, 153.2, 151.7, 132.2, 126.4, 125.5, 124.2, 124.0, 62.7, 14.1; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{12}H_{10}BrNNaO_3$: 317.9736; found: 317.9742.



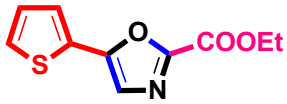

**ethyl 5-(naphthalen-2-yl)oxazole-2-carboxylate (3la):**

Yield 77%; 205.8 mg; light yellow solid; mp 76–78 ℃; IR (KBr): 1724, 1333, 1178, 1127, 747 $cm^{-1}$; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 8.28 (s, 1H), 7.91 (d, $J$ = 8.4 Hz, 2H), 7.87-7.82 (m, 1H), 7.78 (d, $J$ = 8.4 Hz, 1H), 7.63 (s, 1H), 7.56-7.52 (m, 2H), 4.56-4.47 (m, 2H), 1.48 (t, $J$ = 7.2 Hz, 3H); $^{13}$C NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 155.7, 154.4, 151.7, 133.6, 133.1, 128.9, 128.5, 127.8, 127.2, 127.0, 124.7, 124.2, 123.8, 122.1, 62.7, 14.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{16}H_{13}NNaO_3$: 290.0788; found: 290.0791.

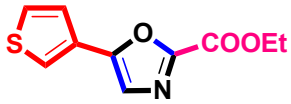



**ethyl 5-(naphthalen-1-yl)oxazole-2-carboxylate (3ma):**

Yield 81%; 216.5 mg; deep yellow solid; mp 60–63 ℃; IR (KBr): 1729, 1261, 1179, 1107, 1021, 804 $cm^{-1}$; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 8.27 (d, $J$ = 8.4 Hz, 1H), 7.97-7.89 (m, 2H), 7.84 (d, $J$ = 7.2 Hz, 1H), 7.63 (s, 1H), 7.60 (d, $J$ = 7.2 Hz, 1H), 7.58-7.51 (m, 2H), 4.56-4.49 (m, 2H), 1.48 (t, $J$ = 7.2 Hz, 3H); $^{13}$C NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 155.7, 153.6, 152.0, 133.7, 130.7, 129.9, 128.8, 127.5, 127.4, 127.2, 126.4, 125.1, 124.4, 123.8, 62.6, 14.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{16}H_{13}NNaO_3$: 290.0788; found: 290.0785.

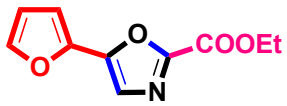



**ethyl 5-(thiophen-2-yl)oxazole-2-carboxylate (3na):**
Yield 81%; 180.8 mg; yellow oil; IR (KBr): 1736, 1530, 1277, 1181, 1119 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.52-7.46 (m, 1H), 7.45-7.41 (m, 1H), 7.39 (s, 1H), 7.13-7.10 (m, 1H), 4.54-4.46 (m, 2H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 155.4, 150.8, 149.7, 128.1, 128.0, 127.5, 126.4, 123.2, 62.6, 14.1; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{10}H_9NNaO_3S$: 246.0195; found: 246.0195.



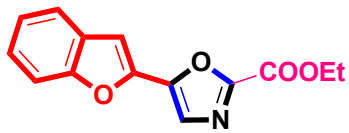

**ethyl 5-(thiophen-3-yl)oxazole-2-carboxylate (3oa):**

Yield 75%; 167.4 mg; deep yellow solid; mp 70–73 ℃; IR (KBr): 1722, 1531, 1337, 1179, 1125 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): δ (ppm) 7.77-7.73 (m, 1H), 7.45-7.41 (m, 1H), 7.40-7.36 (m, 2H), 4.55-4.46 (m, 3H), 1.46 (t, $J$ = 7.2 Hz, 4H); $^{13}C$ NMR (150 MHz, $CDCl_3$) δ (ppm) 155.6, 150.9, 127.7, 127.3, 124.6, 123.4, 123.3, 62.6, 14.1; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{10}H_9NNaO_3S$: 246.0195; found: 246.0192.




**ethyl 5-(furan-2-yl)oxazole-2-carboxylate (3pa):**

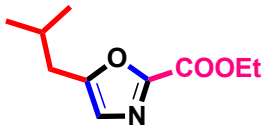
Yield 82%; 158.4 mg; yellow solid; mp 35–37 ℃; IR (KBr): 1739, 1547, 1290, 1182, 1155, 1118, 1015 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.54 (s, 1H), 7.43 (s, 1H), 6.88 (d, $J$ = 3.0 Hz, 1H), 6.57-6.52 (m, 1H), 4.54-4.46 (m, 2H), 1.46 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 155.5, 150.9, 146.4, 144.0, 142.3, 123.4, 111.9, 109.9, 62.7, 14.1; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{10}H_9NNaO_4$: 230.0424; found: 230.0427.




**ethyl 5-(benzofuran-2-yl)oxazole-2-carboxylate (3qa):**

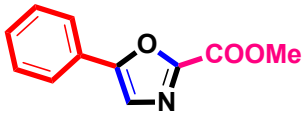
Yield 62%; 159.5 mg; deep yellow solid; mp 69–72 ℃; IR (KBr): 1734, 1441, 1314, 1187, 1128, 747 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.64 (d, $J$ = 7.8 Hz, 2H), 7.53 (d, $J$ = 8.4 Hz, 1H), 7.38 (t, $J$ = 7.8 Hz, 1H), 7.29 (t, $J$ = 7.8 Hz, 1H), 7.23 (s, 1H), 4.57-4.48 (m, 2H), 1.48 (t, $J$ = 7.2 Hz, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 155.4,

155.1, 151.8, 146.2, 143.7, 127.8, 126.0, 125.5, 123.7, 121.8, 111.4, 105.9, 62.9, 14.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{14}H_{11}NNaO_4$: 280.0580; found: 280.0583.



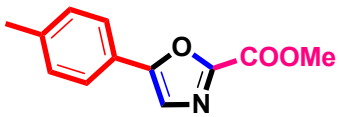

**ethyl 5-isobutyloxazole-2-carboxylate (3ra):**

Yield 75%; 147.9 mg; yellow oil; IR (KBr): 1739, 1524, 1383, 1179, 1154, 1123, 1044 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 6.98 (s, 1H), 4.51-4.43 (m, 2H), 2.62 (d, $J$ = 7.2 Hz, 2H), 2.08-2.01 (m, 1H), 1.43 (t, $J$ = 7.2 Hz, 3H), 0.97 (s, 3H), 0.96 (s, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 156.2, 155.8, 151.6, 125.7, 62.4, 34.6, 27.5, 22.2, 14.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{10}H_{15}NNaO_3$: 220.0944; found: 220.0945.



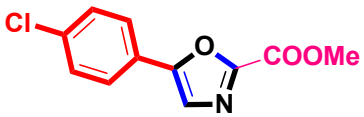

**methyl 5-phenyloxazole-2-carboxylate (3ab):**

Yield 80%; 162.6 mg; light yellow solid; mp 85–88 ℃; IR (KBr): 1730, 1637, 1447, 1190, 1155, 1125, 1044, 774, 690 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.76 (d, $J$ = 7.2 Hz, 2H), 7.53 (s, 1H), 7.46 (t, $J$ = 7.8 Hz, 2H), 7.41 (t, $J$ = 7.8 Hz, 1H), 4.03 (s, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 156.0, 154.3, 151.3, 129.8, 129.0, 126.5, 125.0, 123.8, 53.0; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{11}H_9NNaO_3$: 226.0475; found: 226.0474.




**methyl 5-(p-tolyl)oxazole-2-carboxylate (3bb):**

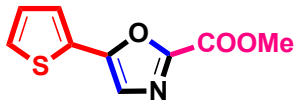
Yield 72%; 156.4 mg; light yellow solid; mp 82–84 ℃; IR (KBr): 1727, 1493, 1372, 1207, 1176, 1131, 813 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 7.64 (d, $J$ = 7.2 Hz, 2H), 7.48 (s, 1H), 7.26 (d, $J$ = 7.8 Hz, 2H), 4.02 (s, 3H), 2.39 (s, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 156.0, 154.6, 151.0, 140.1, 129.7, 125.0, 123.7, 123.3 53.0, 21.4; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{12}H_{11}NNaO_3$: 240.0631; found: 240.0628.




**ethyl 5-(4-chlorophenyl)oxazole-2-carboxylate (3ib):**

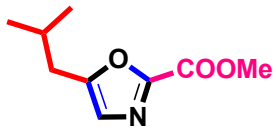
Yield 69%; 164.0 mg; yellow solid; mp 159–161 ℃; IR (KBr): 1723, 1478, 1435, 1409, 1197, 1170, 1129, 1089 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): δ (ppm) 7.69 (d, $J$ = 8.4 Hz, 2H), 7.53 (s, 1H), 7.44 (d, $J$ = 8.4 Hz, 2H), 4.03 (s, 3H); $^{13}C$ NMR (150 MHz,

$CDCl_3$) δ (ppm) 155.9, 153.3, 151.4, 135.8, 129.4, 126.3, 125.0, 124.2, 53.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_{11}H_8ClNNaO_3$: 260.0085; found: 260.0089.




**ethyl 5-(thiophen-2-yl)oxazole-2-carboxylate (3nb):**

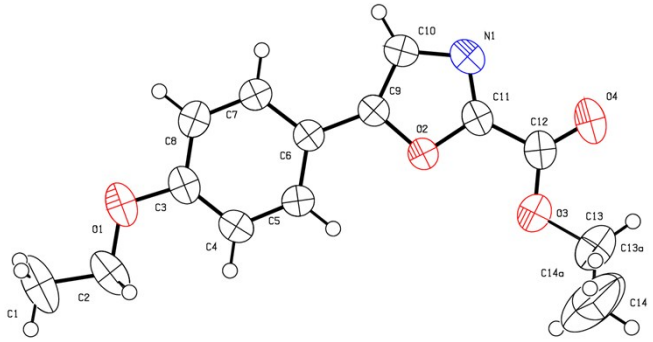
Yield 82%; 171.6 mg; yellow solid; mp 50–52 ℃; IR (KBr): 1733, 1532, 1496, 1280, 1204, 1154, 1118 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): δ (ppm) 7.50 (d, $J$ = 3.6 Hz, 1H), 7.44 (d, $J$ = 4.8 Hz, 1H), 7.39 (s, 1H), 7.13 (t, $J$ = 4.2 Hz, 1H), 4.03 (s, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) δ (ppm) 155.8, 150.6, 149.8, 128.16, 128.11, 127.6, 126.5, 123.4, 53.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_9H_7NNaO_3S$: 232.0039; found: 232.0042.

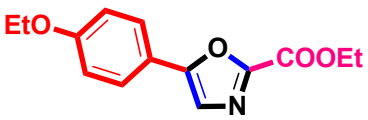



**methyl 5-isobutyloxazole-2-carboxylate (3rb):**

Yield 69%; 126.3 mg; yellow oli; IR (KBr): 1746, 1641, 1383, 1190, 1151, 1125, 1043 $cm^{-1}$; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ (ppm) 6.99 (s, 1H), 3.99 (s, 3H), 2.62 (d, $J$ = 7.2 Hz, 2H), 2.11-2.01 (m, 1H), 0.97 (s, 3H), 0.96 (s, 3H); $^{13}C$ NMR (150 MHz, $CDCl_3$) $\delta$ (ppm) 156.3, 156.2, 151.4, 125.8, 53.0, 34.6, 27.5, 22.2; HRMS (ESI): m/z $[M+Na]^+$ calcd for $C_9H_{13}ClNNaO_3$: 206.0788; found: 206.0783.

**8. Crystallographic data and molecular structure of compounds 3ga**




**3ga**

***Figure S2.*** X-ray crystal structure of **3ga**

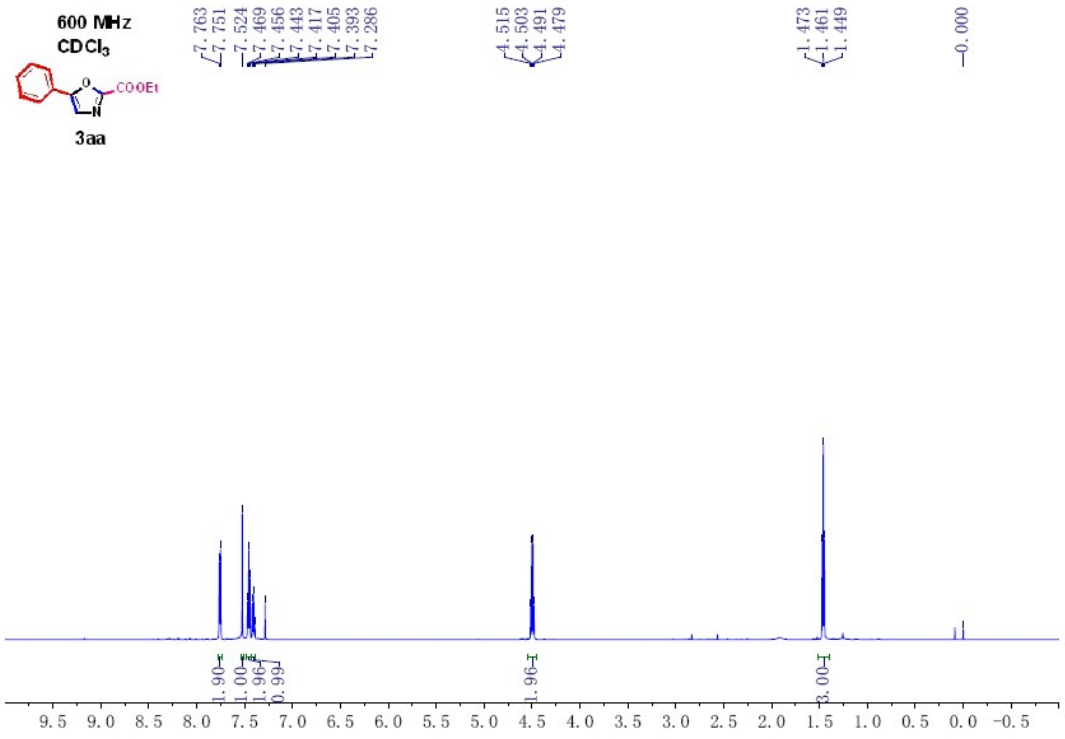
Crystal Data for Compound **3ga**: CCDC 1511246 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic.

```
Bond precision:  C-C = 0.0036 A          Wavelength=0.71073

Cell:             a=14.388(3)      b=6.6658(13)      c=14.112(3)
                  alpha=90         beta=90           gamma=90
Temperature:      293 K

                 Calculated                Reported
Volume           1353.5(5)                 1353.4(5)
Space group      P n m a                   Pnma
Hall group       -P 2ac 2n                 ?
Moiety formula   C14 H15 N O4              ?
Sum formula      C14 H15 N O4              C14 H15 N O4
Mr               261.27                    261.27
Dx,g cm-3        1.282                     1.282
Z                4                         4
Mu (mm-1)        0.095                     0.095
F000             552.0                     552.0
F000'            552.30
h,k,lmax         21,9,21                   20,9,20
Nref             2548                      2437
Tmin,Tmax        0.979,0.983               0.979,0.983
Tmin'            0.979

Correction method= # Reported T Limits: Tmin=0.979 Tmax=0.983
AbsCorr = MULTI-SCAN

Data completeness= 0.956          Theta(max)= 32.130

R(reflections)= 0.0755( 1580)     wR2(reflections)= 0.2460( 2437)

S = 1.011                 Npar= 122
```

