Supporting Information for

Copper-Promoted Direct C–H Alkoxylation of *S,S*-Functionalized Internal Olefins with Alcohols

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Experimental procedures and analytical data

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1. General considerations

The solvents were dried and distilled prior to use by the literature methods. ^{1}H and $^{13}C\{^{1}H\}$ NMR spectra were recorded on a 400 MHz spectrometer and all chemical shift values refer to $CDCl_3$ ($\delta(^{1}H)$, 7.26 ppm; $\delta(^{13}C)$, 77.16 ppm). The HRMS analysis was obtained on a Waters GC-TOF CA156 mass spectrometer. All the melting points were uncorrected. X-ray Crystallographic analysis was achieved by the Analysis Center, Dalian Institute of Chemical Physics, Chinese Academy of Sciences. Analytical TLC plates were viewed by UV light (254 nm). Column chromatographic purifications were performed on SDZF silica gel 160. All the chemical reagents were purchased from commercial sources and used as received unless otherwise indicated. Substrates α-oxo ketene dithioacetals **1** were prepared by the reported procedures.[1-19] 1-Methoxy-1,2-benziodoxol-3-(1H)-one (**6**) was prepared as reported.[20]

References

1 Z. Q. Fu, M. Wang, Y. H. Ma, Q. Liu and J. Liu, *J. Org. Chem*., 2008, **73**, 7625.

2 S. K. Nair, R. Samuel and C. V. Asokan, *Synthesis*, 2001, **4**, 573.

3 E. R. Anabha and C. V. Asokan, *Synthesis*, 2006, **1**, 151.

4 Y. H. Ma, M. Wang, D. Li, B. Bekturhun, J. Liu and Q. Liu, *J. Org. Chem.*, 2009, **74**, 3116.

5 O.-A. C. Maria, G. L.-C. Jose, T. A. Ruben and A.-T. Cecilio, *J. Braz. Chem. Soc*., 2005, **16**, 362.

6 W. W. Jin, W. M. Du, Q. Yang, H. F. Yu, J. P. Chen and Z. K. Yu, *Org. Lett.*, 2011, **13**, 4272.

7 N. Fukada and M. Yuzawa, *Bull. Chem. Soc., Japn.*, 1991, **64**, 3727.

8 Z. Huang and Z. Liu, *Synth. Commun.*, 1989, **19**, 943.

9 R. K. Verma, G. K. Verma, G. Shukla and M. S. Singh, *RSC Adv.*, 2012, **2**, 2413.

10 K. T. Potts, M. J. Cipullo, P. Ralli and G. TheodoriBis, *J. Org. Chem.*, 1982, **47**, 3027.

11 B. Myrboh, C. V. Asokan, H. Ila and H. Junjappa, *Synthesis*, 1984, **1**, 50.

12 H. Yuan, M. Wang, Y. Liu, L. Wang, J. Liu and Q. Liu, *Chem.Eur.-J.*, 2010, **16**, 13450.

13 C. Xu, J. X. Liu, W. B. Ming, Y. J. Liu, J. Liu, M. Wang and Q. Liu, *Chem. Eur.-J.*, 2013, **19**, 9104.

14 Z. F. Mao, F. Huang, H. F. Yu, J. P. Chen, Z. K. Yu and Z. Q. Xu, *Chem. Eur.-J.*, 2014, **20**, 3439.

15 W. W. Jin, W. M. Du, Q. Yang, H. F. Yu, J. P. Chen and Z. K. Yu, *Org. Lett.*, 2011, **13**, 4272.

16 X. G. Yang, K. K. Wu and Z. K. Yu, *Tetrahedron Lett*., 2015, **56**, 4490.

17 P. Wu, F. Huang, J. Lou, Q. N. Wang, Z. Q. Liu and Z. K. Yu, *Tetrahedron Lett.*, 2015, **56**, 2488.

18 P. Wu, L. D. Liang, K. K. Wu and Z. K. Yu, *Org. Lett.*, 2015, **17**, 868.

19 X. G. Yang, K. K. Wu, P. Wu, J. P. Chen, C. L. Sunand Z. K. Yu, *Chem. Eur.-J.*, 2015, **21**, 9323.

20 P. Eisenberger, S. Gischig and A. Togni, *Chem. Eur.-J.*, 2006, **12**, 2579.

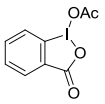
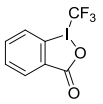
2. Experimental procedures

2.1 C–H alkoxylation of α–oxo ketene dithioacetals 1 with alcohols 2

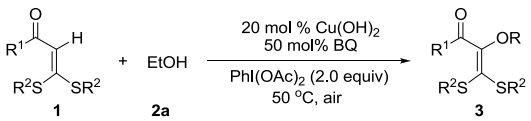
Screening of the reaction conditions: By means of the alkoxylation reaction of *α*-oxo ketene dithioacetal **1a** with EtOH (**2a**) as the model reaction, the reaction conditions were optimized as follows.

Table 1. Screening of the reaction conditions.[a]

Entry	Catalyst (20 mol%)	$PhI(OAc)_2$ (equiv)	Additive	Solvent	Temp (^oC)	Yield[b] (%)
1	$Cu(OH)_2$	1.5		EtOH	25	35
2	$Cu(OH)_2$	1.5	BQ (0.2)	EtOH	25	40
3	$Cu(OH)_2$	1.5	BQ (0.5)	EtOH	25	50
4	$Cu(OH)_2$	1.5	BQ (1.0)	EtOH	25	44
5	$Cu(OH)_2$	1.5	BQ (2.0)	EtOH	25	43
6	$Cu(OH)_2$	1.5	O_2 (1 atm)	EtOH	25	11
7	$Cu(OH)_2$	2.0	BQ (0.5)	EtOH	25	56

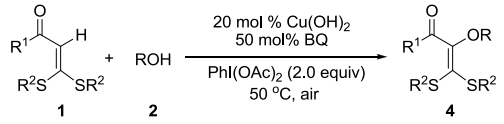
8	$Cu(OH)_2$	2.1	BQ (0.5)	EtOH	25	55
9	$Cu(OH)_2$	2.0	BQ (0.5)	EtOH	50	79 (71)[d]
10[c]	$Cu(OH)_2$	2.0	BQ (0.5)	EtOH	50	79 (72)[d]
11	$Cu(OH)_2$	2.0	BQ (0.5)	EtOH	80	63
12	$Cu(OH)_2$	2.0	BQ (0.5)	EtOH	100	53
13[e]	$Cu(OH)_2$	2.0	BQ (0.5)	THF	50	34
14[e]	$Cu(OH)_2$	2.0	BQ (0.5)	DMF	50	36
15[e]	$Cu(OH)_2$	2.0	BQ (0.5)	DCE	50	56
16[e]	$Cu(OH)_2$	2.0	BQ (0.5)	toluene	50	63
17[e]	$Cu(OH)_2$	2.0	BQ (0.5)	DMSO	50	23
18[f]	$Cu(OH)_2$	2.0	BQ (0.5)	toluene	50	50
19[g]	$Cu(OH)_2$	2.0	BQ (0.5)	toluene	50	36
20	$CuCl_2$	1.5		EtOH	25	21
21	$CuBr_2$	1.5		EtOH	25	23
22	CuI	1.5		EtOH	25	20
23	Cu(OAc)	1.5		EtOH	25	19
24	$Cu(OTf)_2$	1.5		EtOH	25	11
25	 **3a**, 12%	$PhI(OCOPh)_2$ **3a**, 42%	$PhI(OCOCF_3)_2$ **3a'** 32%	PhIO **3a'** 10%	 **3a/3a'**, 0%	

[a] Conditions: **1a** (0.3 mmol), $Cu(OH)_2$ (0.06 mmol), solvent (3 mL), air, 24 h. [b] Determined by ^1H NMR analysis using 1,3,5-trimethoxylbenzene as the internal standard. [c] Under argon atmosphere. [d] Isolated yield given in parathenses. [e] Using 10 equiv EtOH. [f] Using 5 equiv EtOH. [g] Using 2 equiv EtOH.



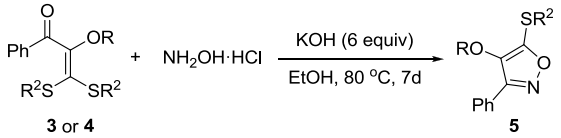
A typical procedure for the alkoxylation of 1 with EtOH – Synthesis of 3,3-bis(methylthio)-2-ethoxyl-1-phenylprop-2-en-1-one (3a): A mixture of α-oxoketene dithioacetal **1a** (112 mg, 0.5 mmol), $Cu(OH)_2$ (10 mg, 0.1 mmol), $PhI(OAc)_2$ (322 mg, 1.0 mmol), and BQ (27 mg, 0.25 mmol) in 5 mL EtOH was stirred at 50 ^oC for 24 h. After cooled to ambient temperature, the resulting mixture was evaporated all the

volatiles under reduced pressure. The resultant residue was purified by silica gel column chromatography (eluent: petroleum ether (60-90 ^{o}C)/ethyl acetate = 200:1, v/v) to afford **3a** as a yellow liquid (95 mg, 71%).



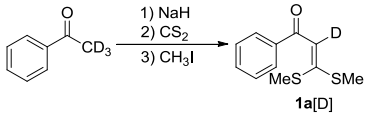
A typical procedure for the alkoxylation of 1 with benzyl alcohols – Synthesis of 3,3-bis(methylthio)-2-benzyloxy-1-phenylprop-2-en-1-one (4i): A mixture of α-oxo ketene dithioacetal **1a** (112 mg, 0.5 mmol), $Cu(OH)_2$ (10 mg, 0.1 mmol), $PhI(OAc)_2$ (322 mg, 1.0 mmol), BQ (27 mg, 0.25 mmol), and BnOH (517 uL, 5 mmol) in 5 mL toluene was stirred at 50 ^{o}C for 24 h. After cooled to ambient temperature, the resulting mixture was evaporated all the volatiles under reduced pressure. The resultant residue was purified by silica gel column chromatography (eluent: petroleum ether (60-90 ^{o}C)/ethyl acetate = 300:1, v/v) to afford **4i** as a yellow solid (104 mg, 63%).

2.2 Derivation of the C-H alkoxylation products 3 or 4 with hydroxylamine



A typical procedure for the reactions of 3 or 4 with hydroxylamine hydrochloride – Synthesis of 5-(methylthio)-3-phenyl-4-(ethoxyl)-oxazole (5a): A mixture of **3a** (134 mg, 0.5 mmol), hydroxylamine hydrochloride (208 mg, 3.0 mmol), and KOH (168 mg, 3.0 mmol) in ethanol (5 mL) was refluxed for 7 days. After cooled to ambient temperature, all the volatiles were removed under reduced pressure. The resulting residue was dissolved in ethyl acetate (10 mL), and washed with water (2×10 mL), and dried over anhydrous Na_2SO_4. The filtrate was evaporated all the volatiles under reduced pressure. The resultant residue was purified by silica gel column chromatography (eluent: petroleum ether (60-90 ^{o}C)/ethyl acetate = 100:1, v/v) to afford **6a** as a colourless liquid (62 mg, 53%).

2.3 Preparation of deuterated α-oxo ketene dithioacetal 1a[D][14]



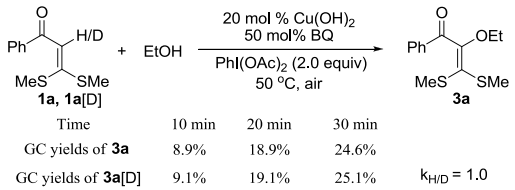
Preparation of deuterated α-oxo ketene dithioacetal 1a[D]**:** Iodomethane (1.57 g, 11 mmol) was added dropwise to a stirred mixture of aceto-D_3-phenone (1.23 g, 10 mmol), NaH (0.80 g, 60% in oil, 20 mmol), CS_2 (1.20 g, 15 mmol), and 1 mL DMF in 19 mL toluene at 0 ^oC. The reaction was complete within 24 h by TLC monitoring. The resulting mixture was poured into 20 g of ice water, extracted with CH_2Cl_2 (3×15 mL). The combined organic phase was dried over anhydrous Na_2SO_4 and filtered. All the volatiles were removed under reduced pressure and the resultant residue was purified by silica gel column chromatography (eluent: petroleum ether (60-90 ℃)/ethyl acetate = 50:1, v/v), affording **1a**[D] (1.46 g, 65% yield, 96%D) as a yellow solid.

2.4 Synthesis of 1-methoxy-1,2-benziodoxol-3-(1H)-one (6)[20]

1-Acetoxy-1,2-benziodoxol-3-(1H)-one (7.0 g, 26.5 mmol) was heated to reflux for 1 h in MeOH (25 mL). After cooled to ambient temperature, crystallization was continued at -10 ^oC. The crystals were dried under vacuum for 20 h, affording **6** (5.6 g, 80%) as a white solid.

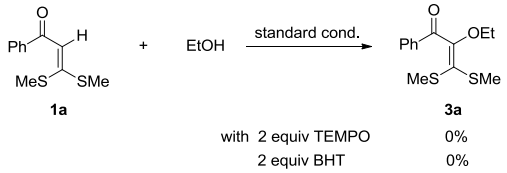
2.5 Kinetic isotope effect (KIE)

The C-H alkoxylation reactions ofα-oxo ketene dithioacetal **1a** and its deuterated form, i.e., **1a**[D], were carried out in a parallel manner under the optimized conditions. A mixture of *α*-oxo ketene dithioacetal **1a** or **1a**[D] (112 mg, 0.5 mmol), $Cu(OH)_2$ (10 mg, 0.1 mmol), $PhI(OAc)_2$ (322 mg, 1.0 mmol), and BQ (27 mg, 0.25 mmol) in 5 mL EtOH was stirred at 50 ^oC. The GC yields from the reactions were carefully checked by the signal integration of the target product **3a** with 1,3,5-methoxylbenzene as the internal standard. The k_H/k_D value was calculated according to the yields of **3a** from the reactions at 10 min, 20 min and 30 min.



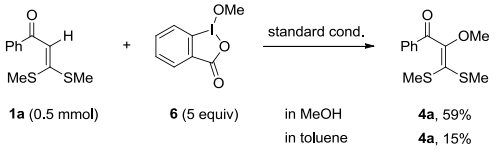
2.6 Radical trapping

Radical trapping experiments: A mixture of *α*-oxo ketene dithioacetal **1a** (112 mg, 0.5 mmol), $Cu(OH)_2$ (10 mg, 0.1 mmol), TEMPO or BHT (1.0 mmol), $PhI(OAc)_2$ (322 mg, 1.0 mmol), and BQ (27 mg, 0.25 mmol) in 5 mL EtOH was stirred at 50 ^oC for 24 h. The resultant mixture was cooled to ambient temperature and subjected to GC analysis by using 1,3,5-methoxylbenzene as the internal standard. No target product **3a** was found in the reaction mixture.



2.7 Mechanistic studies

In order to further verify the reaction mechanism $PhI(OEt)_2$ and PhI(OEt)(OAc) were tried to be prepared from the reaction of $PhI(OAc)_2$ with EtOH using a literature method.[16] Unfortunately, both $PhI(OEt)_2$ and PhI(OEt)(OAc) could not be successfully obtained due to their high susceptibility to thermal and moisture conditions. Alternatively, stable cyclic methoxyiodo(III) compound, that is, 1–methoxy–1,2–benziodoxol–3–(1H)–one (**6**)[17] was prepared and applied to react with **1a** in both methanol and toluene as solvents under the standard conditions, forming **4a** in 59% and 15% yields (Eq. 5), respectively. By increasing temperature to 110 ^oC in a sealed tube the yields could be improved to 71% and 19%, respectively. This result suggests the involvement of alkoxy–iodo(III) species in the C–H alkoxylation of **1** with alcohols.



3. X-Ray crystallographic studies

The X–ray diffraction studies for compound **4i** were carried out on a SMART APEX diffractometer with graphite-monochromated Mo radiation (λ = 0.71073 Å). Cell parameters were obtained by global refinement of the positions of all collected reflections. Intensities were corrected for Lorentz and polarization effects and empirical absorption. The structures were solved by direct methods and refined by full-matrix least squares on F^2. All non-hydrogen atoms were refined anisotropically. All hydrogen atoms were placed in calculated positions. Structure solution and refinement were performed by using the SHELXL-97 package. The X-ray crystallographic files, in CIF format, are available from the Cambridge Crystallographic Data Centre on quoting the deposition numbers CCDC 1469553 for **4i**. Copies of this information may be obtained free of charge from The Director, CCDC, 12 Union Road, Cambridge CB2 IEZ, UK (Fax: +44-1223-336033; e-mail: deposit@ccdc.cam.ac.uk or www: http://www. ccdc.cam.ac.uk).

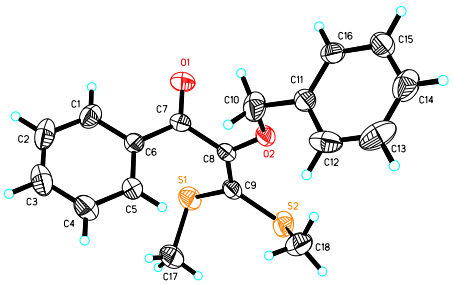


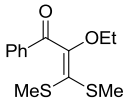
Figure 1. Molecular structure of compound **4i**.

Table 2. Crystal data and structure refinement for compound **4i**.

Identification code	LZQ-443	
Empirical formula	C18 H18 O2 S2	
Formula weight	330.44	
Temperature	293(2) K	
Wavelength	0.71073 Å	
Crystal system	Monoclinic	
Space group	P 21/c	
Unit cell dimensions	a = 16.7723(14) Å	= 90 °
	b = 5.6960(4) Å	= 113.699(10) °

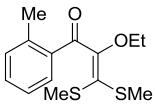
	c = 19.6942(15) Å = 90 °
Volume	1722.8(3) $Å^3$
Z, Density (calculated)	4, 1.274 Mg/m^3
Absorption coefficient	0.313 mm^{-1}
F(000)	696
Crystal size	0.220 x 0.170 x 0.130 mm^3
Theta range for data collection	3.045 to 25.999 °
Index ranges	-20<=h<=14, -7<=k<=7, -20<=l<=24
Reflections collected	7944
Independent reflections	3362 R(int) = 0.0263
Completeness to theta = 25.242 °	99.8 %
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	1.00000 and 0.81096
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	3362 / 0 / 202
Goodness-of-fit on F^2	1.036
Final R indices I>2sigma(I)	R1 = 0.0428, wR2 = 0.0956
R indices (all data)	R1 = 0.0737, wR2 = 0.1144
Extinction coefficient	0.0160(14)
Largest diff. peak and hole	0.138 and -0.201 $e.Å^{-3}$

4. Analytical data



3a

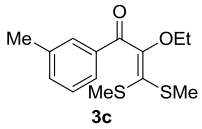
3,3-Bis(methylthio)-2-enthoxy-1-phenylprop-2-en-1-one (3a): 95 mg, 71% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 7.2 Hz, 2H, aromatic CH), 7.59 (t, *J* = 7.4 Hz, 1H, aromatic CH), 7.48 (t, *J* = 7.6 Hz, 2H, aromatic CH), 3.85 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.40 (s, 3H, SMe), 2.05 (s, 3H, SMe), 1.26 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.8 (Cq, C=O), 154.0 (Cq, *C*SMe), 136.7 (Cq of Ph), 133.8, 129.2 and 128.8 (aromatic CH), 117.7 (Cq, *C*OEt), 67.1 (O*CH*$_2$CH$_3$), 18.0 (SMe), 16.0 (SMe), 15.5 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{13}H_{16}O_2S_2$ M+H$^+$: 269.0670; Found: 269.0672.



3b

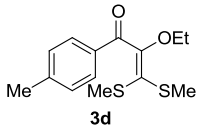
3,3-Bis(methylthio)-2-enthoxy-1-(2-methylphenyl)prop-2-en-1-one (3b): 99 mg,

70% yeld, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.6 Hz, 1H, aromatic CH), 7.42 (t, *J* = 7.5 Hz, 1H, aromatic CH), 7.30 (m, 2H, aromatic CH), 3.96 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.64 (s, 3H, SMe), 2.43 (s, 3H, SMe), 1.94 (s, 3H, Ph-*CH*$_3$), 1.33 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 193.5 (Cq, C=O), 155.0 (Cq, *C*SMe), 139.6 (Cq of Ph), 137.2, 131.9, 129.9 and 125.3 (aromatic CH), 120.6 (Cq, *C*OEt), 67.0 (O*CH*$_2$CH$_3$), 21.1 (Ph-*CH*$_3$), 17.4 (SMe), 16.1 (SMe), 15.5 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{14}H_{18}O_2S_2$ M+H$^+$: 283.0826; Found: 283.0826.



3c

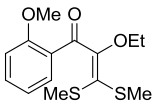
3,3-Bis(methylthio)-2-enthoxy-1-(3-methylphenyl)prop-2-en-1-one (3c): 101 mg, 70% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 7.5 Hz, 1H, aromatic CH), 7.38 (t, *J* = 7.4 Hz, 1H, aromatic CH), 7.24 (m, 2H, aromatic CH), 3.91 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.59 (s, 3H, SMe), 2.38 (s, 3H, SMe), 1.90 (s, 3H, Ph-*CH*$_3$), 1.28 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 193.6 (Cq, C=O), 155.1 (Cq, *C*SMe), 139.8 and 137.3 (Cq of Ph), 131.9, 130.1 and 125.3 (aromatic CH), 120.6 (Cq, *C*OEt), 67.1 (O*CH*$_2$CH$_3$), 21.2 (Ph-*CH*$_3$), 17.4 (SMe), 16.2 (SMe), 15.6 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{14}H_{18}O_2S_2$ M+H$^+$: 283.0826; Found: 283.0827.



3d

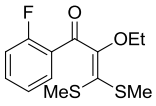
3,3-Bis(methylthio)-2-enthoxy-1-(4-methylphenyl)prop-2-en-1-one (3d): 96 mg, 68% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, *J* = 8.1 Hz, 2H, aromatic CH), 7.28 (m, 2H, aromatic CH), 3.84 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.41 (s, 3H, SMe), 2.38 (s, 3H, SMe), 2.06 (s, 3H, Ph-*CH*$_3$), 1.25 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.5 (Cq, C=O), 154.4 (Cq, *C*SMe), 144.9 and 134.1 (Cq of Ph), 129.6 and 129.4 (aromatic CH), 116.4 (Cq, *C*OEt), 66.9 (O*CH*$_2$CH$_3$), 21.9 (Ph-*CH*$_3$), 18.0 (SMe), 15.9 (SMe), 15.5 (OCH$_2$*CH*$_3$). HRMS Calcd

for $C_{14}H_{18}O_2S_2$ M+H^+: 283.0826; Found: 283.0826.



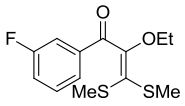
3e

3,3-Bis(methylthio)-2-enthoxy-1-(2-methoxylphenyl)prop-2-en-1-one (3e): 111 mg**,** 74% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (m, 1H, aromatic CH), 7.50 (m, 1H, aromatic CH), 7.01 (m, 1H, aromatic CH), 6.95 (m, 1H, aromatic CH), 3.89 (Ph-O*CH*$_3$), 3.86 (*J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.36 (s, 3H, SMe), 1.93 (s, 3H, SMe), 1.26 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$). δ 191.0 (Cq, C=O), 158.9 (Cq, *C*SMe), 156.5 and 128.1 (Cq of Ph), 134.0, 131.4, 120.7 and 111.9 (aromatic CH), 117.5 (Cq, *C*OEt), 66.9 (O*CH*$_2$CH$_3$), 55.8 (Ph-O*CH*$_3$), 17.7 (SMe), 16.3 (SMe), 15.5 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{14}H_{18}O_3S_2$ M+H^+: 299.0776; Found: 299.0777.



3f

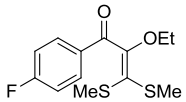
3,3-Bis(methylthio)-2-enthoxy-1-(2-fluorophenyl)prop-2-en-1-one (3f): 104 mg, 72% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (m, 1H, aromatic CH), 7.49 (m, 1H, aromatic CH), 7.23 (m, 1H, aromatic CH), 7.10 (m, 1H, aromatic CH), 3.88 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.39 (s, 3H, SMe), 2.02 (s, 3H, SMe), 1.26 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 188.30 (Cq, C=O), 161.07 (d, *J* = 256.0 Hz, Cq of Ph), 154.4 (Cq, *C*SMe), 134.3 (d, *J* = 8.7 Hz, aromatic CH), 131.08 (d, *J* = 1.4 Hz, aromatic CH), 127.0 (d, *J* = 10.7 Hz, Cq of Ph), 124.4 (d, *J* = 3.7 Hz, aromatic CH), 123.6 (d, *J* = 3.3 Hz, Cq, *C*OEt), 116.5 (d, *J* = 22.1 Hz, aromatic CH), 67.3 (O*CH*$_2$CH$_3$), 17.8 (SMe), 16.4 (SMe), 15.4 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{13}H_{15}O_2S_2F$ M+H^+: 287.0576; Found: 287.0579.



3g

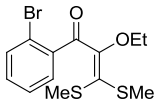
3,3-Bis(methylthio)-2-enthoxy-1-(3-fluorophenyl)prop-2-en-1-one (3g): 106 mg, 74% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) ^{1}H NMR (400 MHz, $CDCl_3$) δ

7.71 (m, 1H, aromatic CH), 7.63 (m, 1H, aromatic CH), 7.45 (m, 1H, aromatic CH), 7.27 (m, 1H, aromatic CH), 3.84 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.39 (s, 3H, SMe), 2.05 (s, 3H, SMe), 1.25 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$) δ 190.4 (Cq, C=O), 162.9 (d, *J* = 248.4 Hz, Cq of Ph), 153.1 (Cq, *C*SMe), 138.9 (d, *J* = 6.3 Hz, Cq of Ph), 130.4 (d, *J* = 7.6 Hz, aromatic CH), 124.9 (d, *J* = 3.0 Hz, aromatic CH), 120.6 (d, *J* = 21.5 Hz, aromatic CH), 119.9 (Cq, *C*OEt), 115.5 (d, *J* = 22.5 Hz, aromatic CH), 67.3 (O*CH*$_2$CH$_3$), 17.9 (SMe), 16.0 (SMe), 15.4 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{13}H_{15}O_2S_2F$ M+H$^+$: 287.0576; Found: 287.0578.



3h

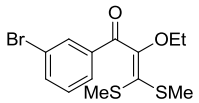
3,3-Bis(methylthio)-2-enthoxy-1-(4-fluorophenyl)prop-2-en-1-one (3h): 109 mg, 76% yield, yellow liquid. ^{1}H NMR (400 MHz, CDCl$_3$) δ 8.0 (m, 2H, aromatic CH), 7.15 (m, 2H, aromatic CH), 3.83 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.40 (s, 3H, SMe), 2.08 (s, 3H, SMe), 1.26 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$) δ 190.2 (Cq, C=O), 166.2 (d, *J* = 255.9 Hz, Cq of Ph), 153.6 (Cq, *C*SMe), 133.0 (d, *J* = 2.9 Hz, aromatic CH, Cq of Ph), 131.9 (d, *J* = 9.5 Hz, aromatic CH), 118.7 (Cq, *C*OEt), 116.1 (d, *J* = 22.1 Hz, aromatic CH), 67.2 (O*CH*$_2$CH$_3$), 18.1 (SMe), 15.9 (SMe), 15.5 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{13}H_{15}O_2S_2F$ M+H$^+$: 287.0576; Found: 287.0576.



3i

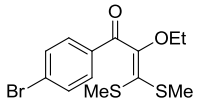
3,3-Bis(methylthio)-2-enthoxy-1-(2-bromophenyl)prop-2-en-1-one (3i): 125 mg, 72% yield, yellow liquid. ^{1}H NMR (400 MHz, CDCl$_3$) δ 7.55 (m, 1H, aromatic CH), 7.44 (m, 1H, aromatic CH), 7.29 (m, 1H, aromatic CH), 7.20 (m, 1H, aromatic CH), 3.86 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.36 (s, 3H, SMe), 1.95 (s, 3H, SMe), 1.19 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$) δ 190.4 (Cq, C=O), 152.4 (Cq, *C*SMe), 140.5 and 132.1 (Cq of Ph), 133.82, 131.8, 130.3 and 127.0 (aromatic CH), 120.8 (Cq, *C*OEt), 67.6 (O*CH*$_2$CH$_3$), 17.9 (SMe), 16.5 (SMe), 15.5 (OCH$_2$*CH*$_3$).

HRMS Calcd for $C_{13}H_{15}O_2S_2Br$ M+H^+: 346.9775; Found: 346.9776.



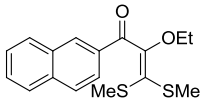
3j

3,3-Bis(methylthio)-2-enthoxy-1-(3-bromophenyl)prop-2-en-1-one (3j): 138 mg, 79% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (s, 1H, aromatic CH), 7.83 (m, 1H, aromatic CH), 7.67 (m, 1H, aromatic CH), 7.34 (m, 1H, aromatic CH), 3.83 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.38 (s, 3H, SMe), 2.05 (s, 3H, SMe), 1.25 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 190.1 (Cq, C=O), 152.8 (Cq, *C*SMe), 138.6 and 122.9 (Cq of Ph), 136.3, 131.8, 130.3 and 127.7 (aromatic CH), 120.6 (Cq, *C*OEt), 67.3 (O*CH*$_2$CH$_3$), 17.9 (SMe), 16.0 (SMe), 15.4 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{13}H_{15}O_2S_2Br$ M+H^+: 346.9775; Found: 346.9777.



3k

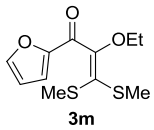
3,3-Bis(methylthio)-2-enthoxy-1-(2-bromophenyl)prop-2-en-1-one (3k): 140 mg, 81% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, *J* = 8.4 Hz, 2H, aromatic CH), 7.61 (d, *J* = 8.4 Hz, 2H, aromatic CH), 3.82 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.38 (s, 3H, SMe), 2.06 (s, 3H, SMe), 1.24 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 190.6 (Cq, C=O), 153.2 (Cq, *C*SMe), 135.5 and 128.9 (Cq of Ph), 132.1, 130.6 (aromatic CH), 119.6 (Cq, *C*OEt), 67.2 (O*CH*$_2$CH$_3$), 18.0 (SMe), 15.9 (SMe), 15.4 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{13}H_{15}O_2S_2Br$ M+H^+: 346.9775; Found: 346.9778.



3l

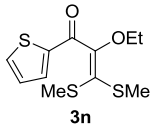
3,3-Bis(methylthio)-2-enthoxy-1-(2-naphthyl)prop-2-en-1-one (3l): 93 mg, 64% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.47 (s, 1H, naphthyl CH), 8.05 (m, 1H, naphthyl CH), 7.98 (m, 1H, naphthyl CH), 7.92 (m, 1H, naphthyl CH), 7.89 (m, 1H, naphthyl CH), 3.90 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.44 (s, 3H, SMe), 2.05 (s, 3H, SMe), 1.28 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ

191.8 (Cq, C=O), 154.2 (Cq, *C*SMe), 136.0, 134.0, 132.6 (Cq of naphthalene), 131.4 (s), 129.8, 128.9, 128.8, 127.9, 127.0 and 124.3 (naphthyl CH), 117.6 (Cq, *C*OEt), 67.2 (O*CH*$_2$CH$_3$), 18.1 (SMe), 15.9 (SMe), 15.5 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{17}H_{18}O_2S_2$ M+H$^+$: 319.0826; Found: 319.0823.



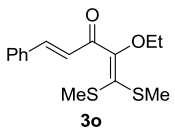
3m

3,3-Bis(methylthio)-2-enthoxy-1-(2-furyl)prop-2-en-1-one (3m): 91 mg, 71% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 (m, 1H, furyl CH), 7.22 (m, 1H, furyl CH), 6.50 (m, 1H, furyl CH), 3.86 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.37 (s, 3H, SMe), 2.14 (s, 3H, SMe), 1.26 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 178.4 (Cq, C=O), 152.5 (Cq, *C*SMe), 147.5 and 119.6 (furyl CH), , 123.2 (Cq of furan), 112.5 (Cq, *C*OEt), 67.4 (O*CH*$_2$CH$_3$), 18.2 (SMe), 16.2 (SMe), 15.4 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{11}H_{14}O_3S_2$ M+H$^+$: 259.0463; Found: 259.0463.



3n

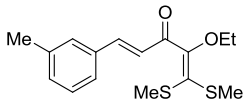
3,3-Bis(methylthio)-2-enthoxy-1-(2-thienyl)prop-2-en-1-one (3n): 82 mg, 60% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 (m, 1H, thienyl CH), 7.68 (m, 1H, thienyl CH), 7.12 (m, thienyl CH), 3.87 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.39 (s, 3H, SMe), 2.15 (s, 3H, SMe), 1.28 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 183.2 (Cq, C=O), 153.3 (Cq, *C*SMe), 143.6 (Cq of thiophene), 134.9, 134.1 and 128.3 (thienyl CH), 122.1 (Cq, *C*OEt), 67.5 (O*CH*$_2$CH$_3$), 18.3 (SMe), 16.2 (SMe), 15.4 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{11}H_{14}O_2S_3$ M+H$^+$: 275.0234; Found: 275.0235.



3o

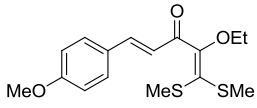
(*E*)-3,3-bis(methylthio)-2-enthoxy-5-phenylpenta-1,4-dien-1-one (3o): 90 mg, 64% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, *J* = 16.0 Hz, 1H, CH=*CH*-Ph), 7.57 (m, 2H, aromatic CH), 7.40 (m, 3H, aromatic CH), 7.09 (d, *J* =

16.0 Hz, 1H, CH=*CH*-CO), 3.89 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.42 (s, 3H, SMe), 2.28 (s, 3H, SMe), 1.32 (dd, *J* = 9.0, 5.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 188.9 (Cq, C=O), 153.8 (Cq, *C*SMe), 144.1 (CH=*CH*-Ph), 134.8 (Cq of Ph), 130.7, 129.1 and 128.6 (aromatic CH), 126.9 (Cq, *C*OEt), 125.3 (CH=*CH*-CO), 67.6 (O*CH*$_2$CH$_3$), 18.5 (SMe), 16.7 (SMe), 15.5 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{15}H_{18}O_2S_2$ M+H$^+$: 295.0826; Found: 295.0825.



3p

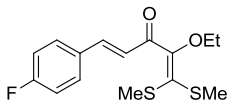
(*E*)-3,3-bis(methylthio)-2-enthoxy-5-(3-methylphenyl)penta-1,4-dien-1-one (3p): 92 mg, 60% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 (d, *J* = 16.0 Hz, 1H, CH=*CH*-Ph), 7.31 (d, *J* = 5.9 Hz, 2H, aromatic CH), 7.20 (dd, *J* = 6.9, 3.1 Hz, 1H, aromatic CH), 7.14 (d, *J* = 7.5 Hz, 1H, aromatic CH), 6.99 (d, *J* = 16.0 Hz, 1H, CH=*CH*-CO), 3.82 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.35 (s, 3H), 2.30 (s, 3H), 2.20 (s, 3H), 1.25 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 189.2 (Cq, C=O), 153.9 (Cq, *C*SMe), 144.4 (CH=*CH*-Ph), 138.8 and 134.7 (Cq of Ph), 131.6, 129.3, 128.9 and 125.7 (aromatic CH), 126.3(Cq, *C*OEt), 125.1 (CH=*CH*-CO), 67.5 (O*CH*$_2$CH$_3$), 21.4 (Ph-*CH*$_3$), 18.5 (SMe), 16.6 (SMe), 15.5 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{16}H_{20}O_2S_2$ M+H$^+$: 309.0983; Found: 309.0986.



3q

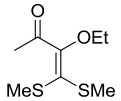
(*E*)-3,3-bis(methylthio)-2-enthoxy-5-(4-methoxylphenyl)penta-1,4-dien-1-one (3q): 102 mg, 63% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 15.9 Hz, 1H, CH=*CH*-Ph), 7.51 (m, 2H, aromatic CH), 6.95 (15.9, 1H, CH=*CH*-C=O), 6.90 (m, 2H, aromatic CH), 3.87 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 3.81 (s, 3H, Ph-O*CH*$_3$), 2.39 (s, 3H, SMe), 2.24 (s, 3H, SMe), 1.30 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 189.1 (Cq, C=O), 161.8 and 127.2 (Cq of Ph), 154.0 (Cq, *C*SMe), 144.1 (CH=*CH*-Ph), 130.2 and 114.4 (aromatic CH), 124.8 (Cq, *C*OEt), 122.9 (CH=*CH*-C=O), 67.2 (O*CH*$_2$CH$_3$), 55.4 (Ph-O*CH*$_3$), 18.3 (SMe), 16.4 (SMe),

15.4 (OCH_2CH_3). HRMS Calcd for $C_{16}H_{20}O_3S_2$ M+H$^+$: 325.0932; Found: 325.0936.



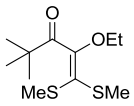
3r

(*E*)-3,3-bis(methylthio)-2-enthoxy-5-(4-flourophenyl)penta-1,4-dien-1-one (3r): 105 mg, 67% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 16.1 Hz, 1H, CH=*CH*-Ph), 7.50 (m, 2H, aromatic CH), 7.07 (m, 2H, aromatic CH), 7.01 (d, *J* = 16.0 Hz, 1H, CH=*CH*-C=O), 3.87 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.41 (s, 3H, SMe), 2.27 (s, 3H, SMe), 1.31 (t, *J* = 7.0 Hz, 3H, OCH_2CH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 188.6 (Cq, C=O), 164.1 (d, *J* = 252.1 Hz, Cq of Ph), 153.6 (Cq, *C*SMe), 142.6 (CH=*CH*-C=O), 131.0 (d, *J* = 3.3 Hz, Cq of Ph), 130.4 (d, *J* = 8.6 Hz, aromatic CH), 127.9 (Cq, *C*OEt), 124.8 (d, *J* = 2.2 Hz, CH=*CH*-Ph), 116.2 (d, *J* = 21.9 Hz, aromatic CH), 67.6 (O*CH*$_2$CH$_3$), 18.5 (SMe), 16.7 (SMe), 15.5 (OCH_2CH_3). HRMS Calcd for $C_{15}H_{17}FO_2S_2$ M+H$^+$: 313.0732; Found: 313.0733.



3s

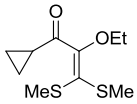
4,4-Bis(methylthio)-3-enthoxybut-3-en-2-one (3s): 65 mg, 63% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.83 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.40 (s, 3H, SMe), 2.34 (s, 3H, SMe), 2.32 (s, 3H, SMe), 1.33 (t, *J* = 7.0 Hz, 3H, OCH_2CH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 196.3 (Cq, C=O), 152.4 (Cq, *C*SMe), 134.0 (Cq, *C*OEt), 67.7 (O*CH*$_2$CH$_3$), 28.7 (C=O*CH*$_3$), 18.4 (SMe), 17.2 (SMe), 15.5 (OCH_2CH_3). HRMS Calcd for $C_8H_{14}O_2S_2$ M+H$^+$: 207.0513; Found: 207.0514.