## 9. references

1. Q. H. Gao, S. Liu, X. Wu, J. J. Zhang and A. X. Wu *Org. Lett.*, 2015, **17**, 2960.

## 10. $^{1}$H and $^{13}$C NMR spectra of compounds 3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COOEt
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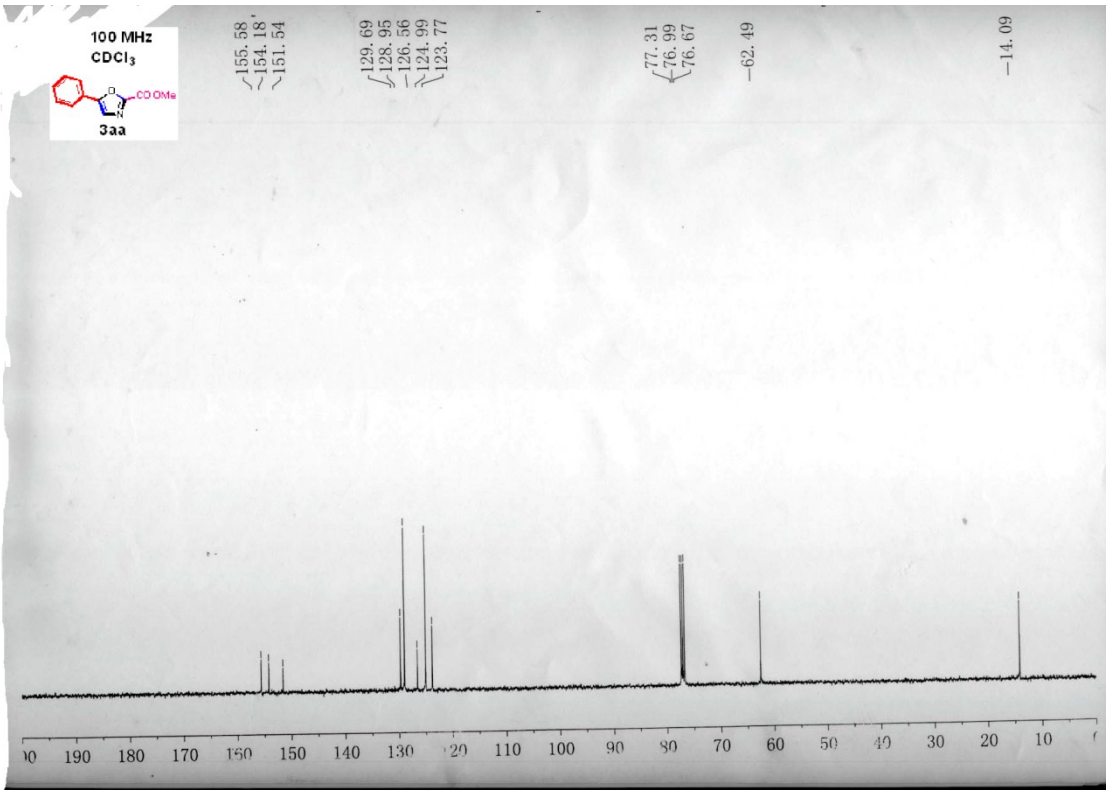
7.751
7.524
7.469
7.456
7.443
7.417
7.405
7.393
7.286
4.515
4.503
4.491
4.479
1.473
1.461
1.449
0.000
1.90
1.00
1.96
0.99
1.96
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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COOMe
3aa
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154.18
151.54
129.69
128.95
126.56
124.99
123.77
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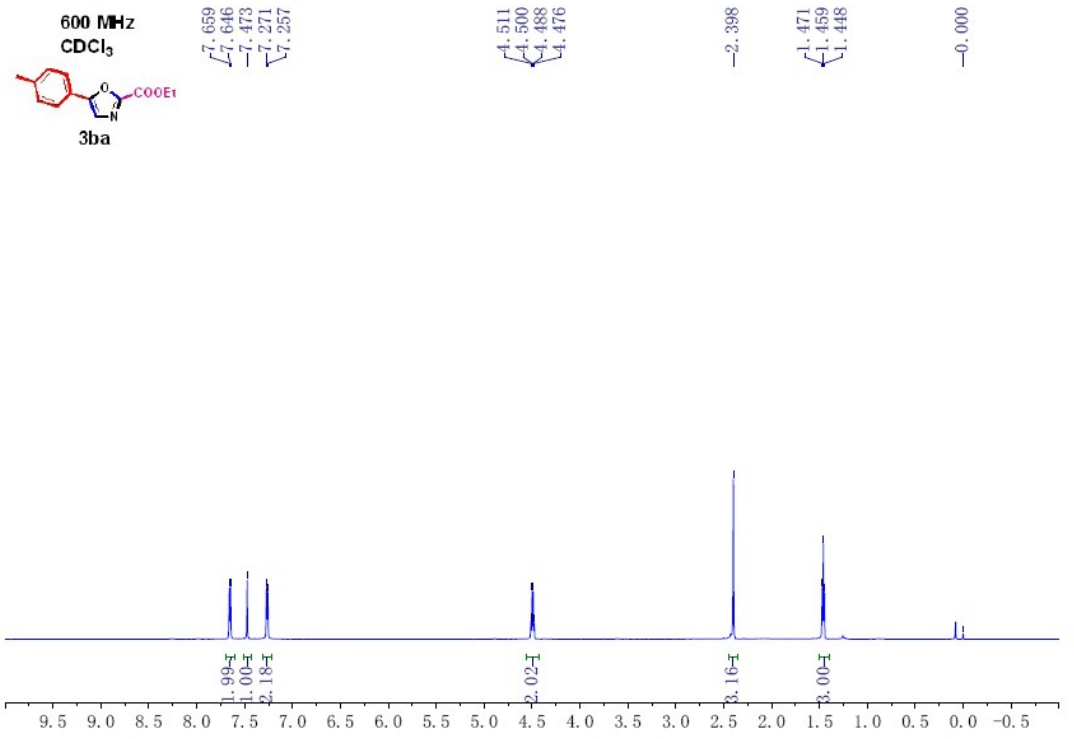
62.49
14.09
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10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COOEt
3ba
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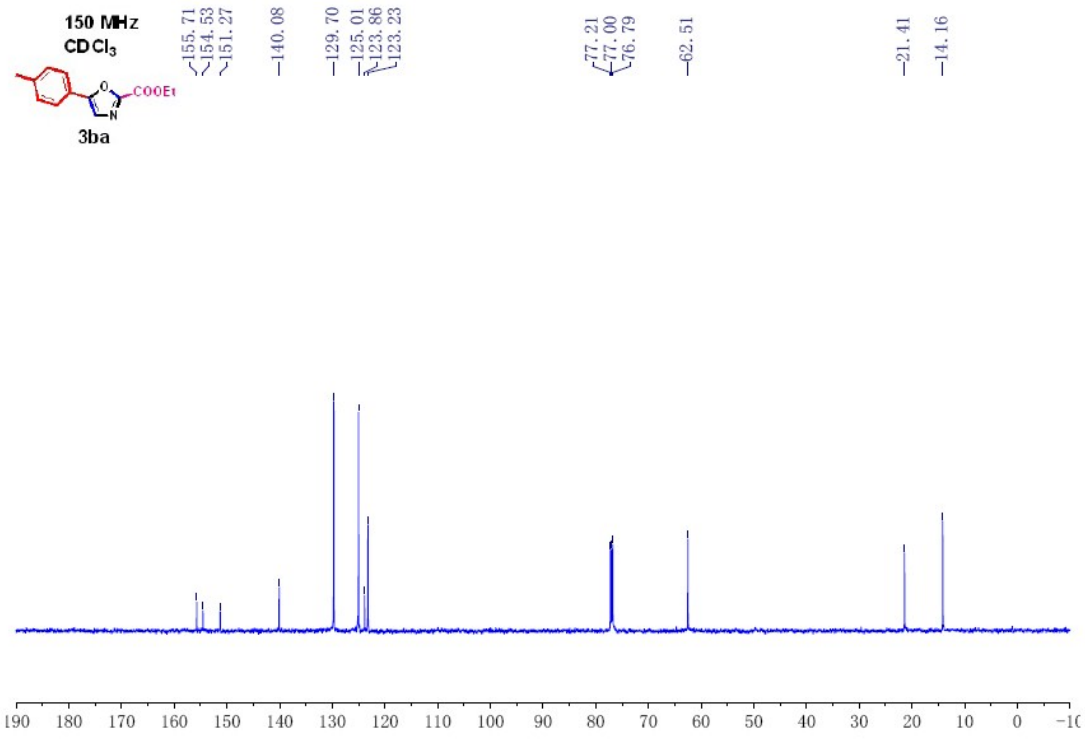
7.646
7.473
7.271
7.257
4.511
4.500
4.488
4.476
2.398
1.471
1.459
1.448
0.000
1.99
1.00
2.18
2.02
3.16
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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151.27
140.08
129.70
125.01
123.86
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77.00
76.79
62.51
21.41
14.16
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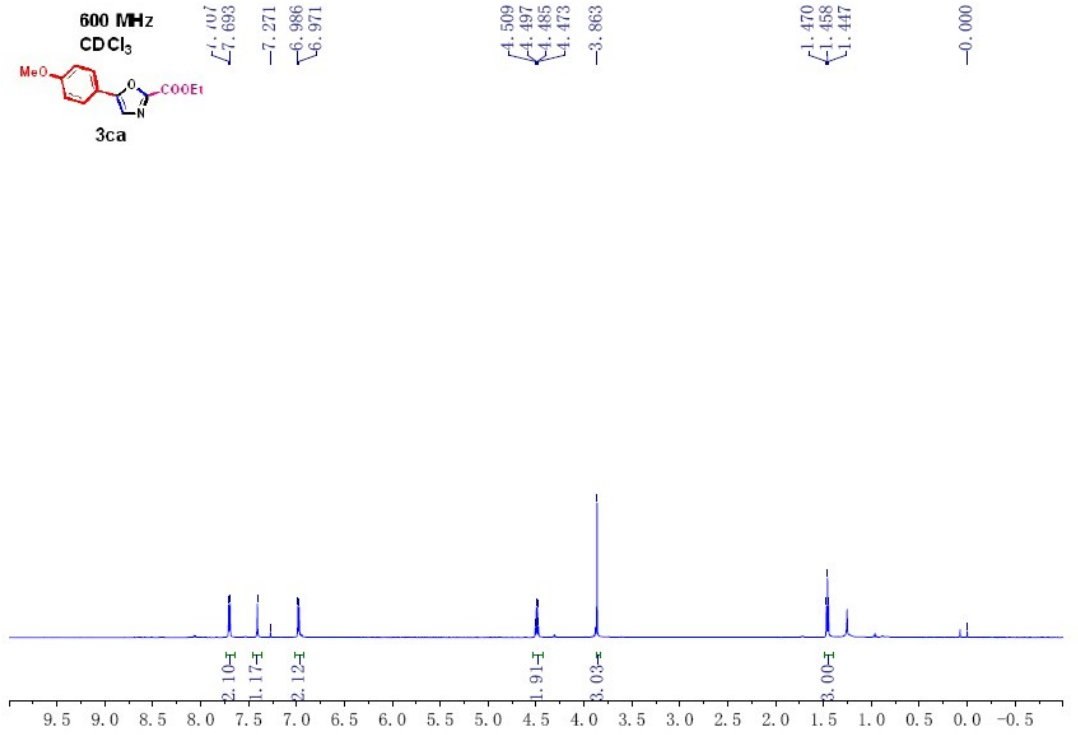
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COOEt
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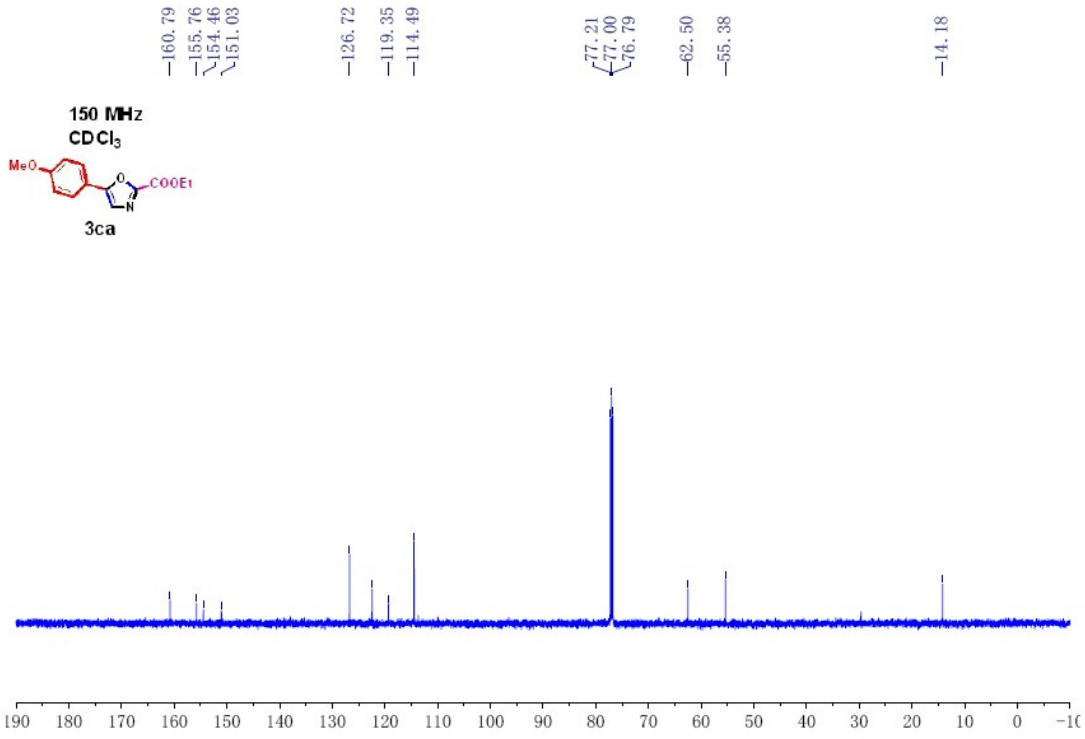
7.271
6.986
6.971
4.509
4.497
4.485
4.473
3.863
1.470
1.458
1.447
0.000
2.10
1.17
2.12
1.91
3.03
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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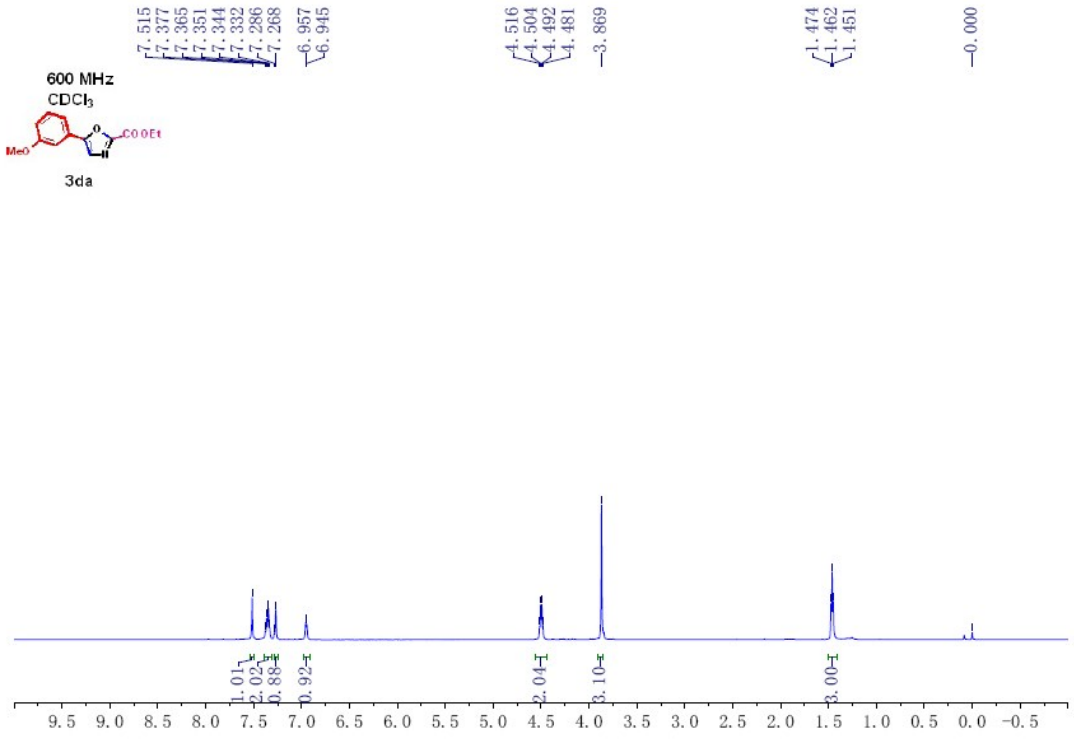
154.46
151.03
126.72
119.35
114.49
77.21
77.00
76.79
62.50
55.38
14.18
150 MHz
CDCl3
MeO
COOEt
3ca
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10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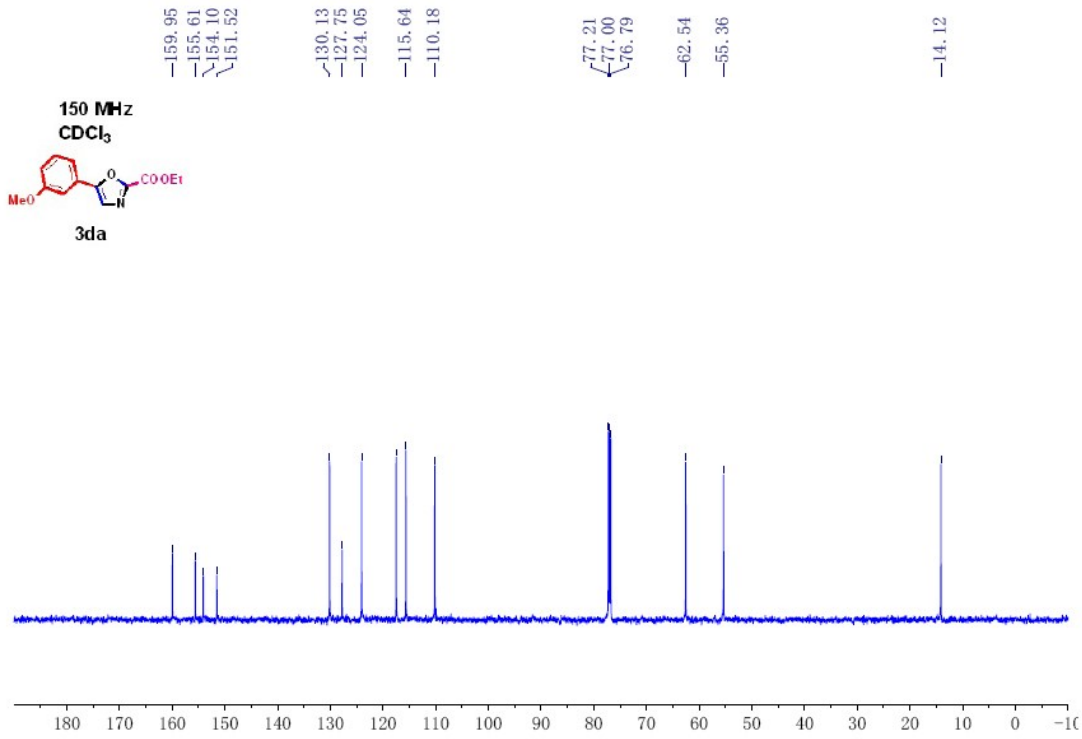
7.377
7.365
7.351
7.344
7.332
7.286
7.268
6.957
6.945
4.516
4.504
4.492
4.481
3.869
1.474
1.462
1.451
0.000
600 MHz
CDCl3
COOEt
MeO
3da
1.01
2.02
0.88
0.92
2.04
3.10
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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155.61
154.10
151.52
130.13
127.75
124.05
115.64
110.18
77.21
77.00
76.79
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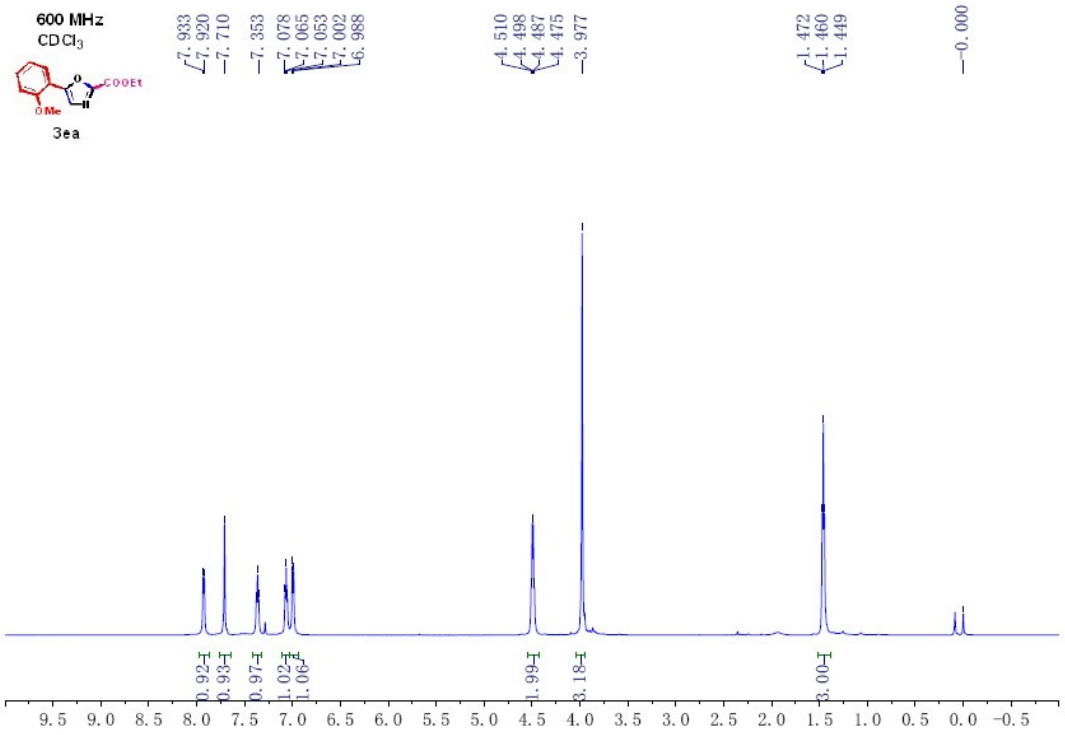
55.36
14.12
150 MHz
CDCl3
COOEt
MeO
3da
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10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CDCl3
3ea
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7.920
7.710
7.353
7.078
7.065
7.053
7.002
6.988
4.510
4.498
4.487
4.475
3.977
1.472
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1.449
0.000
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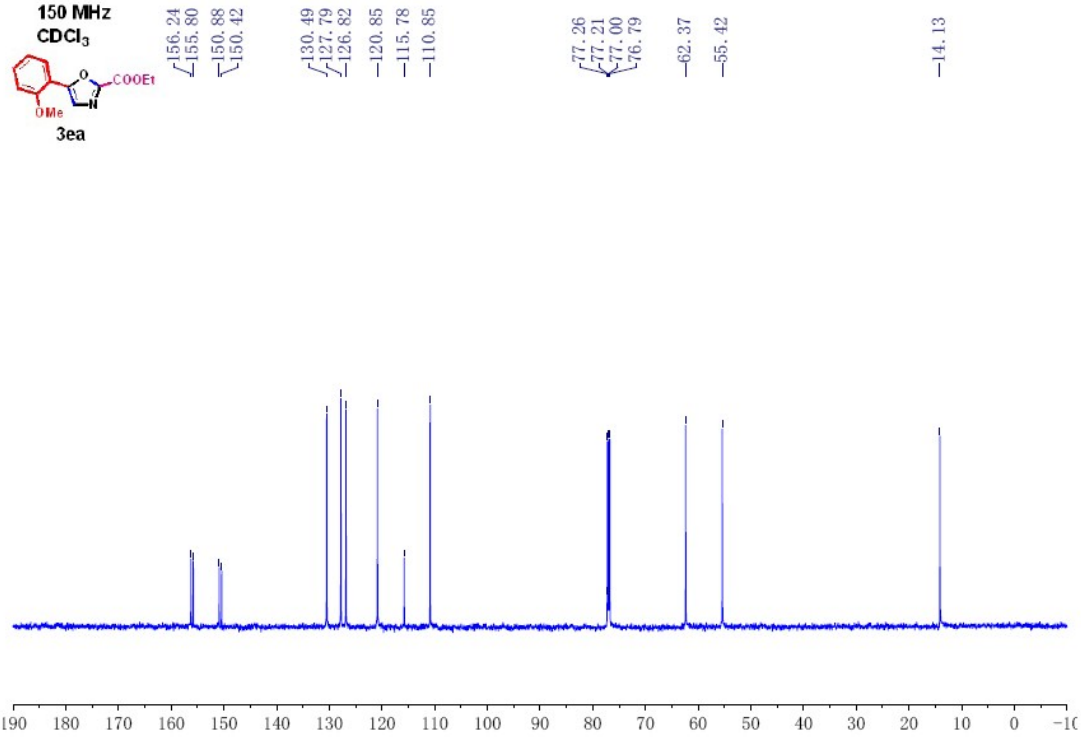
0.93
0.97
1.02
1.06
1.99
3.18
3.00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150.88
150.42
130.49
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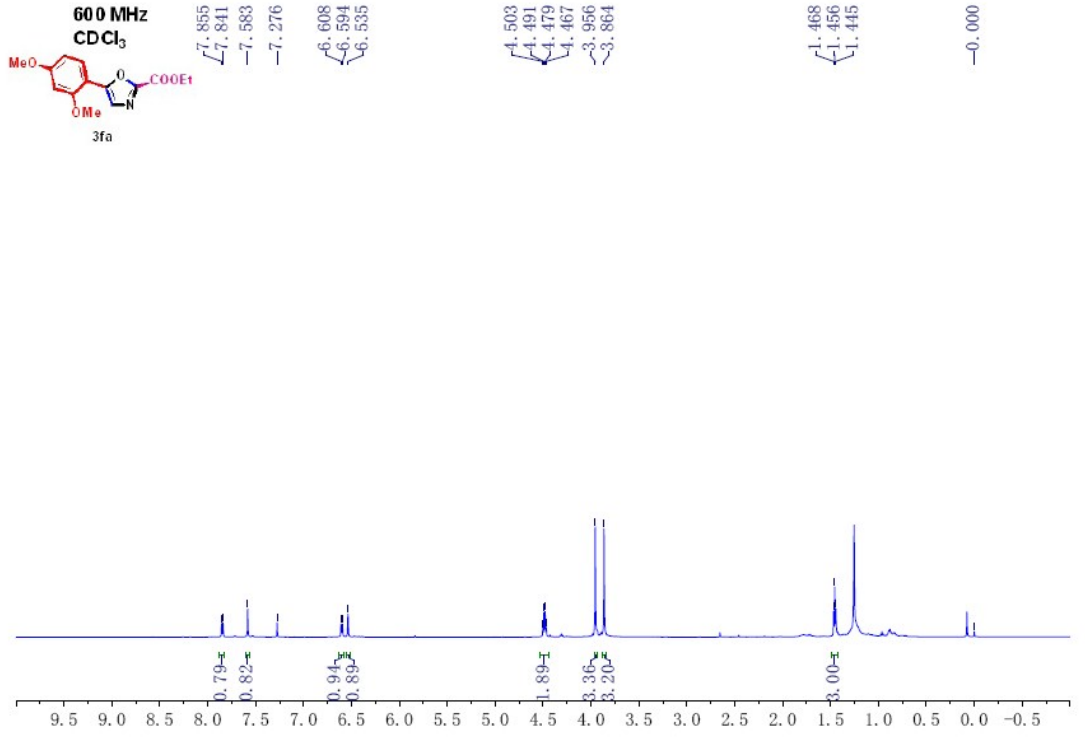
77.00
76.79
62.37
55.42
14.13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MeO
COOEt
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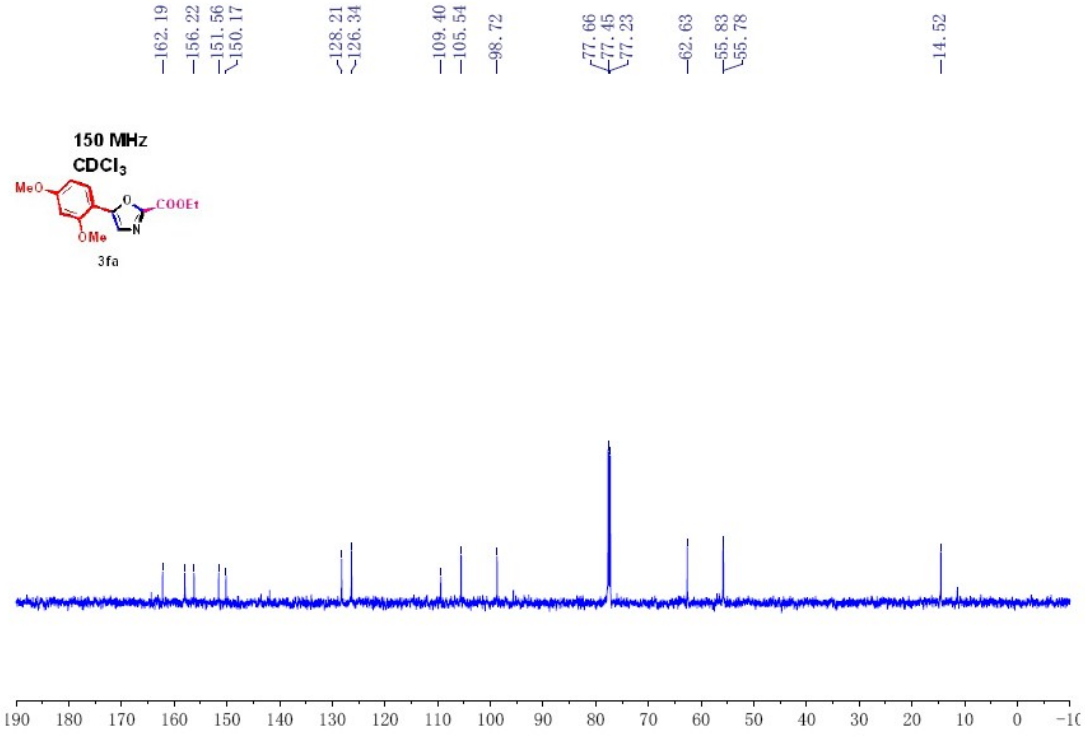
4.503
4.491
4.479
4.467
3.956