3t

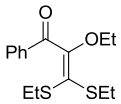
3,3-Bis(methylthio)-2-enthoxy-1-*tert*-butylprop-2-en-1-one (3t): 52 mg, 56% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.79 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 2.29 (s, 3H, SMe), 2.16 (s, 3H, SMe), 1.27 (d, *J* = 7.1 Hz, 3H, OCH_2CH_3), 1.20 (s, 9H, (CH_3)$_3$C). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 208.6 (Cq, C=O), 155.5 (Cq, *C*SMe), 117.8 (Cq, *C*OEt), 67.8 (O*CH*$_2$CH$_3$), 43.7 ((CH$_3$)$_3$*C*), 27.1 (C=O*CH*$_3$), 17.9 (SMe),

15.7 (OCH_2CH_3), 15.1 ($(CH_3)_3C$). HRMS Calcd for $C_{11}H_{20}O_2S_2$ M+H^+: 249.0983; Found: 249.1006.



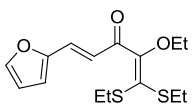
3u

3,3-Bis(methylthio)-2-enthoxy-1-cyclopropylprop-2-en-1-one (3u): 65 mg, 56% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.86 (q, *J* = 7.0 Hz, 2H, OCH_2CH_3), 2.45 (m, 1H, cyclopropyl CH), 2.35(s, 3H, SMe) 2.29 (s, 3H, SMe), 1.32 (t, *J* = 7.0 Hz, 3H, OCH_2CH_3), 1.14 (m, 2H, cyclopropyl CH_2), 0.95 (m, 2H, cyclopropyl CH_2). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 198.7 (Cq, C=O), 153.4 (Cq, *C*SMe), 130.0 (Cq, *C*OEt), 67.7 (OCH_2CH_3), 19.9 (cyclopropyl CH), 18.4 (SMe), 16.9 (SMe), 15.5 (OCH_2CH_3), 12.3 (cyclopropyl CH_2). HRMS Calcd for $C_{10}H_{16}O_2S_2$ M+H^+: 233.0670; Found: 233.0670.



3v

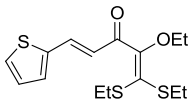
3,3-Bis(ethylthio)-2-enthoxy-1-phenylprop-2-en-1-one (3v): 111 mg, 75% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 (m, 2H, aromatic CH), 7.56 (t, *J* = 7.4 Hz, 1H, aromatic CH), 7.45 (t, *J* = 7.6 Hz, 2H, aromatic CH), 3.83 (q, *J* = 7.0 Hz, 2H, OCH_2CH_3), 2.88 (q, *J* = 7.3 Hz, 2H, SCH_2CH_3), 2.57 (q, *J* = 7.4 Hz, 2H, SCH_2CH_3), 1.30 (t, *J* = 7.3 Hz, 3H, SCH_2CH_3), 1.23 (t, *J* = 7.0 Hz, 3H, OCH_2CH_3), 1.04 (t, *J* = 7.4 Hz, 3H, SCH_2CH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.9 (Cq, C=O), 155.6 (Cq, *C*SMe), 136.5 (Cq of Ph), 133.7, 129.3 and 128.8 (aromatic CH), 114.6 (Cq, *C*OEt), 67.1 (OCH_2CH_3), 28.4 (SCH_2CH_3), 26.7 (SCH_2CH_3), 15.4 (SCH_2CH_3), 15.3 (SCH_2CH_3), 14.0 (OCH_2CH_3). HRMS Calcd for $C_{15}H_{20}O_2S_2$ M+H^+: 297.0983; Found: 297.0986.



3w

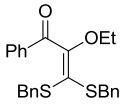
(*E*)-3,3-bis(ethylthio)-2-enthoxy-5-(2-furyl)penta-1,4-dien-1-one (3w): 111 mg, 71% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 (s, 1H, furyl CH), 7.39

(d, *J* = 15.7 Hz, 1H, CH=*CH*-furan), 6.96 (d, *J* = 15.7 Hz, 1H, CH=*CH*-C=O), 6.68 (m, 1H, furyl CH), 6.50 (m, 1H, furyl CH), 3.88 (q, *J* = 7.0 Hz, 2H, $_3$ O*CH*$_2$CH), 2.91 (q, *J* = 7.3 Hz, 2H, S*CH*$_2$CH$_3$), 2.78 (q, *J* = 7.4 Hz, 2H, S*CH*$_2$CH$_3$), 1.26 (m, 9H, OCH$_2$*CH*$_3$ and SCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$) δ 188.8 (Cq, C=O), 155.4 (Cq, *C*SMe), 151.6 (Cq of furan), 145.3, 129.9, 123.1, 116.3 (furyl CH or CH=CH), 112.8 (Cq, *C*OEt), 67.5 (O*CH*$_2$CH$_3$), 28.8 (S*CH*$_2$CH$_3$), 27.5 (S*CH*$_2$CH$_3$), 15.5 (SCH$_2$*CH*$_3$), 15.2 (SCH$_2$*CH*$_3$), 14.4 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{15}H_{20}O_3S_2$ M+H$^+$: 313.0932; Found: 313.0931.



3x

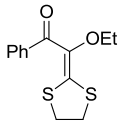
(*E*)-3,3-bis(methylthio)-2-enthoxy-5-(2-thienyl)penta-1,4-dien-1-one (3x): 115 mg, 70% yield, yellow liquid. ^{1}H NMR (400 MHz, CDCl$_3$) δ 7.74 (d, *J* = 15.7 Hz, 1H, CH=*CH*-thiophene), 7.40 (m, 1H, thienyl CH), 7.29 (m, 1H, thienyl CH), 7.06 (m, 1H, thienyl CH), 6.87 (d, *J* = 15.7 Hz, 1H, CH=*CH*-C=O), 3.88 (q, *J* = 6.9 Hz, 2H, O*CH*$_2$CH$_3$), 2.91 (q, *J* = 7.3 Hz, 2H, S*CH*$_2$CH$_3$), 2.78 (q, *J* = 7.3 Hz, 2H, S*CH*$_2$CH$_3$), 1.29 (m, 6H, OCH$_2$*CH*$_3$ and SCH$_2$*CH*$_3$), 1.23 (t, *J* = 7.3 Hz, 3H, SCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$) δ 188.7 (Cq, C=O), 155.3 (Cq, *C*SMe), 140.4 (Cq of thiophene), 136.4, 131.9, 129.2, 128.5, 124.5 (thienyl CH or CH=CH), 123.4 (Cq, *C*OEt), 67.5 (O*CH*$_2$CH$_3$), 28.8 (S*CH*$_2$CH$_3$), 27.5 (S*CH*$_2$CH$_3$), 15.5 (SCH$_2$*CH*$_3$)), 15.2 (SCH$_2$*CH*$_3$)), 14.5 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{15}H_{20}O_2S_3$ M+H$^+$: 329.0704; Found: 329.0702.



3y

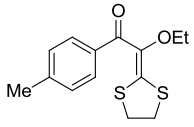
3,3-Bis(benzylthio)-2-enthoxy-1-phenylprop-2-en-1-one (3y): 141 mg, 67% yield, yellow liquid. ^{1}H NMR (400 MHz, CDCl$_3$) δ 7.60 (m, 2H, aromatic CH), 7.53 (t, *J* = 7.4 Hz, 1H, aromatic CH), 7.42 (m, 2H, aromatic CH), 7.35 (t, *J* = 7.6 Hz, 4H, aromatic CH), 7.30 (m, 1H, aromatic CH), 7.18 (m, 3H, aromatic CH), 7.03 (dd, *J* = 6.6, 2.9 Hz, 2H, aromatic CH), 4.10 (s, 2H, Ph*CH*$_2$S), 3.73 (s, 2H, Ph*CH*$_2$S), 3.68 (q,

J = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 1.15 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$) ^{13}C NMR (101 MHz, CDCl$_3$) δ 191.5 (Cq, C=O), 157.6 (Cq, *C*SMe), 138.4, 136.8 and 136.1 (Cq of Ph), 133.5, 129.3, 129.2, 129.1, 128.7, 128.5, 128.4 and 127.1 (aromatic CH), 112.3 (Cq, *C*OEt), 67.11 (O*CH*$_2$CH$_3$), 39.17 (Ph*CH*$_2$S), 37.02 (Ph*CH*$_2$S), 15.24 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{25}H_{24}O_2S_2$ M+H$^+$: 421.1296; Found: 421.1290.



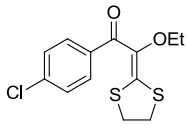
3z

2-(1,3-dithiolan-2-ylidene)-2-ethoxy-1-phenylethanone (3z): 70 mg, 53% yield, yellow liquid. ^{1}H NMR (400 MHz, CDCl$_3$) δ 8.00 (d, *J* = 7.8 Hz, 2H, aromatic CH), 7.48 (t, *J* = 7.0 Hz, 1H, aromatic CH), 7.40 (t, *J* = 7.5 Hz, 2H, aromatic CH), 3.60 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 3.45 (m, 2H, SCH$_2$), 3.37 (m, 2H, SCH$_2$), 1.16 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$) δ 187.1 (Cq, C=O), 154.3 (Cq, *C*SMe), 142.6 (Cq, *C*OEt), 137.5 (Cq of Ph), 131.9, 129.2 and 128.1 (aromatic CH), 68.8 (O*CH*$_2$CH$_3$), 40.0 (SCH$_2$), 35.9 (SCH$_2$), 15.5 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{13}H_{14}O_2S_2$ M+H$^+$: 267.0513; Found: 267.0510.



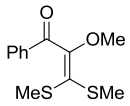
3z1

2-(1,3-dithiolan-2-ylidene)-2-ethoxy-1-(p-tolyl)ethanone (3z1): 78 mg, 56% yield, yellow liquid. ^{1}H NMR (400 MHz, CDCl$_3$) δ 7.94 (d, *J* = 8.1 Hz, 2H, aromatic CH), 7.21 (d, *J* = 8.0 Hz, 2H, aromatic CH), 3.61 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 3.44 (m, 2H, SCH$_2$), 3.47 (m, 2H, SCH$_2$), 2.39 (s, 3H, Ph-*CH*$_3$), 1.19 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, CDCl$_3$) δ 186.7 (Cq, C=O), 153.7 (Cq, *C*SMe), 142.8 (Cq of Ph), 142.6 (Cq, *C*OEt), 134.8 (Cq of Ph), 129.4 and 128.9 (aromatic CH), 68.7 (O*CH*$_2$CH$_3$), 39.9 (SCH$_2$), 35.9 (SCH$_2$), 21.8 (Ph-*CH*$_3$), 15.6 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{14}H_{16}O_2S_2$ M+H$^+$: 281.0670; Found: 281.0670.



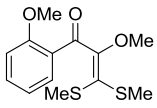
3z2

1-(4-chlorophenyl)-2-(1,3-dithiolan-2-ylidene)-2-ethoxyethanone (3z2): 81 mg, 54% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 (m, 2H, aromatic CH), 7.38 (m, 2H, aromatic CH), 3.59 (q, *J* = 7.0 Hz, 2H, O*CH*$_2$CH$_3$), 3.45 (m, 2H, SCH$_2$), 3.36 (dd, *J* = 7.1, 4.9 Hz, 2H, SCH$_2$), 1.17 (t, *J* = 7.0 Hz, 3H, OCH$_2$*CH*$_3$). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 185.5 (s), 155.4 (Cq, *C*SMe), 142.3 (Cq, *C*OEt), 138.1 and 135.7 (Cq of Ph), 130.7 and 128.4 (aromatic CH), 68.8 (O*CH*$_2$CH$_3$), 44.0 (SCH$_2$), 36.0 (SCH$_2$), 15.5 (OCH$_2$*CH*$_3$). HRMS Calcd for $C_{13}H_{13}ClO_2S_2$ M+H$^+$: 301.0124; Found: 301.0122.



4a

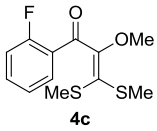
3,3-Bis(methylthio)-2-methoxy-1-phenylprop-2-en-1-one (4a): 91 mg, 72% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.94 (m, 2H, aromatic CH), 7.58 (m, 1H, aromatic CH), 7.48 m, 2H, aromatic CH), 3.63 (s, 3H, OMe), 2.38 (s, 3H, SMe), 2.02 (s, 3H, SMe). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.5 (Cq, C=O), 154.6 (Cq, *C*SMe), 136.7 (Cq of Ph), 133.8, 129.1 and 128.8 (aromatic CH), 116.7 (Cq, *C*OMe), 58.3 (OMe), 17.8 (SMe), 16.0 (SMe). HRMS Calcd for $C_{12}H_{14}O_2S_2$ M+H$^+$: 255.0513; Found: 255.0515.



4b

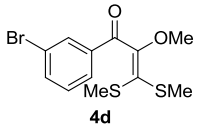
3,3-Bis(methylthio)-2-methoxy-1-(2-methoxylphenyl)prop-2-en-1-one (4b): 88 mg, 62% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (dd, *J* = 7.7, 1.5 Hz, 1H, aromatic CH), 7.41 (m, 1H, aromatic CH), 6.97 (t, *J* = 7.5 Hz, 1H, aromatic CH), 6.90 (d, *J* = 8.4 Hz, 1H, aromatic CH), 3.80 (s, 3H, OMe), 3.63 (s, 3H, OMe), 2.29 (s, 3H, SMe), 1.83 (s, 3H, SMe). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 190.8 (Cq, C=O), 158.9 (Cq, *C*SMe), 157.3, 128.2 and 115.8 (Cq), 134.2, 131.4, 120.9 and 111.9 (aromatic

CH), 58.2 and 55.7 (OMe), 17.5 (SMe), 16.3 (SMe). HRMS Calcd for $C_{12}H_{16}O_3S_2$ M+H$^+$: 285.0619; Found: 285.0617.



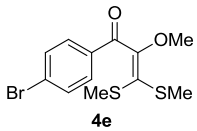
4c

3,3-Bis(methylthio)-2-methoxy-1-(2-fluorophenyl)prop-2-en-1-one (4c): 94 mg, 69% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (m, 1H, aromatic CH), 7.44 (m, 1H, aromatic CH), 7.19 (m, 1H, aromatic CH), 7.05 (m, 1H, aromatic CH), 3.62 (s, 3H, OMe), 2.32 (s, 3H, SMe), 1.93 (s, 3H, SMe). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 188.0 (Cq, C=O), 160.9 (d, *J* = 255.7 Hz, Cq), 155.1 (Cq, *C*SMe), 134.31 (d, *J* = 8.8 Hz, aromatic CH), 130.9 (d, *J* = 1.3 Hz, aromatic CH), 127.1 (d, *J* = 10.7 Hz, Cq), 124.5 (d, *J* = 3.7 Hz, aromatic CH), 122.7 (d, *J* = 3.6 Hz, Cq), 116.5 (d, *J* = 22.0 Hz, aromatic CH), 58.5 (OMe), 17.6 (SMe), 16.4 (SMe). HRMS Calcd for $C_{12}H_{13}FO_2S_2$ M+H$^+$: 273.0419; Found: 273.0418.



4d

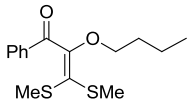
3,3-Bis(methylthio)-2-methoxy-1-(3-bromophenyl)prop-2-en-1-one (4d): 116.6 mg, 70% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (s, 1H, aromatic CH), 7.84 (d, *J* = 7.8 Hz, 1H, aromatic CH), 7.68 (m, 1H, aromatic CH), 7.36 (t, *J* = 7.9 Hz, 1H, aromatic CH), 3.64 (s, 3H, OMe), 2.39 (s, 3H, SMe), 2.04 (s, 3H, SMe). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 189.9 (Cq, C=O), 153.5(Cq, *C*SMe), 138.7, 123.08 and 119.61 (Cq), 136.5, 131.8, 130.4 and 127.6 (aromatic CH), 58.6 (OMe), 17.8 (SMe), 16.1 (SMe). HRMS Calcd for $C_{12}H_{13}BrO_2S_2$ M+H$^+$: 332.9619; Found: 332.9621.



4e

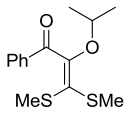
3,3-Bis(methylthio)-2-methoxy-1-(4-bromophenyl)prop-2-en-1-one (4e): 123 mg, 74% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (d, *J* = 8.6 Hz, 2H, aromatic CH), 7.63 (d, *J* = 8.6 Hz, 2H, aromatic CH), 3.63 (s, 3H, OMe), 2.39 (s, 3H, SMe), 2.05 (s, 3H, SMe). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 190.44 (Cq, C=O),

153.8 (Cq, *C*SMe), 135.6, 129.0 and 118.6 (Cq), 132.2 and 130.6 (aromatic CH), 58.5 (OMe), 17.9 (SMe), 16.0 (SMe). HRMS Calcd for $C_{12}H_{13}BrO_2S_2$ M+H$^+$: 332.9619; Found: 332.9619.



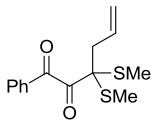
4f

3,3-Bis(methylthio)-2-butoxy-1-phenylprop-2-en-1-one (4f): 92 mg, 62% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (m, 2H, aromatic CH), 7.58 (m, 1H, aromatic CH), 7.48 m, 2H, aromatic CH), 3.75 (m, 2H, OCH_2), 2.36 (s, 3H, SMe), 2.07 (s, 3H, SMe), 1.60 (m, 2H, butyl CH_2), 1.36 (m, 2H, butyl CH_2), 0.86 (m, 3H, butyl CH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.9 (Cq, C=O), 154.2 (Cq, *C*SMe), 136.7 (Cq of Ph), 133.7, 129.2 and 128.8 (aromatic CH), 117.4 (Cq, *C*OCH_2), 71.0 (OCH_2), 31.9 (OCH_2*CH_2*), 19.0 (SMe), 18.0 (SMe), 15.9 (butyl CH_2), 13.8 (butyl CH_3). HRMS Calcd for $C_{15}H_{20}O_2S_2$ M+H$^+$: 297.0983; Found: 297.0985.



4g

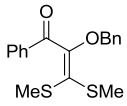
3,3-Bis(methylthio)-2-*iso*propoxy-1-phenylprop-2-en-1-one (4g): 95 mg, 67% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (m, 2H, aromatic CH), 7.58 m, 1H, aromatic CH), 7.47 (m, 2H, aromatic CH), 4.07 (m, 1H, O*CH*), 2.39 (s, 3H, SMe), 2.08 (s, 3H, SMe), 1.22 (m, 6H, CH(*CH_3*)$_2$).^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.9 (Cq, C=O), 153.4 (Cq, *C*SMe), 136.5 (Cq of Ph), 133.7, 129.4 and 128.7 (aromatic CH), 119.8 (Cq, *C*OCH), 74.4 (O*CH*), 22.7 (SMe), 18.3 (SMe), 15.8 (CH(*CH_3*)$_2$). HRMS Calcd for $C_{14}H_{18}O_2S_2$ M+H$^+$: 283.0826; Found: 283.0826.



4h

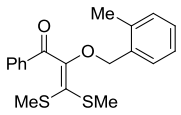
3,3-Bis(methylthio)-1-phenylhex-5-ene-1,2-dione (4h): 74 mg, 53% yield, colourless liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (m, 2H, aromatic CH), 7.64 (m, 1H, aromatic CH), 7.48 (m, 2H, aromatic CH), 5.95 (m, 1H, $CH=CH_2$), 5.21 (m, 2H, $CH=CH_2$), 2.92 (d, *J* = 6.8 Hz, 2H, CH_2), 2.05 (s, 6H, SMe). ^{13}C{^{1}H} NMR (100

MHz, $CDCl_3$) δ 193.7(Cq, C=O), 192.3 (Cq, C=O), 134.6 ($CH=CH_2$), 133.5 (Cq of Ph), 132.0, 129.6, 128.8 (aromatic CH), 119.4 ($CH=CH_2$), 67.5 (*C*SMe), 38.4 (CH_2), 12.1 (SMe). HRMS Calcd for $C_{14}H_{16}O_2S_2$ $M+H^+$: 281.0670; Found: 281.0669.



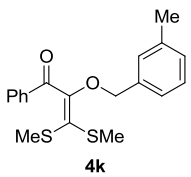
4i

3,3- Bis(methylthio) -2-(benzyloxy)-1-phenylprop-2-en-1-one (4i): 104 mg, 63% yield, yellow solid, m.p.: 55-57 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.75 (m, 2H, aromatic CH), 7.44 (m, 1H, aromatic CH), 7.32 (m, 2H, aromatic CH), 7.17 (m, 5H, aromatic CH), 4.77 (s, 2H, OCH_2), 2.26 (s, 3H, SMe), 1.92 (s, 3H, SMe). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.5 (Cq, C=O), 152.9 (Cq, *C*SMe), 136.9 and 136.2 (Cq of Ph), 133.4, 129.1, 128.5, 128.4, 128.3 and 128.2 (aromatic CH), 121.0 (Cq, *C*OCH), 72.8 (OCH_2), 17.8 (SMe), 15.9 (SMe). HRMS Calcd for $C_{18}H_{18}O_2S_2$ $M+H^+$: 331.0826; Found: 331.0828.



4j

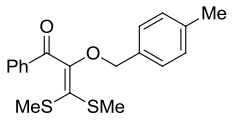
3,3-Bis(methylthio)-2-((2-methylbenzyl)oxy)-1-phenylprop-2-en-1-one (4j): 130 mg, 76% yield, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.93 (m, 2H, aromatic CH), 7.62 (m, 1H, aromatic CH), 7.50 (m, 2H, aromatic CH), 7.31 (m, 1H, aromatic CH), 7.24 (m, 1H, aromatic CH), 7.16 (m, 2H, aromatic CH), 4.93 (s, 2H, OCH_2), 2.42 (s, 3H, SMe), 2.35 (s, 3H, SMe), 2.10 (s, 3H, Ph-CH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.7 (Cq, C=O), 153.2 (Cq, *C*SMe), 137.3, 136.9 and 134.3 (Cq of Ph), 133.5, 130.4, 129.6, 129.2, 128.7, 128.6 and 125.9 (aromatic CH), 120.7 (Cq, *C*OCH), 71.2 (OCH_2), 18.9 (Ph-CH_3), 17.8 (SMe), 15.9 (SMe). HRMS Calcd for $C_{19}H_{20}O_2S_2$ $M+H^+$: 345.0983; Found: 345.0983.



4k

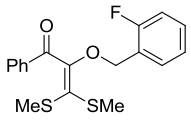
3,3-Bis(methylthio)-2-((3-methylbenzyl)oxy)-1-phenylprop-2-en-1-one (4k): 120

mg, 70% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (m, 2H, aromatic CH), 7.55 (m, 1H, aromatic CH), 7.42 (m, 2H, aromatic CH), 7.19 (m, 2H, aromatic CH), 7.09 (m, 2H, aromatic CH), 4.84 (s, 2H, OCH_2), 2.37 (s, 3H, SMe), 2.31 (s, 3H, SMe), 2.03 (s, 3H, Ph-*CH_3*). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 191.6 (Cq, C=O), 153.1 (Cq, *C*SMe), 138.1, 136.9 and 133.2 (Cq of Ph), 133.4, 129.1, 128.5 and 128.3 (aromatic CH), 120.8 (Cq, *C*OCH), 72.8 (OCH_2), 21.3 (Ph-*CH_3*), 17.8 (SMe), 16.0 (SMe). HRMS Calcd for $C_{19}H_{20}O_2S_2$ M+H^+: 345.0983; Found: 345.0983.



4l

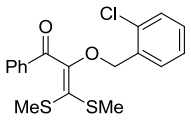
3,3-Bis(methylthio)-2-((4-methylbenzyl)oxy)-1-phenylprop-2-en-1-one (4l): 130 mg, 76% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (m, 2H, aromatic CH), 7.55 (m, 1H, aromatic CH), 7.43 (m, 2H, aromatic CH), 7.17 (m, 1H, aromatic CH), 7.12 (m, 1H, aromatic CH), 7.07 (m, 2H, aromatic CH), 4.84 (s, 2H, OCH_2), 2.38 (s, 3H, SMe), 2.27 (s, 3H, SMe), 2.03 (s, 3H, Ph-*CH_3*). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 191.7 (Cq, C=O), 153.1 (Cq, *C*SMe), 138.1, 136.9 and 136.2 (Cq of Ph), 133.5, 129.3, 129.2, 129.01, 128.6, 128.4 and 125.41 (aromatic CH), 121.0 (Cq, *C*OCH), 72.9 (OCH_2), 21.4 (Ph-*CH_3*), 17.8 (SMe), 16.0 (SMe). HRMS Calcd for $C_{19}H_{20}O_2S_2$ M+H^+: 345.0983; Found: 345.0980.



4m

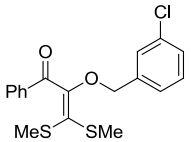
3,3-Bis(methylthio)-2-((2-flourobenzyl)oxy)-1-phenylprop-2-en-1-one (4m): 108 mg, yield 62%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (m, 2H, aromatic CH), 7.48 (m, 1H, aromatic CH), 7.37 (m, 3H, aromatic CH), 7.17 (m, 1H, aromatic CH), 7.01 (m, 1H, aromatic CH), 6.89 (m, 1H, aromatic CH), 4.85 (s, 2H, OCH_2), 2.28 (s, 3H, SMe), 1.97 (s, 3H, SMe). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 191.4 (Cq, C=O), 161.7 (d, *J* = 248.4 Hz, Cq of Ph), 152.8 (Cq, *C*SMe), 136.9 (Cq of Ph), 133.6 (aromatic CH, 130.6 (d, *J* = 3.7 Hz, aromatic CH), 130.3 (d, *J* = 8.2 Hz, aromatic CH), 129.2 (aromatic CH), 128.7 (aromatic CH), 124.2 (d, *J* = 3.7 Hz), 123.6 (d, *J* = 14.4

Hz, Cq of Ph), 121.8 (Cq, *C*OCH$_2$), 115.5 (s), 115.4 (d, *J* = 21.1 Hz, aromatic CH), 66.6 (d, *J* = 4.1 Hz, OCH$_2$), 17.9 (SMe), 16.0 (SMe). HRMS Calcd for $C_{18}H_{17}FO_2S_2$ M+H$^+$: 349.0742; Found: 349.0740.



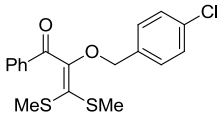
4n

3,3-Bis(methylthio)-2-((2-chlorobenzyl)oxy)-1-phenylprop-2-en-1-one (4n): 128 mg, 70% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 7.6 Hz, 2H, aromatic CH), 7.55 (m, 2H, aromatic CH), 7.45 (m, 2H, aromatic CH), 7.29 (m, 1H, aromatic CH), 7.22 (m, 2H, aromatic CH), 4.97 (s, 2H, OCH$_2$), 2.37 (s, 3H, SMe), 2.06 (s, 3H, SMe). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.4 (Cq, C=O), 152.8 (Cq, *C*SMe), 136.8, 134.1 and 133.2 (Cq of Ph), 133.6, 129.8, 129.5, 129.4, 129.2, 128.7 and 126.9 (aromatic CH), 121.3 (Cq, *C*OCH$_2$), 69.9 (OCH$_2$), 17.8 (SMe), 16.0 (SMe). HRMS Calcd for $C_{18}H_{17}O_2S_2Cl$ M+H$^+$: 365.0437; Found: 365.0440.



4o

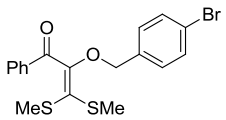
3,3-Bis(methylthio)-2-((3-chlorobenzyl)oxy)-1-phenylprop-2-en-1-one (4o): 133 mg, 73% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (m, 2H, aromatic CH), 7.56 (m, 1H, aromatic CH), 7.44 (m, 2H, aromatic CH), 7.32 (s, 1H, aromatic CH), 7.21 (m, 3H, aromatic CH), 4.83 (s, 2H, OCH$_2$), 2.38 (s, 3H, SMe), 2.04 (s, 3H, SMe). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.5 (Cq, C=O), 152.5 (Cq, *C*SMe), 138.3, 136.8 and 134.4 (Cq of Ph), 133.7, 129.8, 129.2, 128.7, 128.5, 128.3 and 126.2 (aromatic CH), 122.0 (Cq, *C*OCH$_2$), 72.1 (OCH$_2$), 17.8 (SMe), 15.9 (SMe). HRMS Calcd for $C_{18}H_{17}O_2S_2Cl$ M+H$^+$: 365.0437; Found: 365.0438.



4p

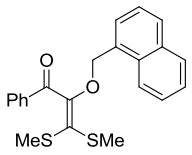
3,3-Bis(methylthio)-2-((4-chlorobenzyl)oxy)-1-phenylprop-2-en-1-one (4p): 139 mg, yield 76%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (m, 2H, aromatic

CH), 7.56 (m, 1H, aromatic CH), 7.43 (m, 2H, aromatic CH), 7.25 (m, 4H, aromatic CH), 4.83 (s, 2H, OCH_2), 2.36 (s, 3H, SMe), 2.03 (s, 3H, SMe). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.5 (Cq, C=O), 152.6 (Cq, *C*SMe), 136.9, 134.8 and 134.3 (Cq of Ph), 133.6, 129.7, 129.2 and 128.7 (aromatic CH), 121.8 (Cq, *C*OCH_2), 72.1 (OCH_2), 17.8 (SMe), 15.9 (SMe). HRMS Calcd for $C_{18}H_{17}O_2S_2Cl$ $M+H^+$: 365.0437; Found: 365.0439.



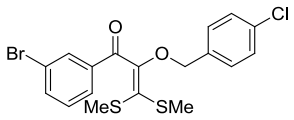
4q

3,3-Bis(methylthio)-2-((4-bromobenzyl)oxy)-1-phenylprop-2-en-1-one (4q): 143 mg, 70% yield, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.83 (d, *J* = 7.2 Hz, 2H, aromatic CH), 7.56 (m, 1H, aromatic CH), 7.43 (m, 4H, aromatic CH), 7.18 (d, *J* = 8.3 Hz, 2H, aromatic CH), 4.81 (s, 2H, OCH_2), 2.37 (s, 3H, SMe), 2.03 (s, 3H, SMe). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.5 (Cq, C=O), 152.6 (Cq, *C*SMe), 136.9, 135.4 and 122.4 (Cq of Ph) 133.6, 131.7, 129.9, 129.2 and 128.7 (aromatic CH), 121.8 (Cq, *C*OCH_2), 72.1 (OCH_2), 17.9 (SMe), 15.9 (SMe). HRMS Calcd for $C_{18}H_{17}O_2S_2Br$ $M+H^+$: 408.9932; Found: 408.9935.



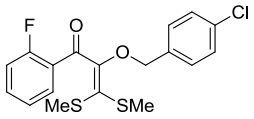
4r

3,3-bis(methylthio)-2-(naphthalen-1-ylmethoxy)-1-phenylprop-2-en-1-one (4r): 123 mg, 64% yield, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) ^1H NMR (400 MHz, $CDCl_3$) δ 8.11 (d, *J* = 7.6 Hz, 1H, aromatic CH), 7.83 (d, *J* = 8.2 Hz, 3H, aromatic CH), 7.78 (d, *J* = 8.2 Hz, 1H, aromatic CH), 7.52 (m, 4H, aromatic CH), 7.39 (d, *J* = 8.1 Hz, 2H, aromatic CH), 7.31 (m, 1H, aromatic CH), 5.35 (s, 2H, OCH_2), 2.33 (s, 3H, SMe), 2.03 (s, 3H, SMe). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.7 (Cq, C=O), 152.9 (Cq, *C*SMe), 137.0, 133.7 and 131.8, 131.7 (Cq of Ph), 133.4, 129.5, 129.1, 128.5, 127.8, 126.5, 125.9, 125.1 and 124.2 (aromatic CH), 121. 8 (*C*OCH_2), 71.3 (OCH_2), 17.8 (SMe), 16.1 (SMe). HRMS Calcd for $C_{22}H_{20}O_2S_2$ $M+H^+$: 381.0983; Found: 381.0983.



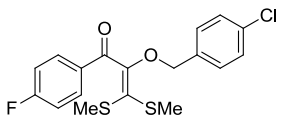
4s

3,3-Bis(methylthio)-2-((4-chlorobenzyl)oxy)-1-(3-bromophenyl)prop-2-en-1-one (4s): 169 mg, 76% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 (m, 1H, aromatic CH), 7.62 (m, 2H, aromatic CH), 7.22 (m, 5H, aromatic CH), 4.80 (s, 2H, OCH_2), 2.33 (s, 3H, SMe), 1.98 (s, 3H, SMe). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 189.7 (Cq, C=O), 151.4 (Cq, *C*SMe), 138.9, 134.6, 134.4, 124.5 and 122.7 (Cq), 136.0, 131.8, 130.1, 129.7, 128.7 and 127.4 (aromatic CH), 72.1 (OCH_2), 17.6 (SMe), 15.9 (SMe). HRMS Calcd for $C_{18}H_{16}BrClO_2S_2$ M+H$^+$: 442.9542; Found: 442.9540.



4t

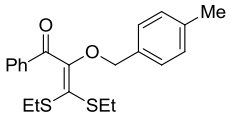
3,3-Bis(methylthio)-2-((4-chlorobenzyl)oxy)-1-(2-flourophenyl)prop-2-en-1-one (4t): 134 mg, 70% yield, yellow liquid.^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (m, 2H, aromatic CH), 7.19 (m, 4H, aromatic CH), 7.03 (m, 2H, aromatic CH), 4.74 (s, 2H, OCH_2), 2.29 (s, 3H, SMe), 1.98 (s, 3H, SMe). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 189.9 (Cq, C=O), 166.0 (d, *J* = 255.8 Hz, Cq), 152.2 (Cq, *C*SMe), 134.7, 134.4 and 122.7 (Cq), 133.3 (d, *J* = 2.8 Hz, Cq), 131.9 (d, *J* = 9.4 Hz, aromatic CH), 129.7 and 128.7 (aromatic CH) , 115.9 (d, *J* = 22.0 Hz, aromatic CH), 72.2 (OCH_2), 17.9 (SMe), 15.9 (SMe). HRMS Calcd for $C_{18}H_{16}FClO_2S_2$ M+H$^+$: 383.0343; Found: 383.0345.



4u

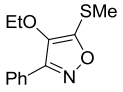
3,3-Bis(methylthio)-2-((4-chlorobenzyl)oxy)-1-(4-flourophenyl)prop-2-en-1-one (4u): 125 mg, 65% yield, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (m, 1H, aromatic CH), 7.39 (m, 1H, aromatic CH), 7.20 (m, 5H, aromatic CH), 7.11 (m, 1H, aromatic CH), 7.00 (m, 1H, aromatic CH), 4.75 (s, 2H, OCH_2), 2.29 (s, 3H, SMe), 1.96 (s, 3H, SMe). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 187.9 (C=O), 160.9 (d, *J* = 255.7 Hz, Cq), 153.0 (Cq, *C*SMe), 134.9 134.2 and 130.9 (Cq), 134.1 (d, *J* = 8.7 Hz, aromatic CH), 129.8, 128.7 and 127.3 (aromatic CH), 124.4 (d, *J* = 3.7 Hz, aromatic

CH), 116.5 (d, *J* = 22.0 Hz, aromatic CH), 72.4 (OCH_2), 17.8 (SMe), 16.5 (SMe). HRMS Calcd for $C_{18}H_{16}FClO_2S_2$ M+H^+: 383.0343; Found: 383.0340.



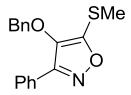
4v

3,3-Bis(ethylthio)-2-((4-methylbenzyl)oxy)-1-phenylprop-2-en-1-one (4v): 147 mg, 79% yield, yellow solid, m.p.: 57-58 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 7.4 Hz, 2H, aromatic CH), 7.42 (t, *J* = 7.4 Hz, 1H, aromatic CH), 7.29 (t, *J* = 7.7 Hz, 2H, aromatic CH), 7.08 (d, *J* = 7.9 Hz, 2H, aromatic CH), 6.96 (d, *J* = 7.8 Hz, 2H, aromatic CH), 4.70 (s, 2H, OCH_2), 2.75 (q, *J* = 7.3 Hz, 2H, S*CH*$_2$), 2.46 (q, *J* = 7.4 Hz, 2H, S*CH*$_2$), 2.18 (s, 3H, Ph-*CH*$_3$), 1.17 (t, *J* = 7.3 Hz, 3H, CH_2*CH*$_3$), 0.91 (t, *J* = 7.4 Hz, 3H, CH_2*CH*$_3$). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.6 (Cq, C=O), 154.8 (Cq, *C*SMe), 137.9 (s), 136.7 and 133.1 (s), 133.4 (s), 129.2, 129.0, 128.5 and 128.3 (aromatic CH), 117.5 (Cq, *C*OCH_2), 72.8 (OCH_2), 28.3 (S*CH*$_2$), 26.6 (S*CH*$_2$), 21.2 (Ph-*CH*$_3$), 15.3 (CH_2*CH*$_3$), 13.9 (CH_2*CH*$_3$). HRMS Calcd for $C_{21}H_{24}O_2S_2$ M+H^+: 373.1296; Found: 373.1294.



5a

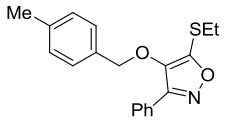
5-(Methylthio)-4-ethoxy-3-phenylisoxazole (5a): 62 mg, 53% yield, colourless liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.93 (m, 2H, aromatic CH), 7.45 (dd, *J* = 3.0, 2.2 Hz, 3H, aromatic CH), 4.15 (q, *J* = 7.0 Hz, 2H, OCH_2), 2.56 (s, 3H, SMe), 1.35 (t, *J* = 7.0 Hz, 3H, CH_2*CH*$_3$). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 156.6 (Cq, *C*SMe), 152.4 (Cq, *C*=N), 139.3 (Cq of Ph), 130.0, 128.8 and 127.3 (aromatic CH), 128.3 (Cq, *C*OCH_2), 69.7 (OCH_2), 16.9 (SMe), 15.4 (CH_2*CH*$_3$). HRMS Calcd for $C_{12}H_{13}NO_2S$ M+H^+: 236.0745; Found: 236.0743.



5b

5-(Methylthio)-4-(benzyloxy)- 3-phenylisoxazole (5b): 93 mg, 62% yield, colourless liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 3.4 Hz, 2H, aromatic CH), 7.47 (m, 3H, aromatic CH), 7.35 (s, 5H, aromatic CH), 5.10 (s, 2H, OCH_2), 2.50

(s, 3H, SMe). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 156.9 (Cq, *C*=SMe), 153.2 (Cq, *C*=N), 138.8 and 136.0 (Cq of Ph), 128.2 (Cq, *C*OCH_2), 130.1, 128.9, 128.7, 128.6, 128.4 and 127.4 (aromatic CH), 75.4 (OCH_2), 16.8 (SMe). HRMS Calcd for $C_{17}H_{15}NO_2S$ $M+H^+$: 298.0902; Found: 298.0900.