3.864
1.468
1.456
1.445
0.000
0.79
0.82
0.94
0.89
1.89
3.36
3.20
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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55.83
55.78
14.52
150 MHz
CDCl3
MeO
COOEt
OMe
3fa
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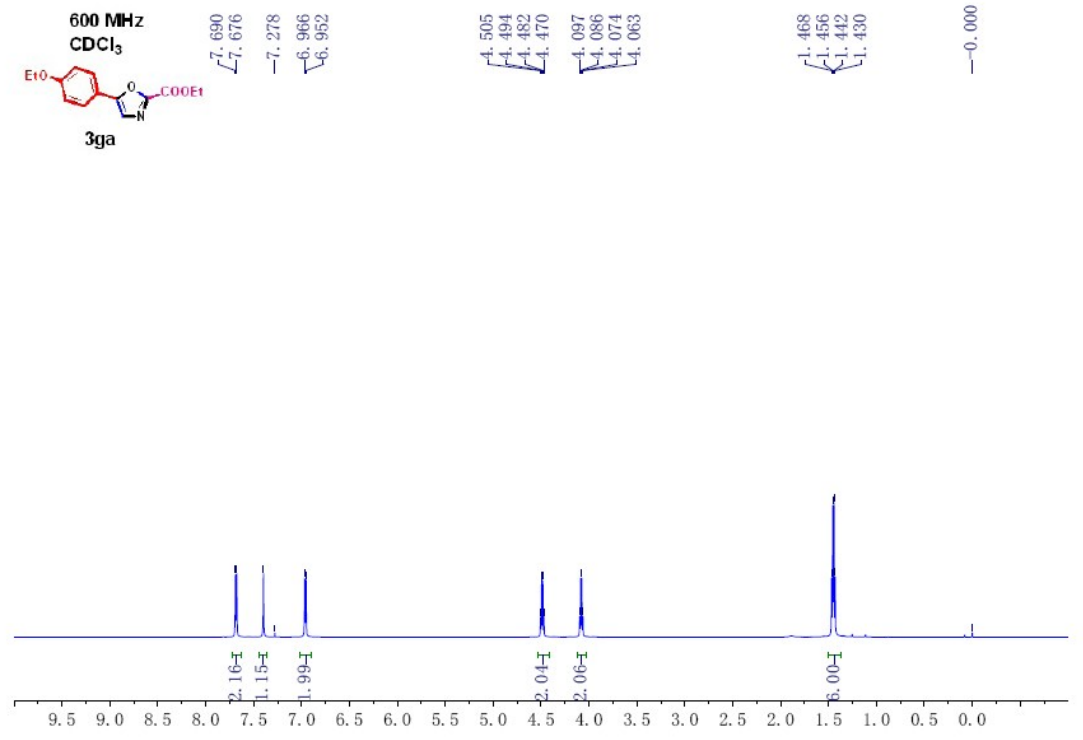
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CDCl3
EtO
COOEt
3ga
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6.952
4.505
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4.482
4.470
4.097
4.086
4.074
4.063
1.468
1.456
1.442
1.430
0.000
2.16
1.15
1.99
2.04
2.06
6.00
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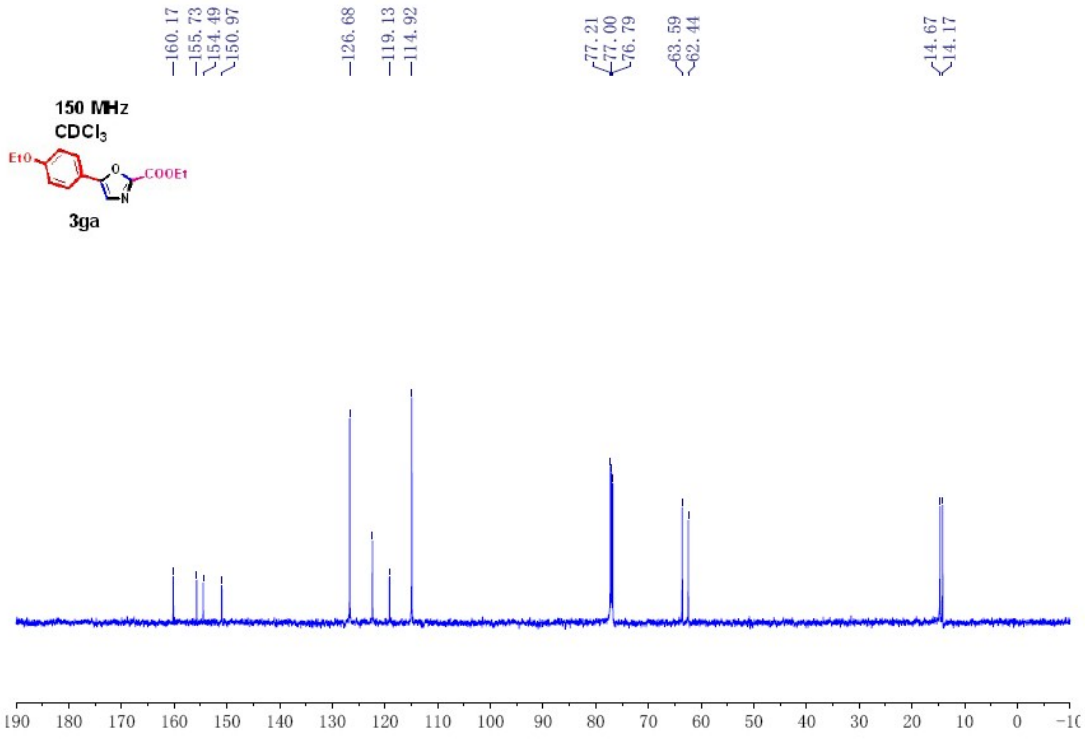
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EtO
COOEt
3ga
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14.17
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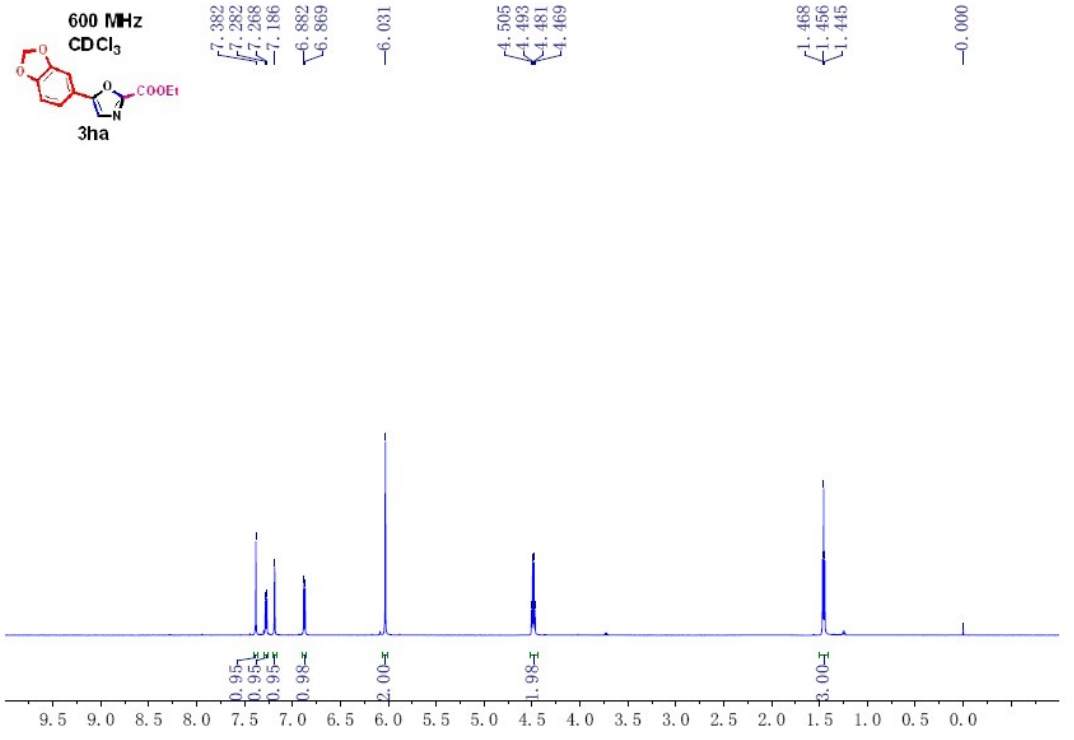
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1.468
1.456
1.445
0.000
0.95
0.95
0.95
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2.00
1.98
3.00
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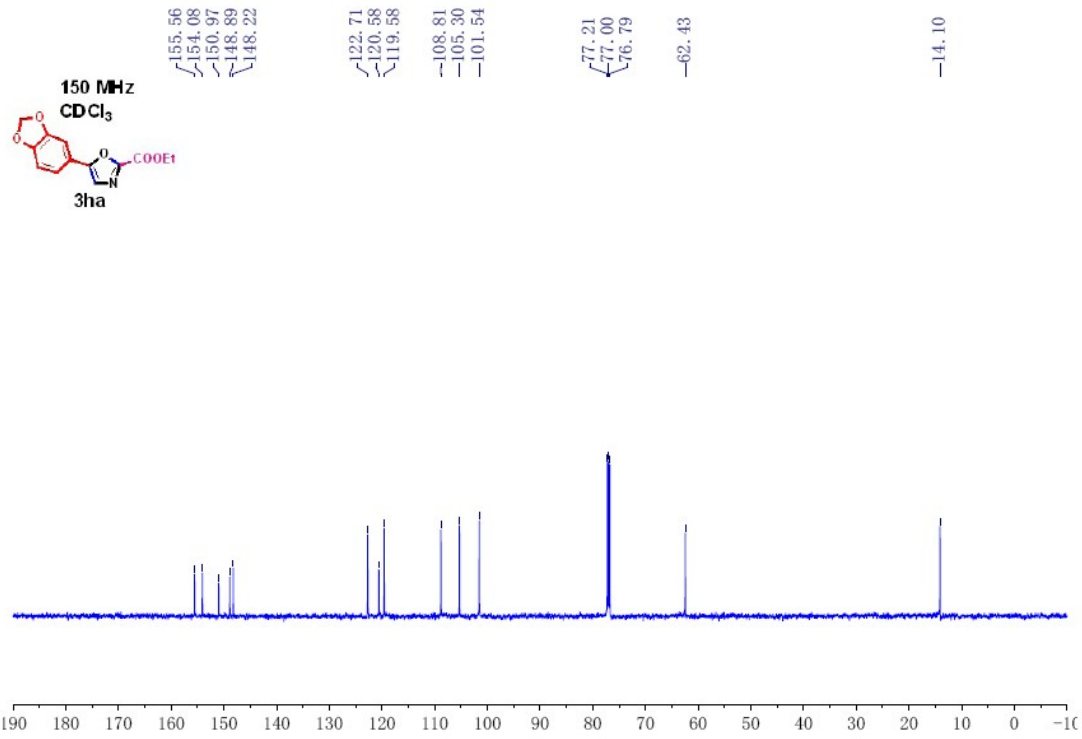
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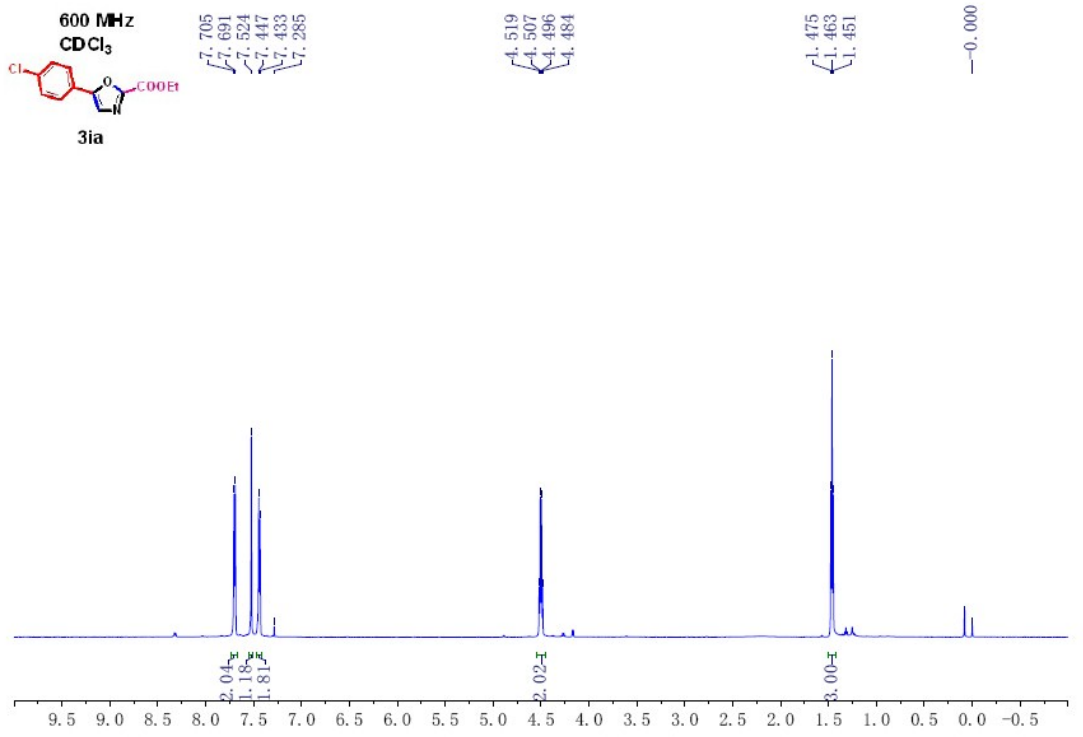
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7.285
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2.04
1.18
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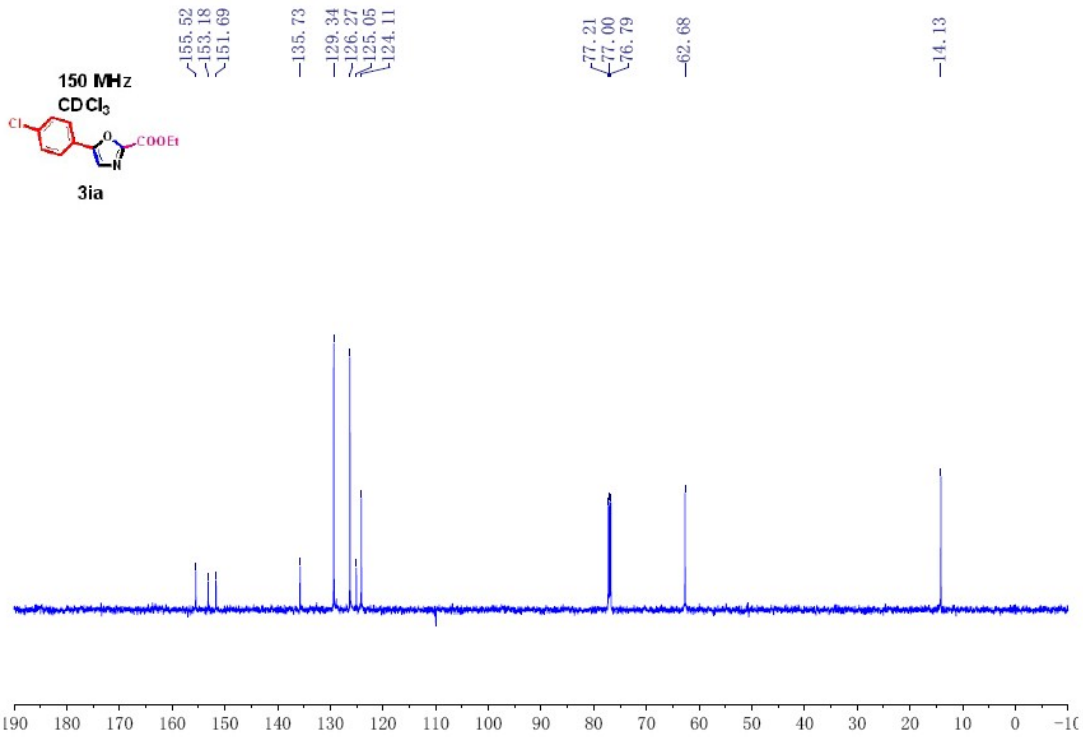
2.02
3.00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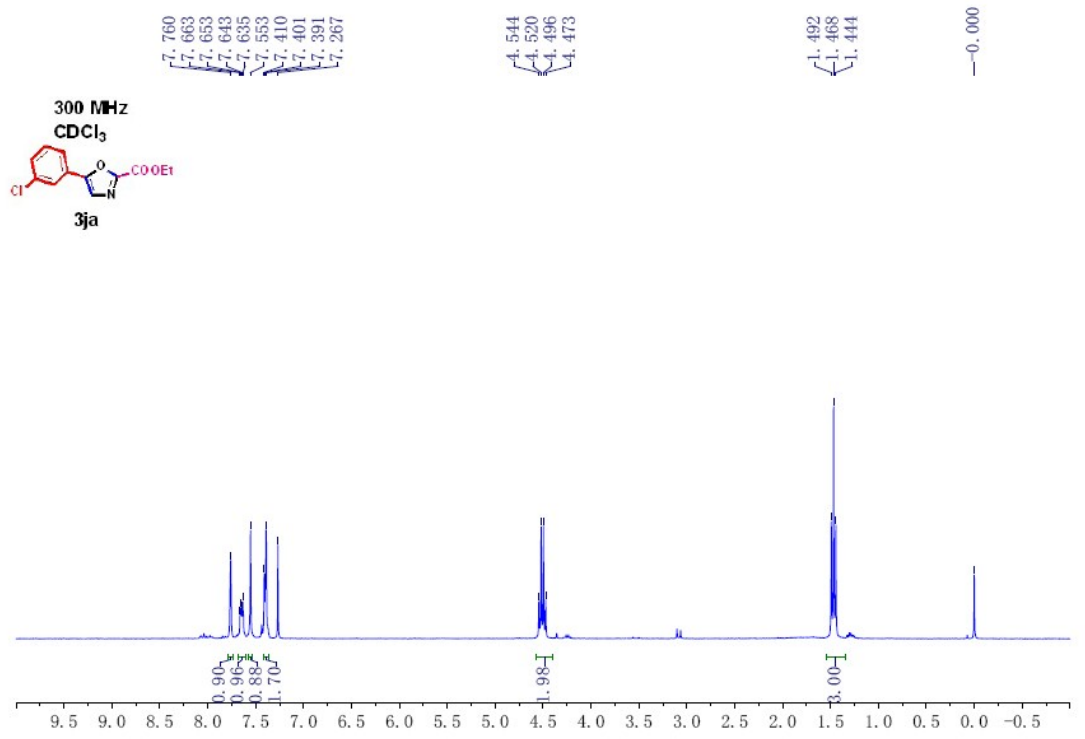
14.13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7.653