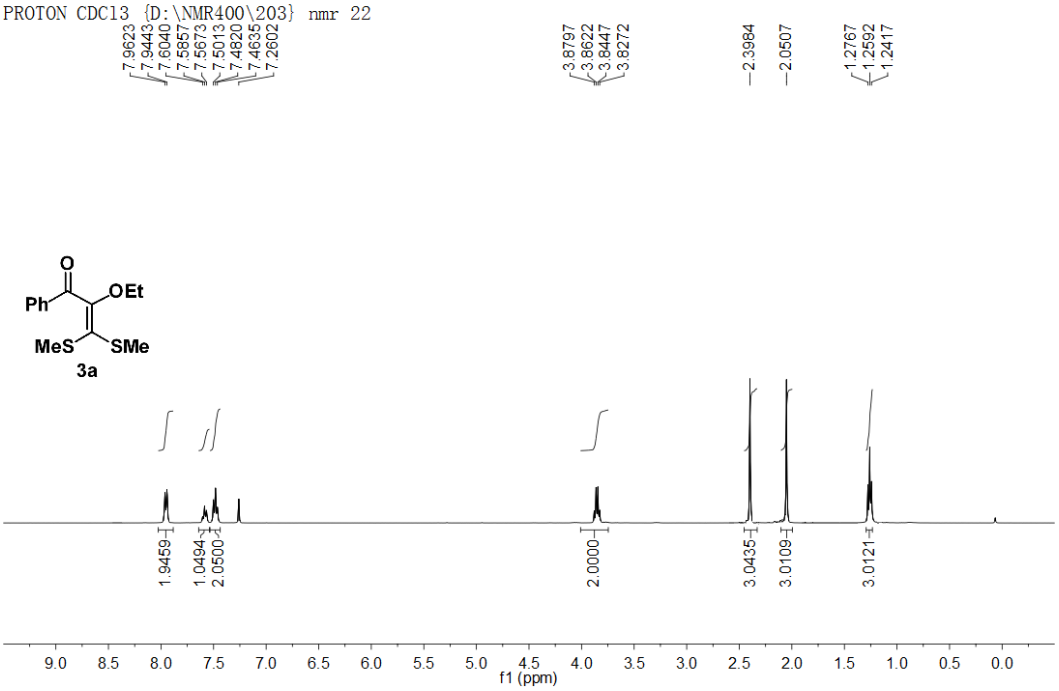
5c

5-(Ethylthio)-4-((4-methylbenzyl)oxy)-3-phenylisoxazole (5c): 88 mg, 54% yield, colourless liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (m, 2H, aromatic CH), 7.35 (m, 3H, aromatic CH), 7.14 (d, *J* = 7.6 Hz, 2H, aromatic CH), 7.05 (d, *J* = 7.7 Hz, 2H, aromatic CH), 4.98 (s, 2H, OCH_2), 2.86 (q, *J* = 7.3 Hz, 2H, SCH_2), 2.25 (s, 3H, Ph-*CH_3*), 1.25 (t, *J* = 7.4 Hz, 3H, CH_2*CH_3*). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 156.7 (Cq, *C*=SMe), 152.2 (Cq, *C*=N), 140.2, 138.3 and 132.9 (Cq of Ph), 128.2 (Cq, *C*OCH_2), 129.9, 129.2, 128.7, 128.5 and 127.3 (aromatic CH), 75.4 (OCH_2), 29.0 (SCH_2), 21.3 (Ph-*CH_3*), 15.5 (CH_2*CH_3*). HRMS Calcd for $C_{19}H_{19}NO_2S$ $M+H^+$: 326.1215; Found: 326.1213.

5. Copies of NMR spectra

LZQ-393-1

PROTON CDC13 {D:\NMR400\203} nmr 22



LZQ-393-1

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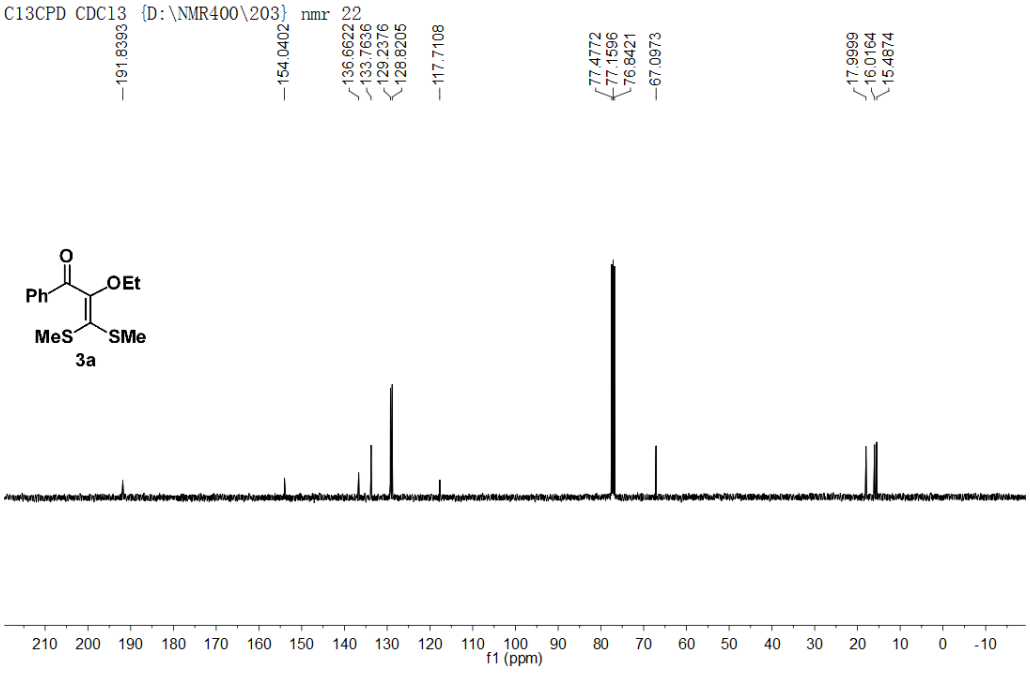
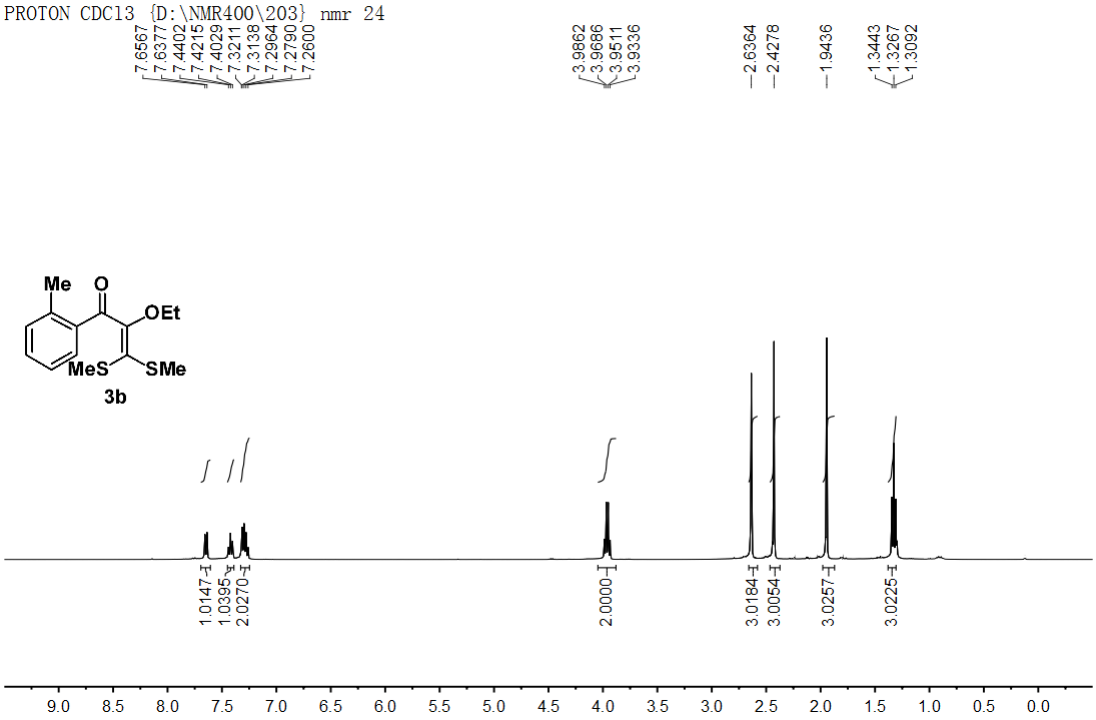


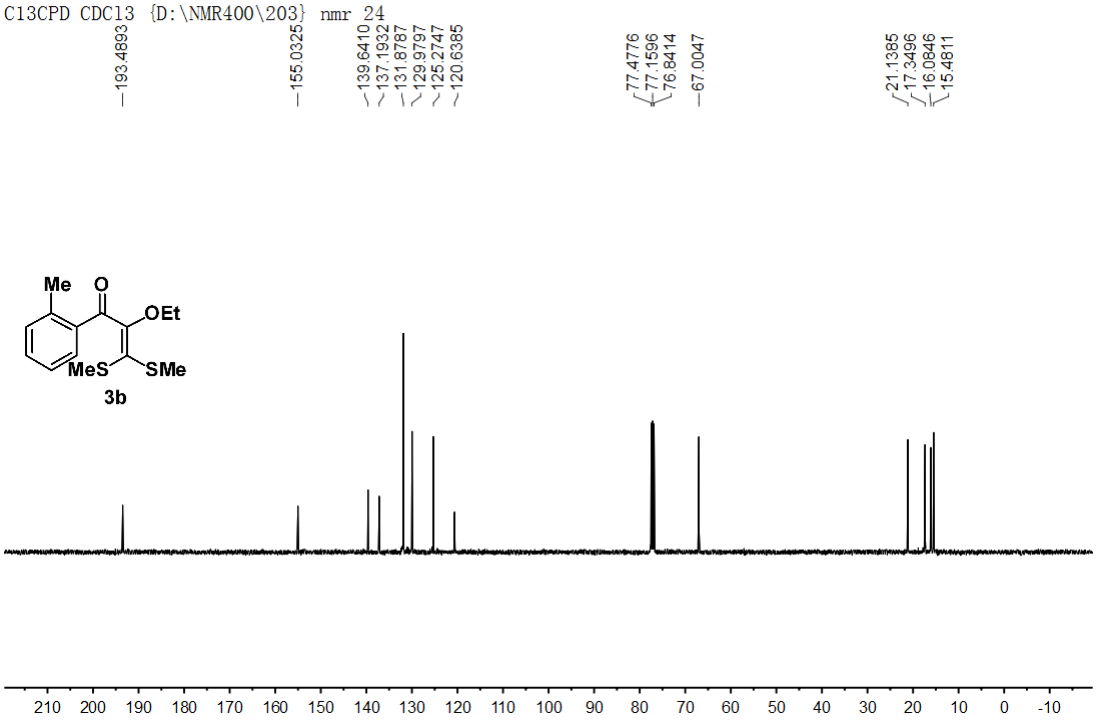
lzq-758

PROTON CDCl3 {D:\NMR400\203} nmr 24



lzq-758

C13CPD CDCl3 {D:\NMR400\203} nmr 24



LZQ-394

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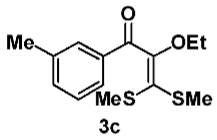

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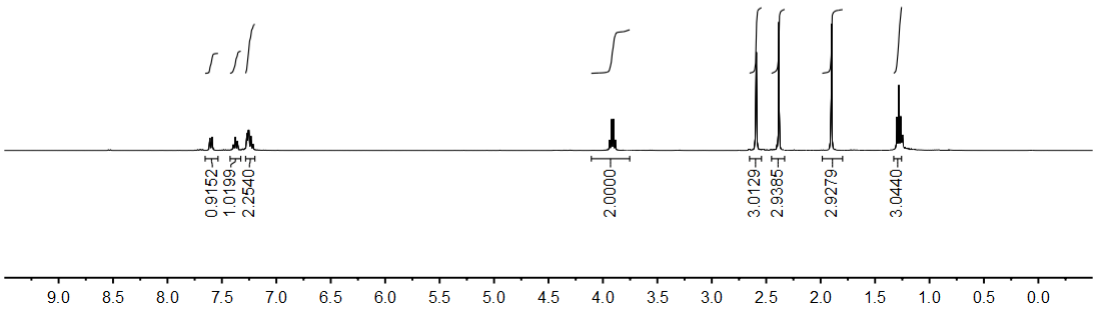

LZQ-394

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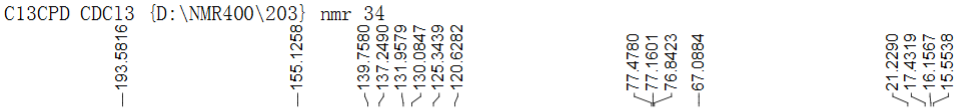

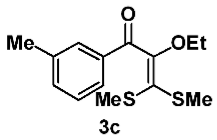

3c

LZQ-408

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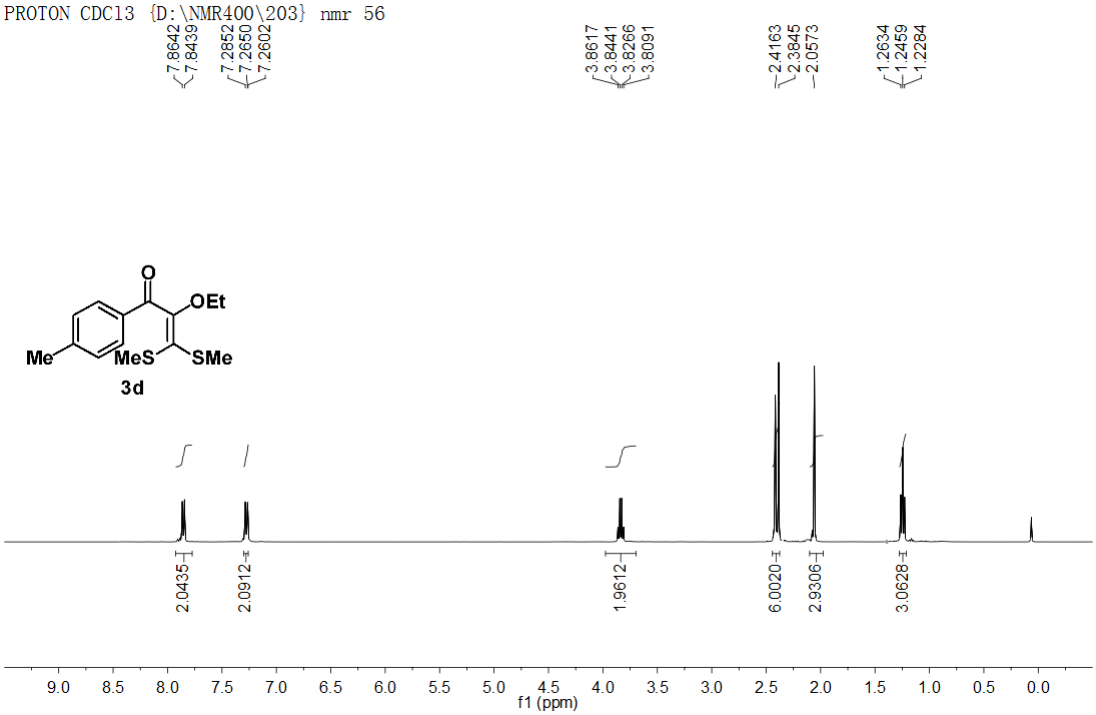

LZQ-408

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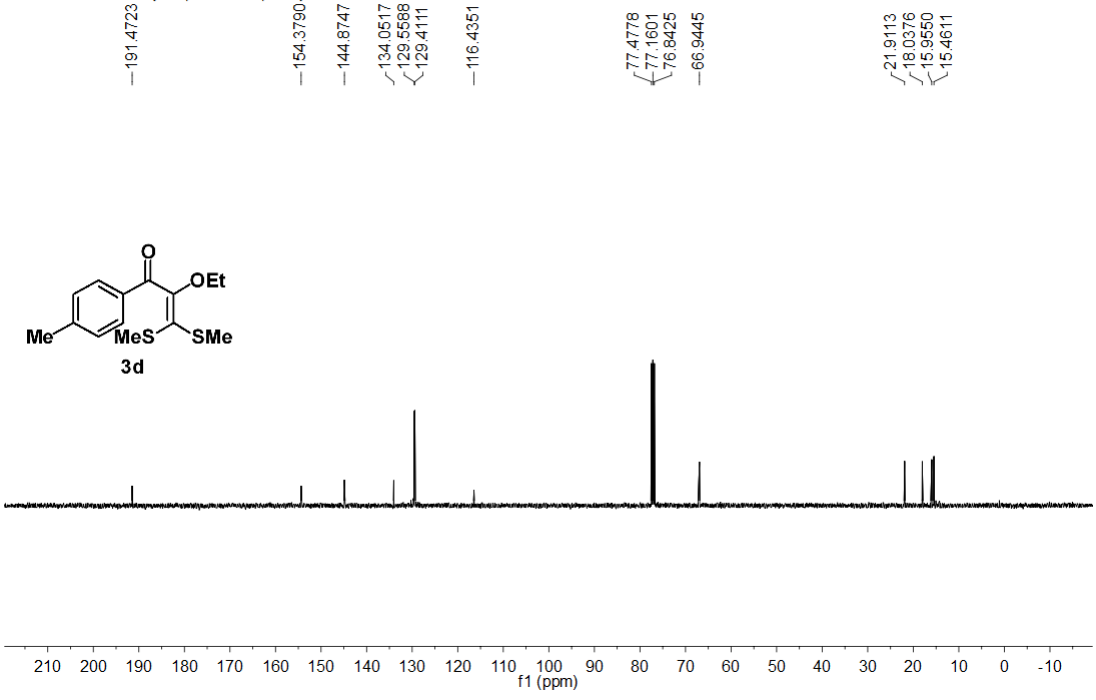

LZQ-414

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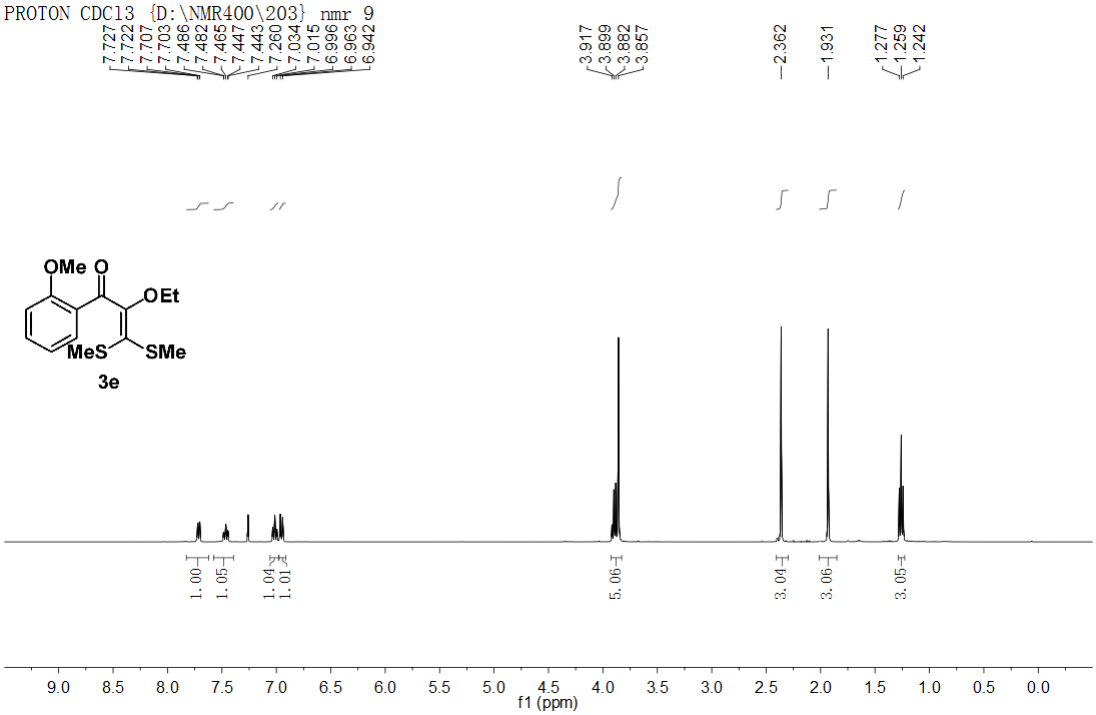

LZQ-414

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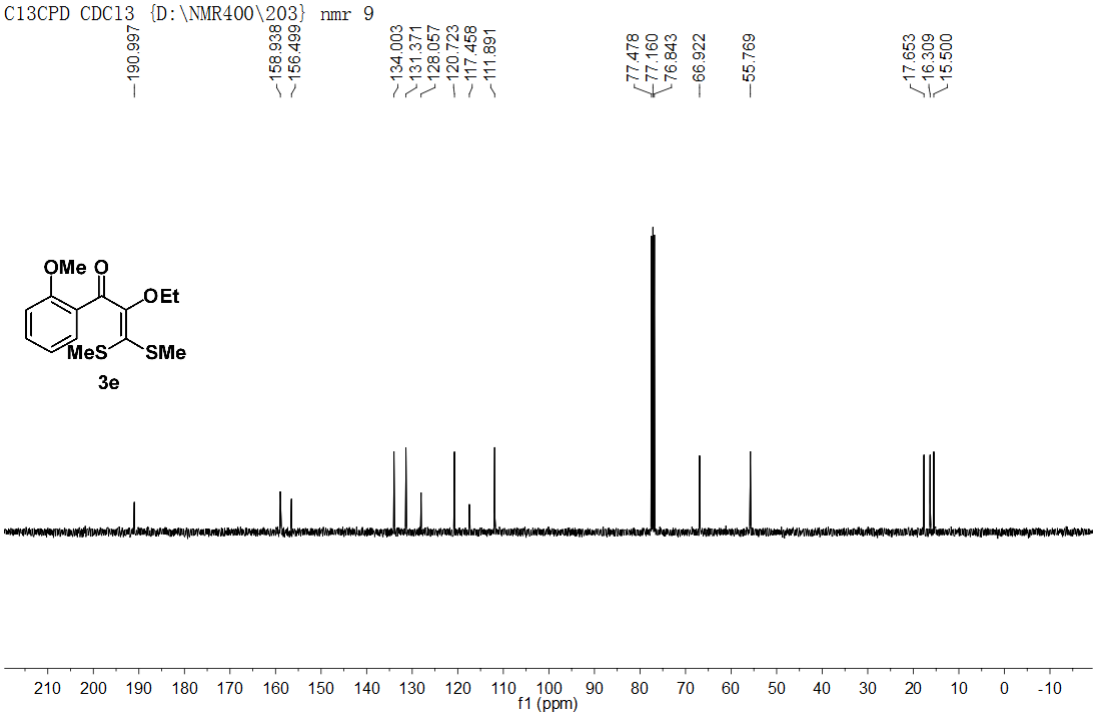

LZQ-410-1

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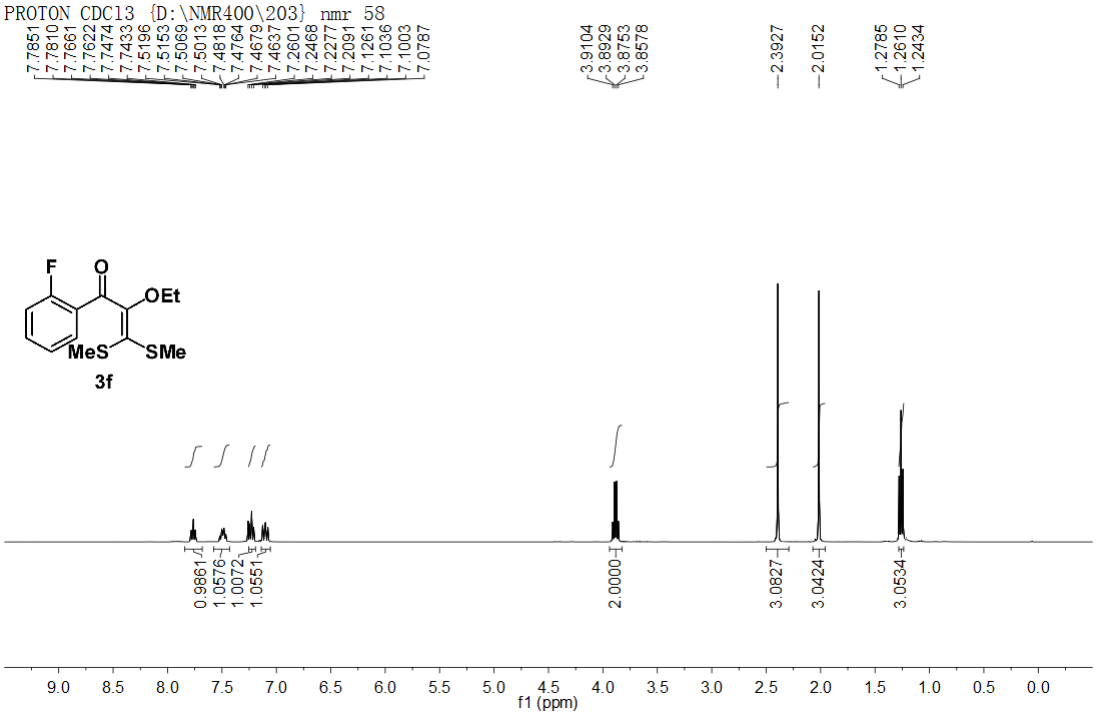
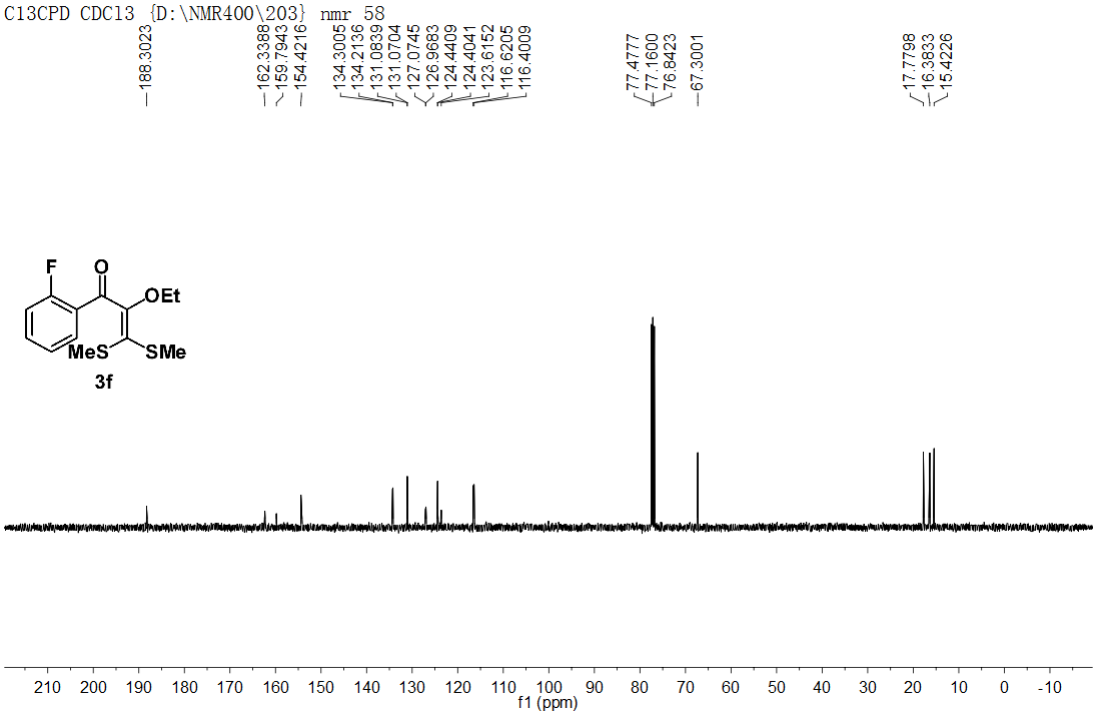


LZQ-410-1

C13CPD CDC13 {D:\NMR400\203} nmr 58



LZQ-411

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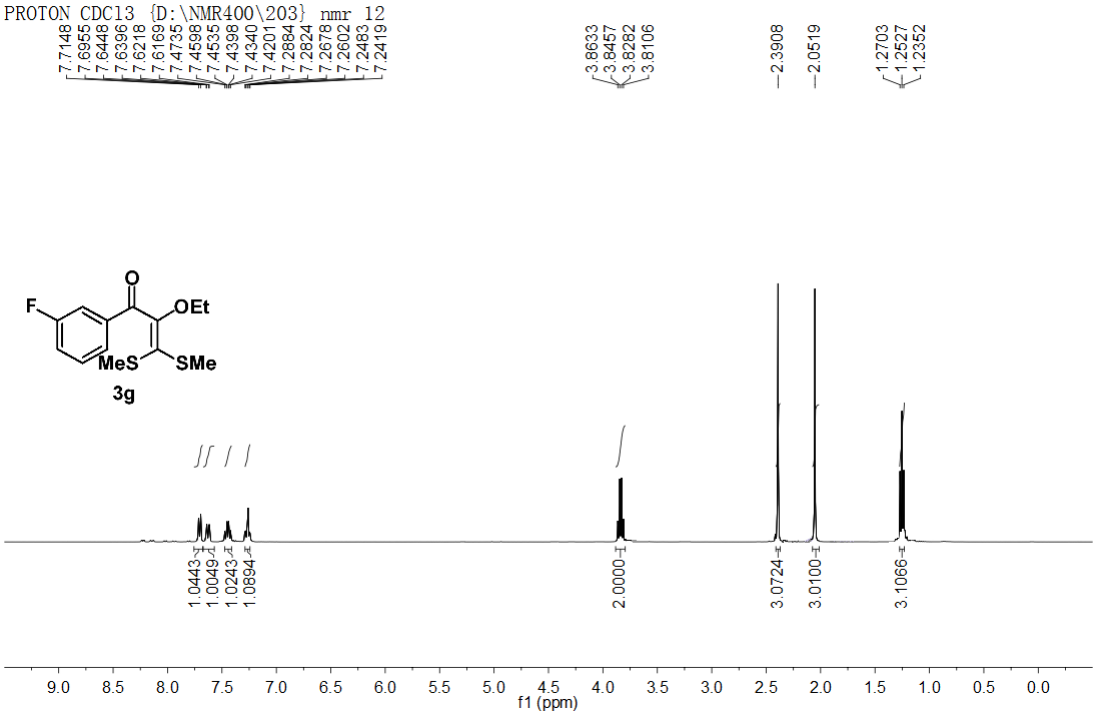

LZQ-411

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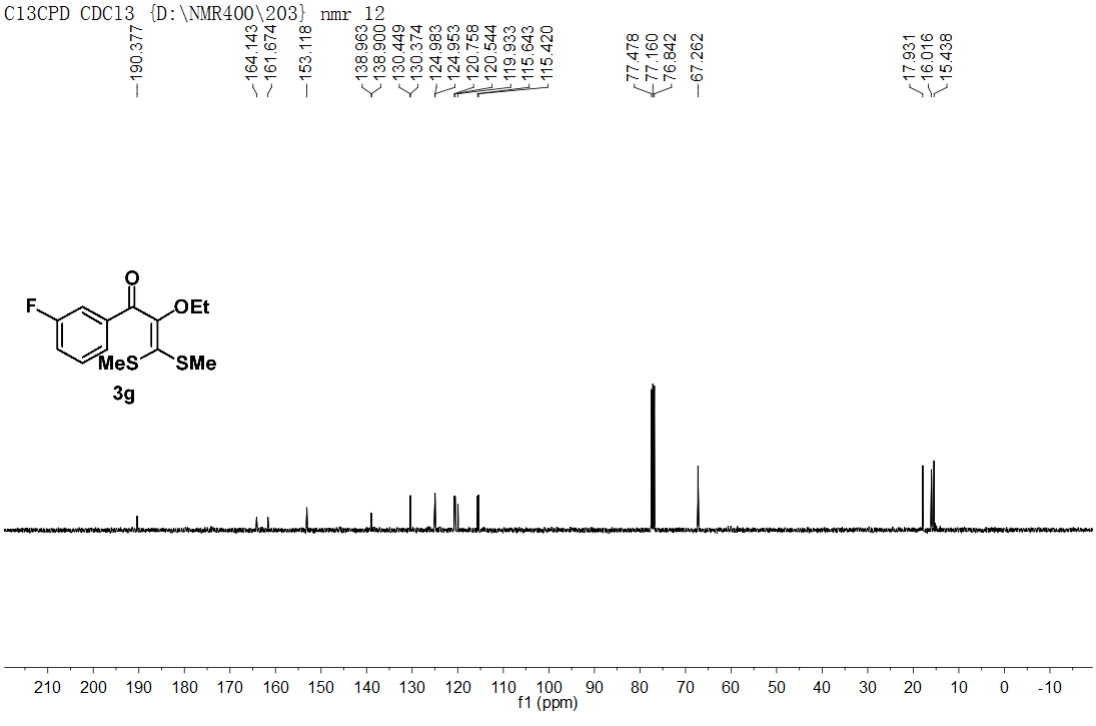

LZQ412

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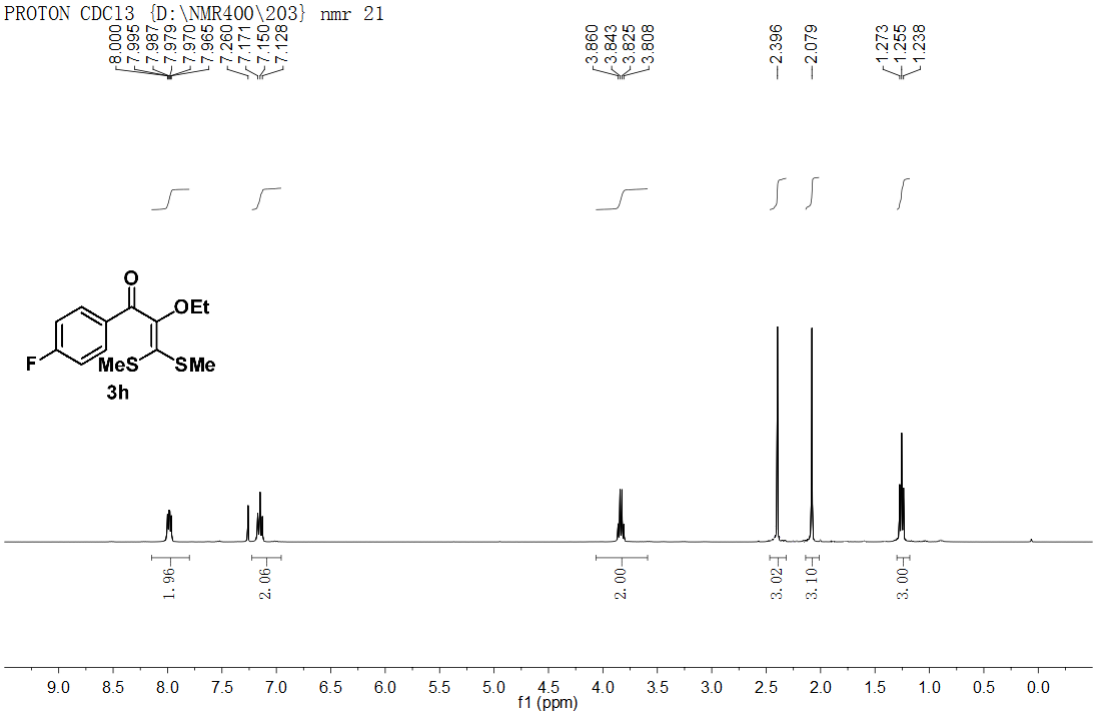

LZQ412

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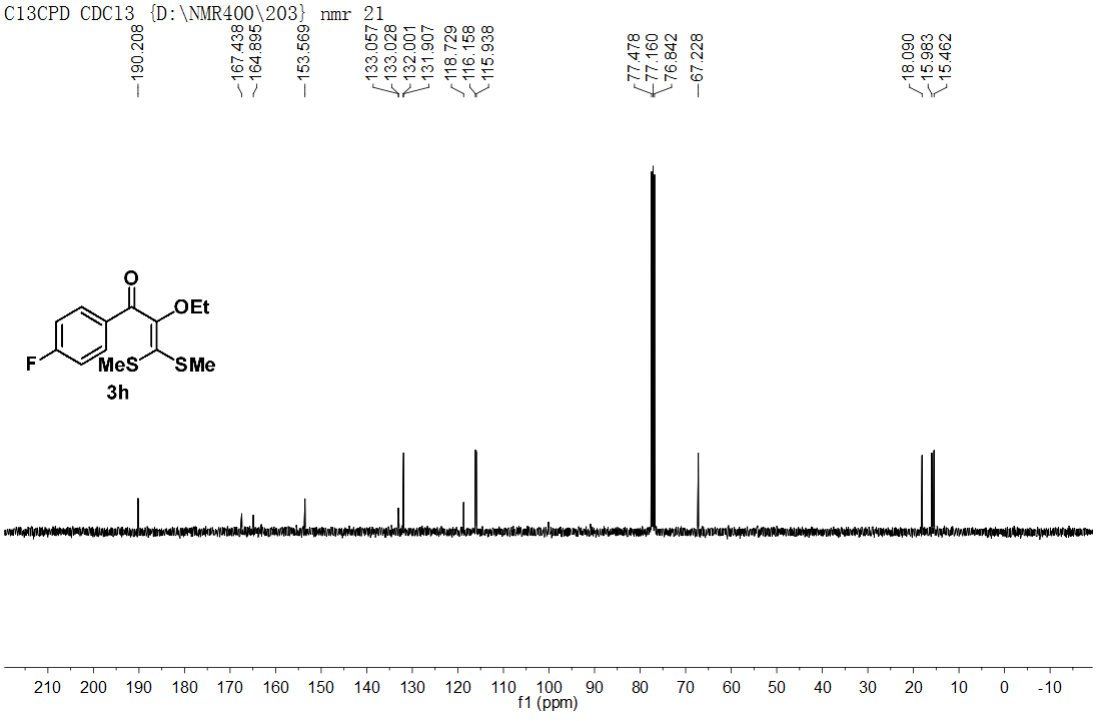

LZQB-1

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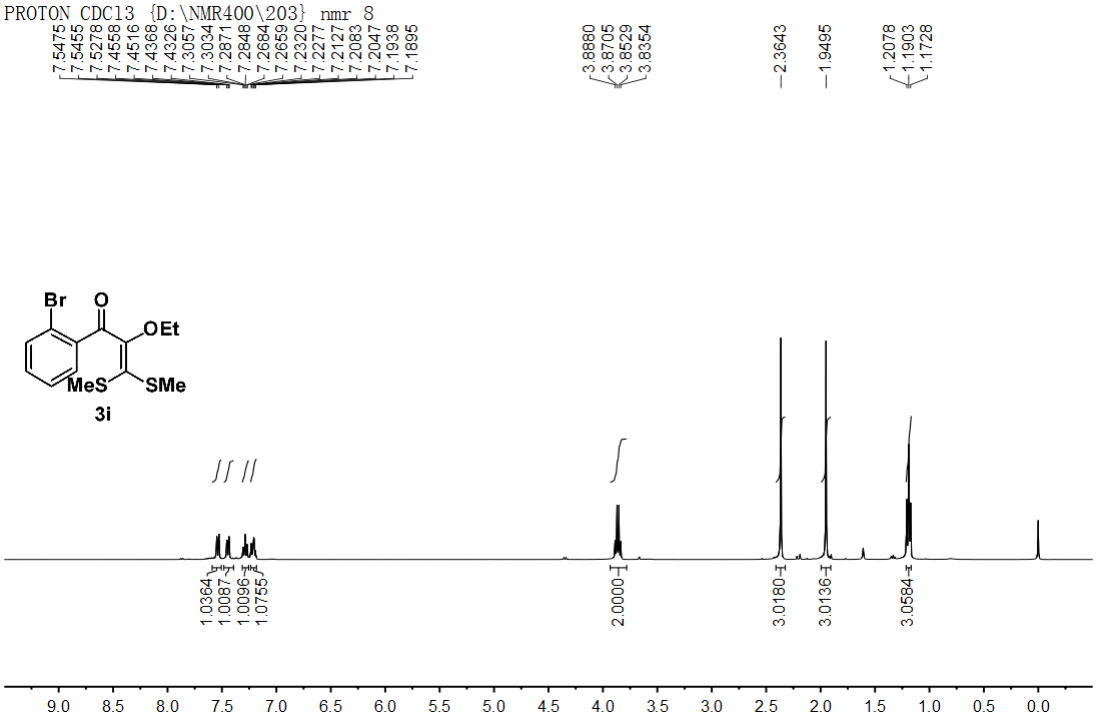

LZQB-1

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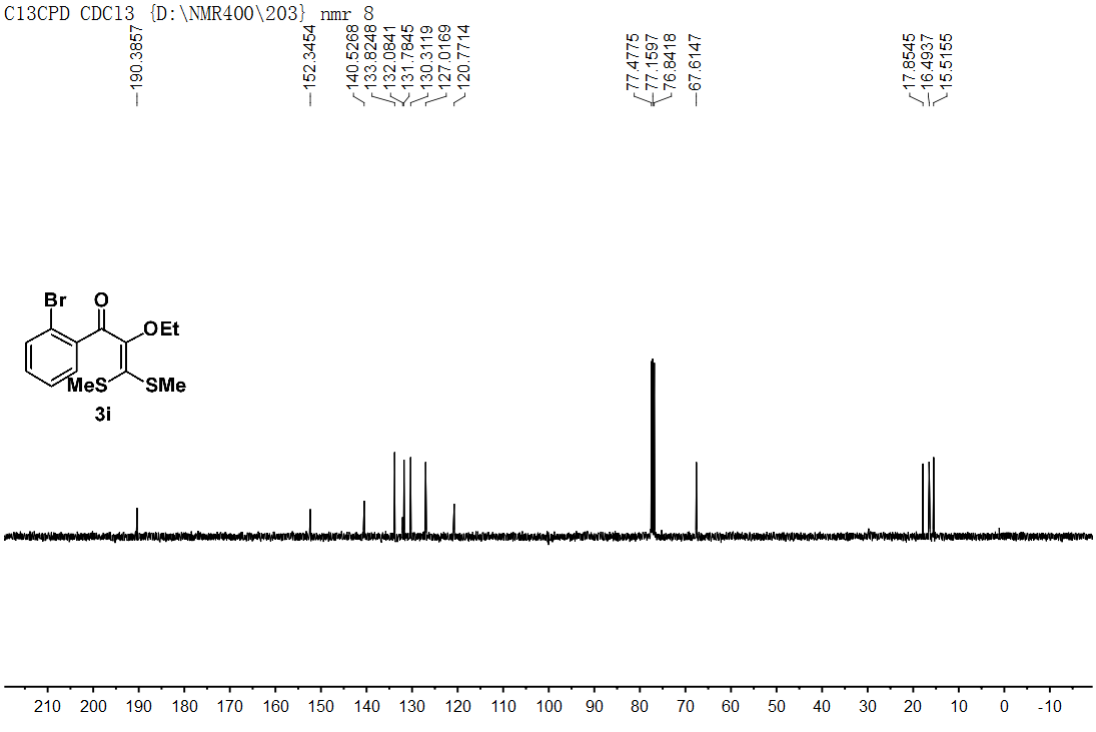

LZQ-507

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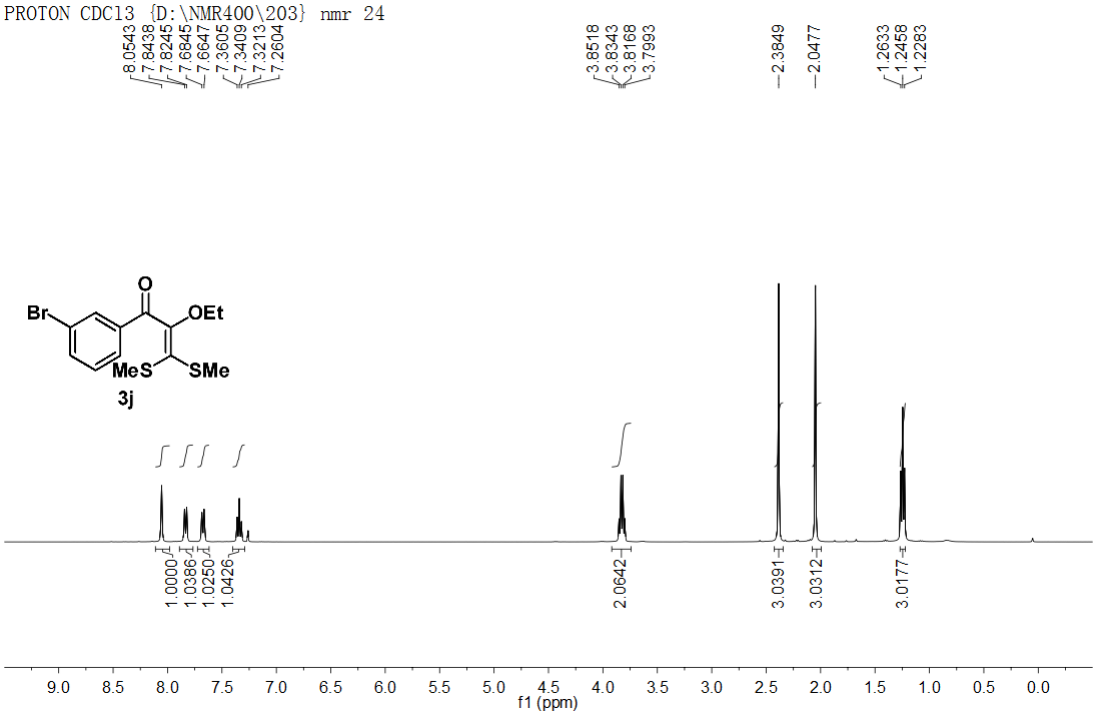

LZQ-507

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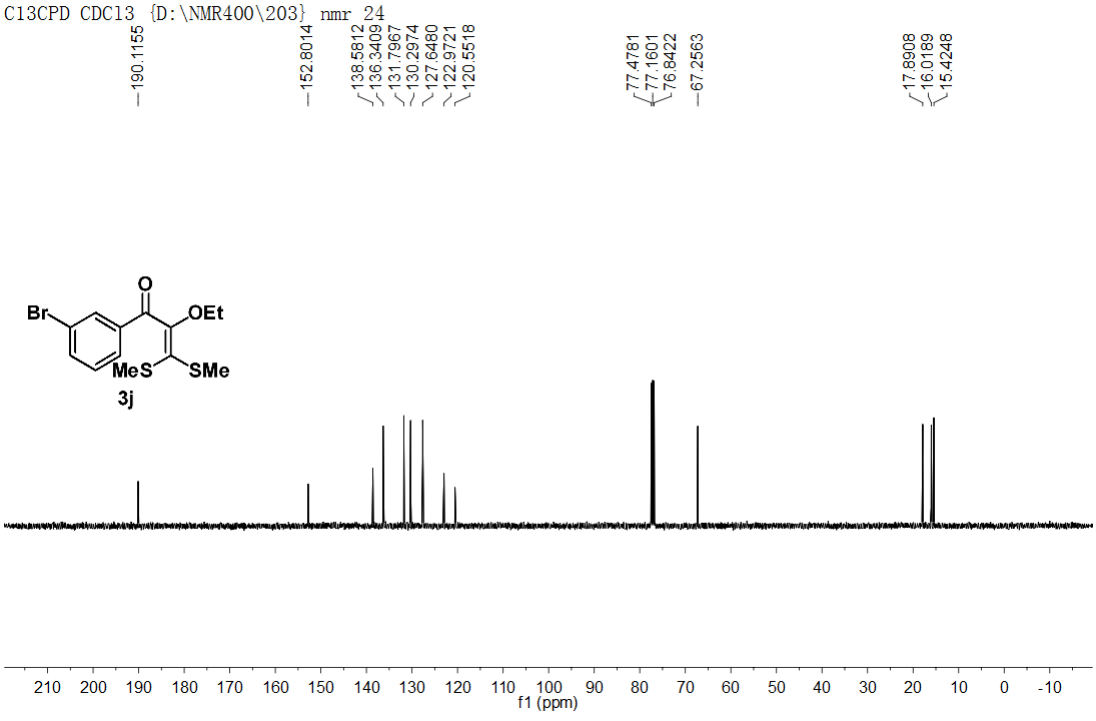

LZQ-508

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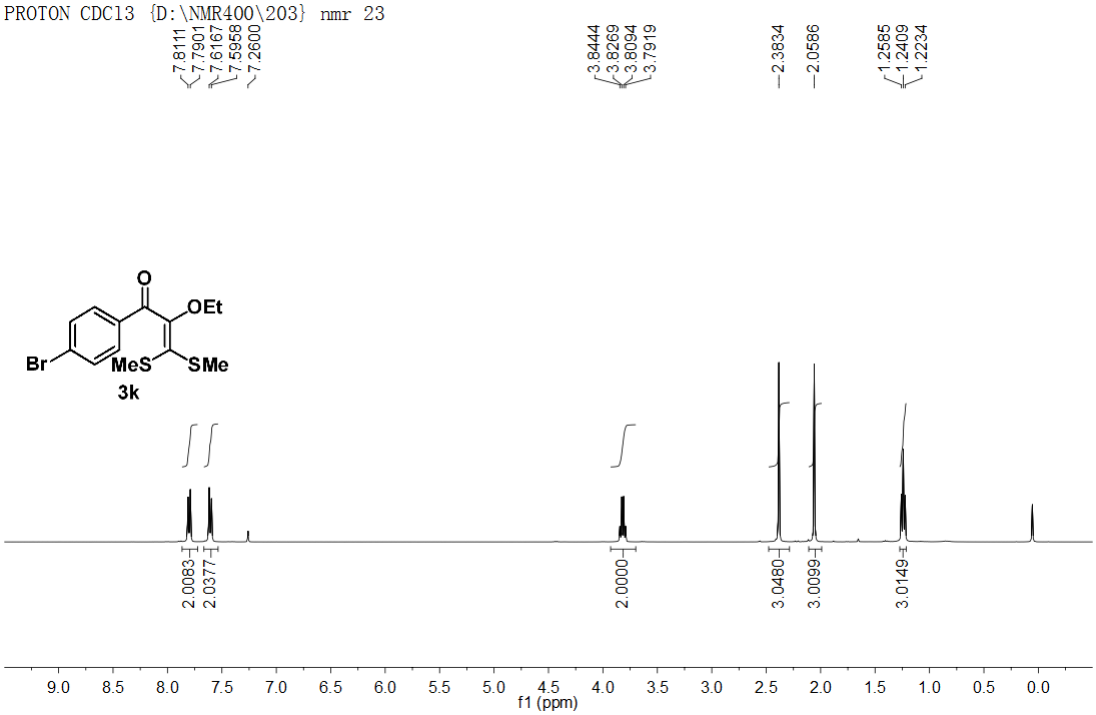

LZQ-508

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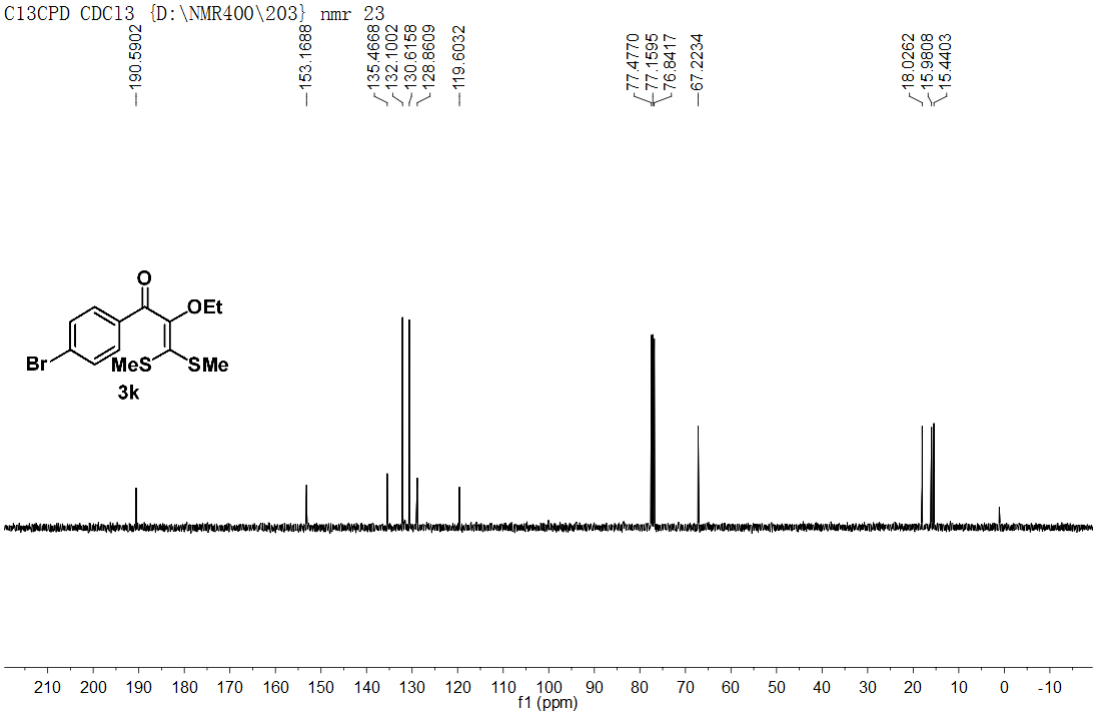

LZQ-413

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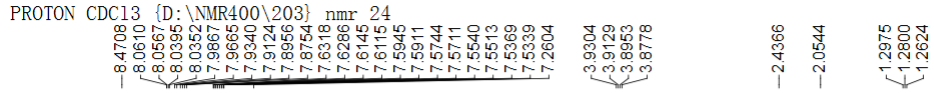

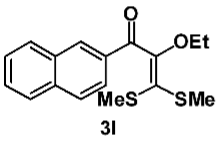

3l

LZQ-413

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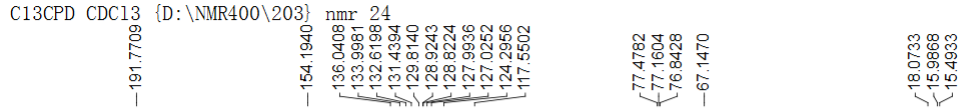

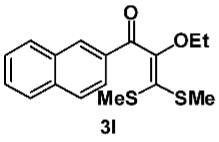

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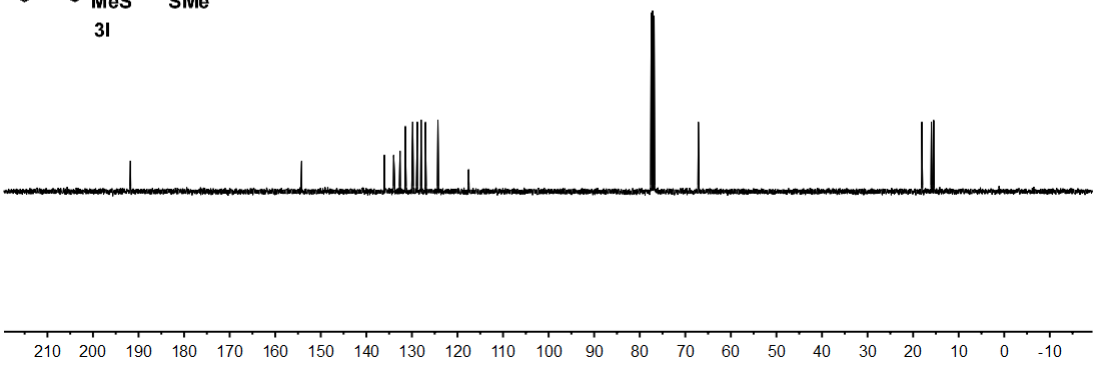
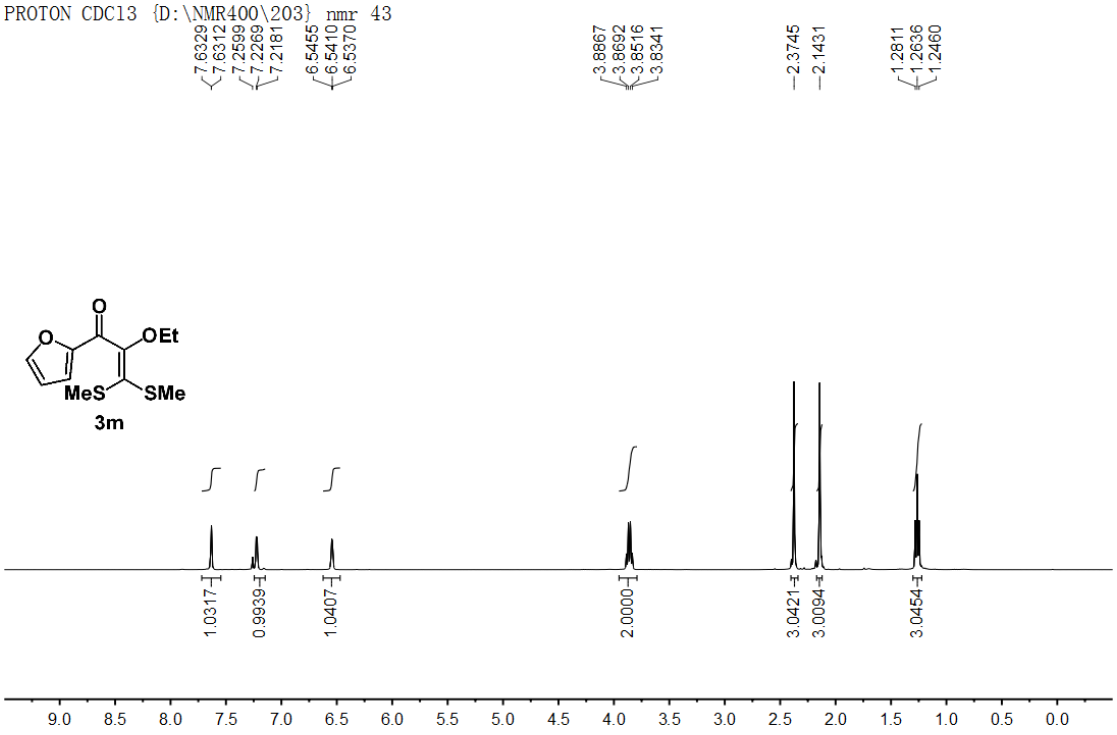


LZQ-446

PROTON CDCl3 {D:\NMR400\203} nmr 43



LZQ-446

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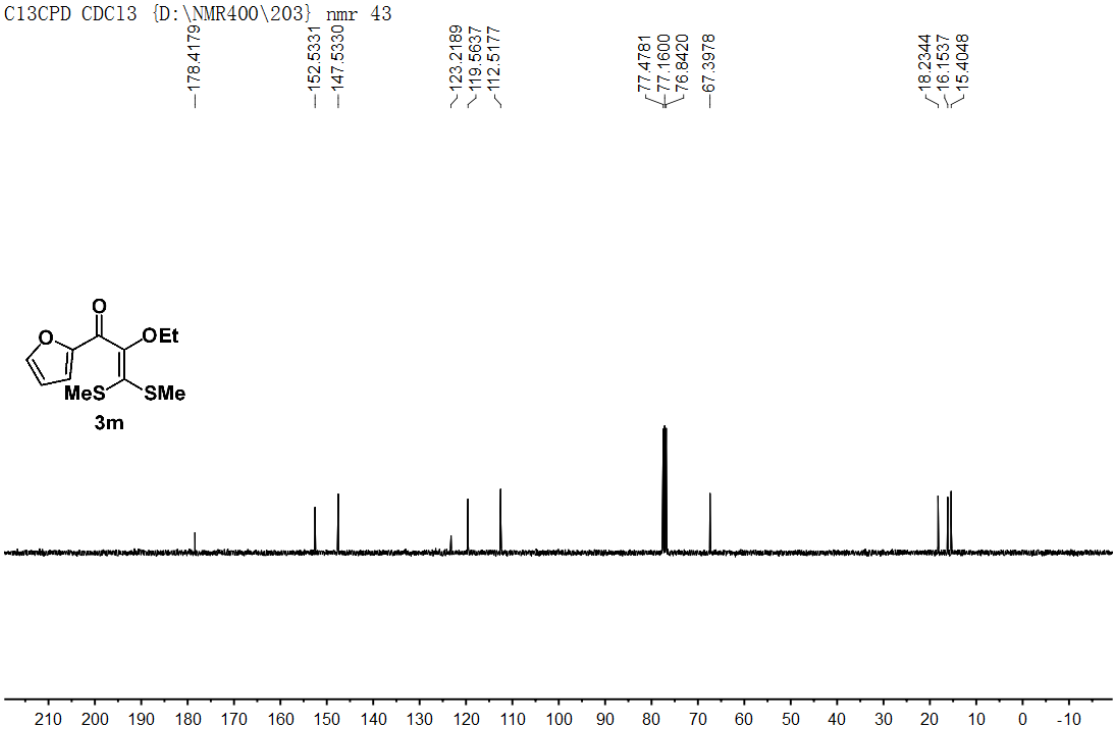
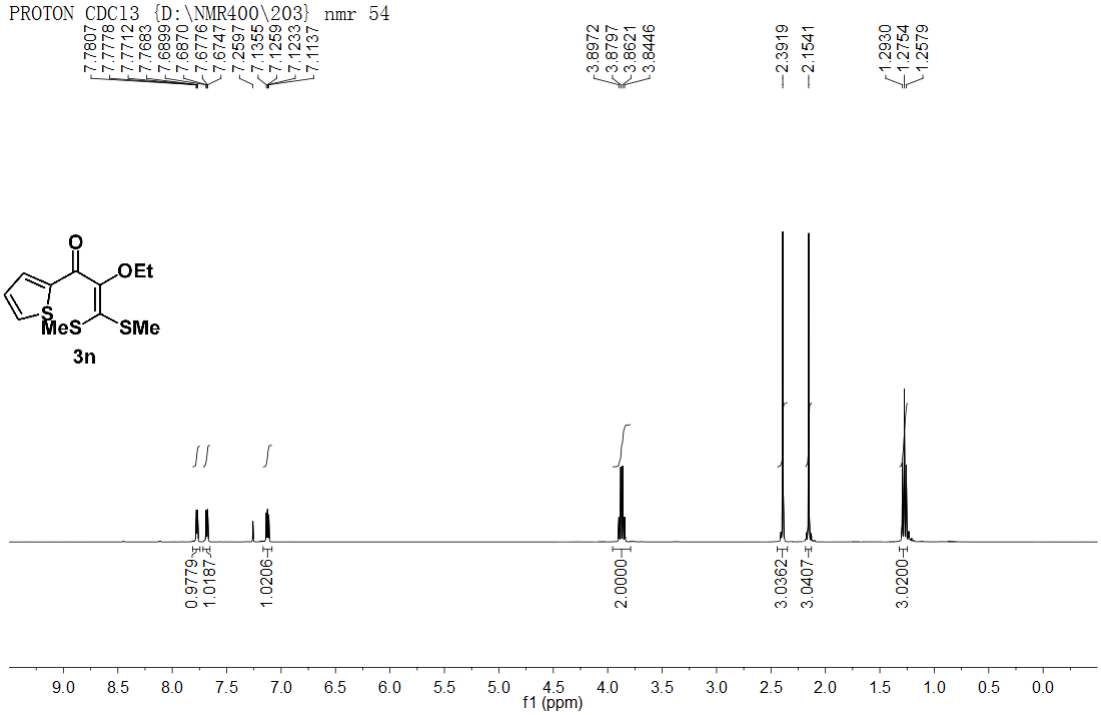


LZQ-413

PROTON CDC13 {D:\NMR400\203} nmr 54



LZQ-413

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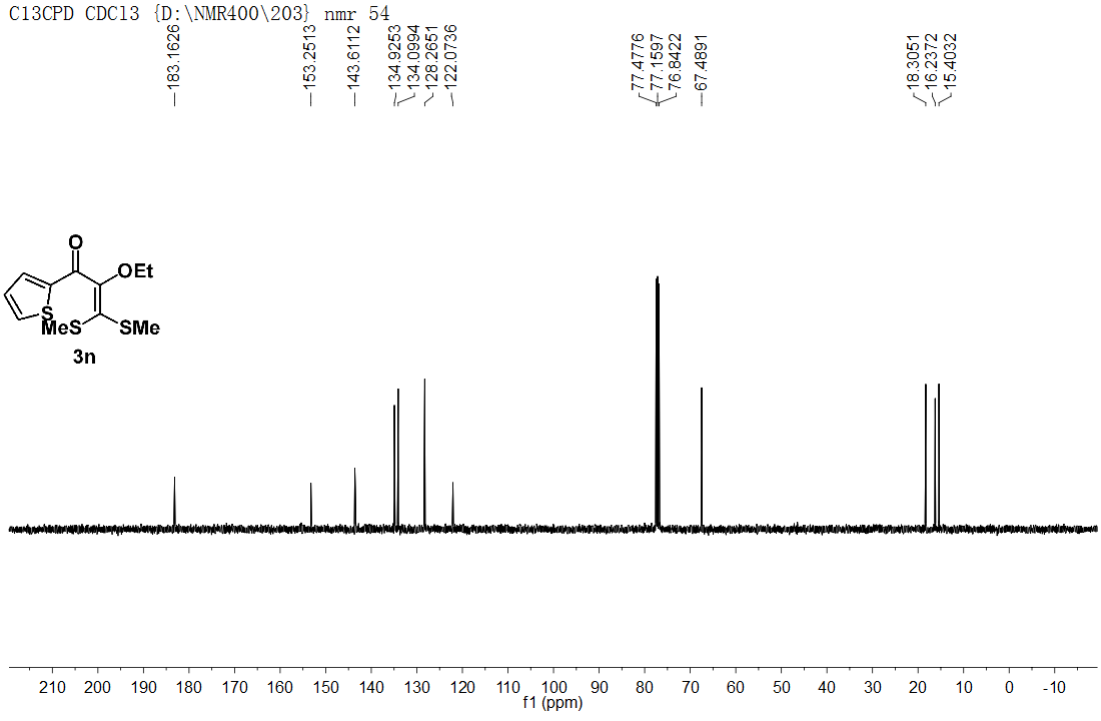

LZQ-437

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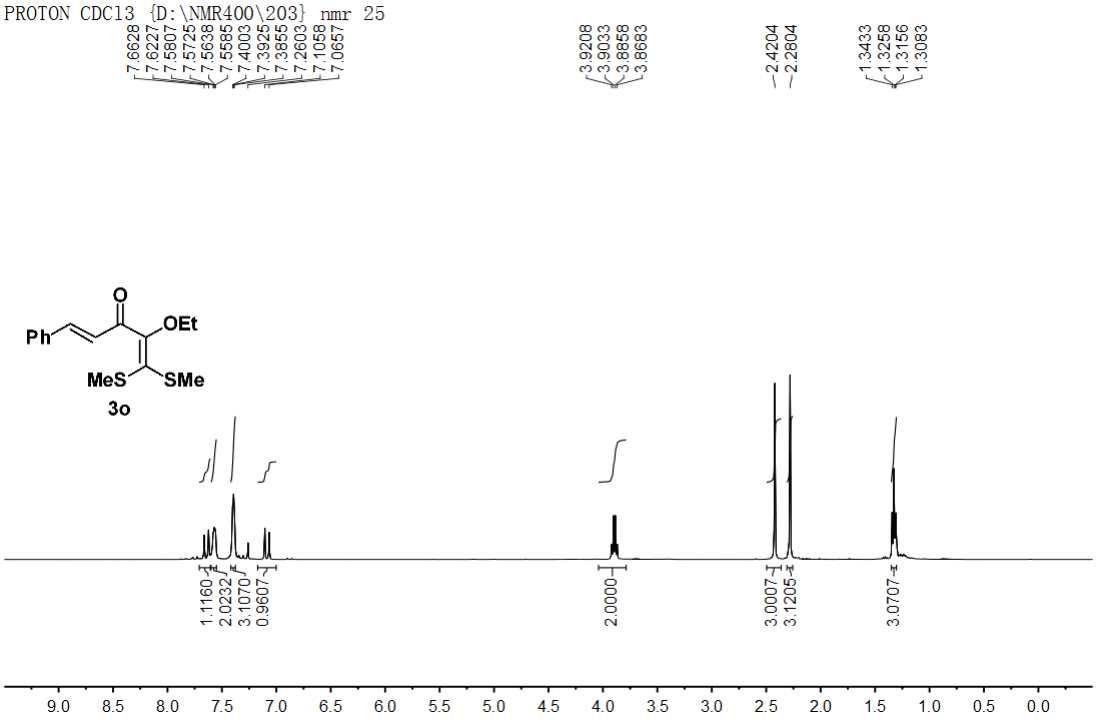

LZQ-437

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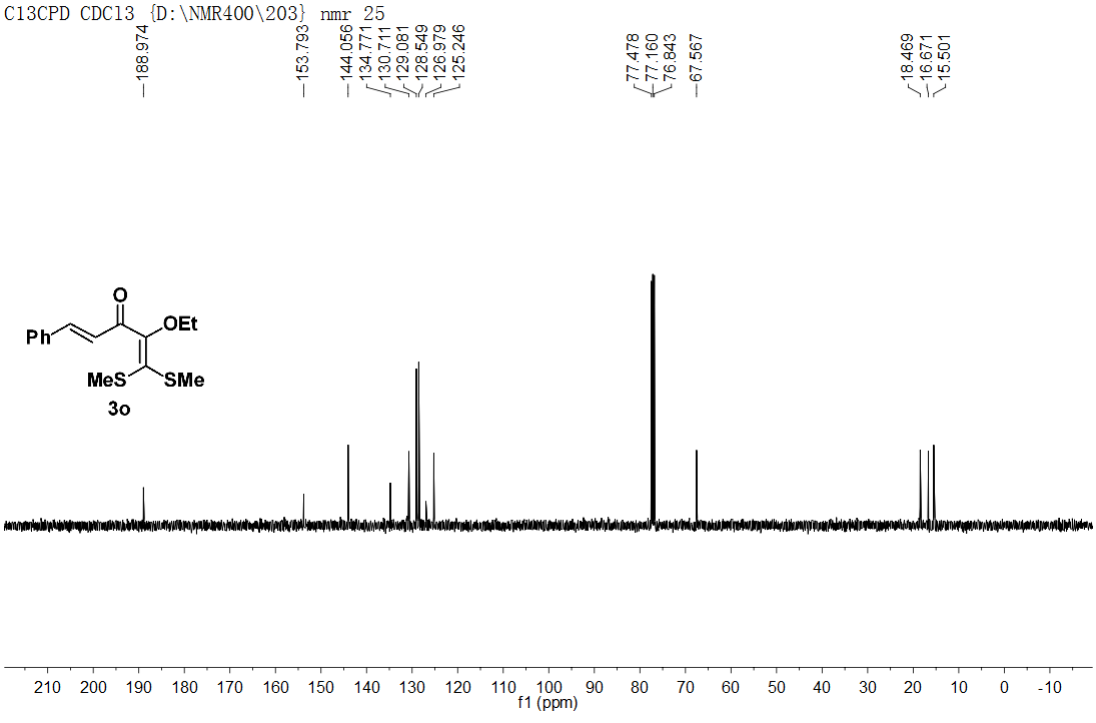

LZQ-435

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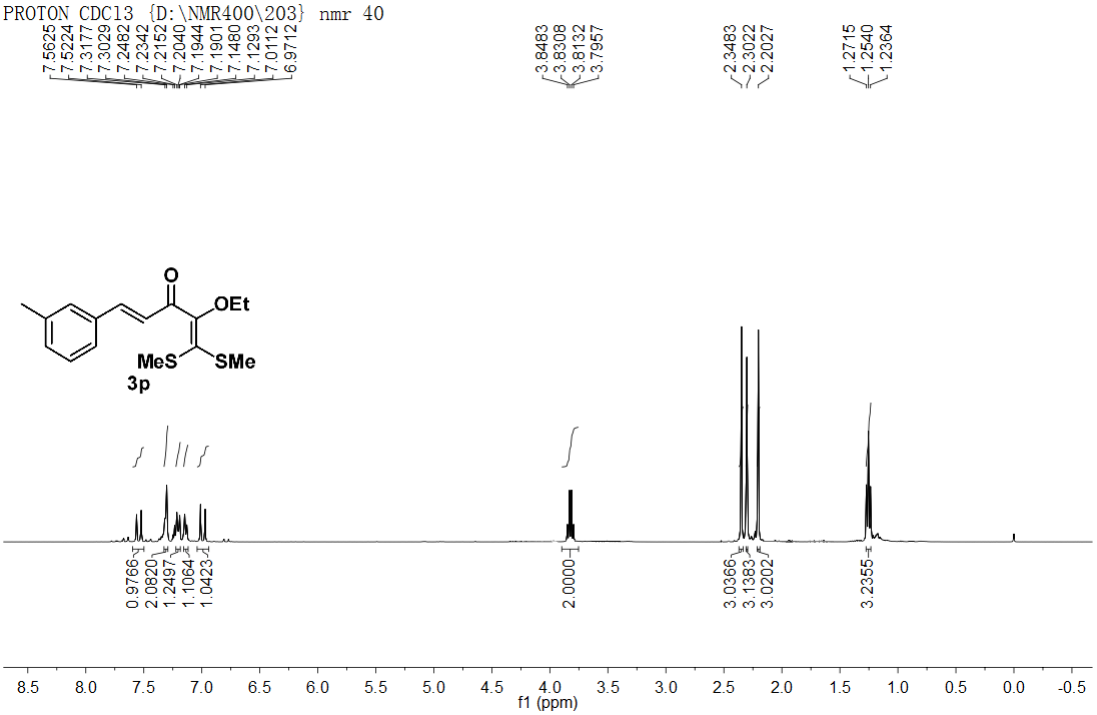

LZQ-435

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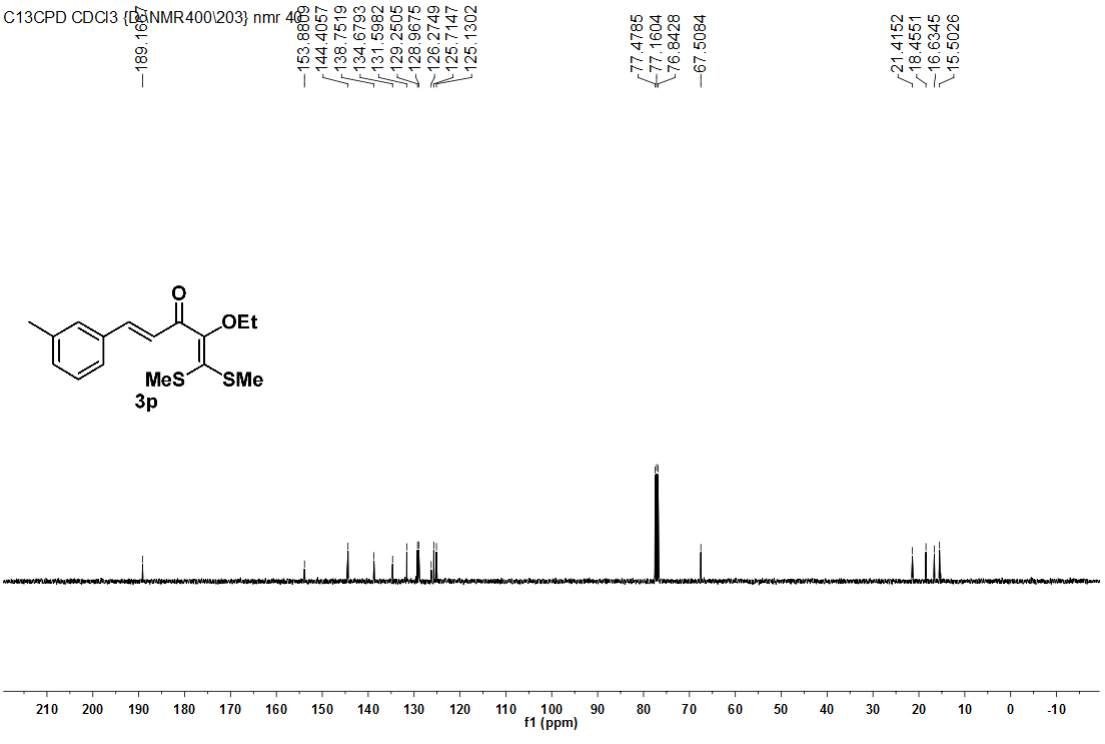

LZQ-563-2

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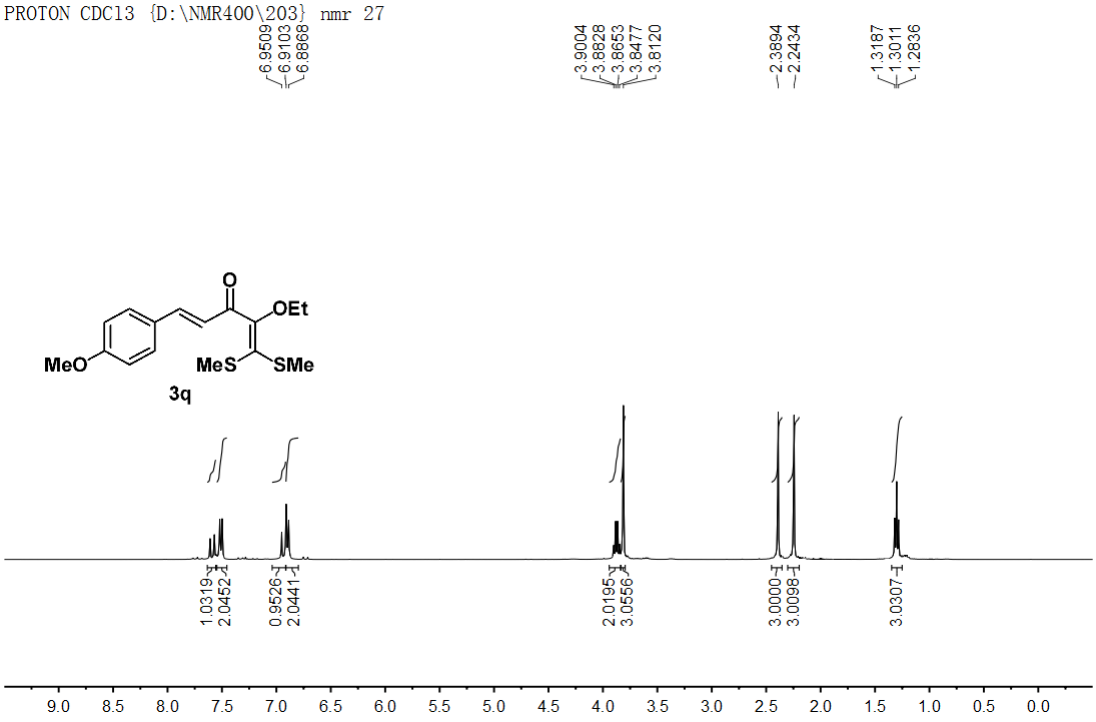