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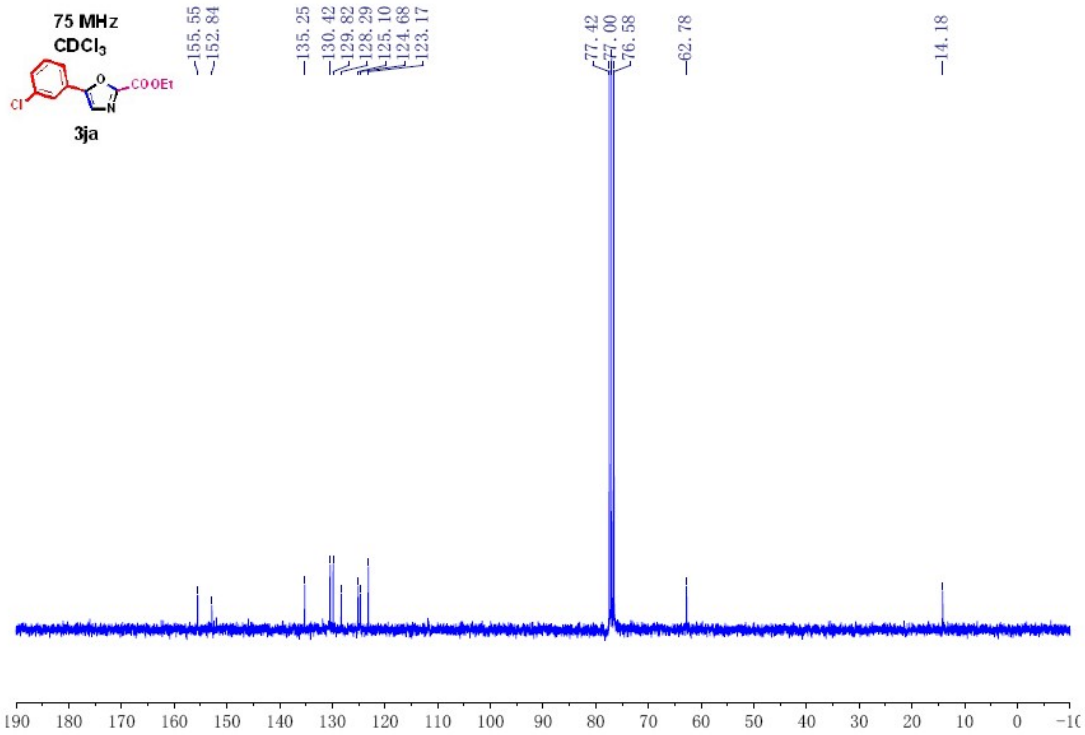
7.635
7.553
7.410
7.401
7.391
7.267
4.544
4.520
4.496
4.473
1.492
1.468
1.444
0.000
300 MHz
CDCl3
COOEt
Cl
3ja
0.90
0.96
0.88
1.70
1.98
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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COOEt
Cl
3ja
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152.84
135.25
130.42
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128.29
125.10
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123.17
77.42
77.00
76.58
62.78
14.18
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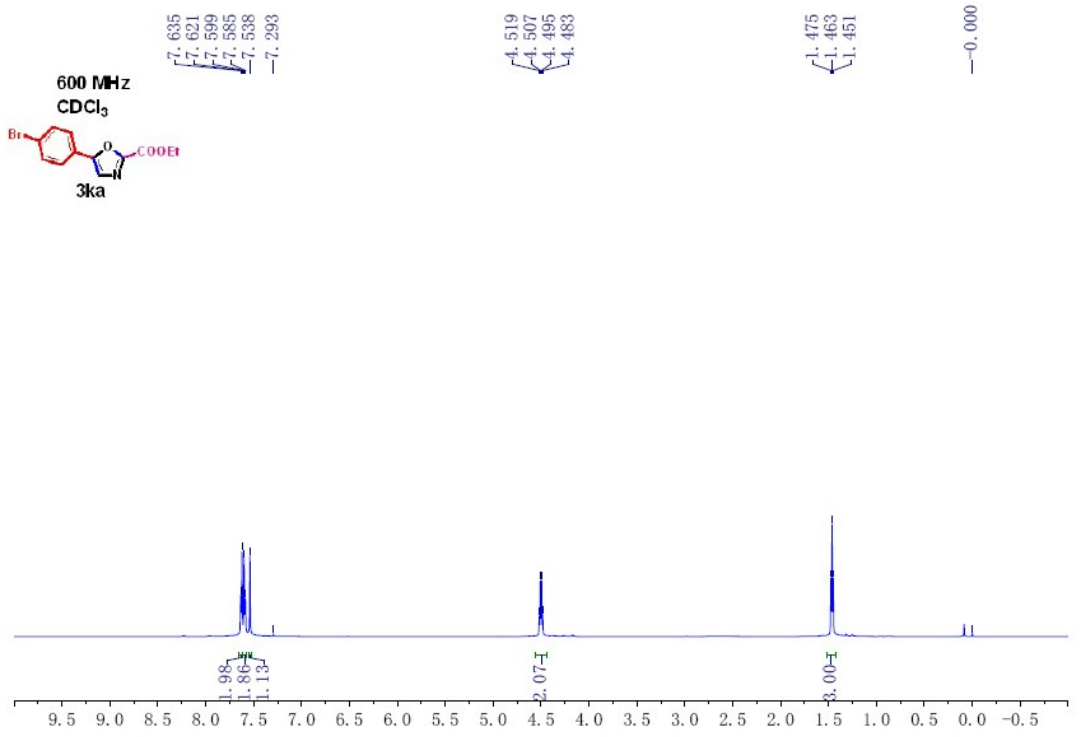
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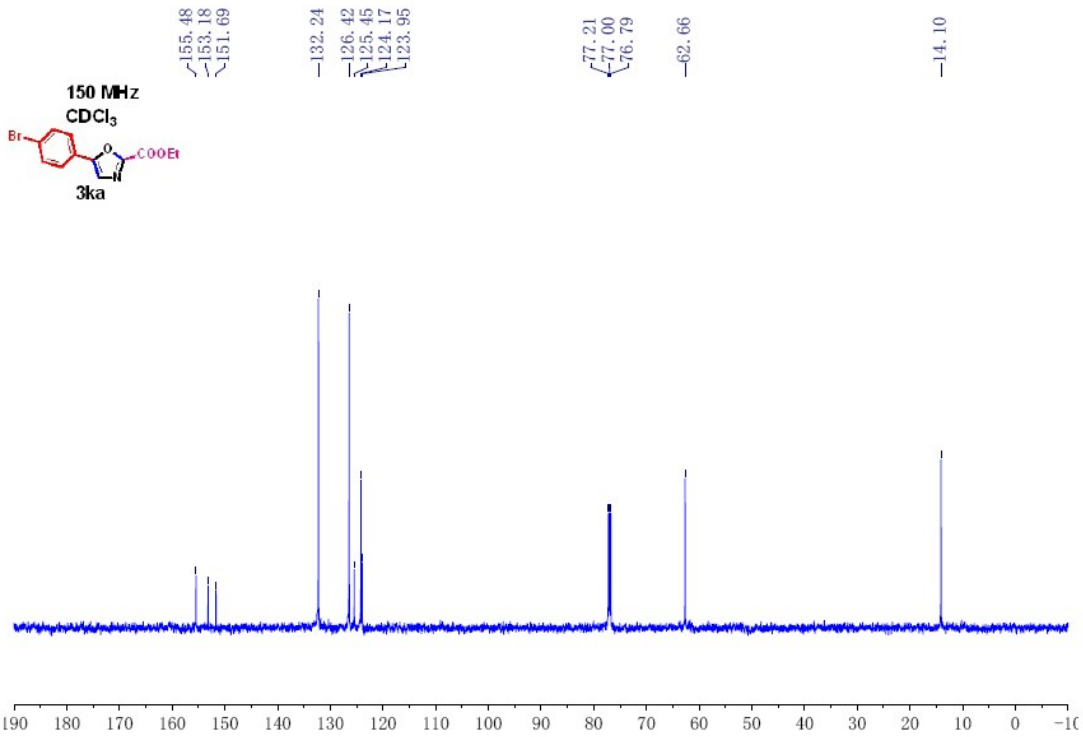
7.621
7.599
7.585
7.538
7.293
4.519
4.507
4.495
4.483
1.475
1.463
1.451
0.000
600 MHz
CDCl3
Br
COOEt
3ka
1.98
1.86
1.13
2.07
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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153.18
151.69
132.24
126.42
125.45
124.17
123.95
77.21
77.00
76.79
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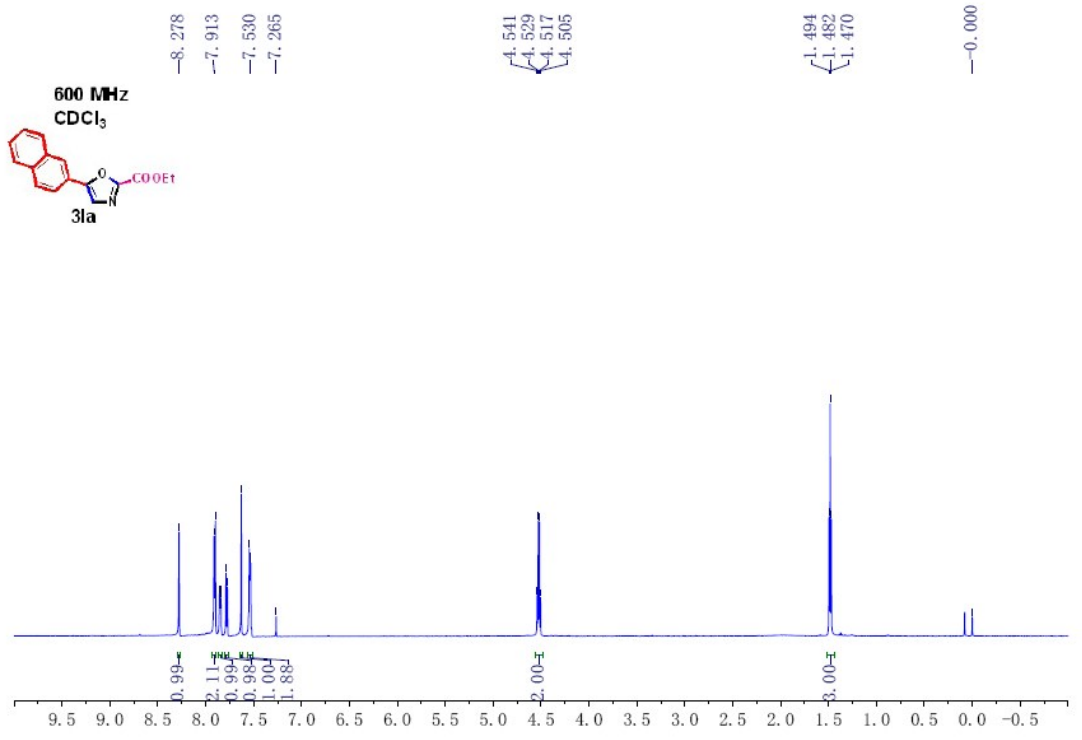
14.10
150 MHz
CDCl3
Br
COOEt
3ka
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10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7.530
7.265
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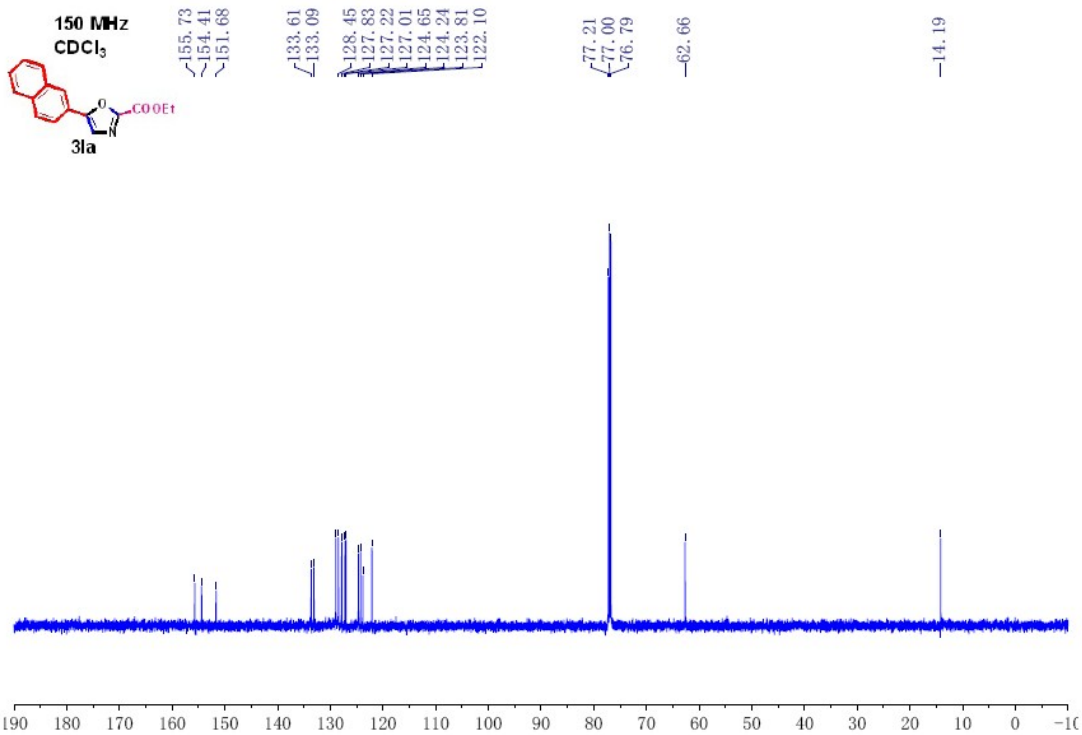
4.529
4.517
4.505
1.494
1.482
1.470
0.000
600 MHz
CDCl3
COOEt
3la
0.99
2.11
0.99
0.98
1.00
1.88
2.00
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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128.45
127.83
127.22
127.01
124.65
124.24
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77.21