LZQ-563-2

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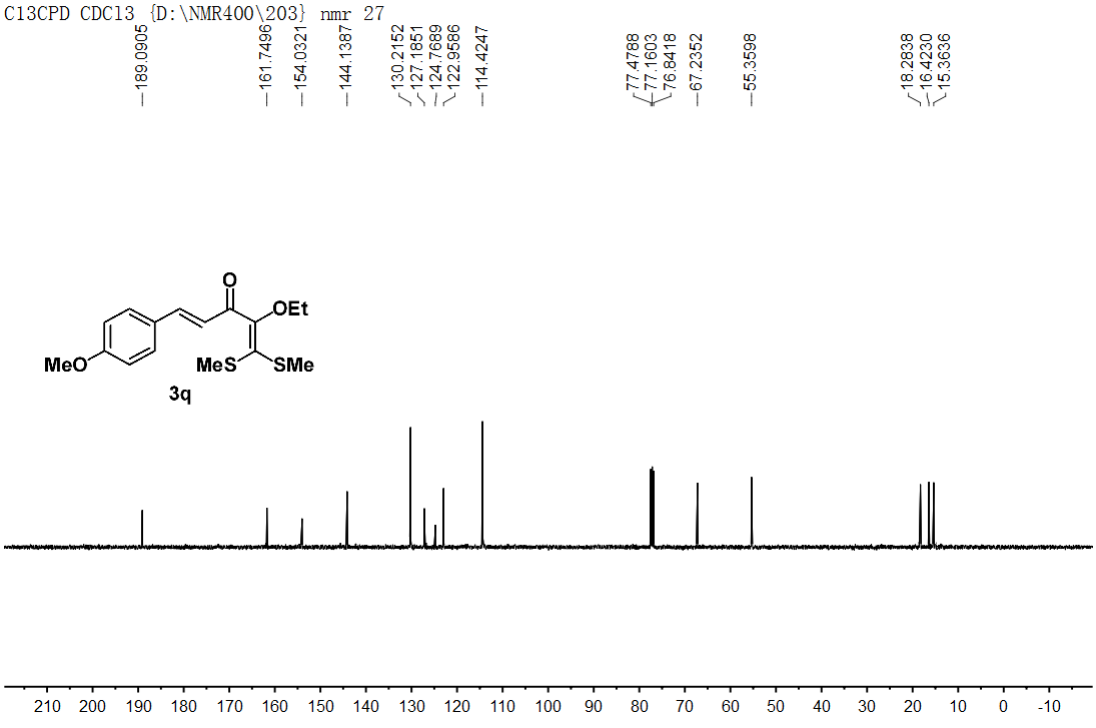

LZQ-434

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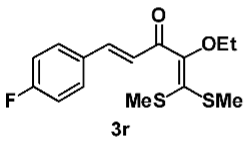
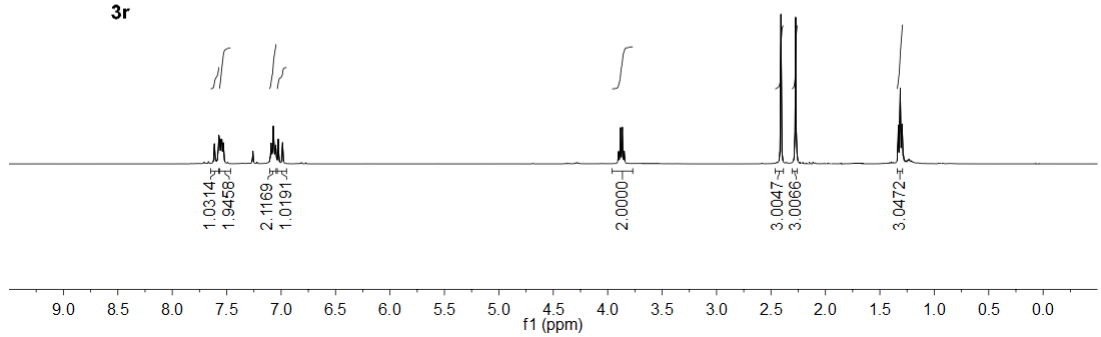
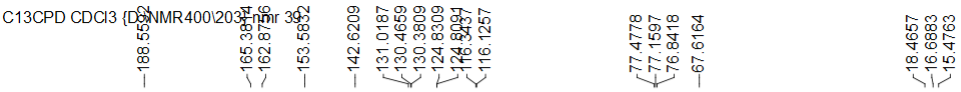


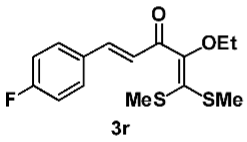
3r



LZQ-434

C13CPD CDCl3 {D:\NMR400\203} nmr 39





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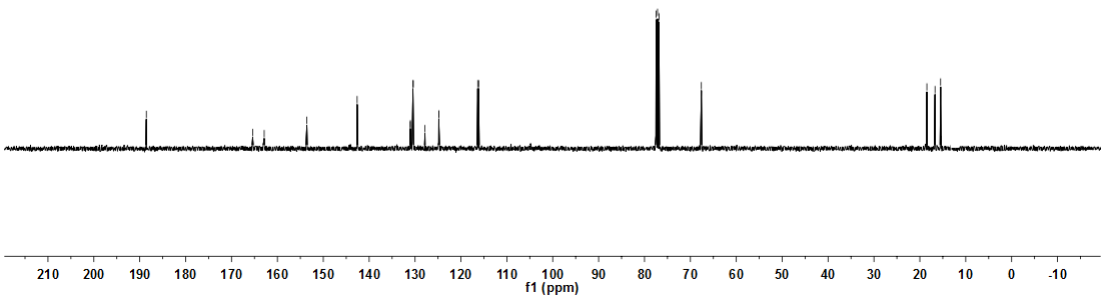
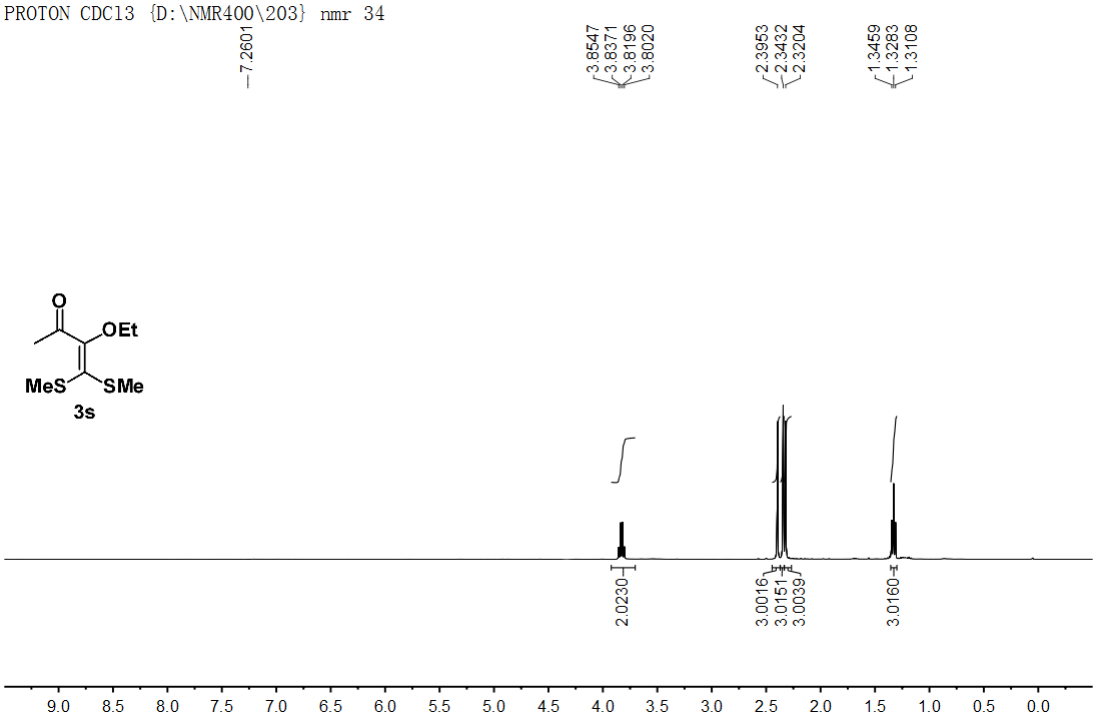


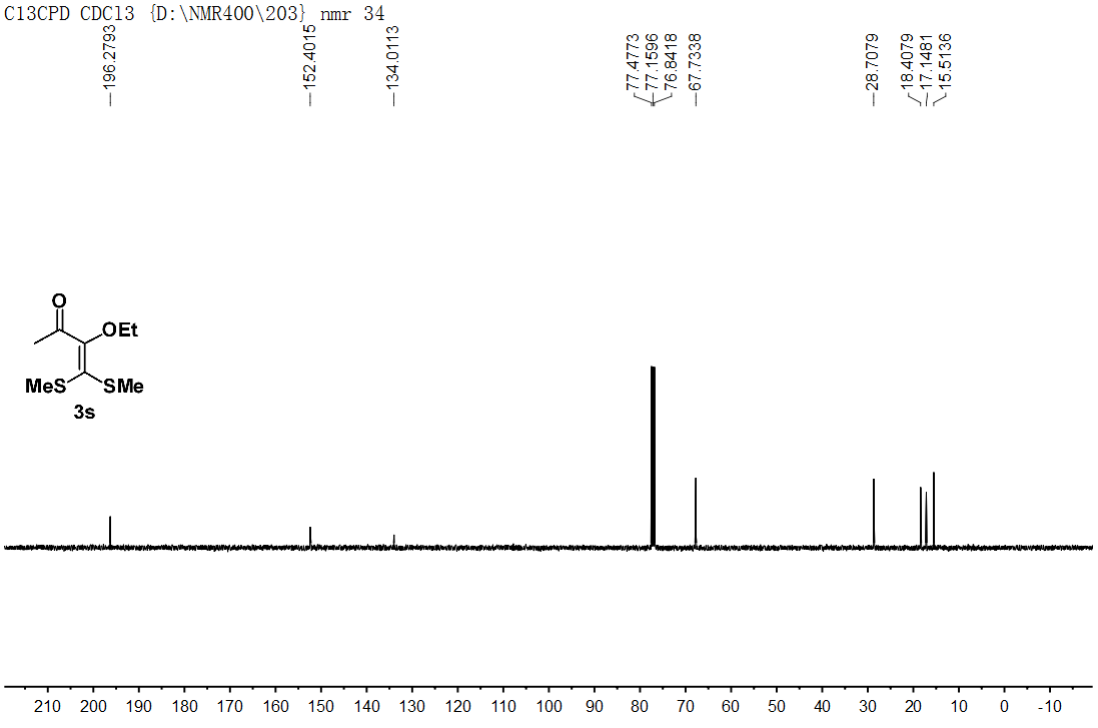
LZQB-805

PROTON CDC13 {D:\NMR400\203} nmr 34



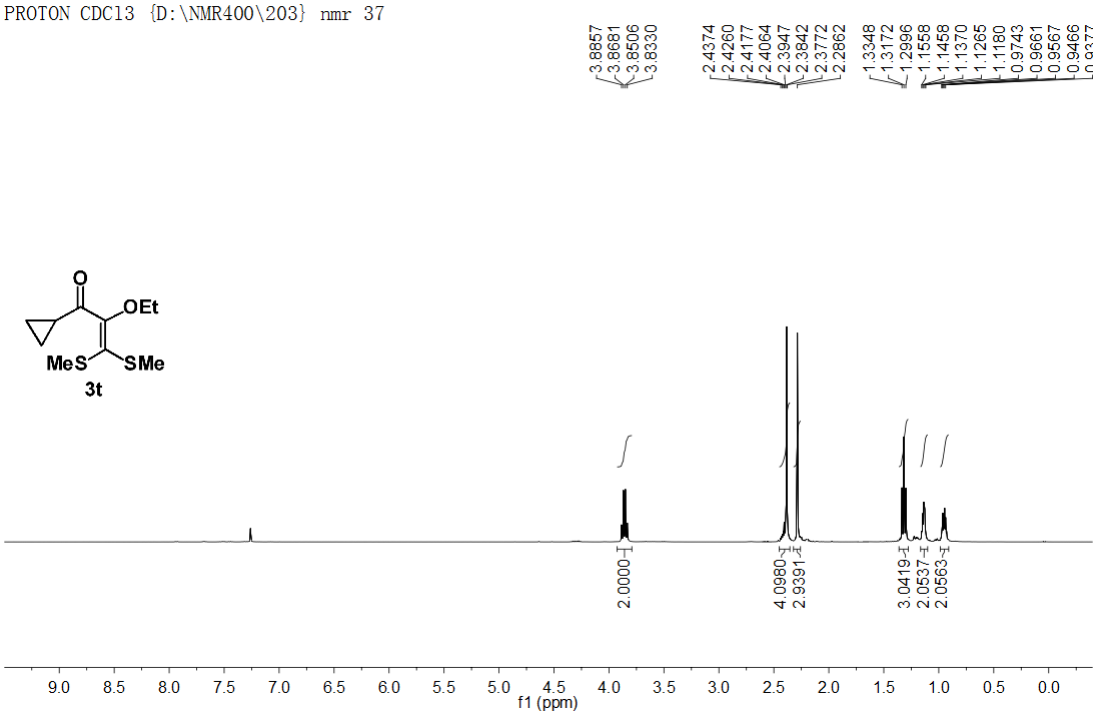
LZQB-805

C13CPD CDC13 {D:\NMR400\203} nmr 34



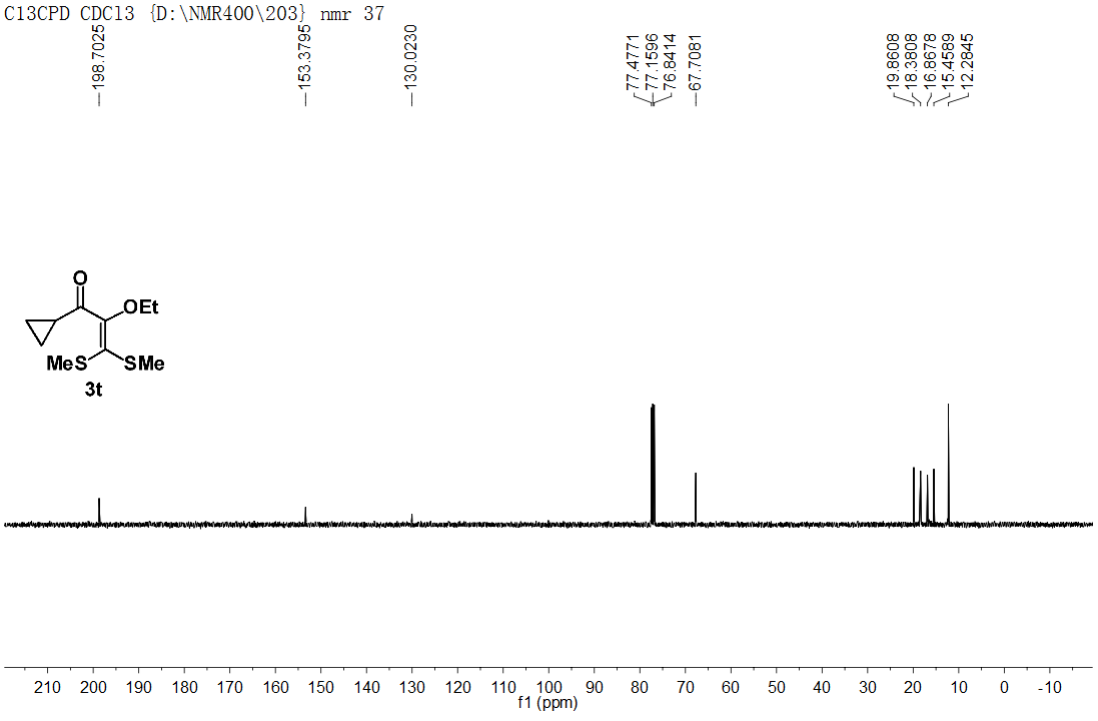
LZQ-397

PROTON CDC13 {D:\NMR400\203} nmr 37



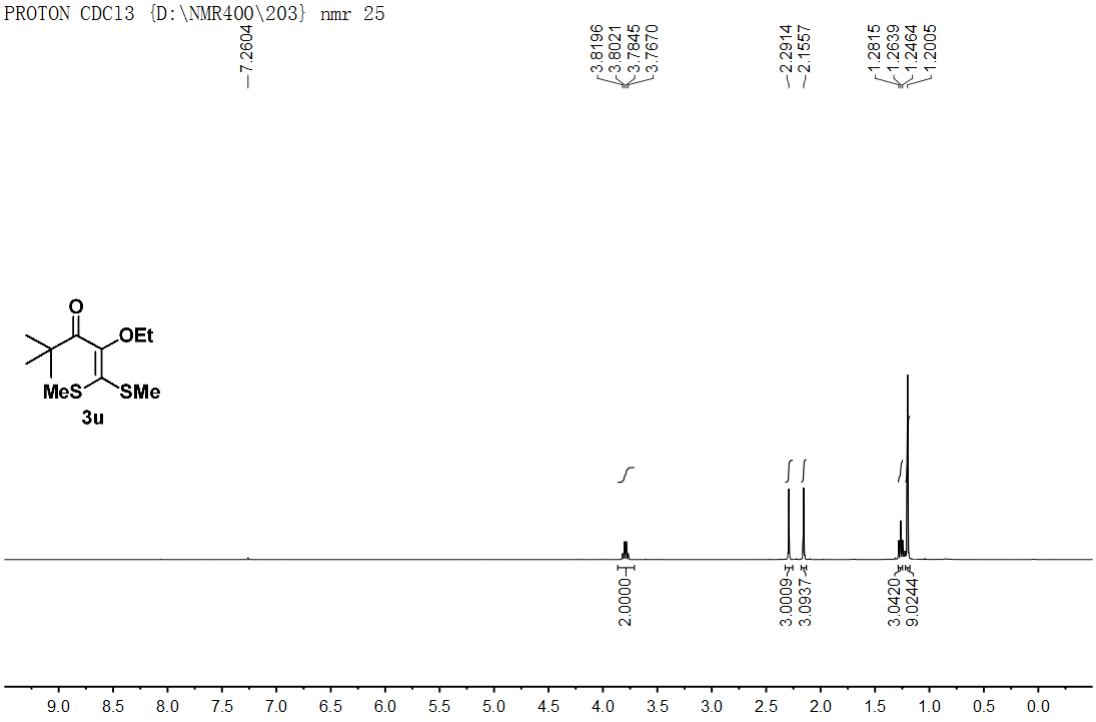
LZQ-397

C13CPD CDC13 {D:\NMR400\203} nmr 37



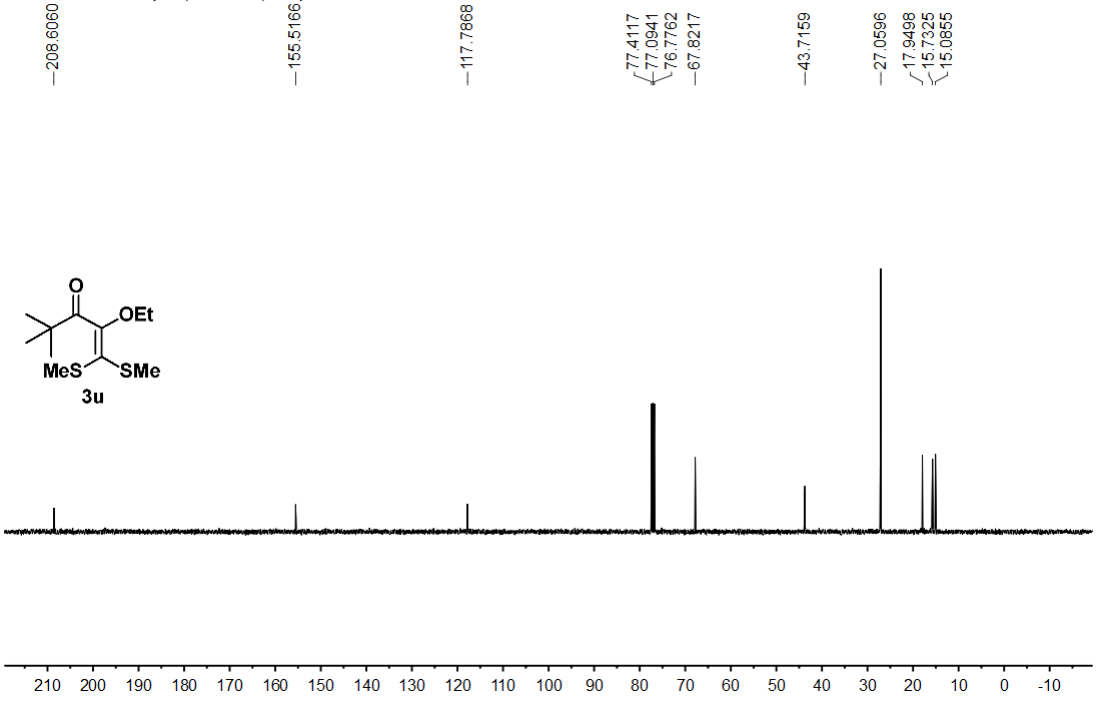
lzq-757

PROTON CDCl3 {D:\NMR400\203} nmr 25



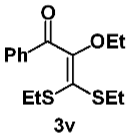
lzq-757

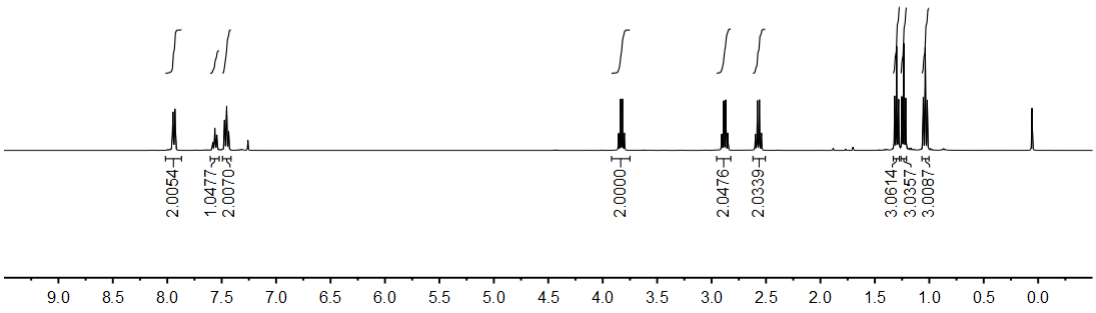
C13CPD CDCl3 {D:\NMR400\203} nmr 25



LZQ-426

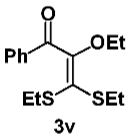
PROTON CDC13 {D:\NMR400\203} nmr 11





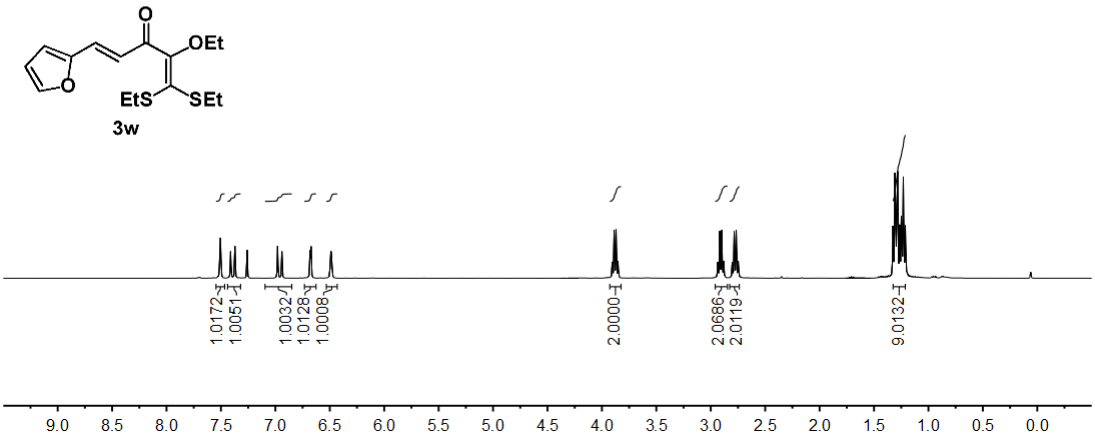
LZQ-426

C13CPD CDC13 {D:\NMR400\203} nmr 11



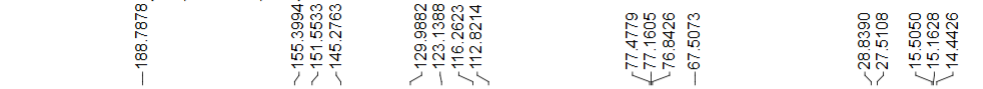
LZQ-438

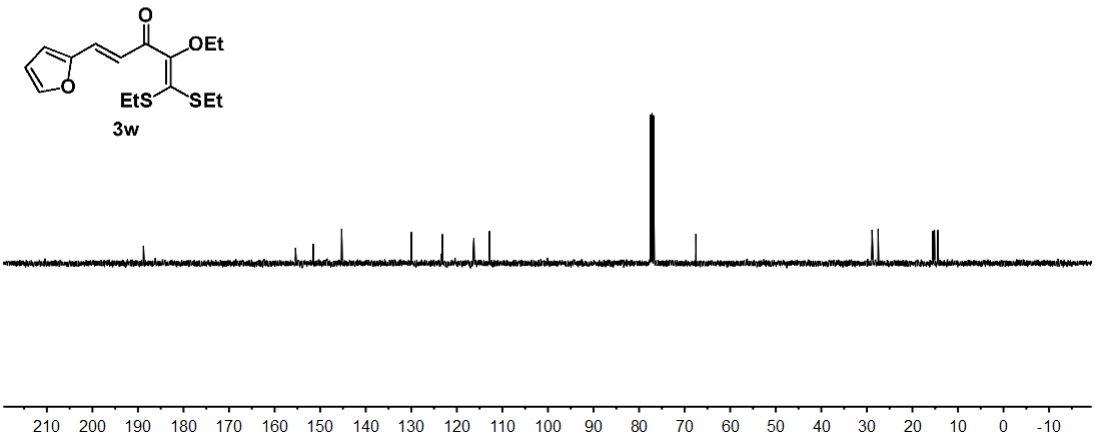
PROTON CDCl3 {D:\NMR400\203} nmr 39



LZQ-438

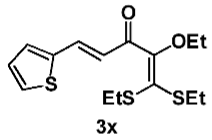
C13CPD CDCl3 {D:\NMR400\203} nmr 39





LZQ-439

PROTON CDC13 {D:\NMR400\203} nmr 31



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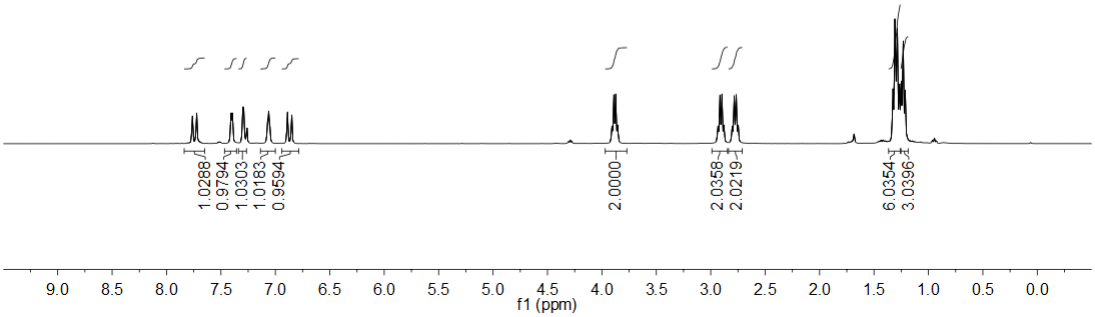
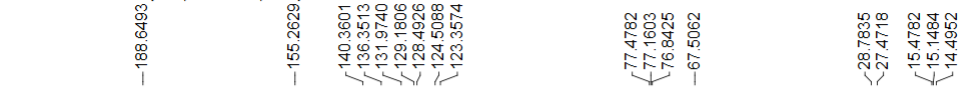
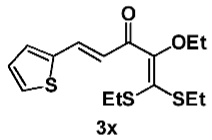


LZQ-439

C13CPD CDC13 {D:\NMR400\203} nmr 31





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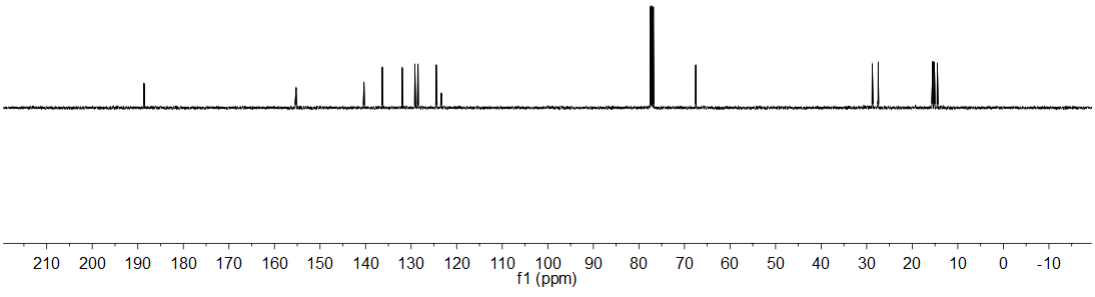
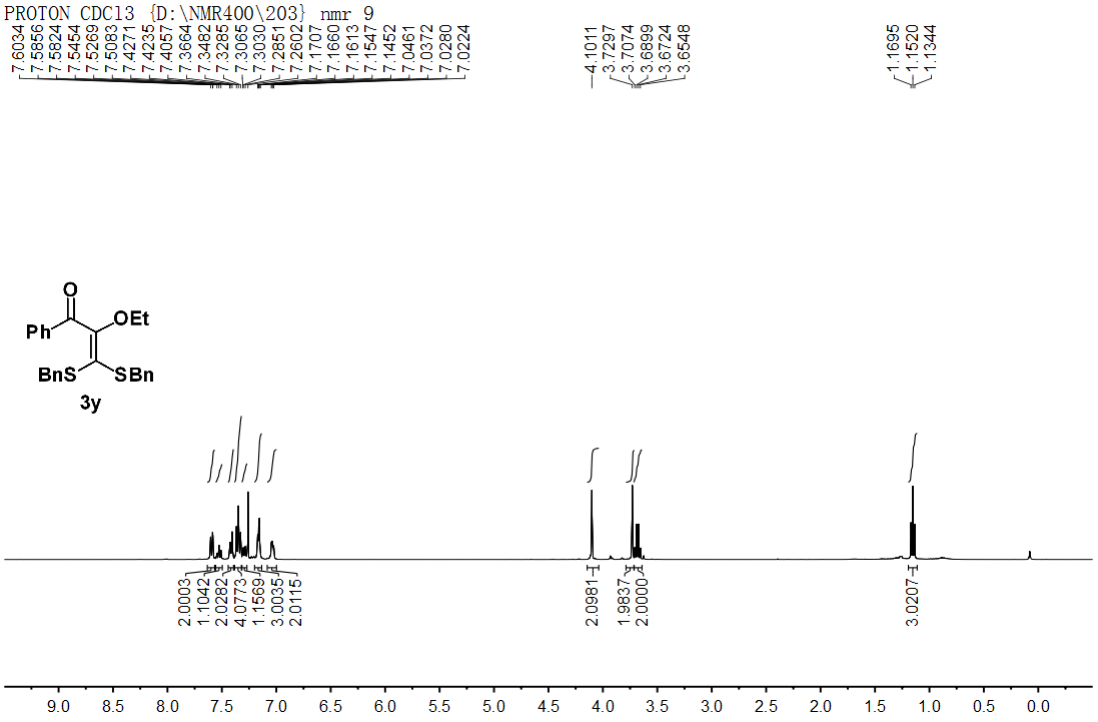


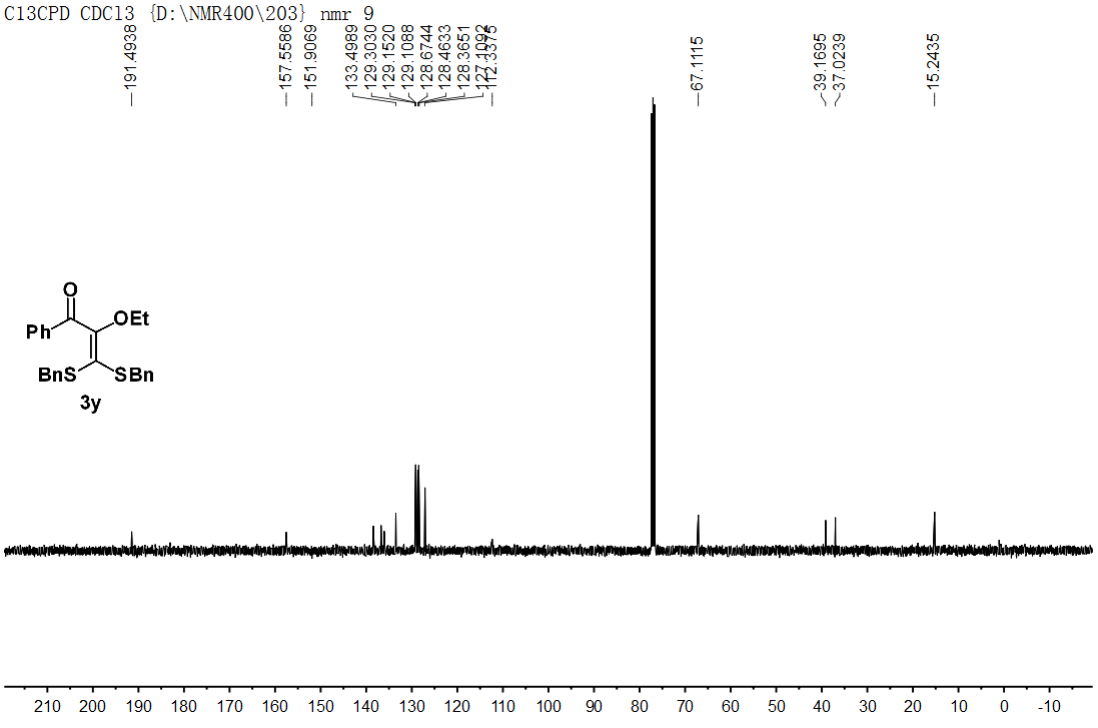
LZQ-462

PROTON CDCl3 {D:\NMR400\203} nmr 9



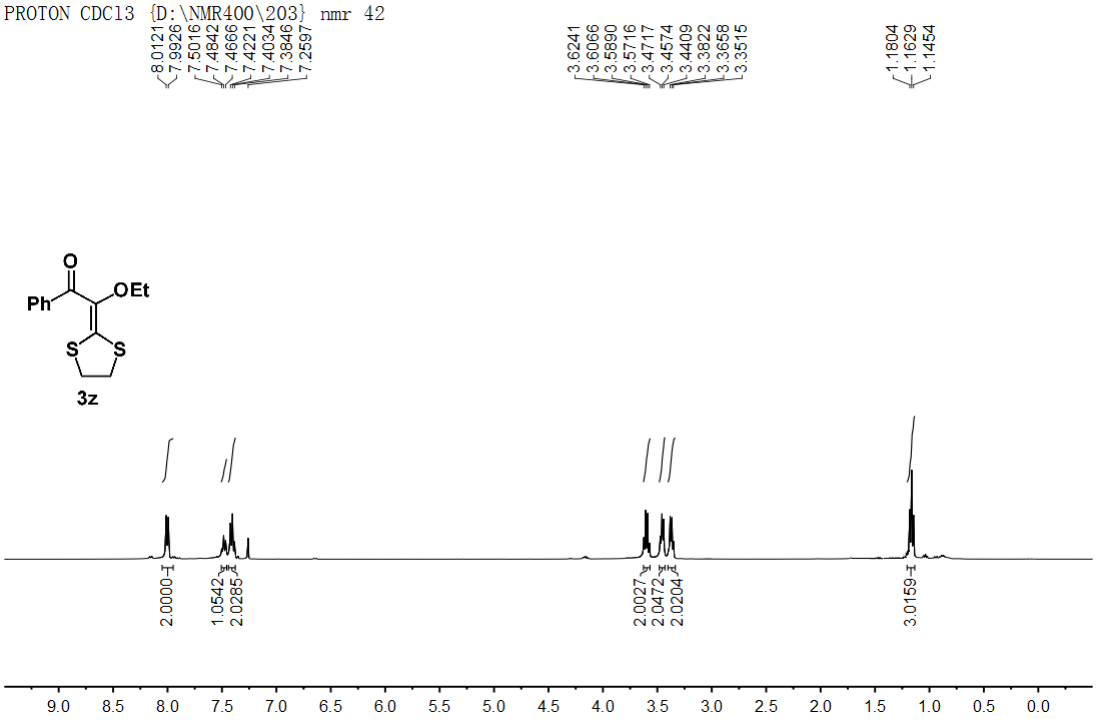
LZQ-462

C13CPD CDCl3 {D:\NMR400\203} nmr 9



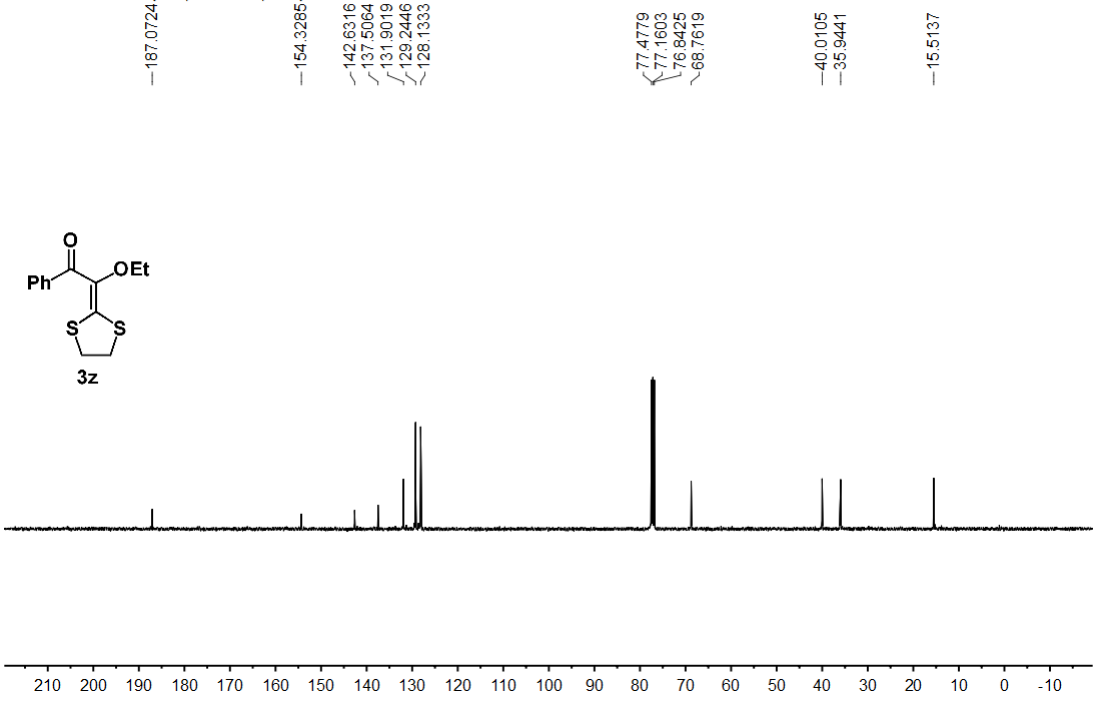
LZQ-B-2

PROTON CDCl3 {D:\NMR400\203} nmr 42



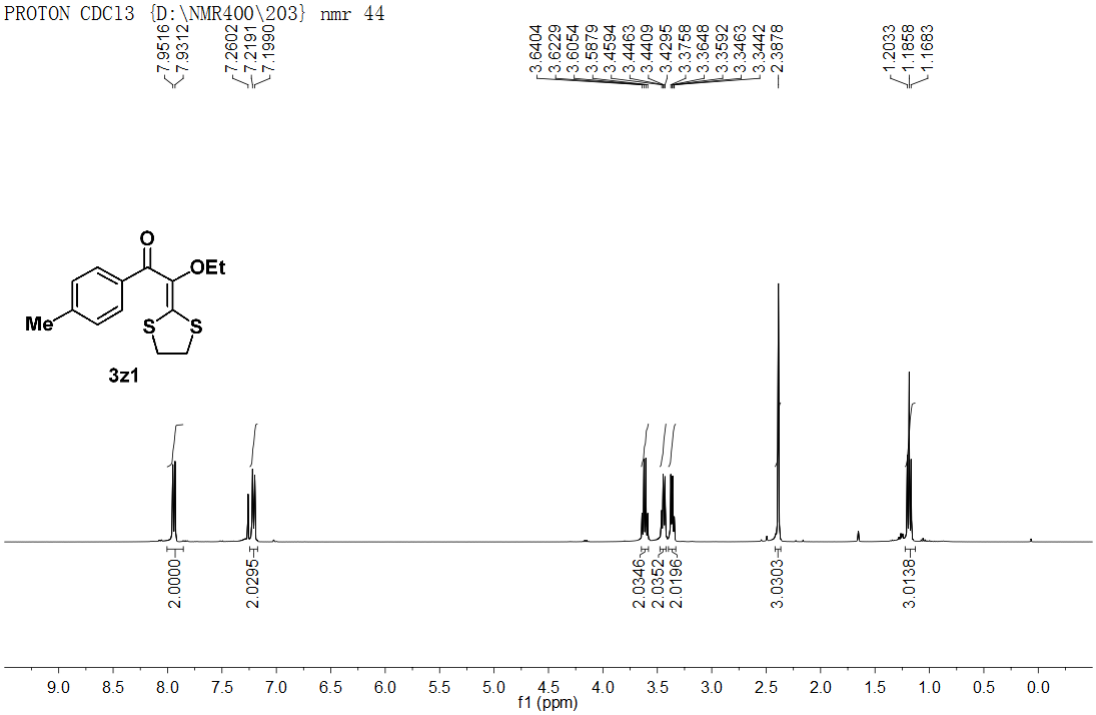
LZQ-B-2

C13CPD CDCl3 {D:\NMR400\203} nmr 42



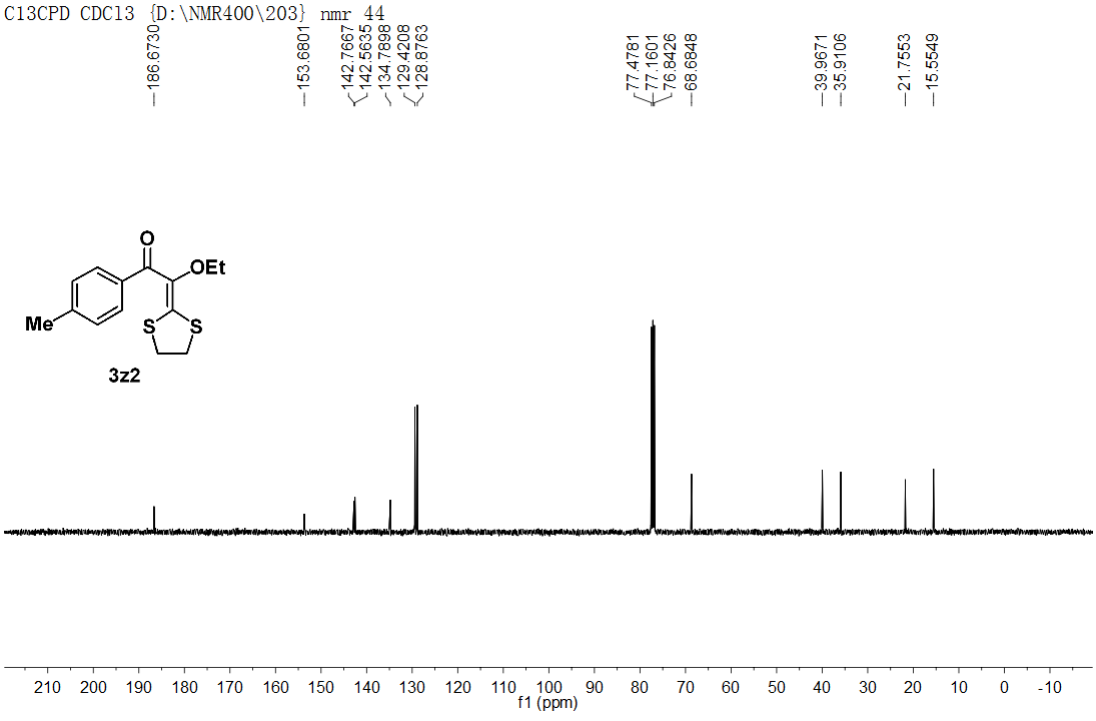
LZQ-449

PROTON CDC13 {D:\NMR400\203} nmr 44



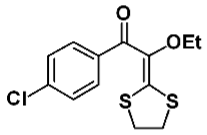
LZQ-449

C13CPD CDC13 {D:\NMR400\203} nmr 44

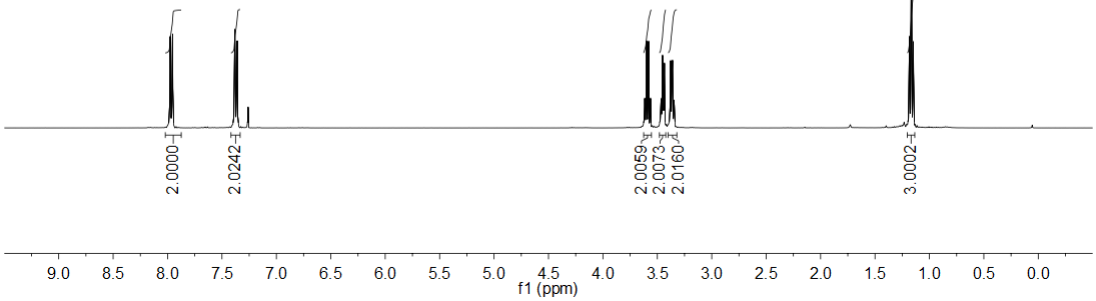


LZQ-448

PROTON CDCl3 {D:\NMR400\203} nmr 43

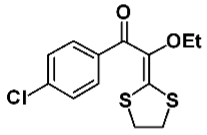


3z2

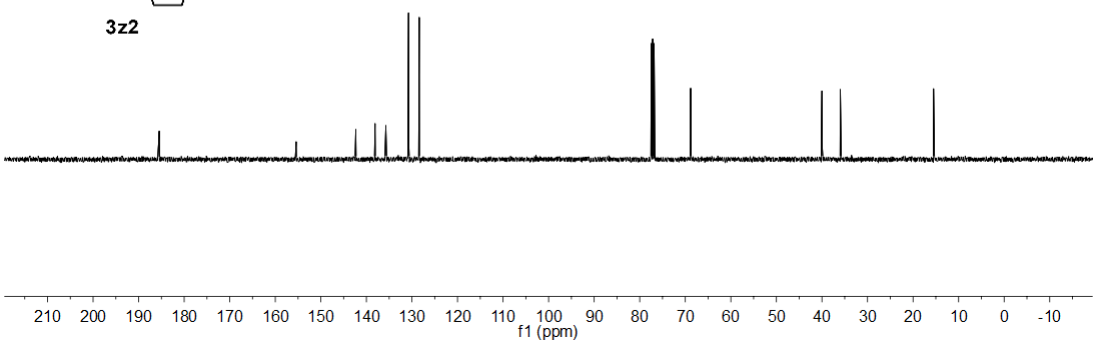


LZQ-448

C13CPD CDCl3 {D:\NMR400\203} nmr 43

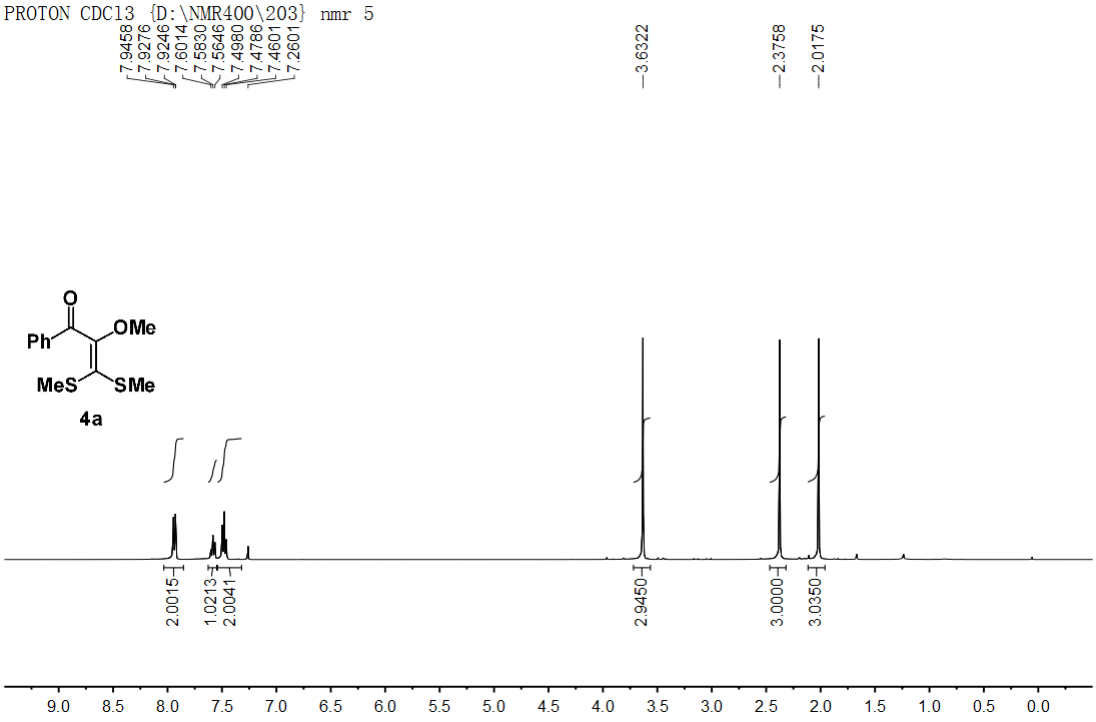


3z2



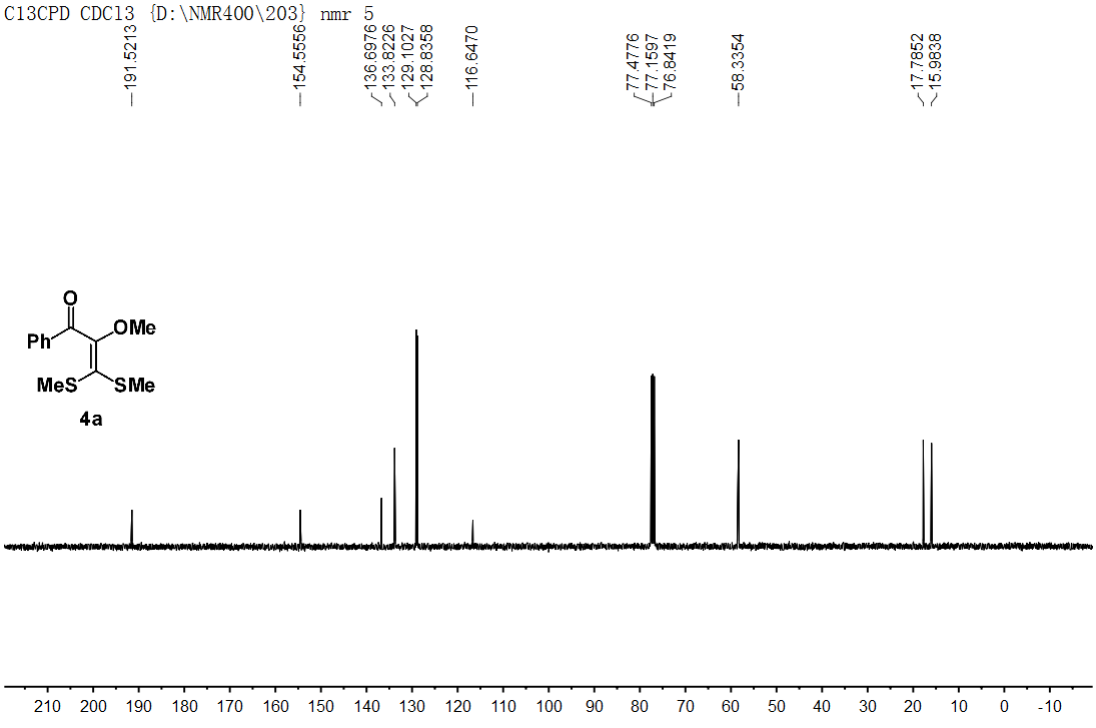
LZQ-380-7

PROTON CDCl3 {D:\NMR400\203} nmr 5



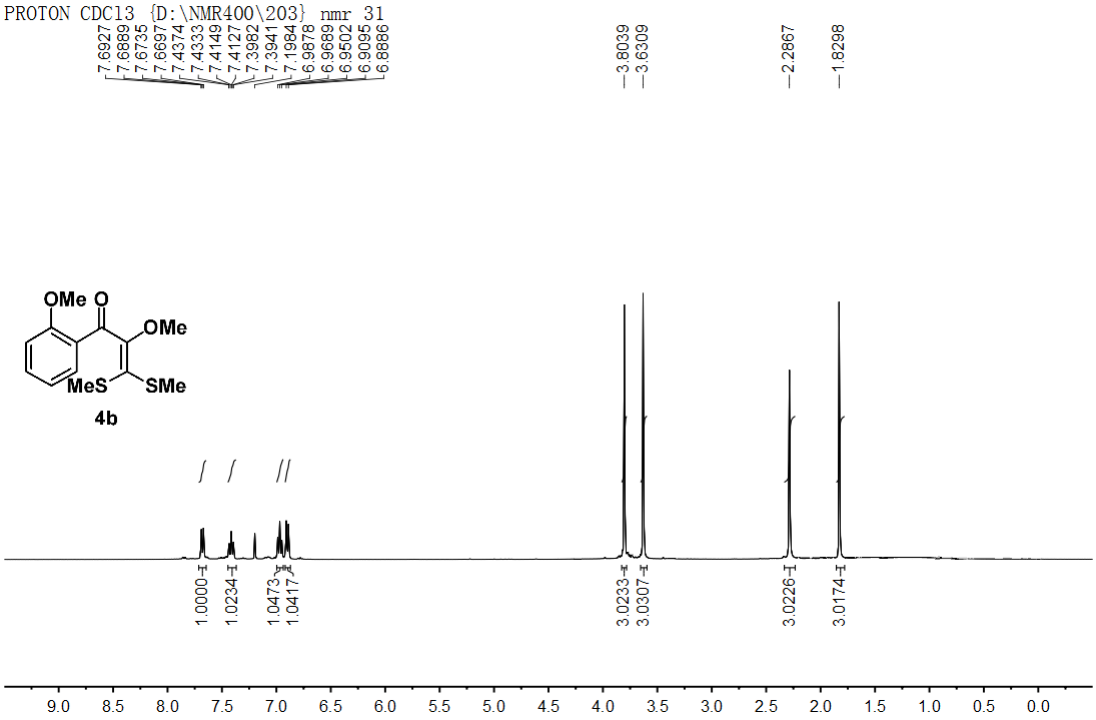
LZQ-380-7

C13CPD CDCl3 {D:\NMR400\203} nmr 5



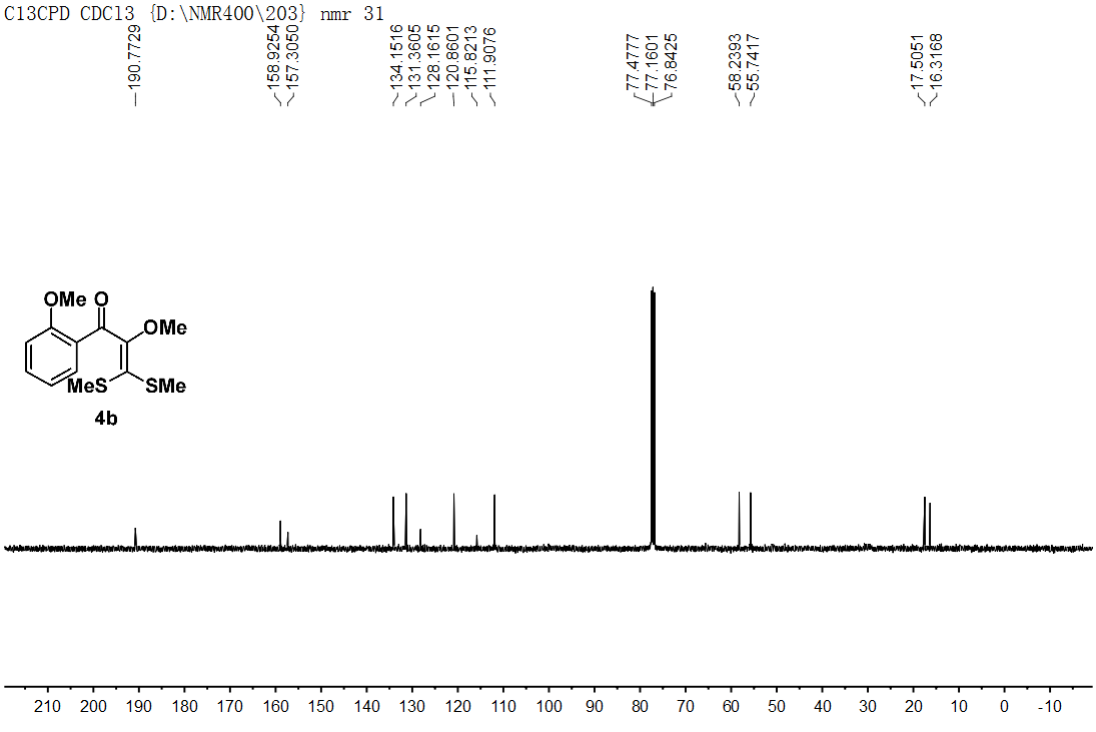
LZQ-869

PROTON CDCl3 {D:\NMR400\203} nmr 31



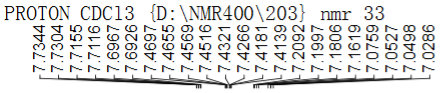
LZQ-869

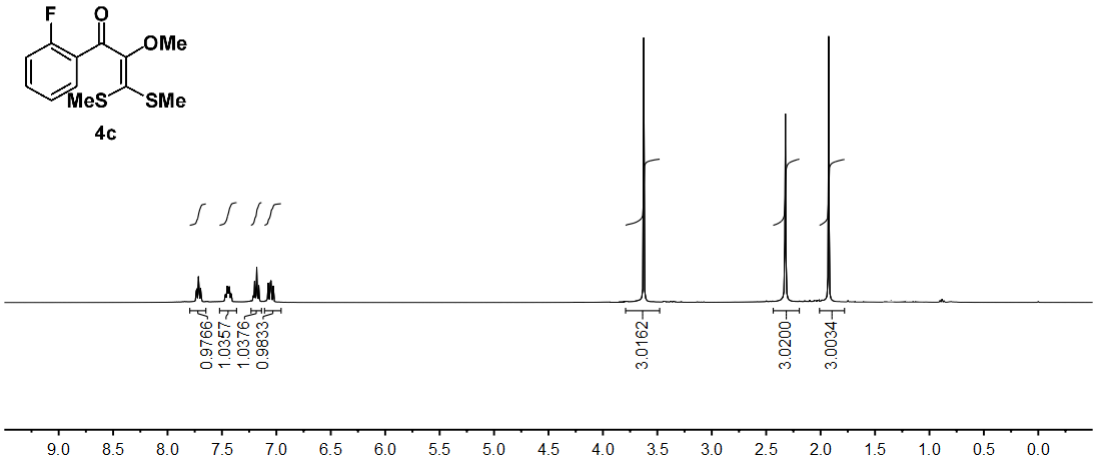
C13CPD CDCl3 {D:\NMR400\203} nmr 31



LZQ-868

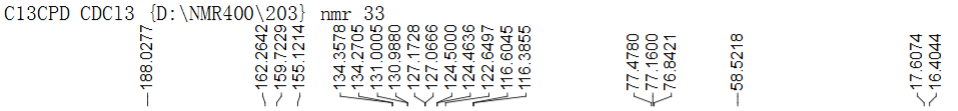
PROTON CDCl3 {D:\NMR400\203} nmr 33

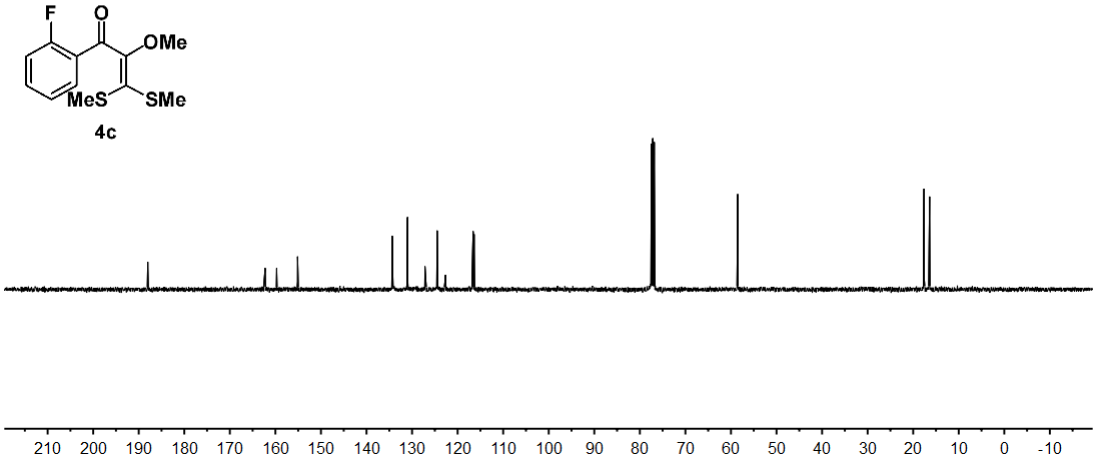




LZQ-868

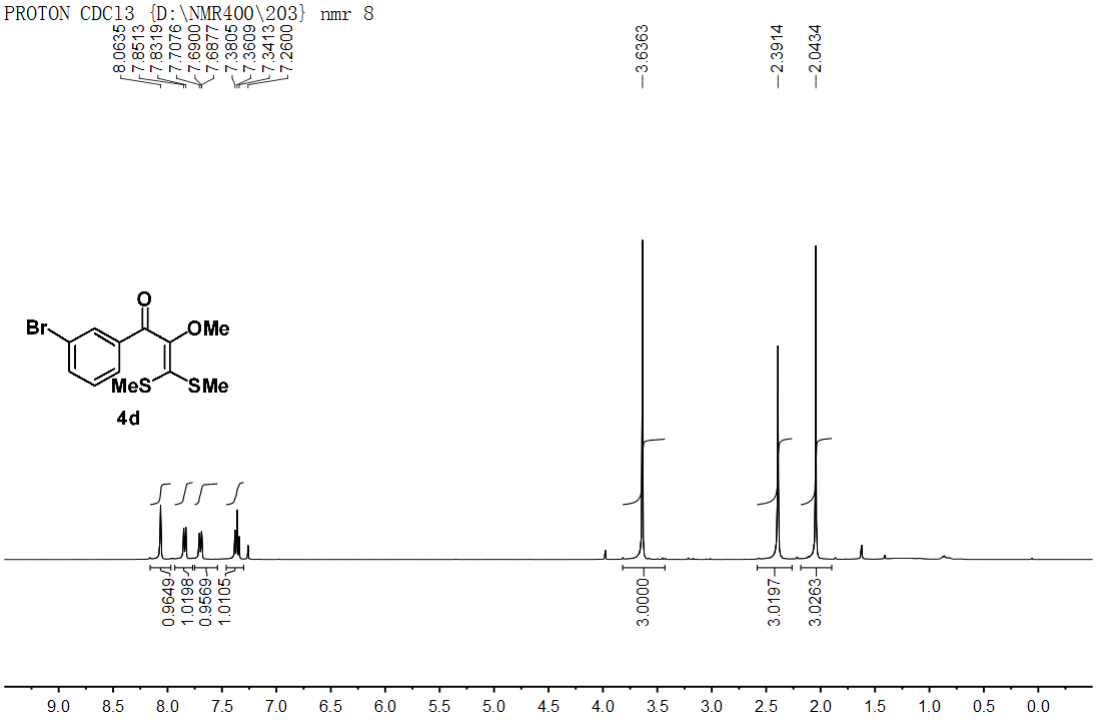
C13CPD CDCl3 {D:\NMR400\203} nmr 33





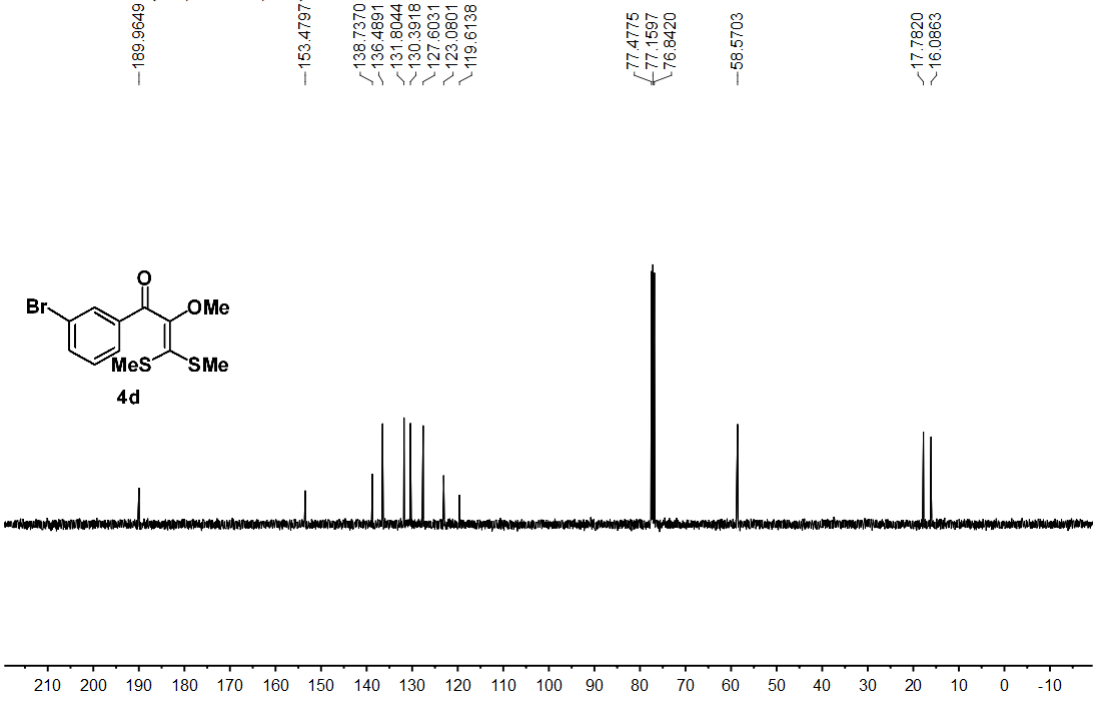
LZQ-862

PROTON CDCl3 {D:\NMR400\203} nmr 8



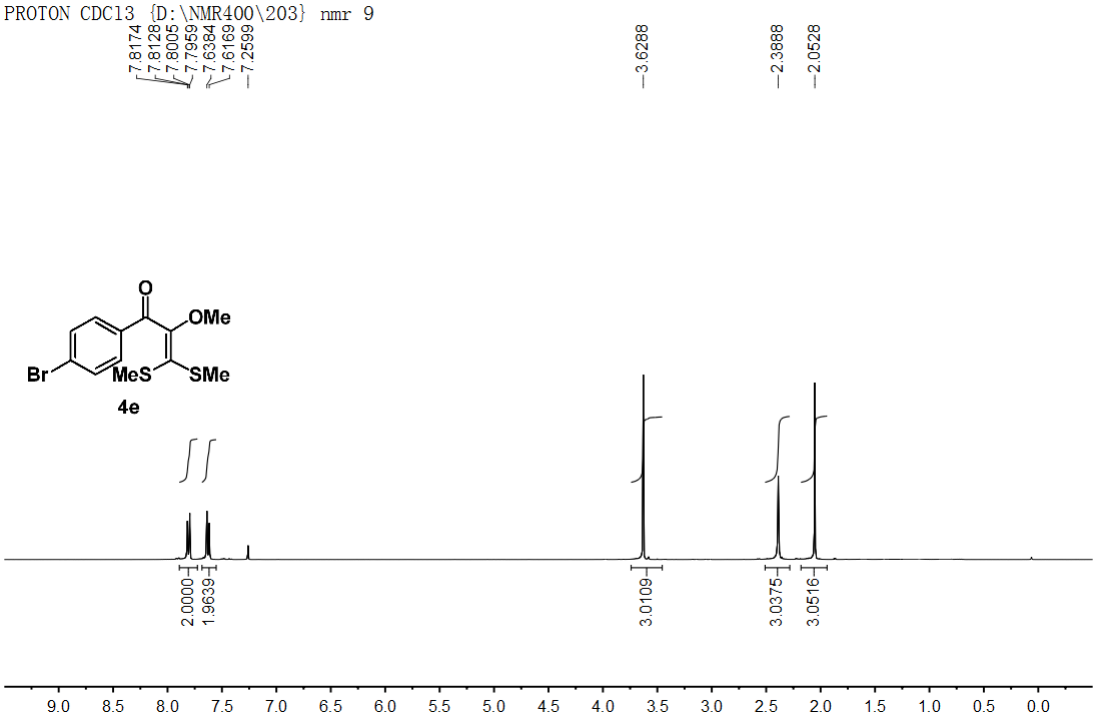
LZQ-862

C13CPD CDCl3 {D:\NMR400\203} nmr 8



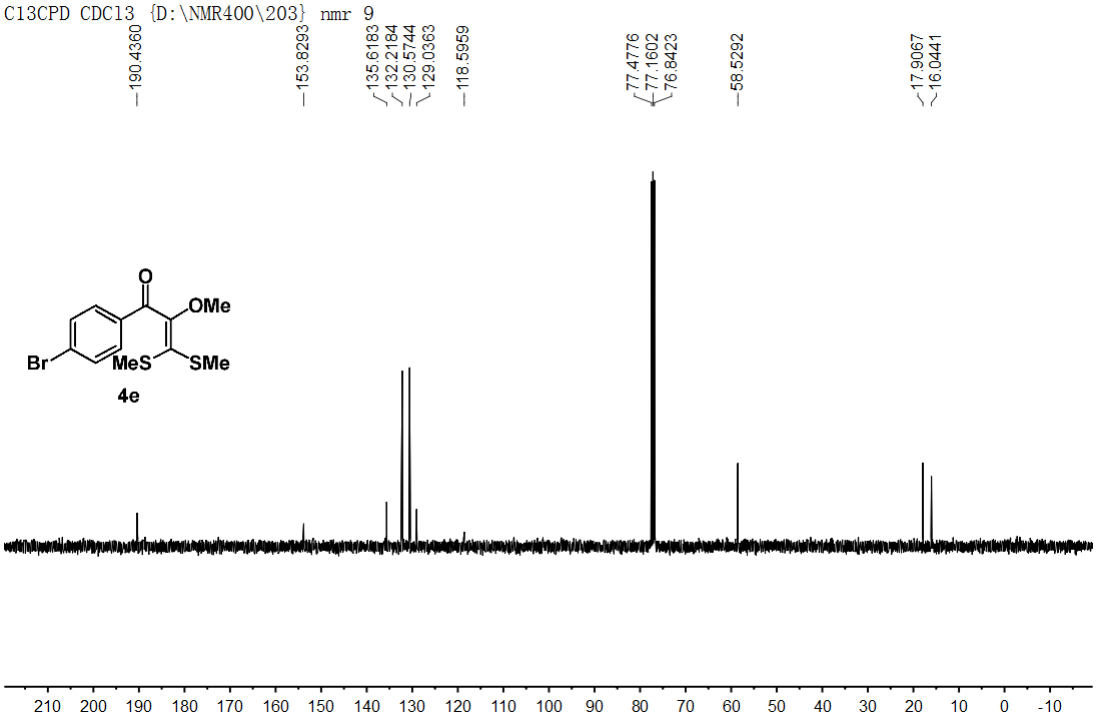