77.00
76.79
62.66
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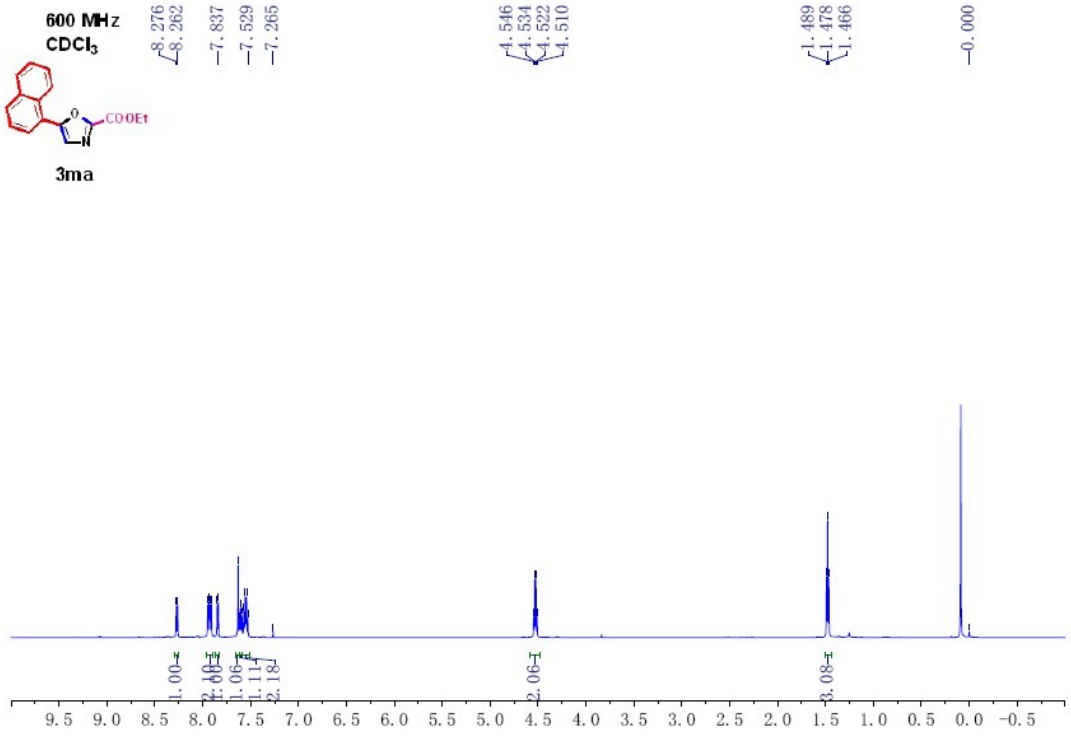
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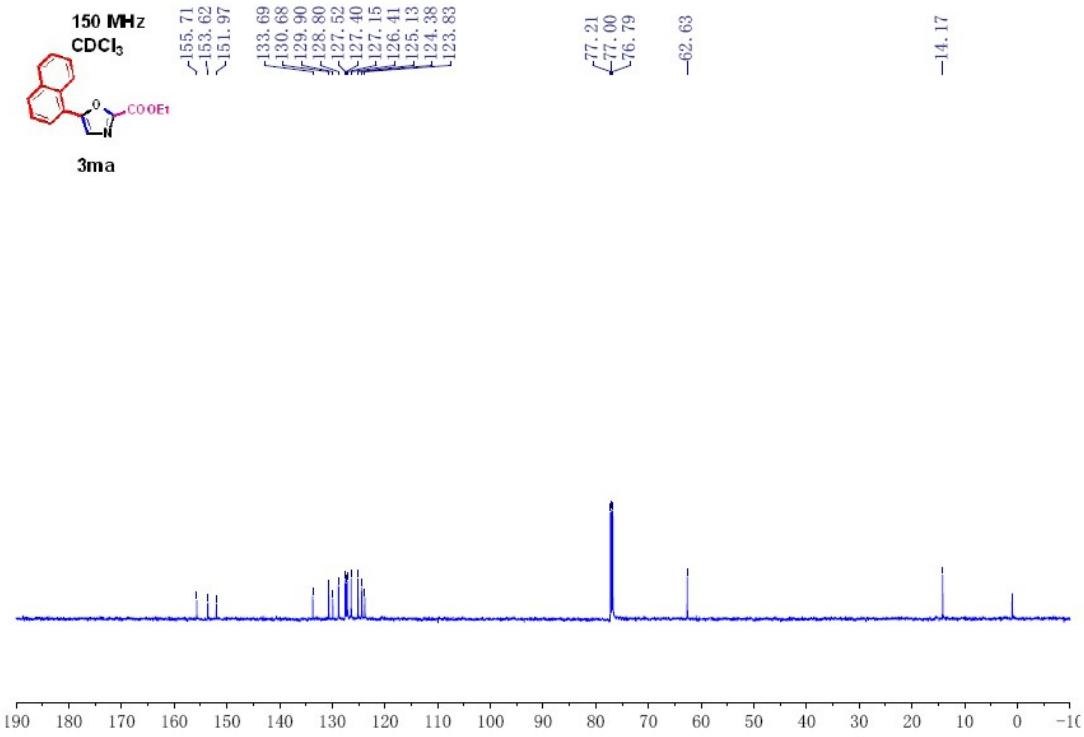
7.265
4.546
4.534
4.522
4.510
1.489
1.478
1.466
0.000
COOEt
3ma
1.00
2.00
1.06
1.11
2.18
2.06
3.08
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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127.40
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125.13
124.38
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76.79
62.63
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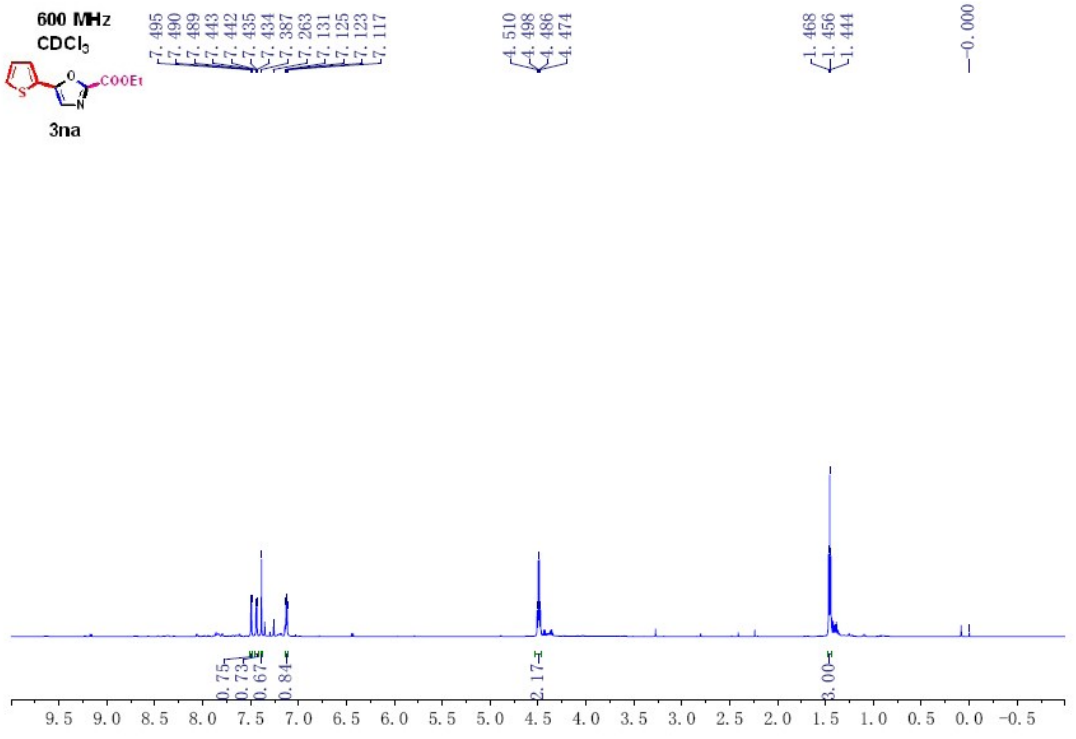
COOEt
3ma
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10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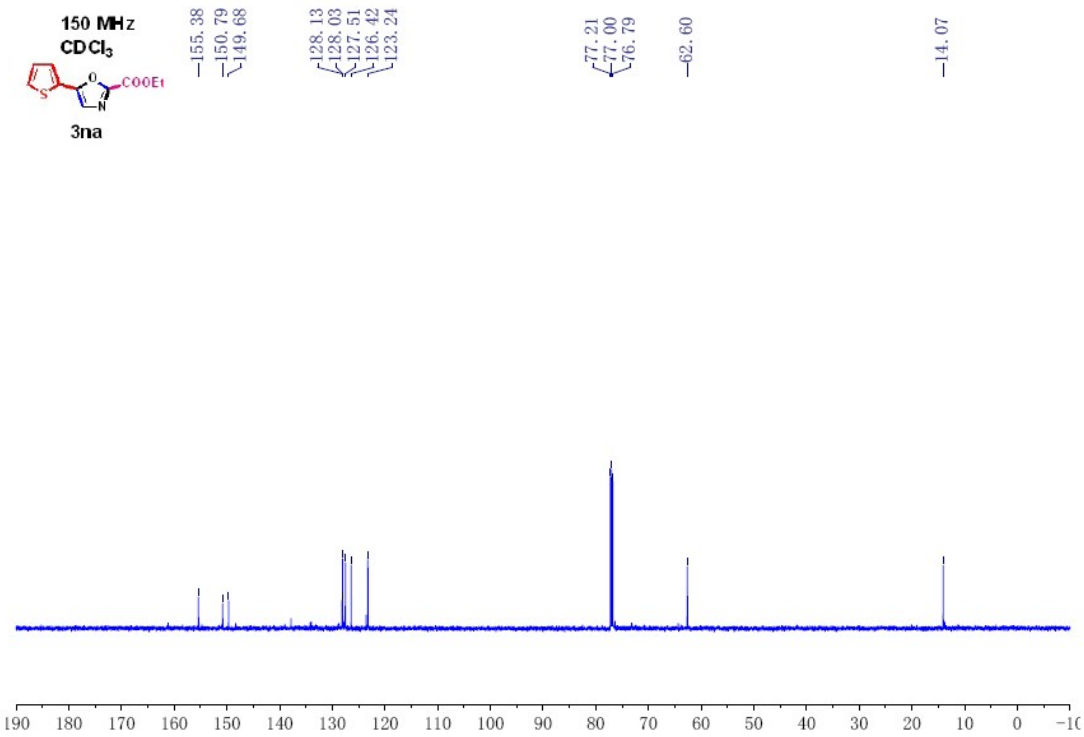
7.434
7.387
7.263
7.131
7.125
7.123
7.117
4.510
4.498
4.486
4.474
1.468
1.456
1.444
0.000
0.75
0.73
0.67
0.84
2.17
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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77.00
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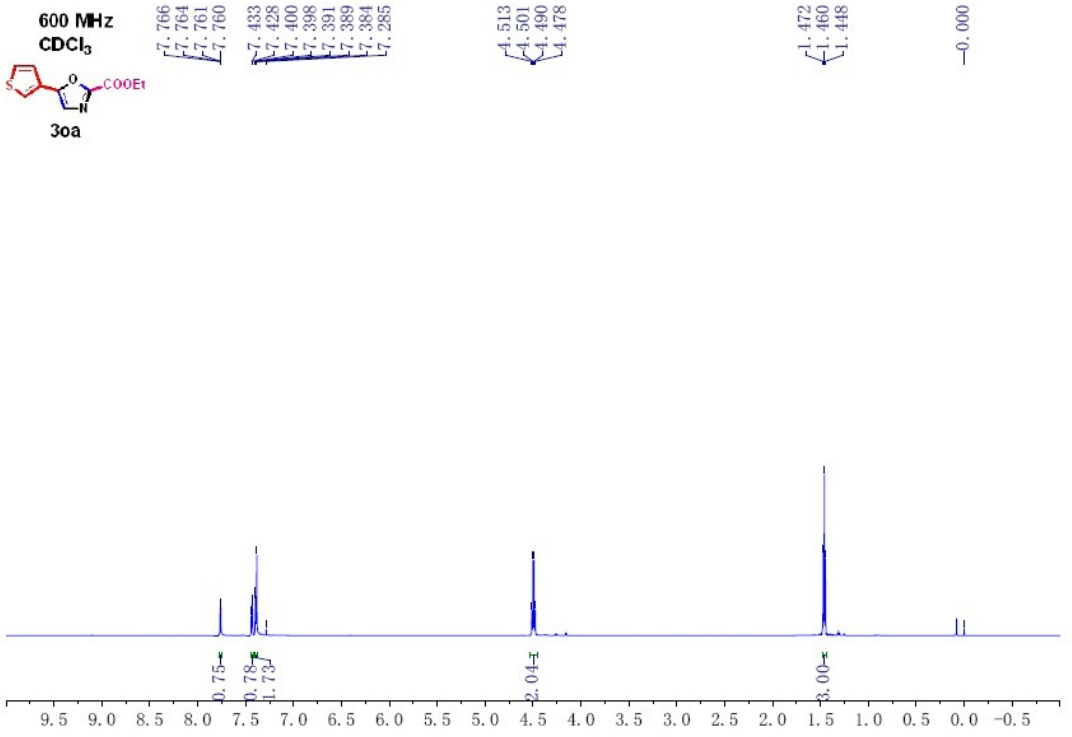
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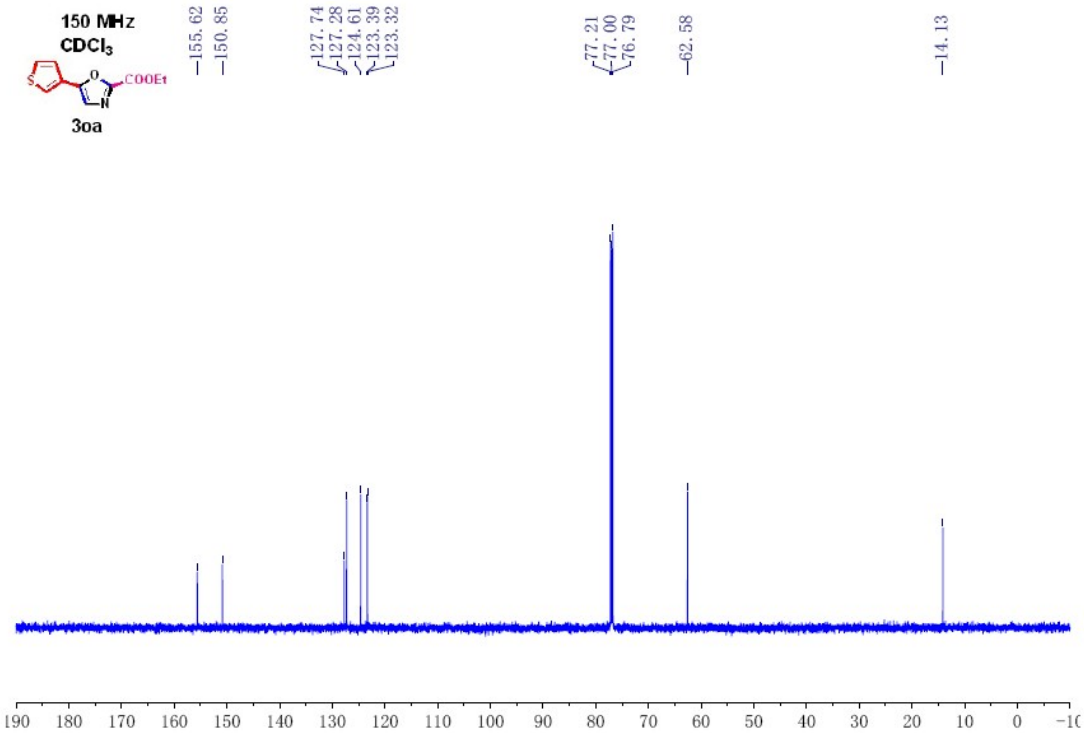
7.384
7.285
4.513
4.501
4.490
4.478
1.472
1.460
1.448
0.000
0.75
0.78
1.73
2.04
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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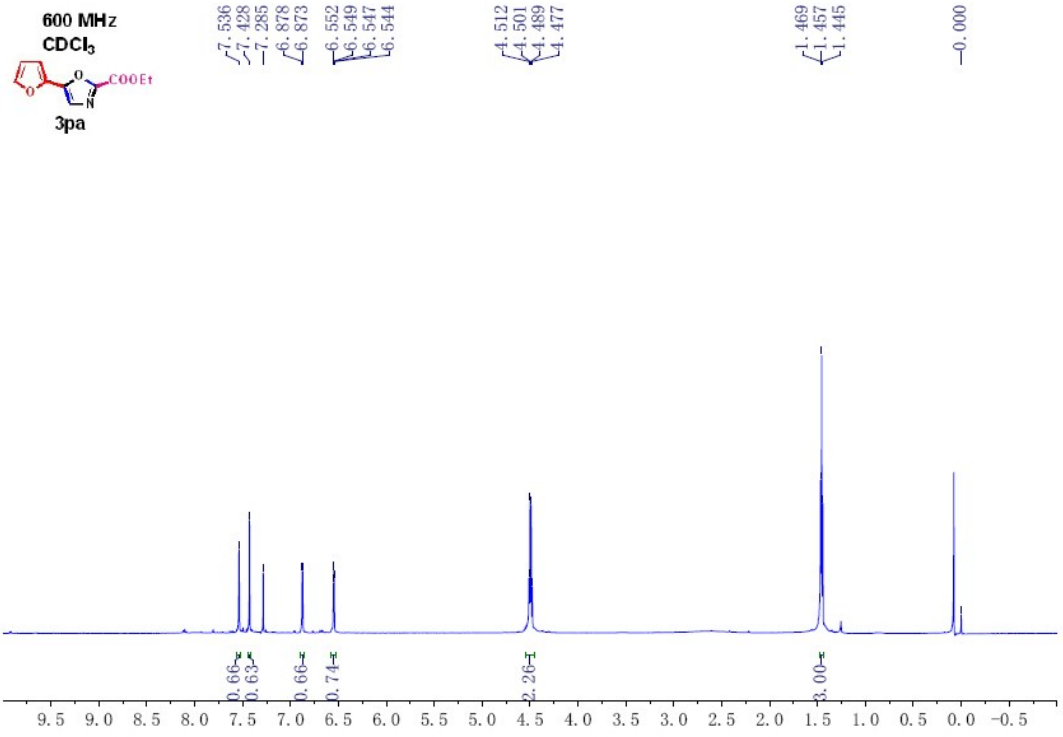
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4.501
4.489
4.477
1.469
1.457
1.445
0.000
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0.63
0.66
0.74
2.26
3.00
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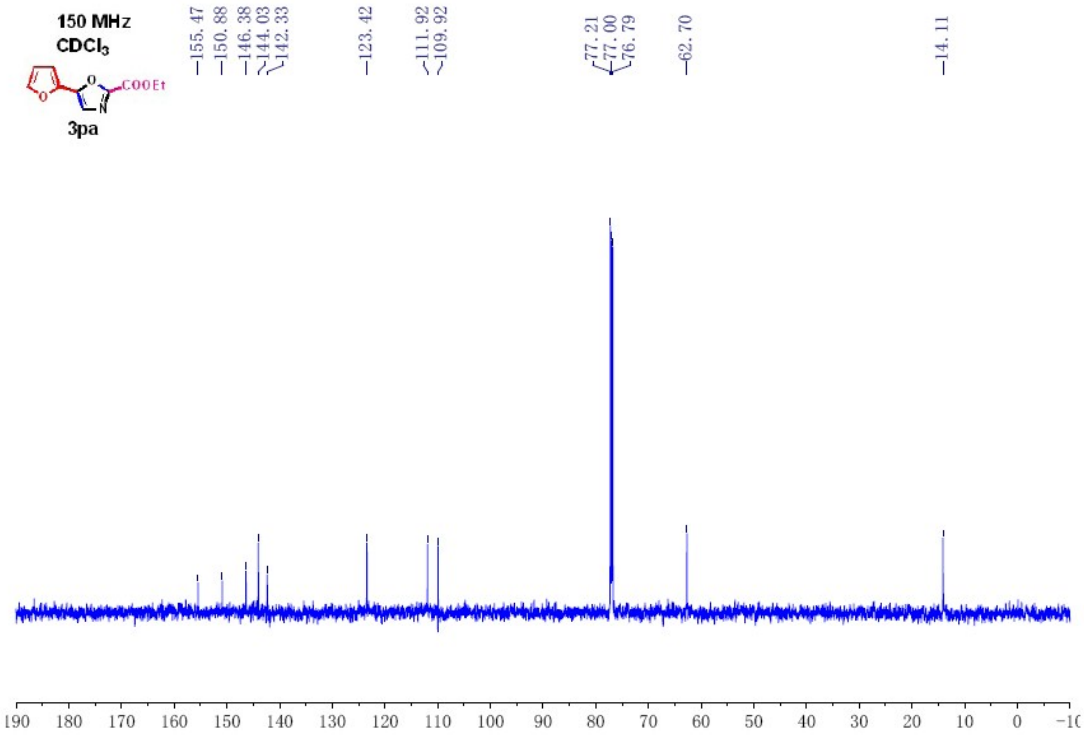
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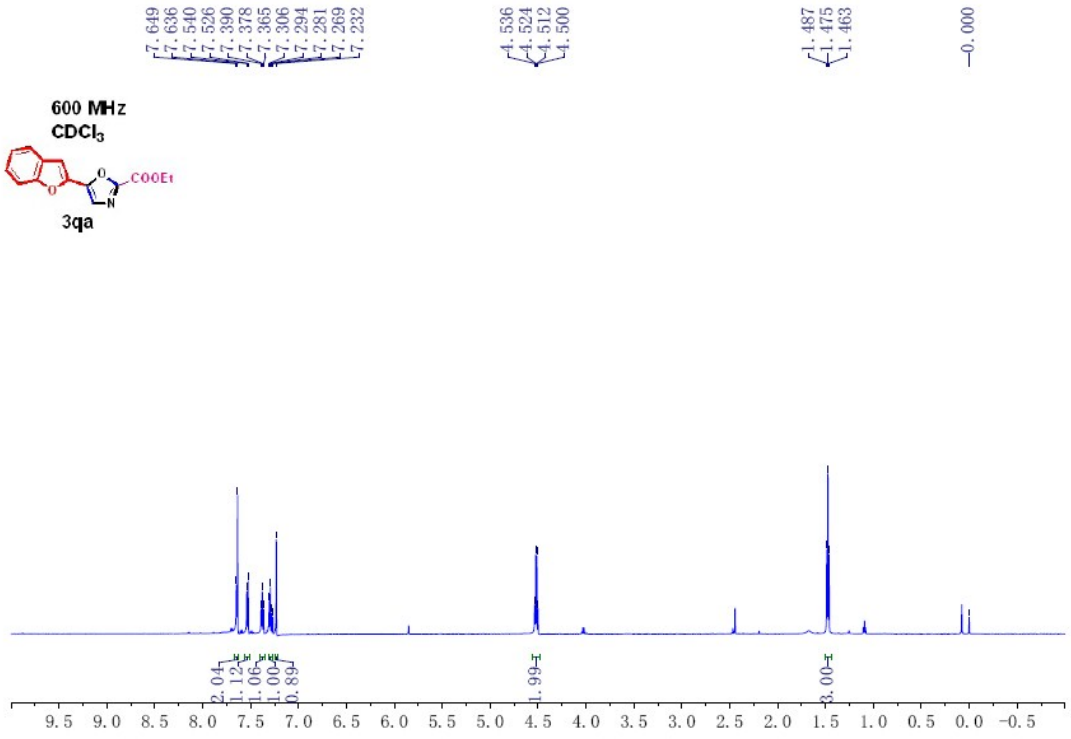
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7.390
7.378
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7.306
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7.269
7.232
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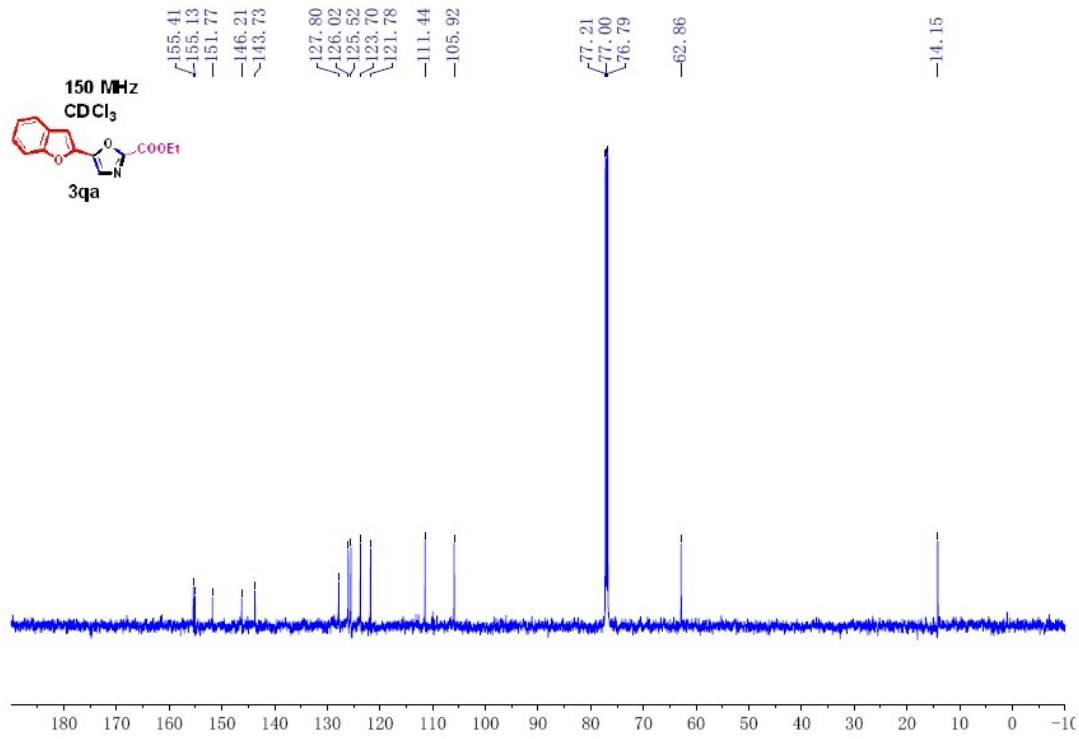
4.524
4.512
4.500
1.487
1.475
1.463
0.000
600 MHz
CDCl3
COOEt
3qa
2.04
1.12
1.06
1.00
0.89
1.99
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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127.80
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121.78
111.44
105.92
77.21
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COOEt
3qa
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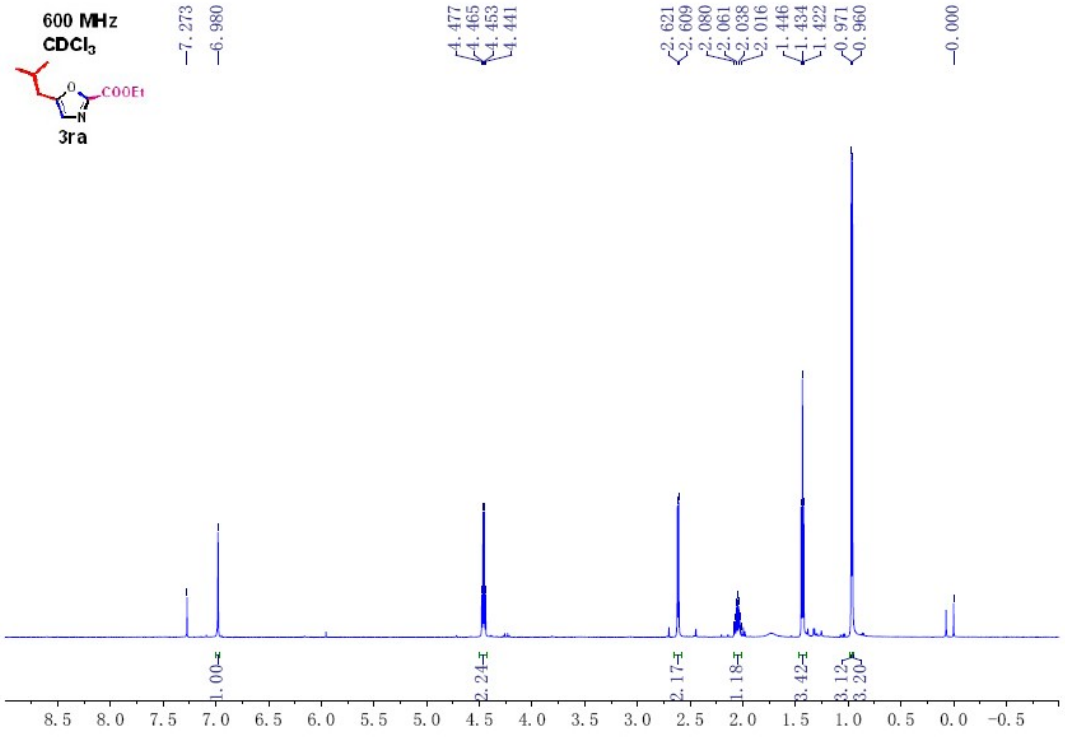
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2.038
2.016
1.446
1.434
1.422
0.971
0.960
0.000
1.00
2.24
2.17
1.18
3.42
3.12
3.20
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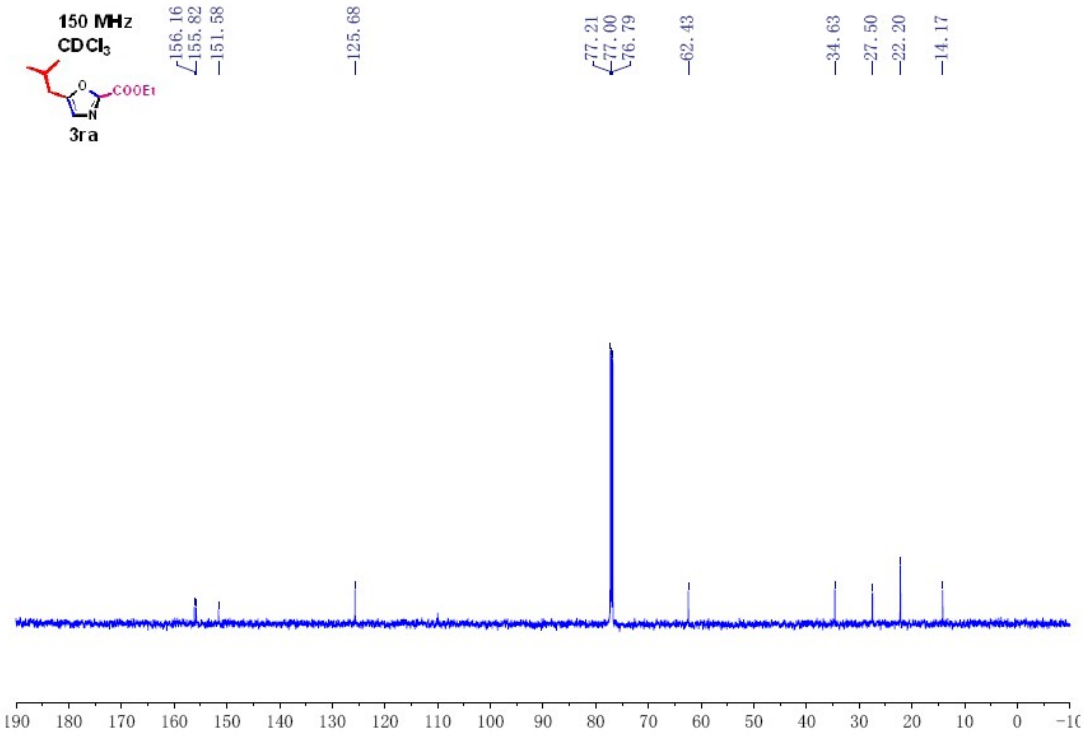
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34.63
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22.20
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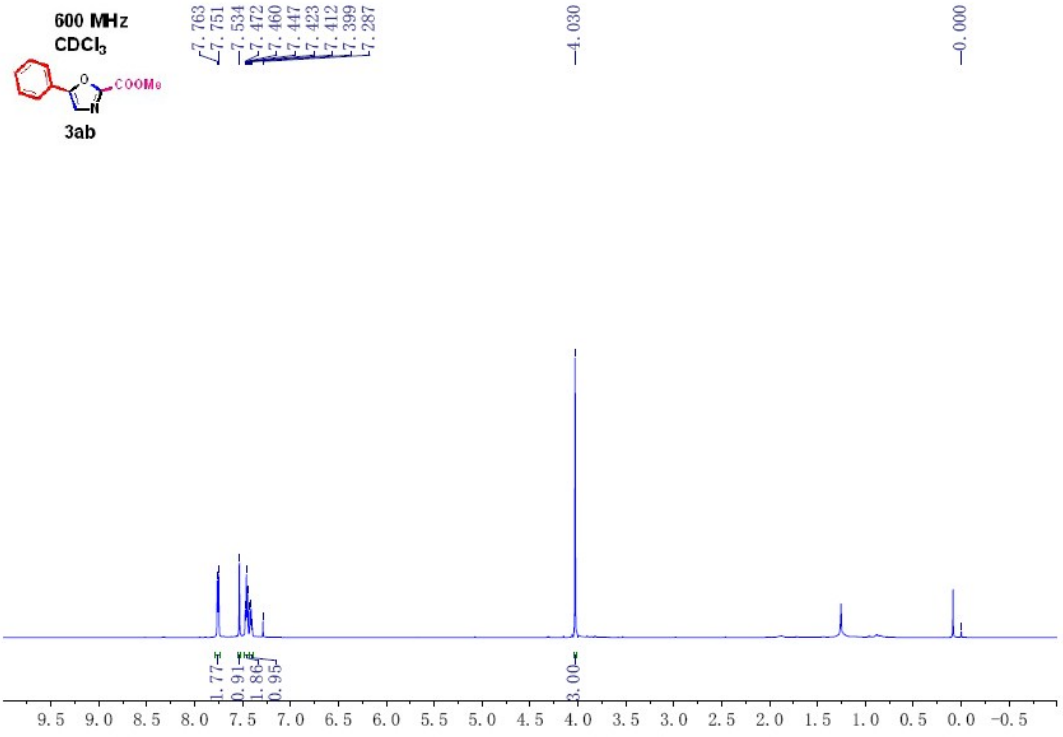
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7.460
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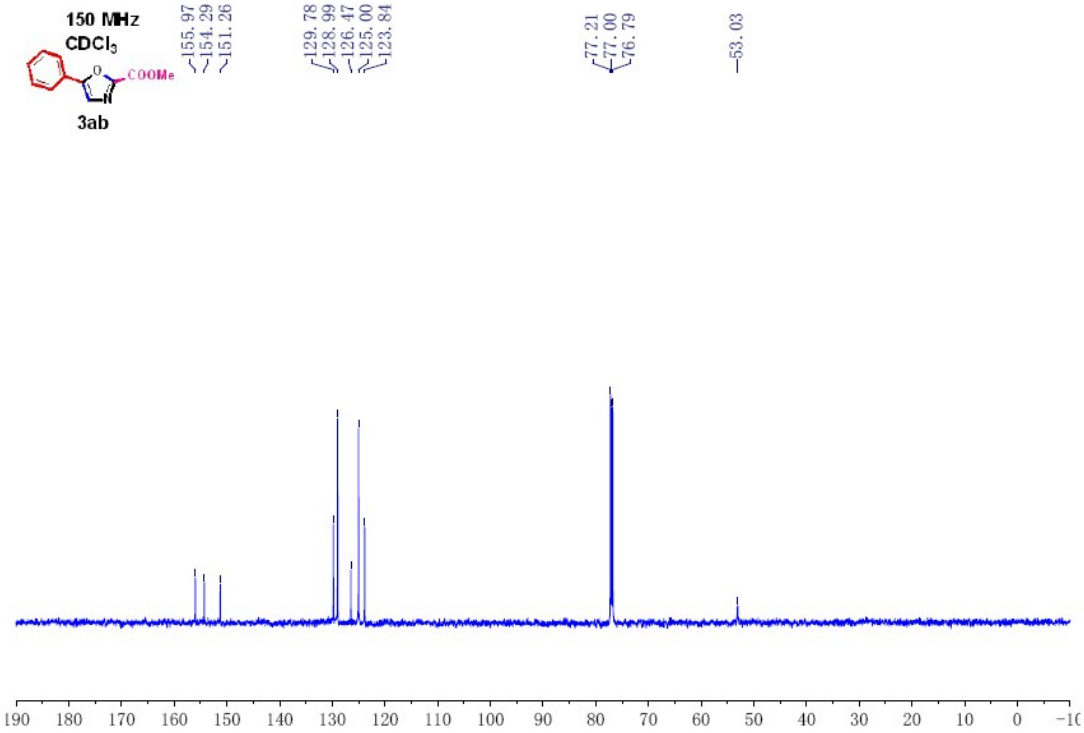
7.423
7.412
7.399
7.287
4.030
0.000
1.77
0.91
1.86
0.95
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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76.79
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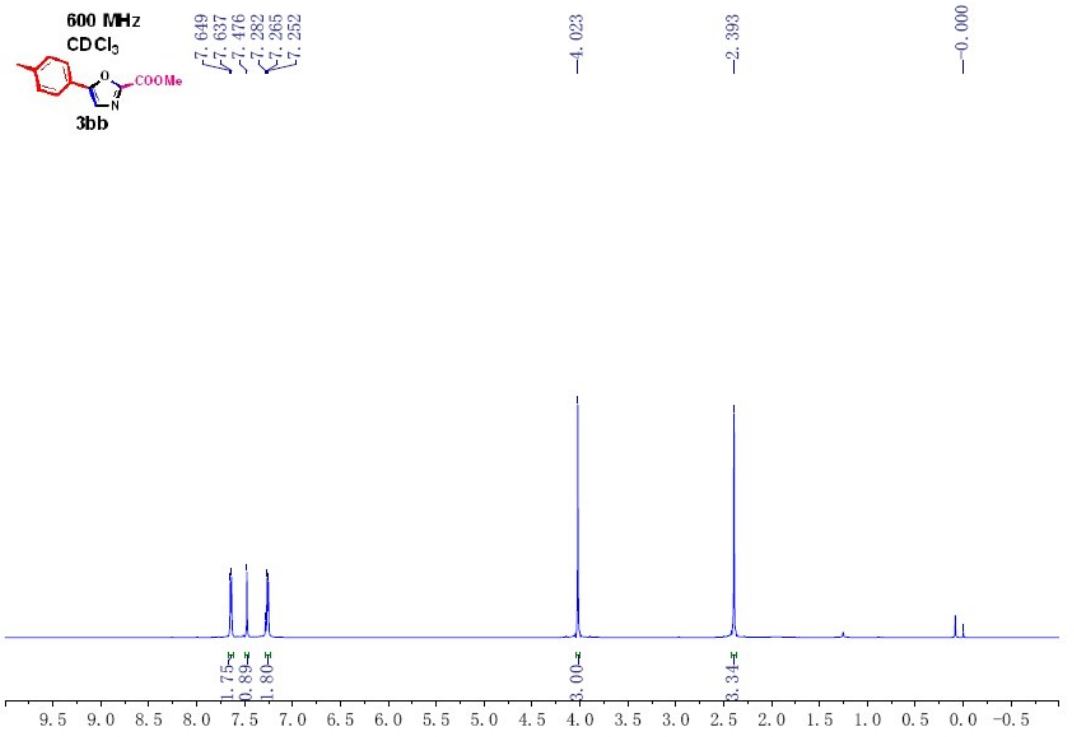