LZQ-863

PROTON CDCl3 {D:\NMR400\203} nmr 9



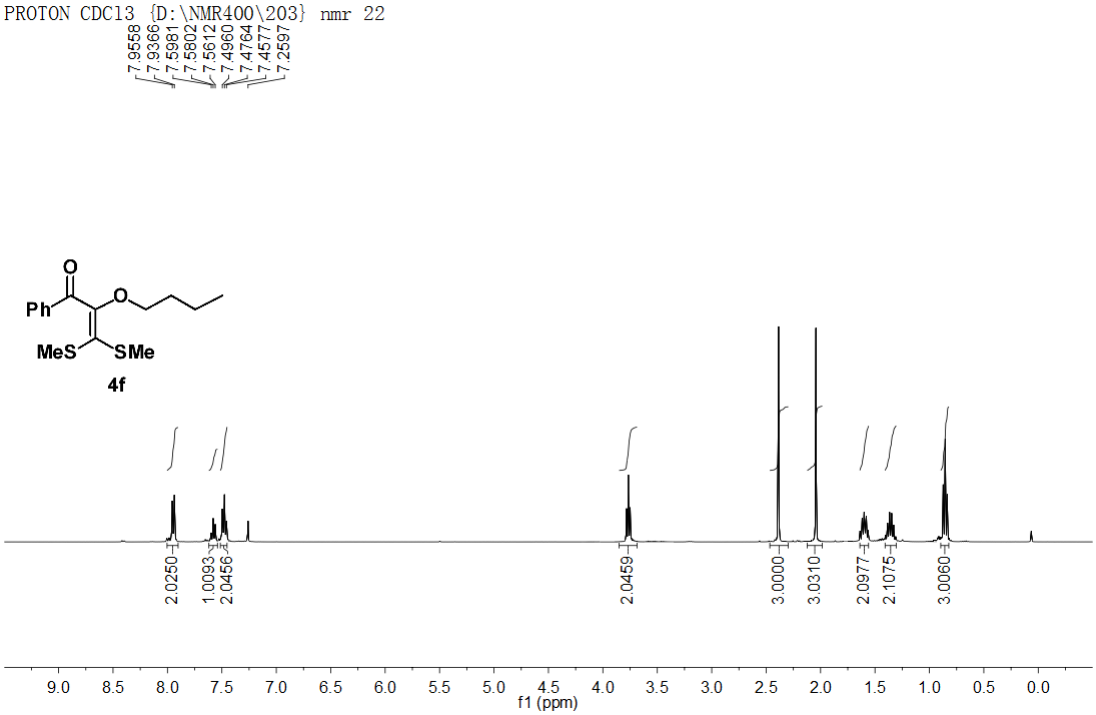
LZQ-863

C13CPD CDCl3 {D:\NMR400\203} nmr 9



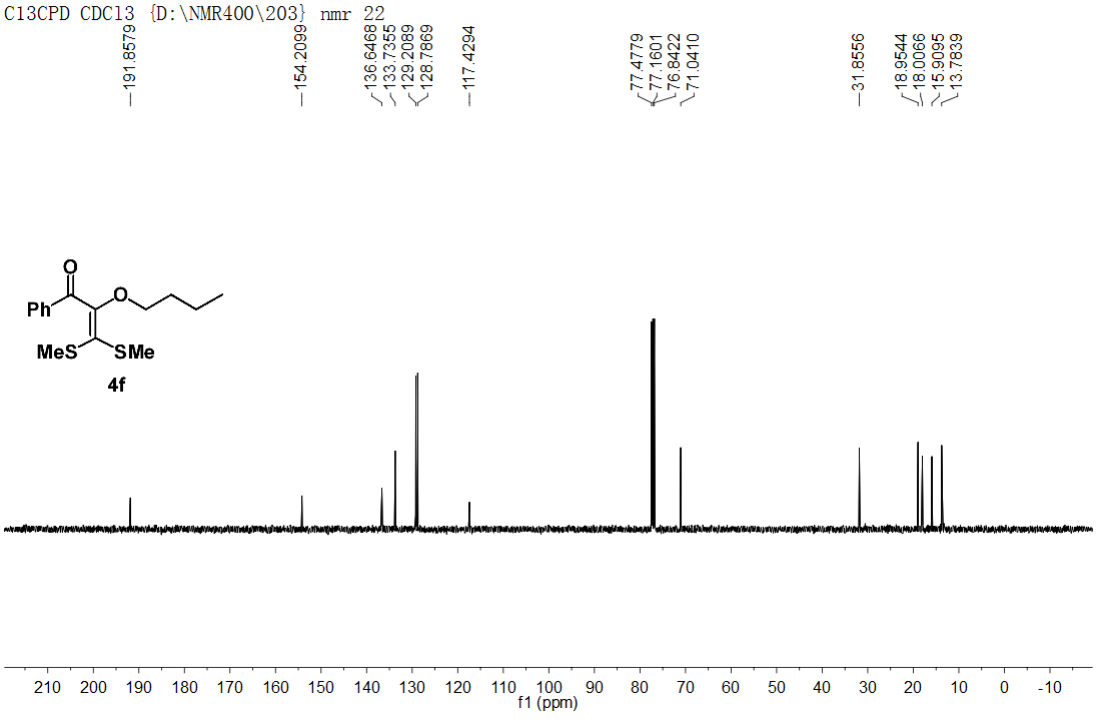
LZQ-490

PROTON CDCl3 {D:\NMR400\203} nmr 22



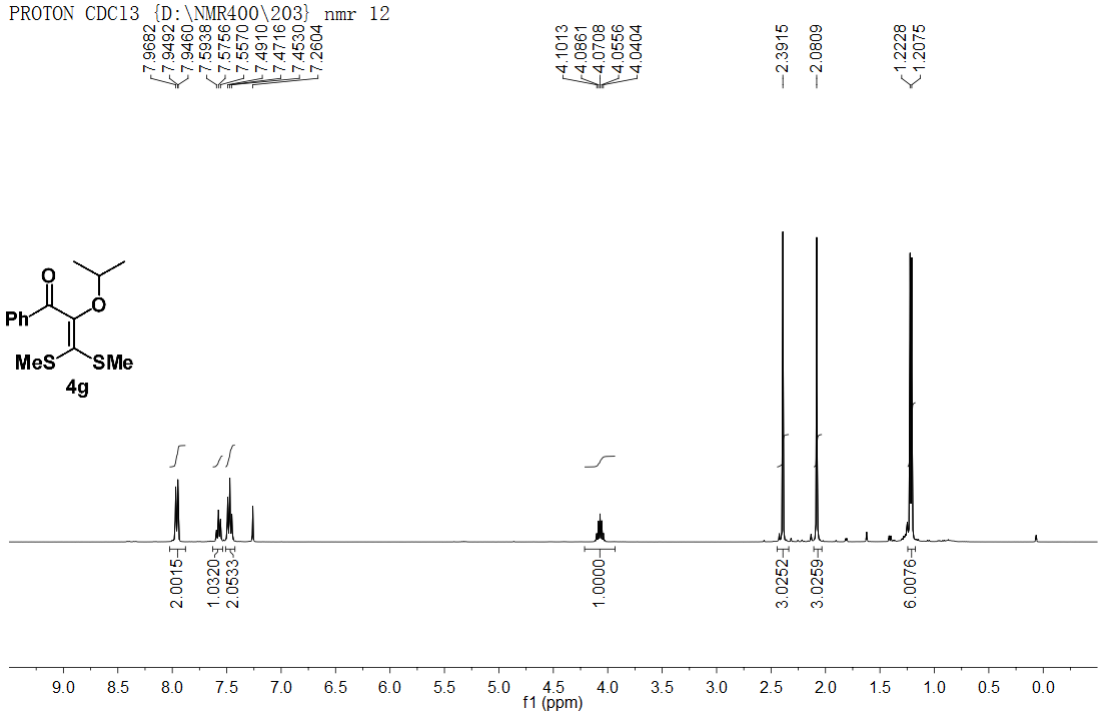
LZQ-490

C13CPD CDCl3 {D:\NMR400\203} nmr 22



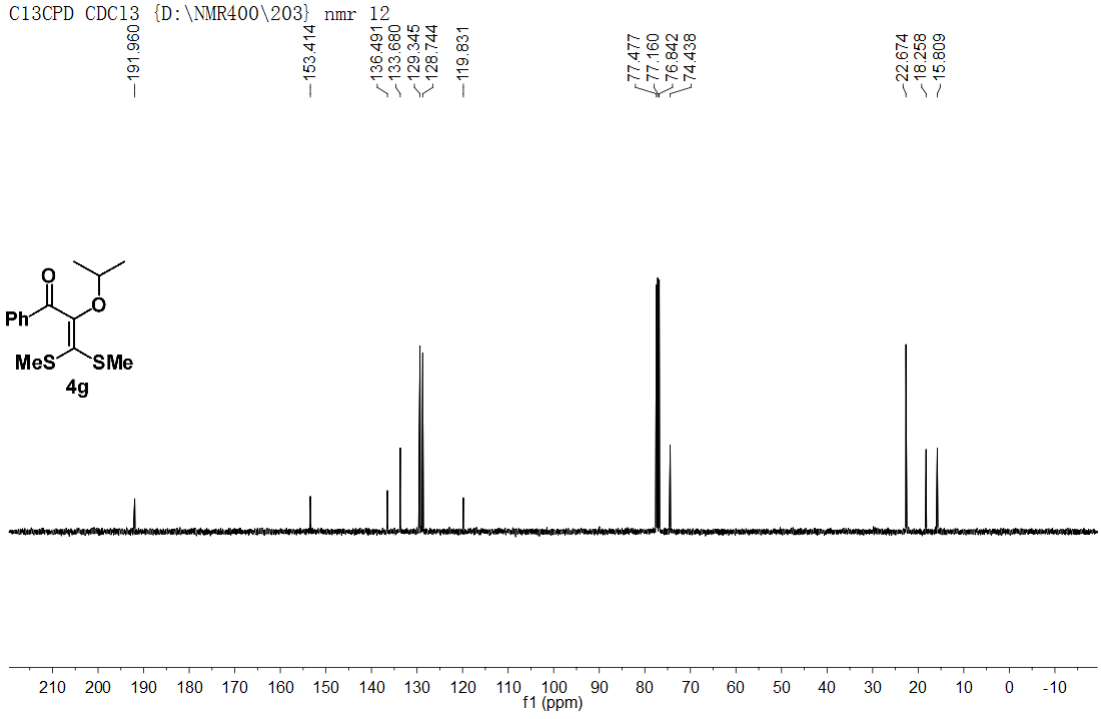
LZQ-430

PROTON CDC13 {D:\NMR400\203} nmr 12



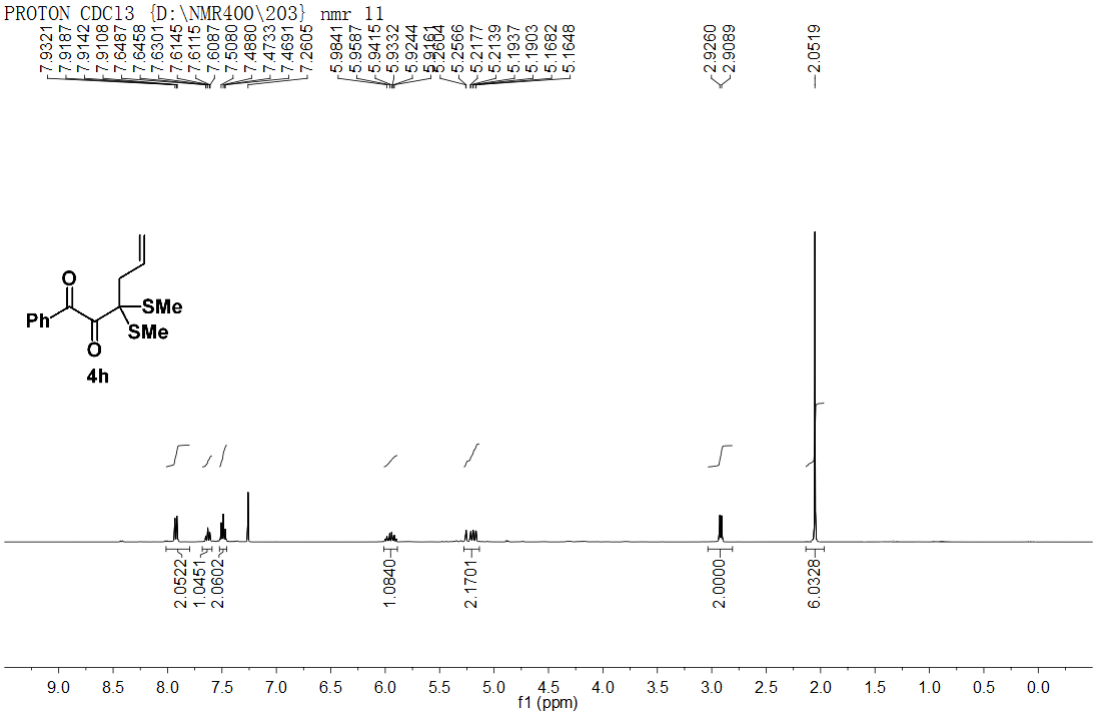
LZQ-430

C13CPD CDC13 {D:\NMR400\203} nmr 12



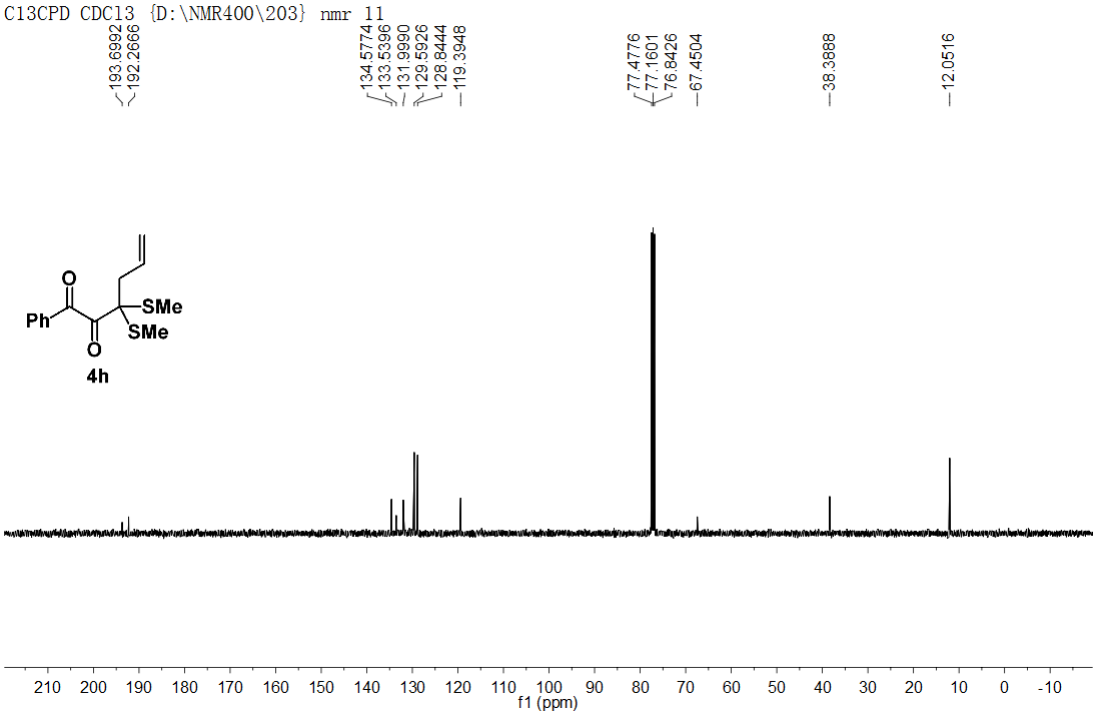
LZQ-424

PROTON CDCl3 {D:\NMR400\203} nmr 11



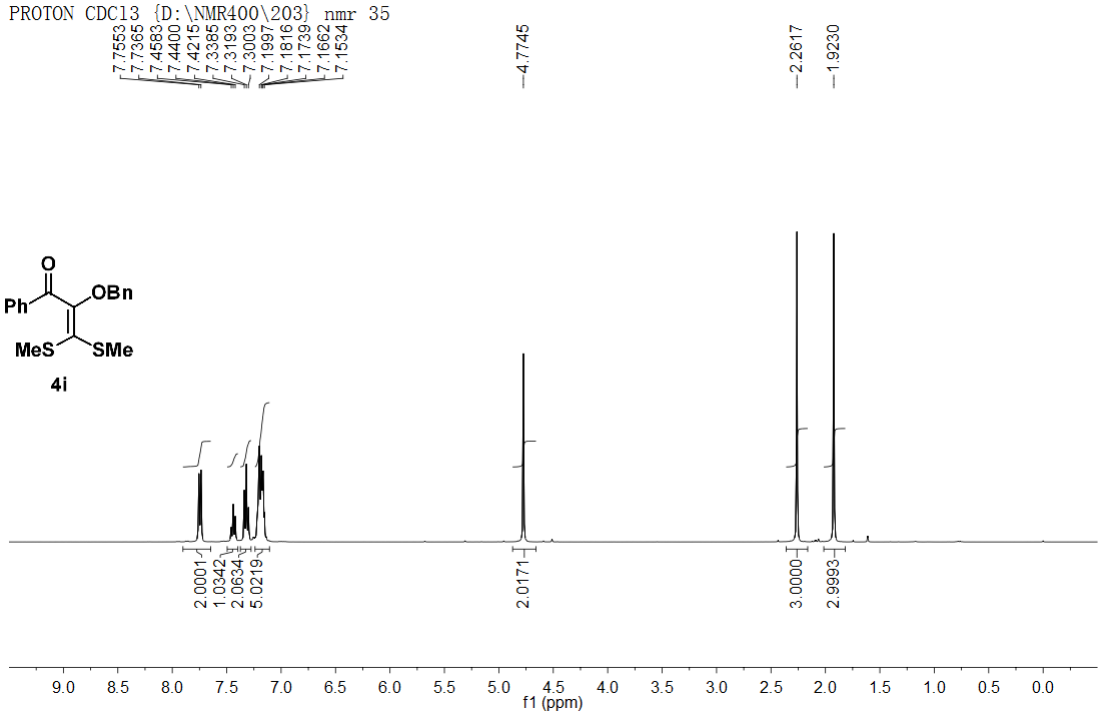
LZQ-424

C13CPD CDCl3 {D:\NMR400\203} nmr 11



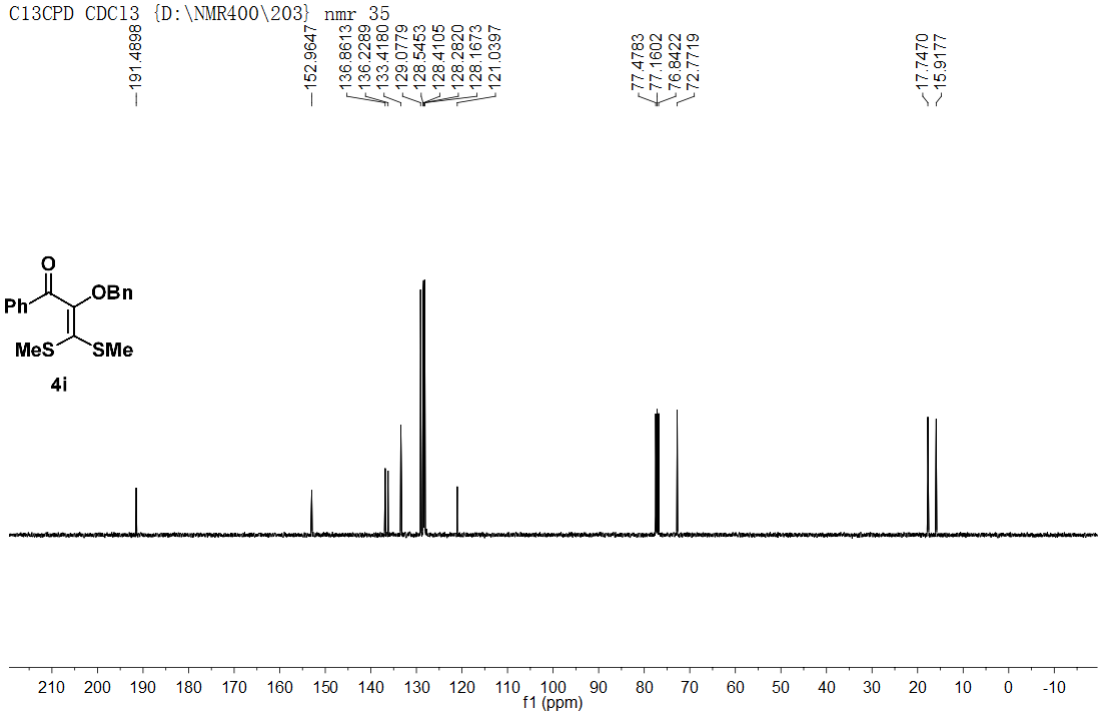
LZQ-443

PROTON CDC13 {D:\NMR400\203} nmr 35



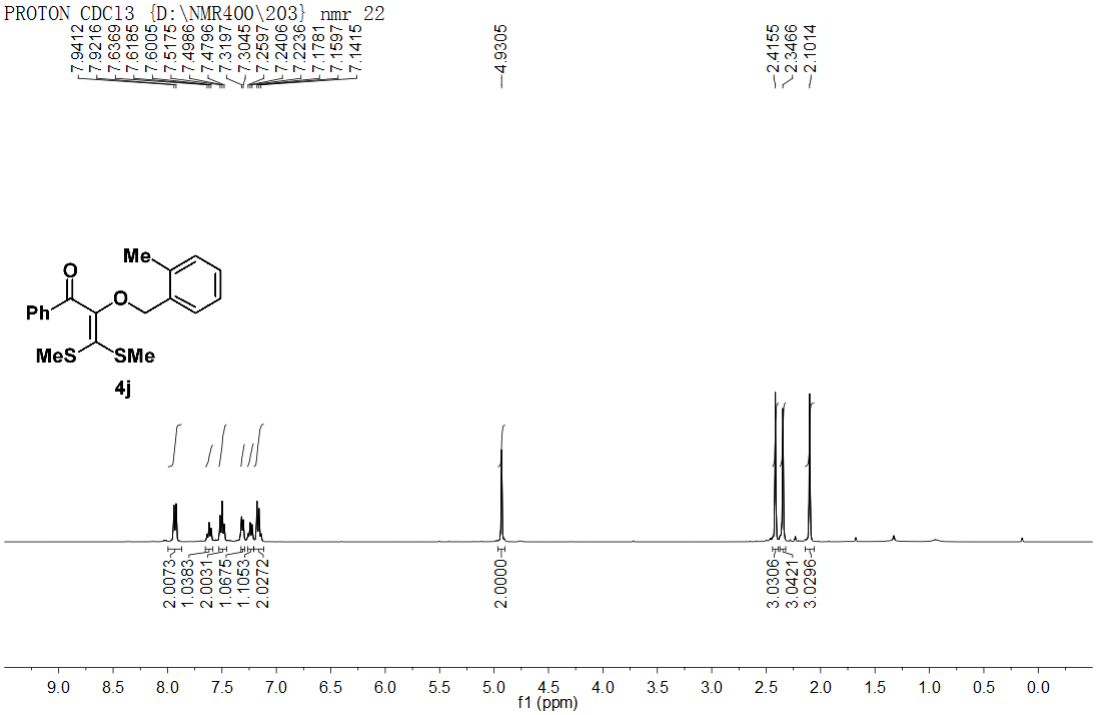
LZQ-443

C13CPD CDC13 {D:\NMR400\203} nmr 35



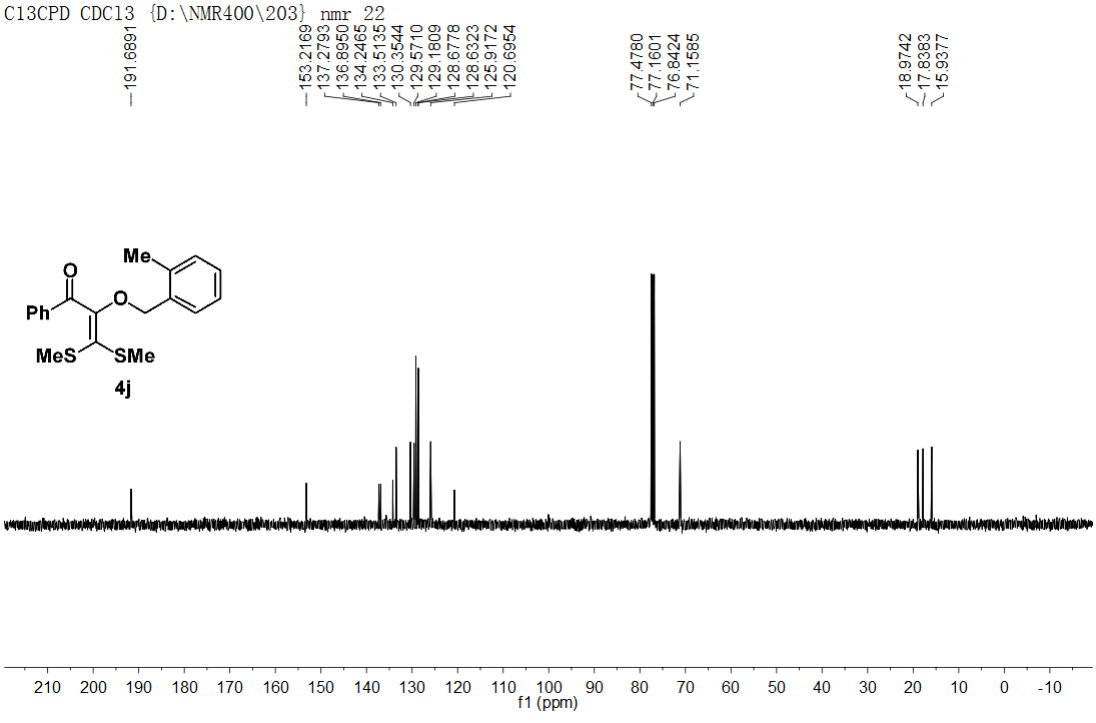
LZQ-509

PROTON CDCl3 {D:\NMR400\203} nmr 22



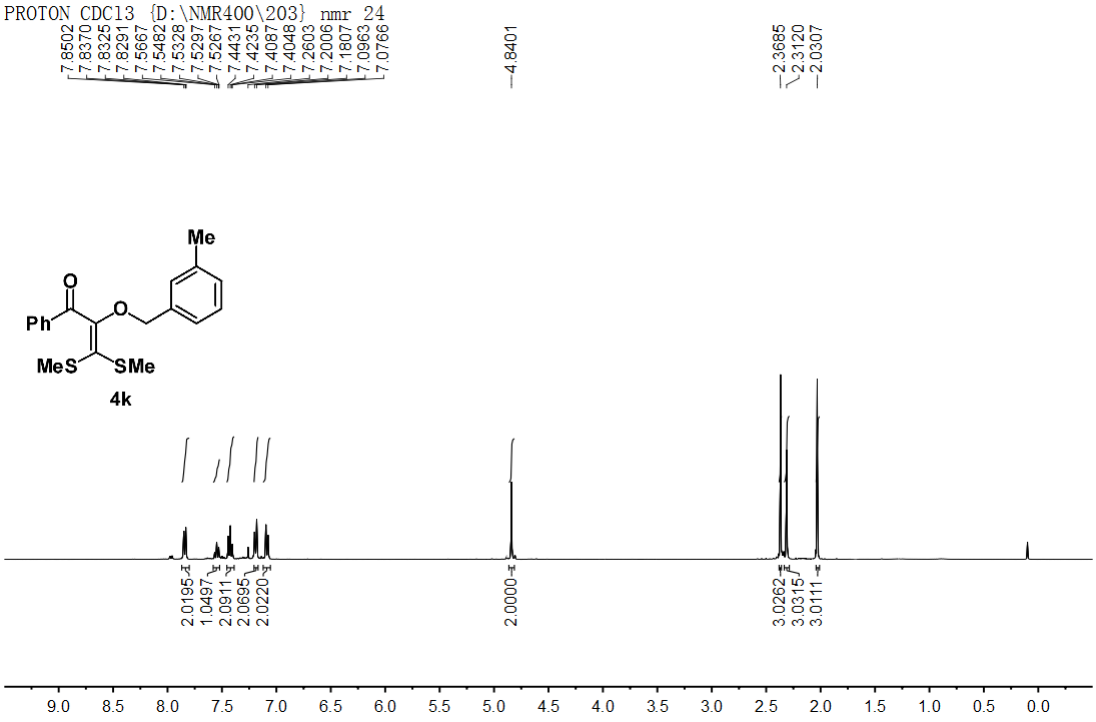
LZQ-509

C13CPD CDCl3 {D:\NMR400\203} nmr 22



LZQ-487

PROTON CDC13 {D:\NMR400\203} nmr 24



LZQ-487

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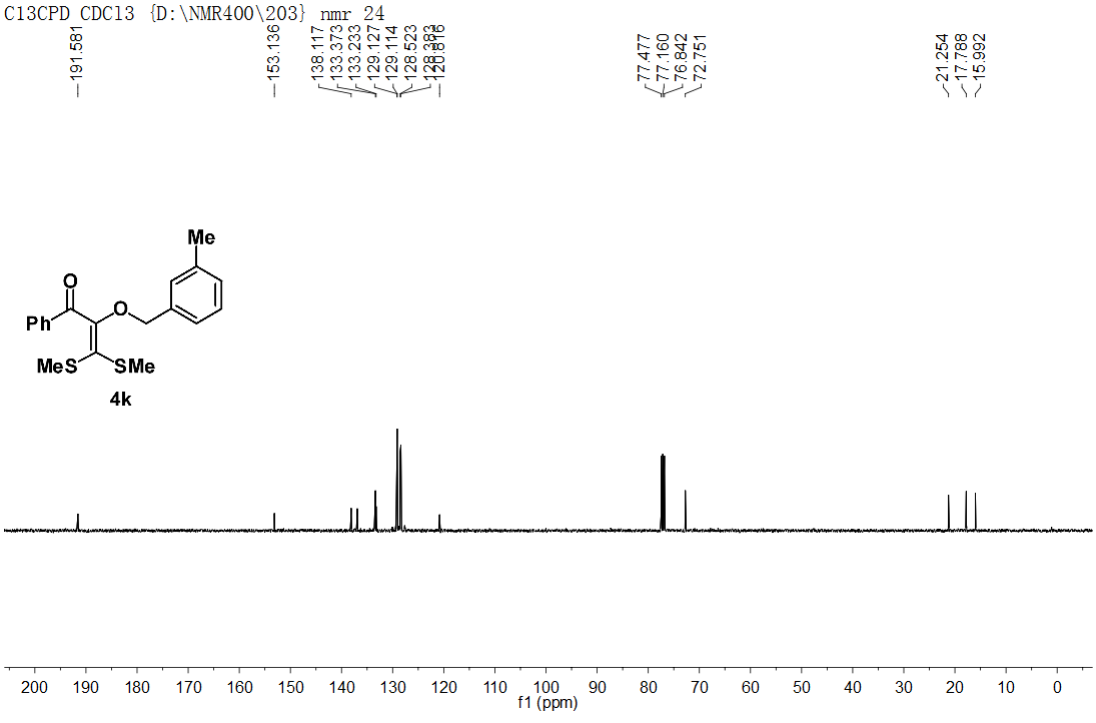
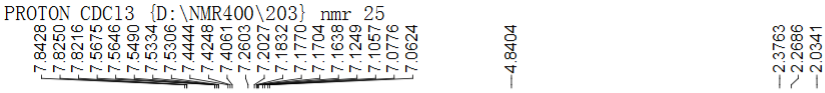
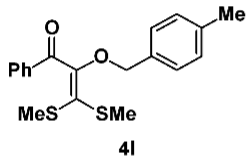


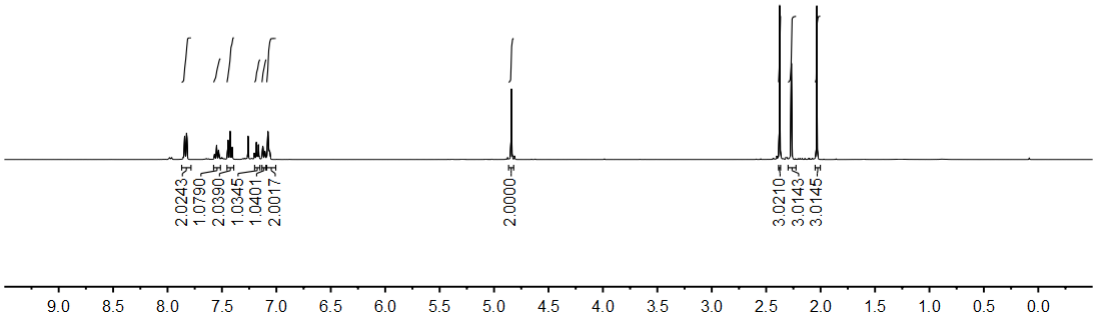
LZQ-488

PROTON CDC13 {D:\NMR400\203} nmr 25



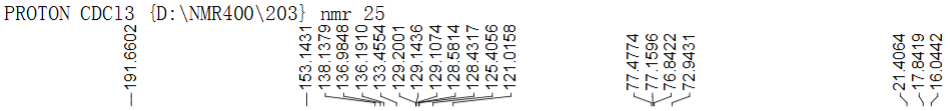


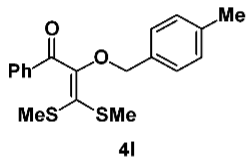
4l



LZQ-488

PROTON CDC13 {D:\NMR400\203} nmr 25





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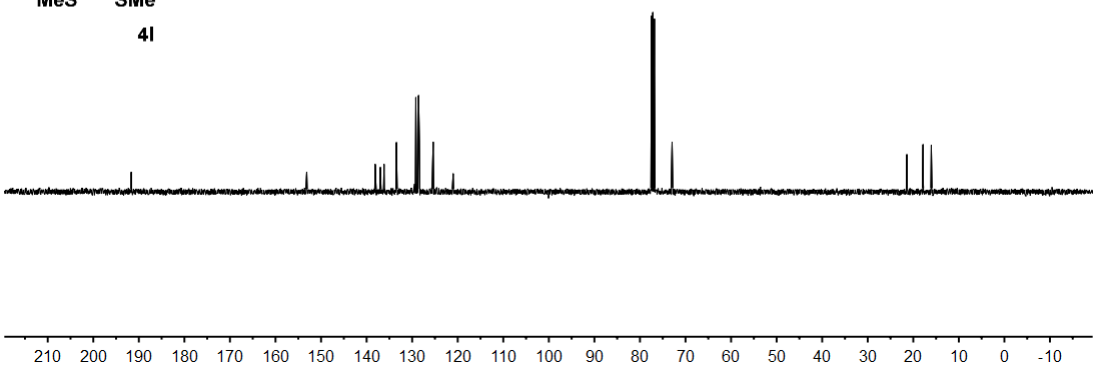
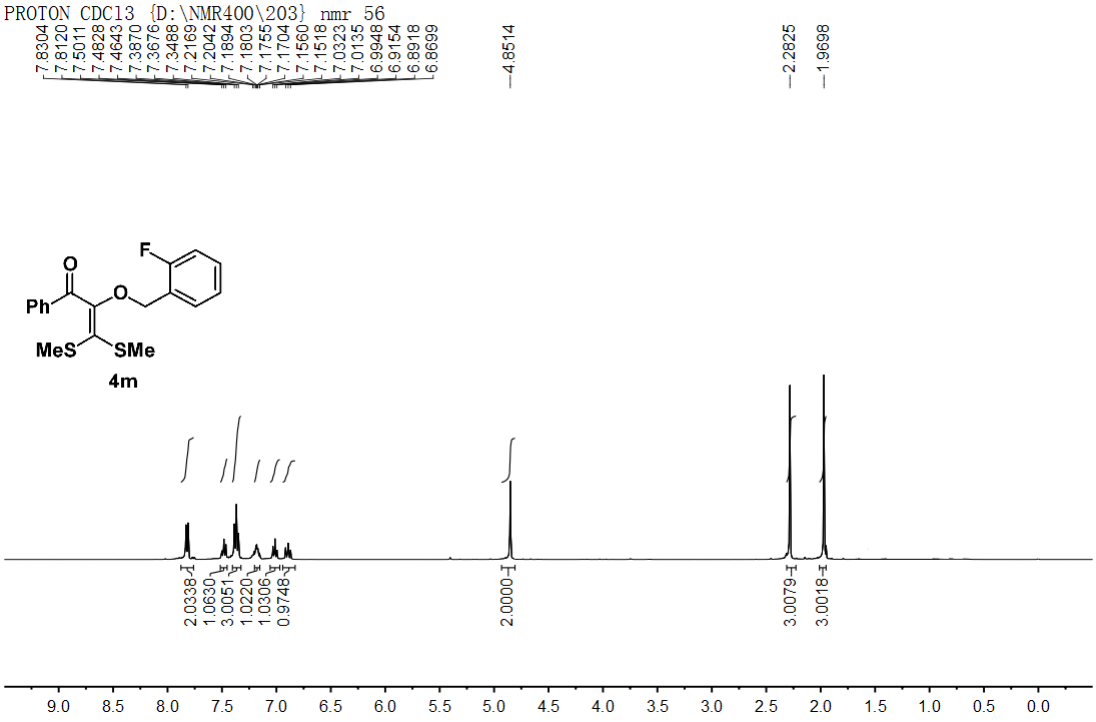