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7.282
7.265
7.252
4.023
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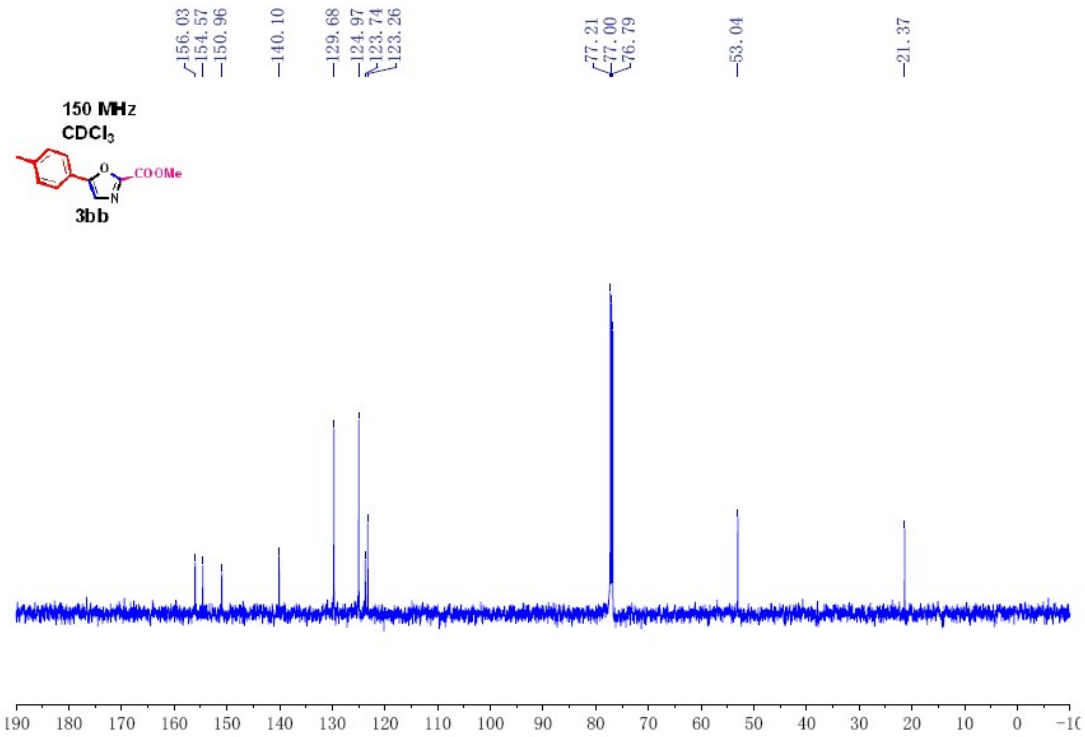
1.75
0.89
1.80
3.00
3.34
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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140.10
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124.97
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123.26
77.21
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76.79
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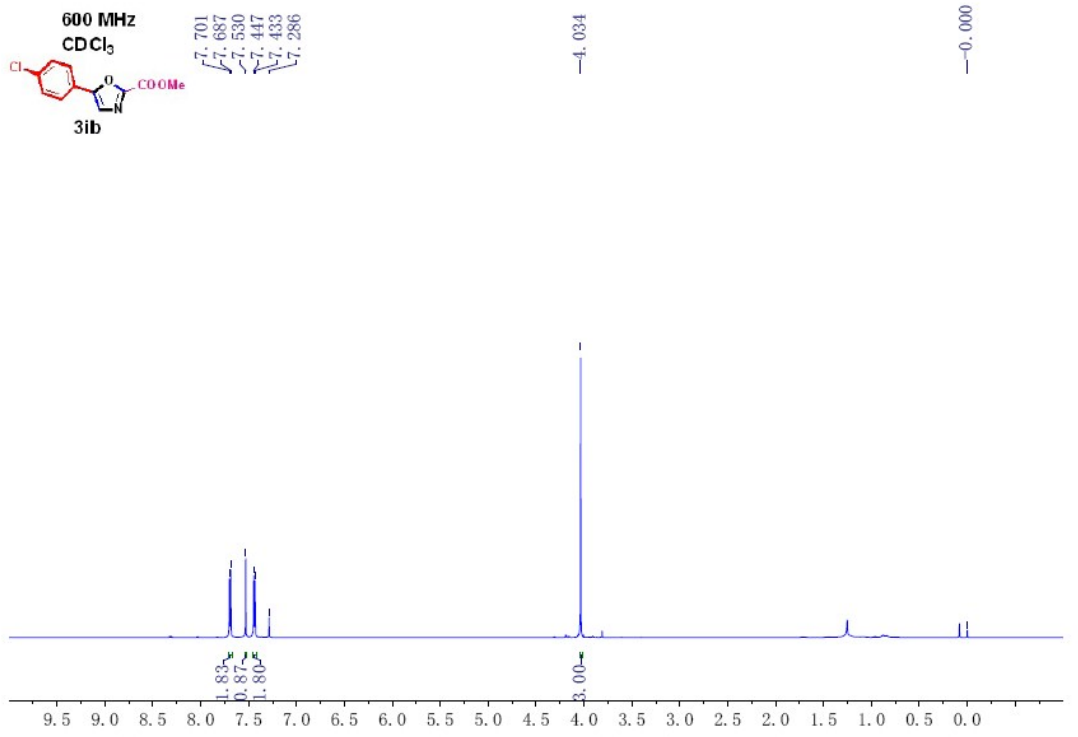
150 MHz
CDCl3
COOMe
3bb
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10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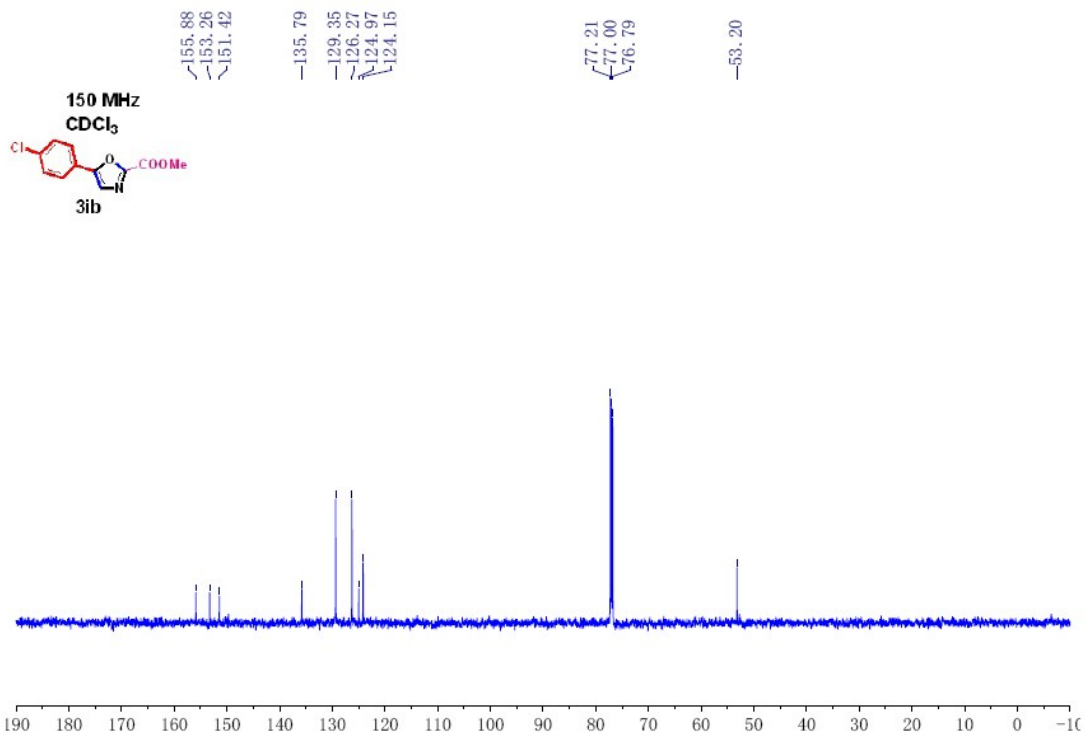
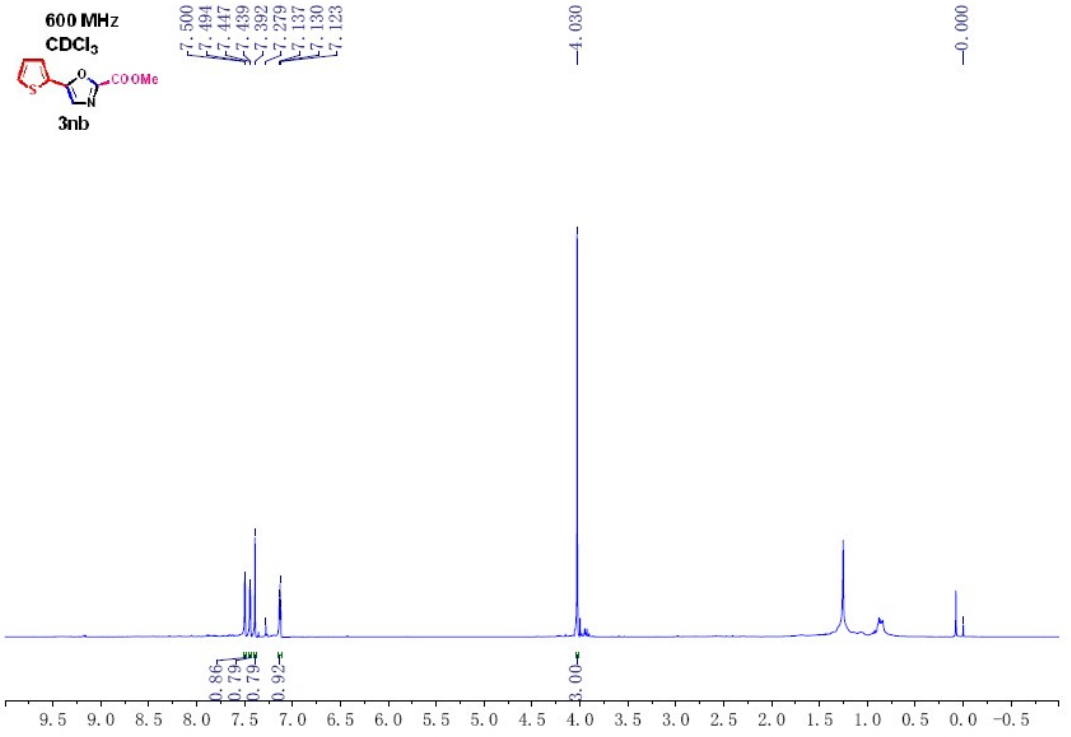
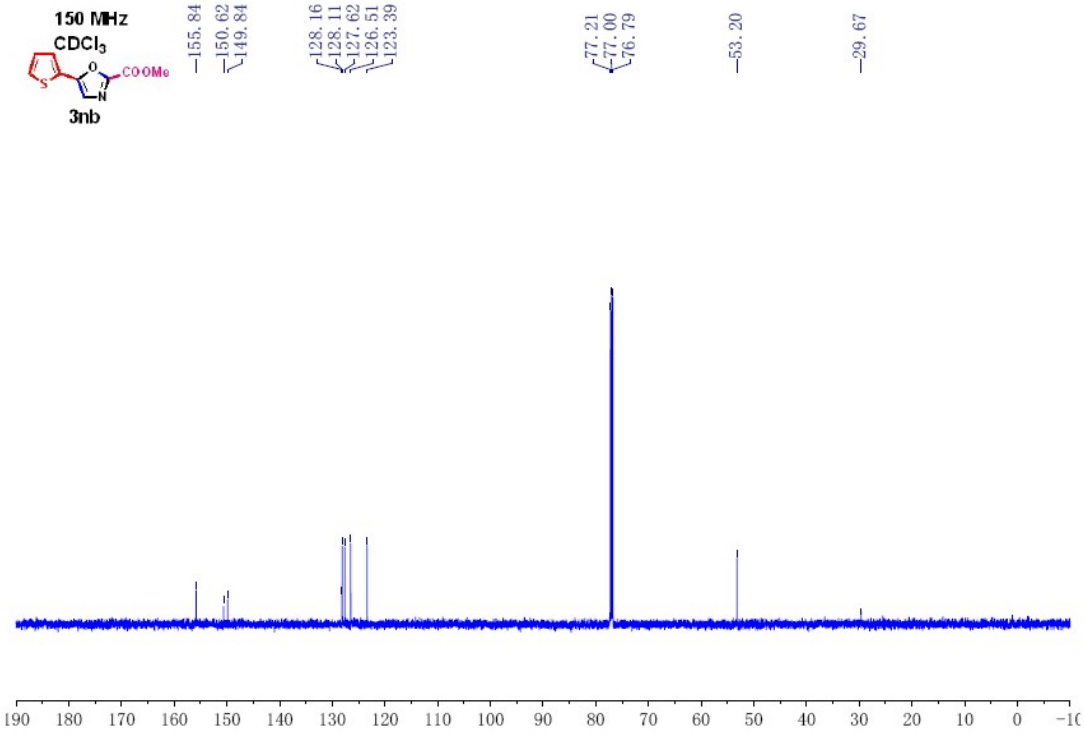
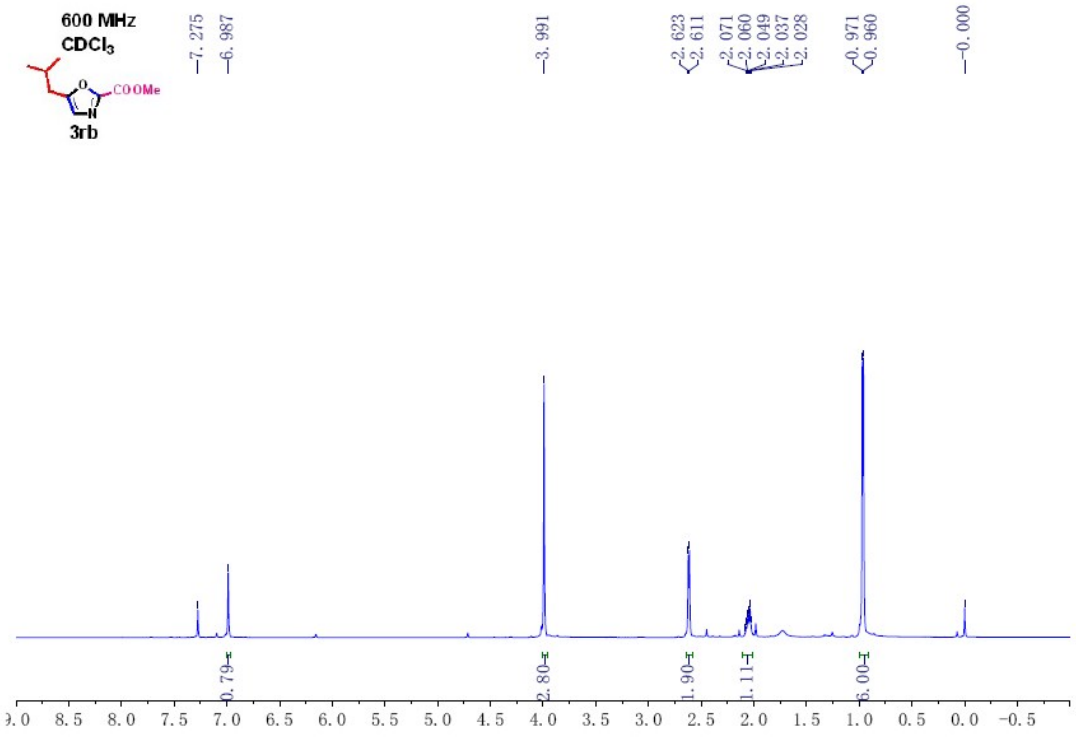
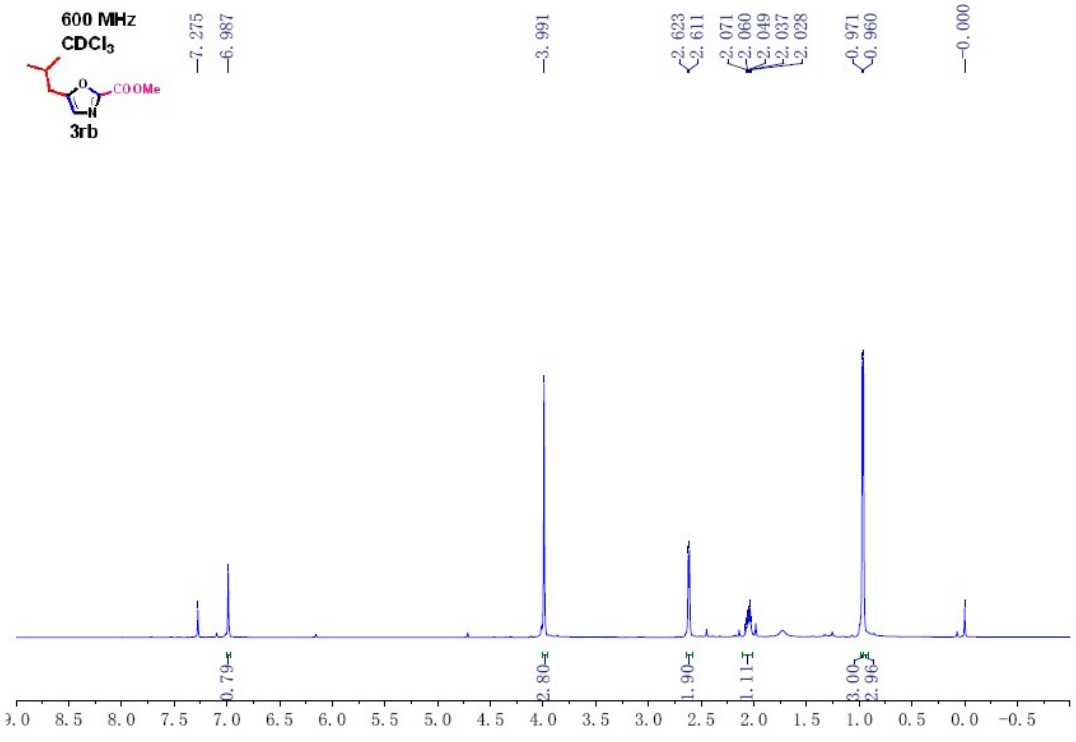
1.80
3.00


150 MHz
CDCl3
3ib
155.88
153.26
151.42
135.79
129.35
126.27
124.97
124.15
77.21
77.00
76.79
53.20


600 MHz
CDCl3
COOMe
3nb
7.500
7.494
7.447
7.439
7.392
7.279
7.137
7.130
7.123
4.030
0.000
0.86
0.79
0.79
0.92
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5


150 MHz
CDCl3
COOMe
3nb
155.84
150.62
149.84
128.16
128.11
127.62
126.51
123.39
77.21
77.00
76.79
53.20
29.67
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10


600 MHz
CDCl3
COOMe
3rb
7.275
6.987
3.991
2.623
2.611
2.071
2.060
2.049
2.037
2.028
0.971
0.960
0.000
0.79
2.80
1.90
1.11
6.00


600 MHz
CDCl3
COOMe
3rb
7.275
6.987
3.991
2.623
2.611
2.071
2.060
2.049
2.037
2.028
0.971
0.960
0.000
0.79
2.80
1.90
1.11
3.00
2.96