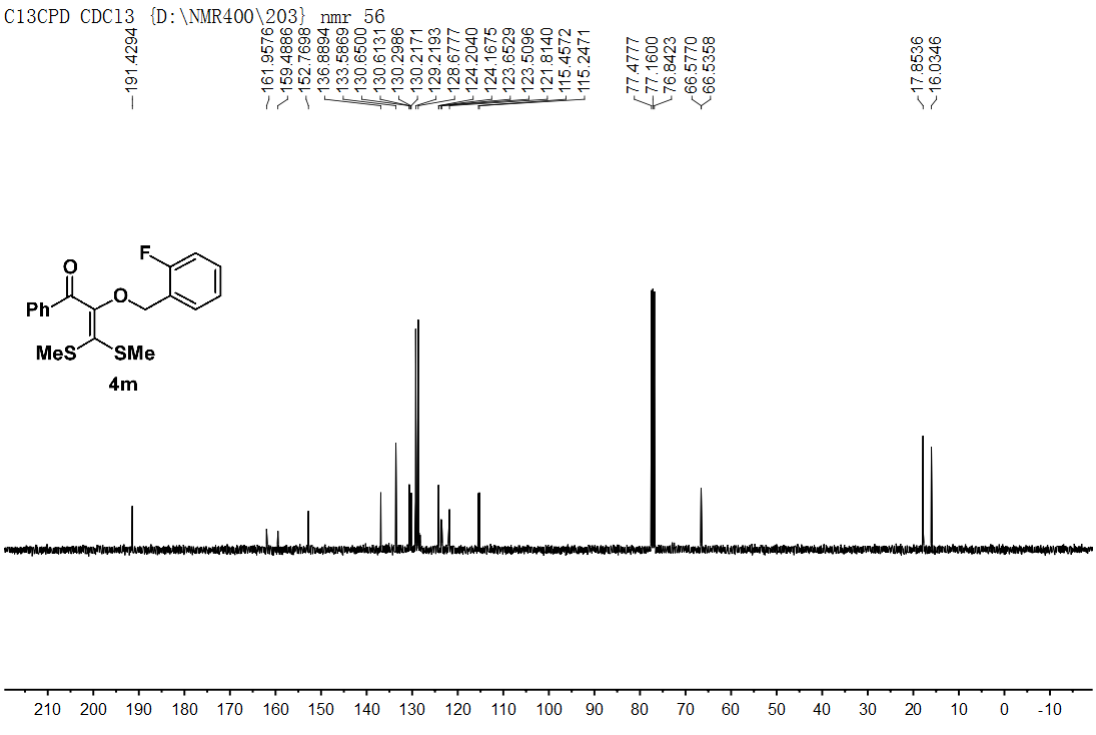
LZQ-767

PROTON CDCl3 {D:\NMR400\203} nmr 56



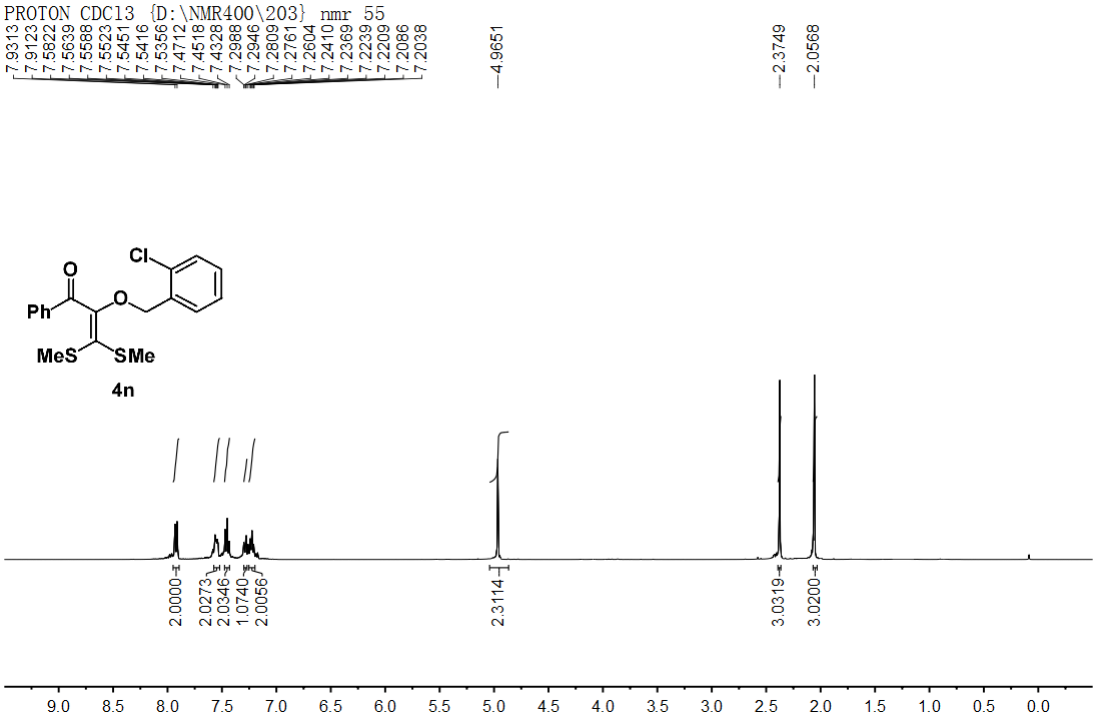
LZQ-767

C13CPD CDCl3 {D:\NMR400\203} nmr 56



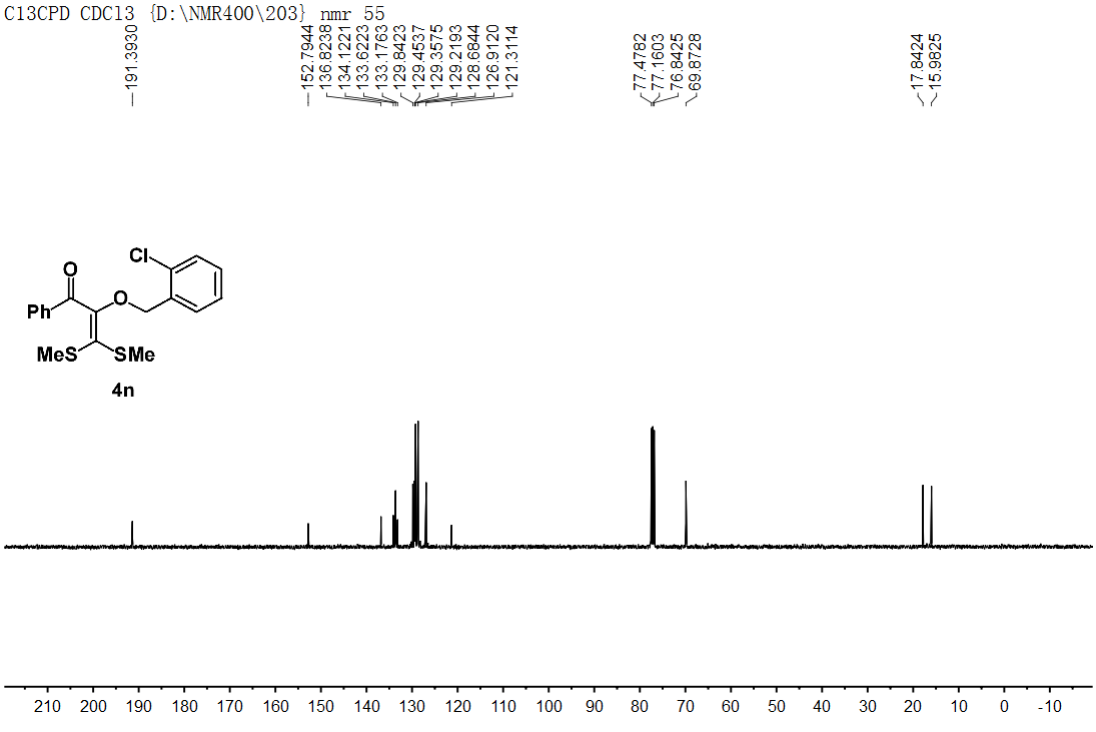
LZQ-775

PROTON CDCl3 {D:\NMR400\203} nmr 55



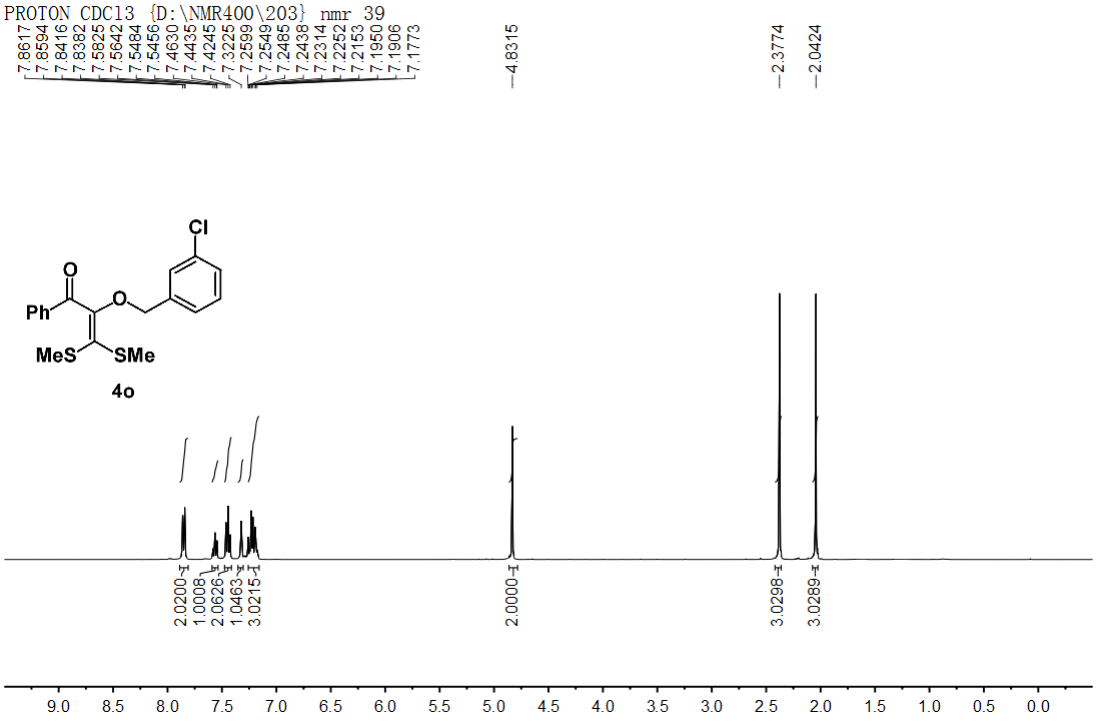
LZQ-775

C13CPD CDCl3 {D:\NMR400\203} nmr 55



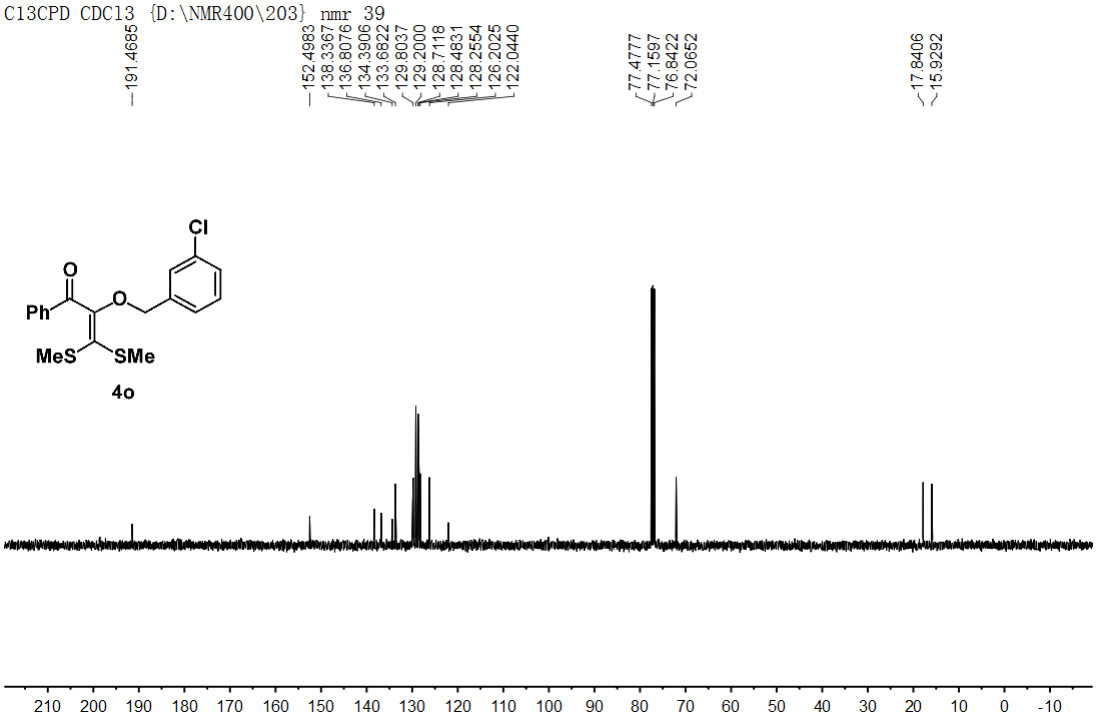
LZQ-766

PROTON CDCl3 {D:\NMR400\203} nmr 39



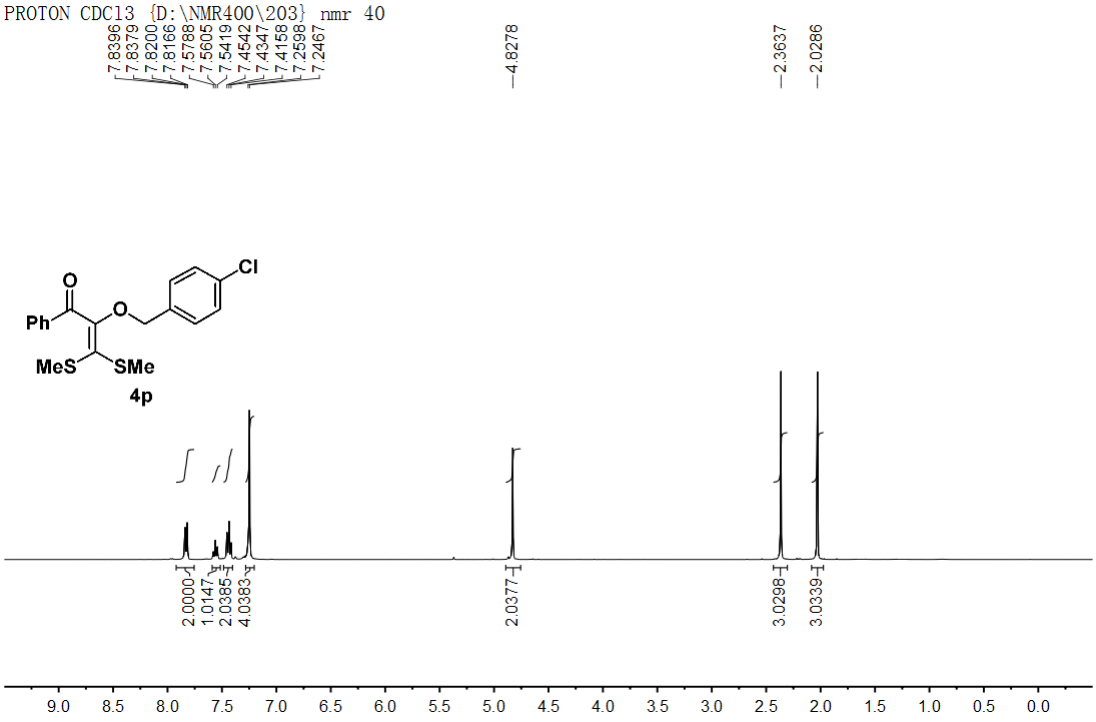
LZQ-766

C13CPD CDCl3 {D:\NMR400\203} nmr 39



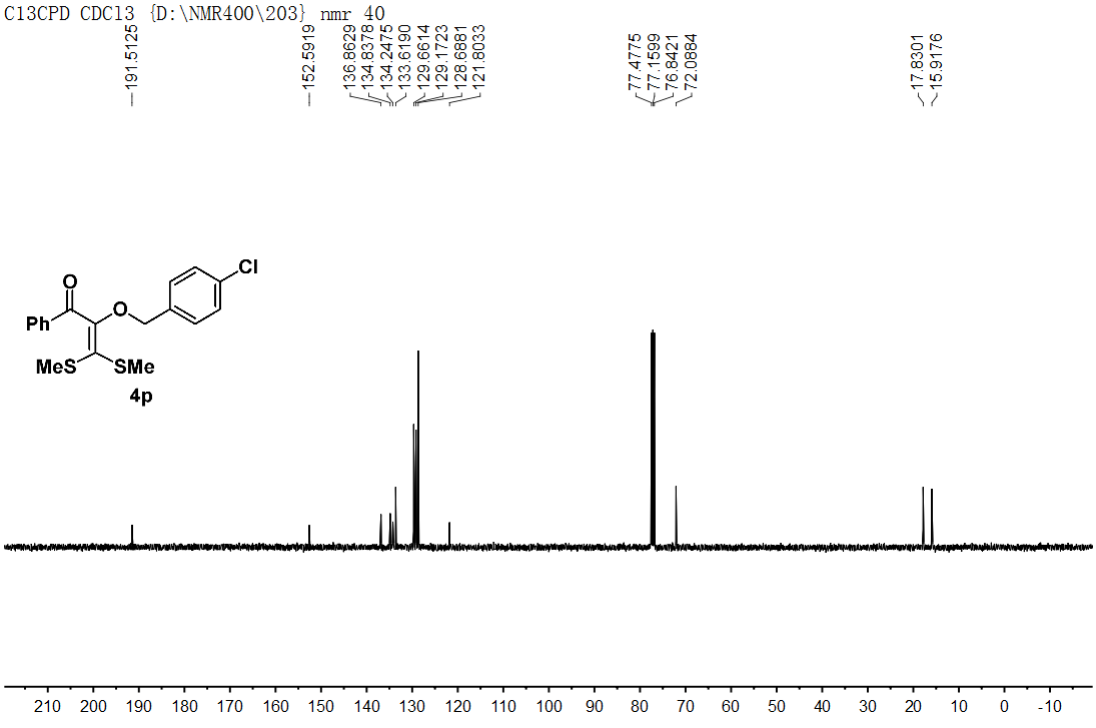
LZQ-765

PROTON CDCl3 {D:\NMR400\203} nmr 40



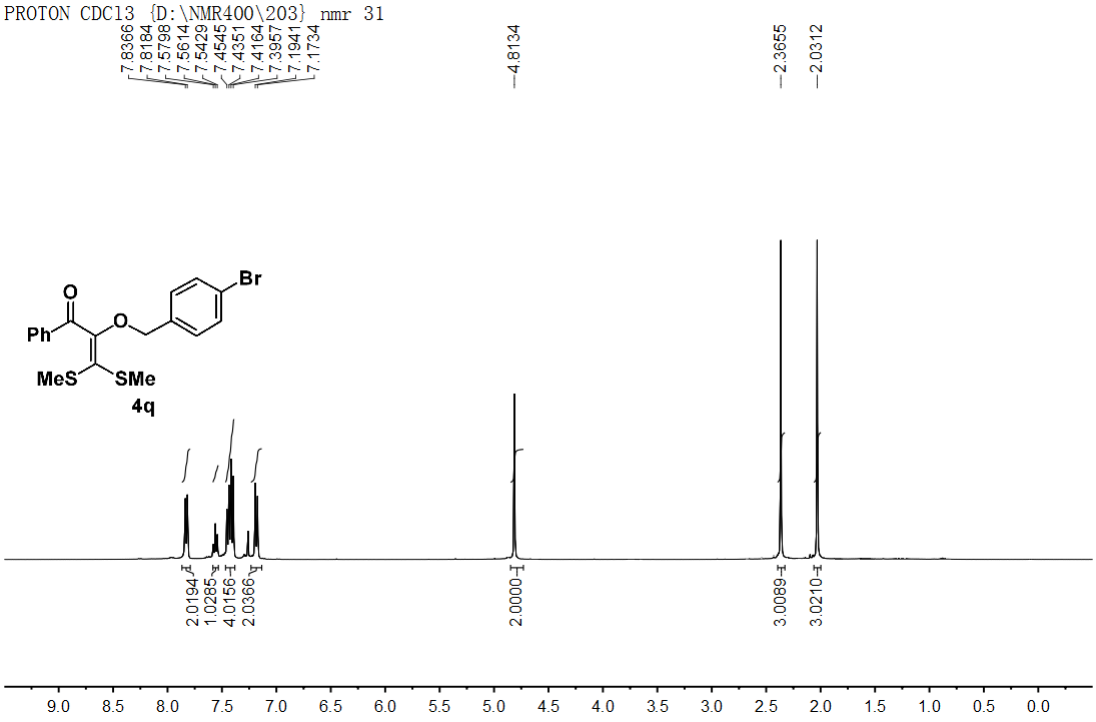
LZQ-765

C13CPD CDCl3 {D:\NMR400\203} nmr 40



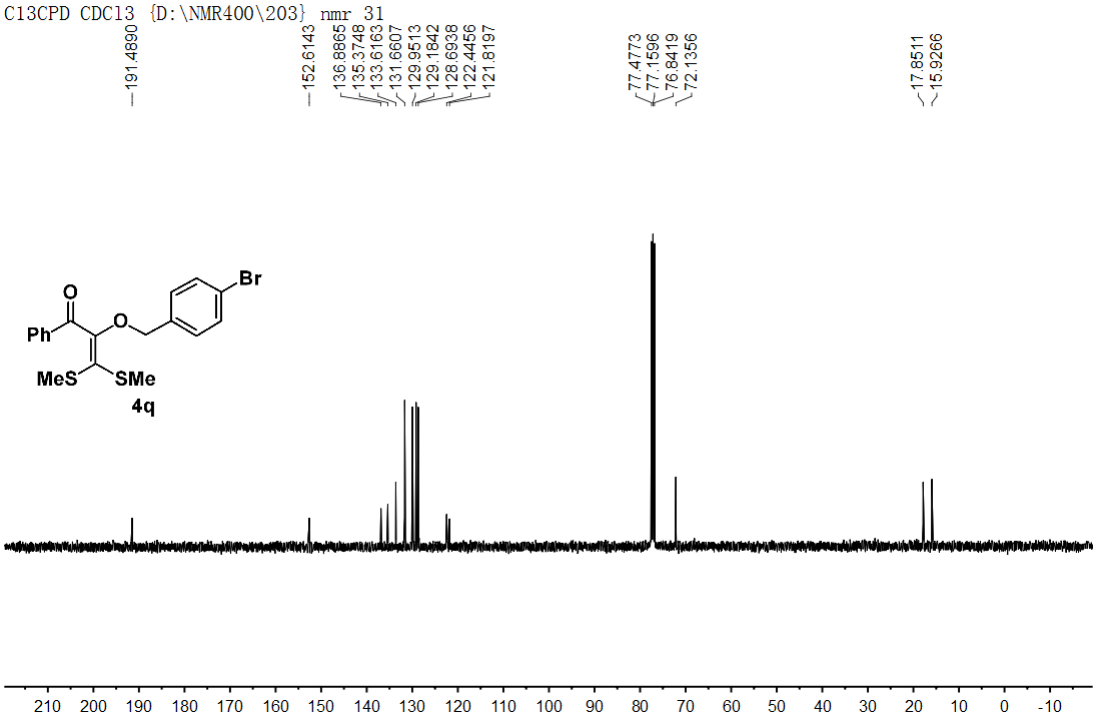
LZQ-776

PROTON CDCl3 {D:\NMR400\203} nmr 31



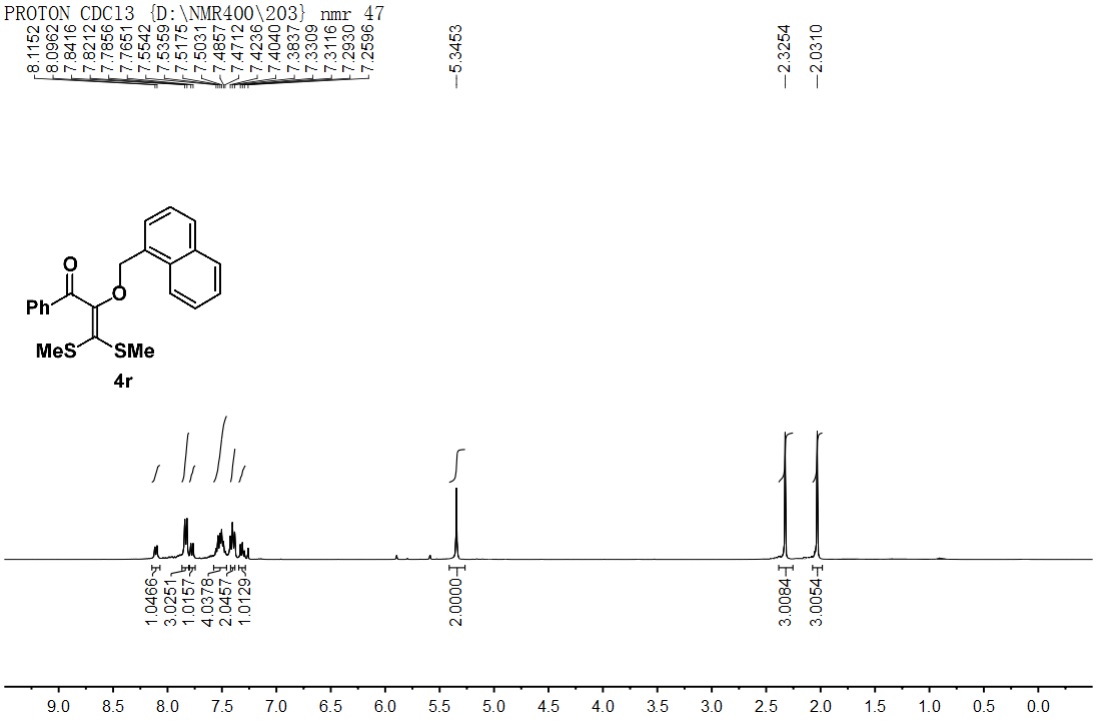
LZQ-776

C13CPD CDCl3 {D:\NMR400\203} nmr 31



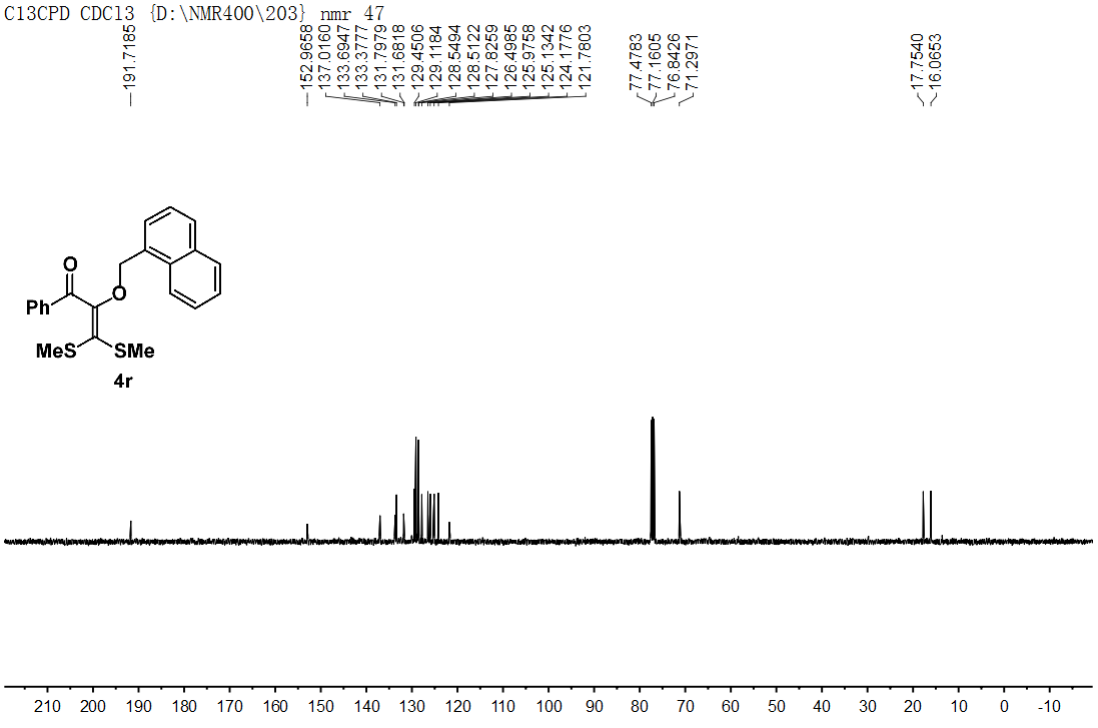
LZQ-430

PROTON CDCl3 {D:\NMR400\203} nmr 47



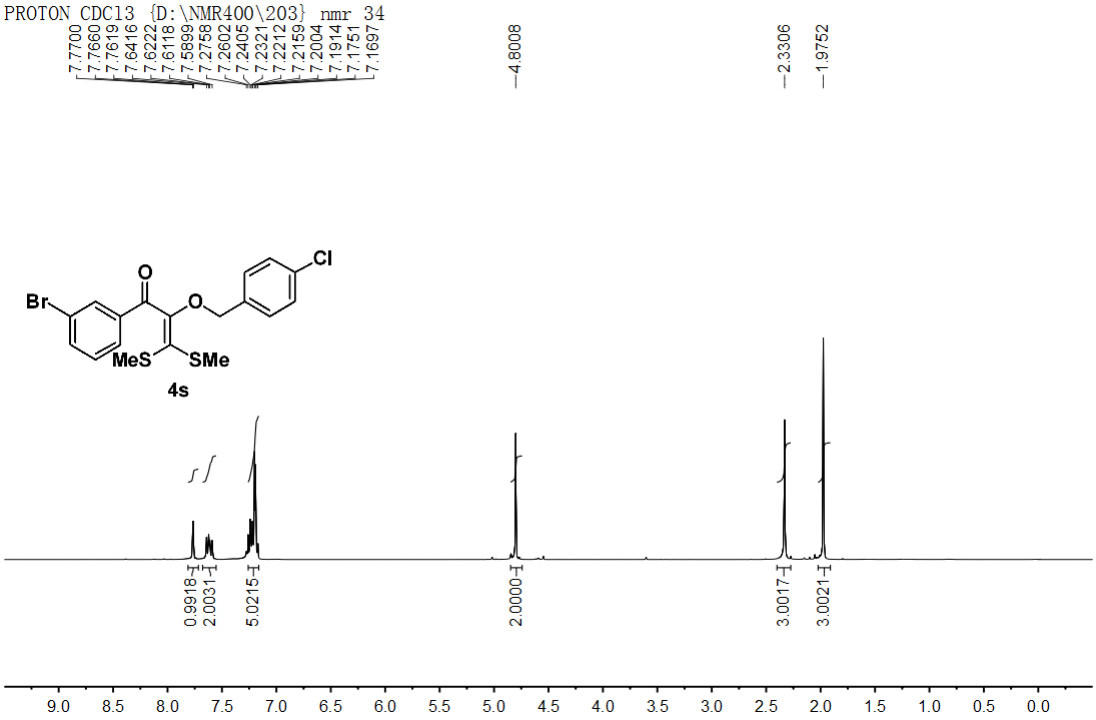
LZQ-430

C13CPD CDCl3 {D:\NMR400\203} nmr 47



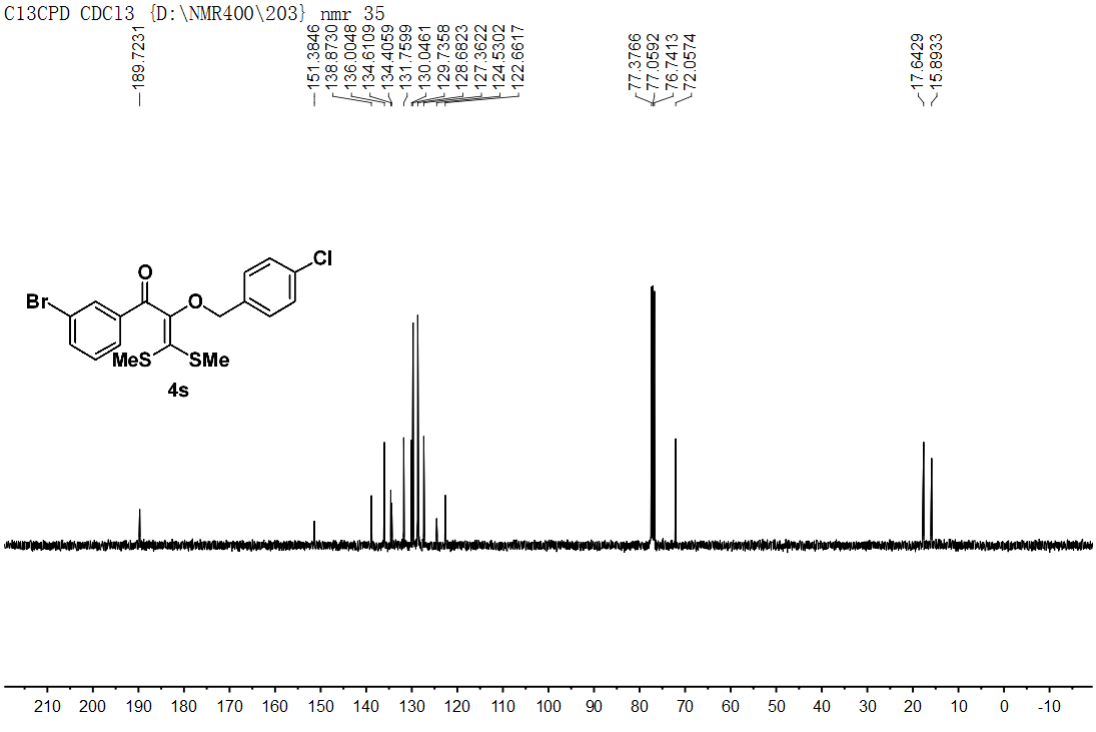
LZQ-884

PROTON CDCl3 {D:\NMR400\203} nmr 34



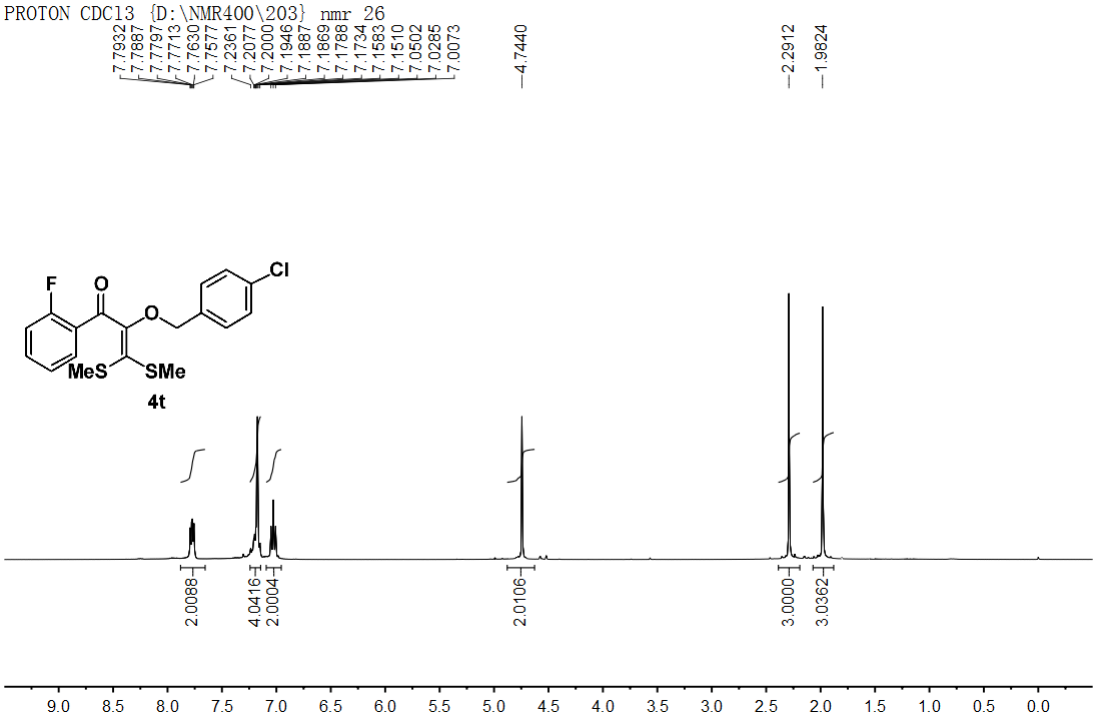
LZQ-884

C13CPD CDCl3 {D:\NMR400\203} nmr 35



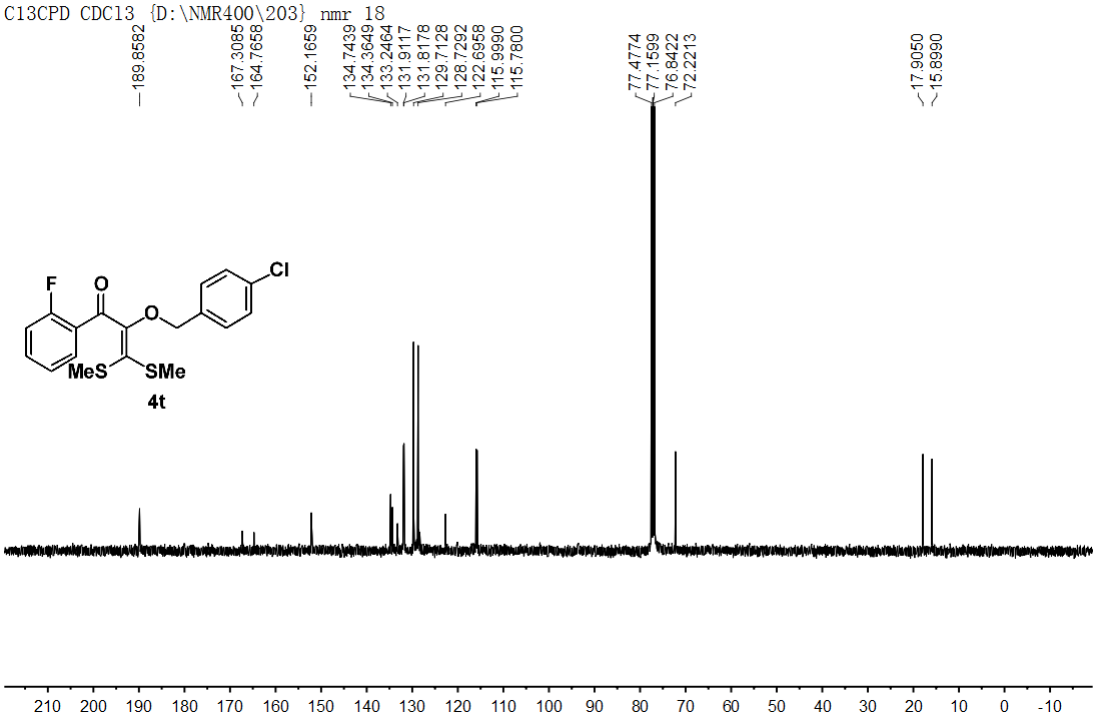
LZQ-841

PROTON CDCl3 {D:\NMR400\203} nmr 26



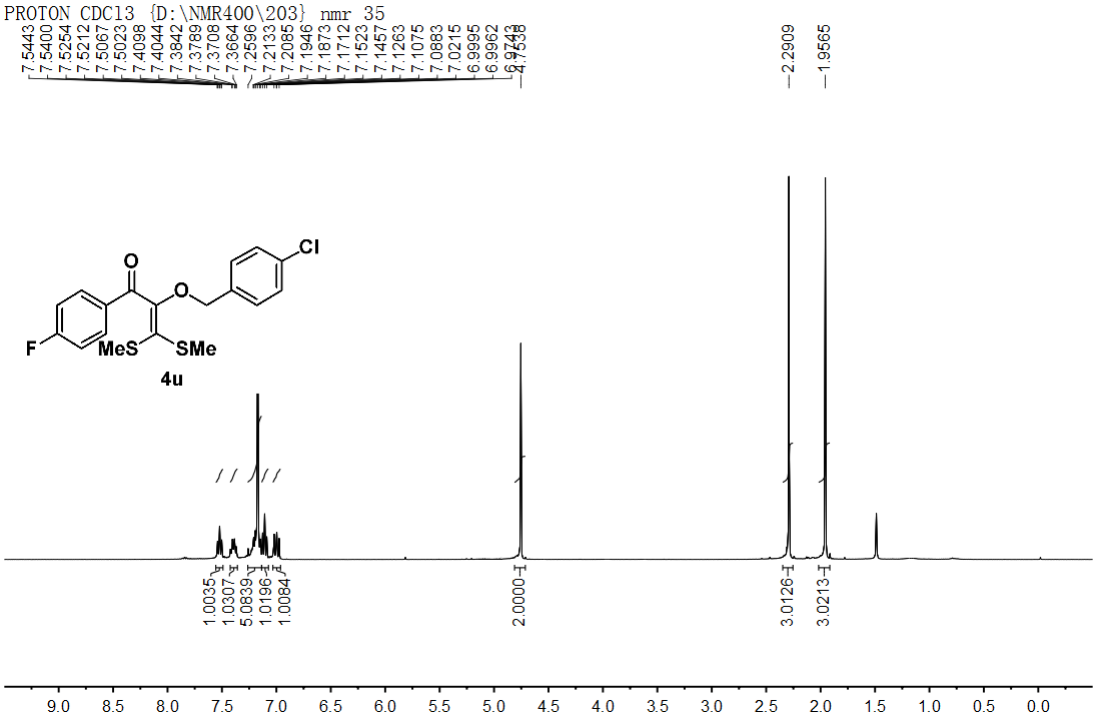
LZQ-841

C13CPD CDCl3 {D:\NMR400\203} nmr 18



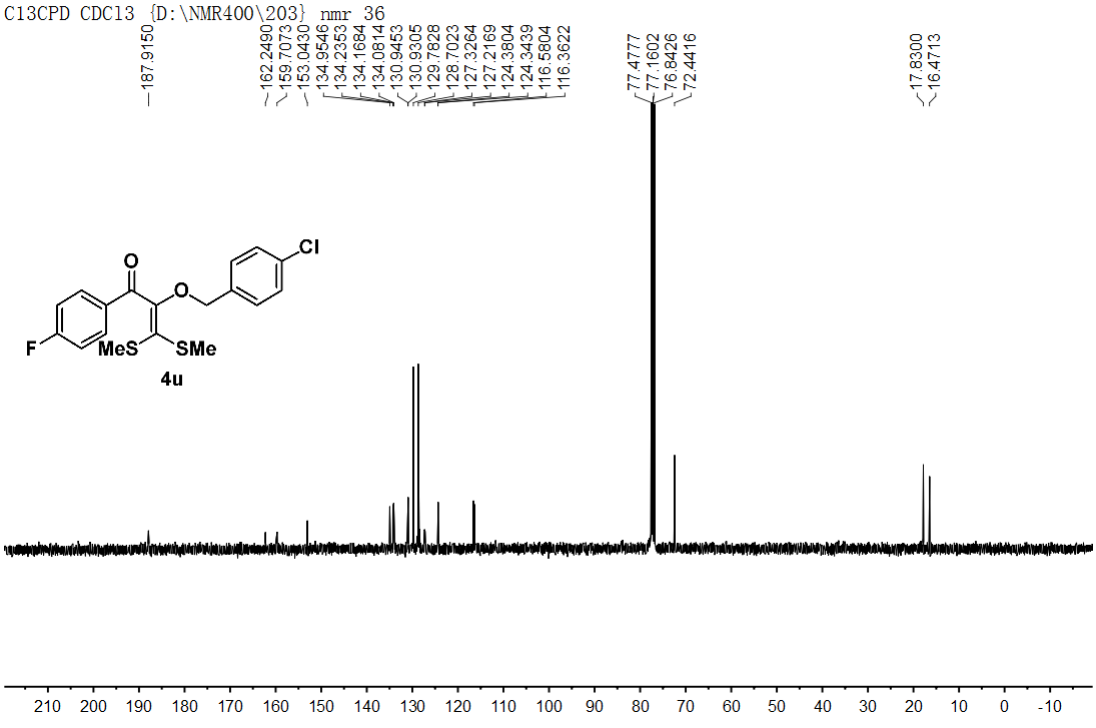
LZQ-885

PROTON CDC13 {D:\NMR400\203} nmr 35



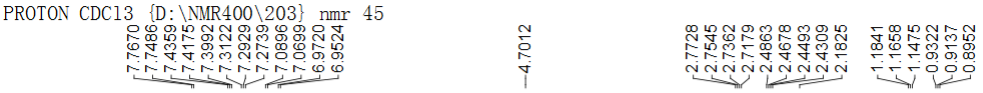
LZQ-885

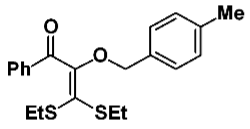
C13CPD CDC13 {D:\NMR400\203} nmr 36



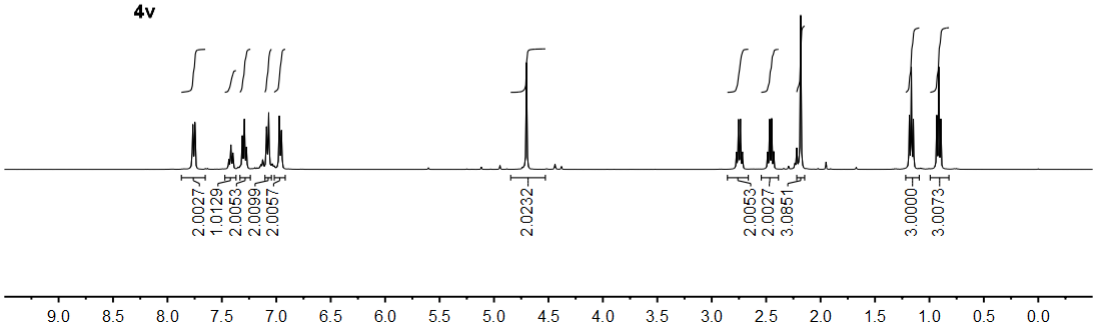
LZQ-469

PROTON CDC13 {D:\NMR400\203} nmr 45



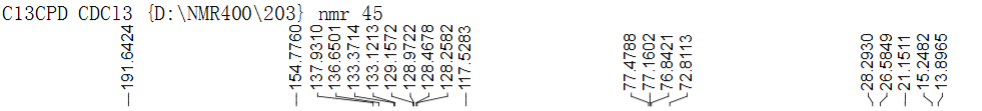


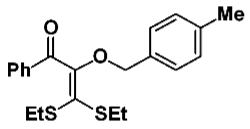
4v



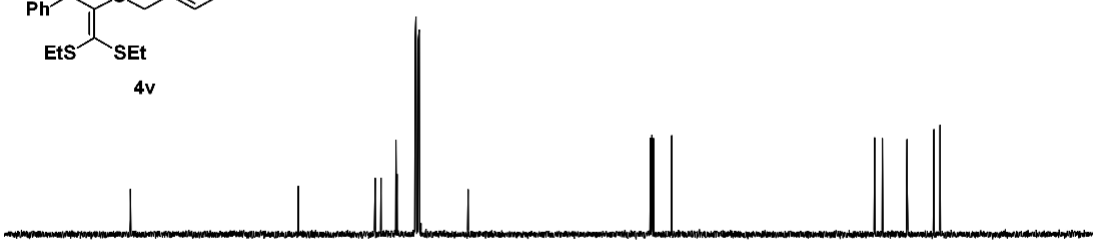
LZQ-469

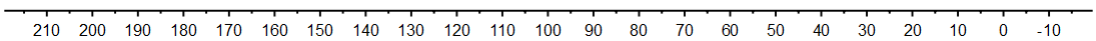
C13CPD CDC13 {D:\NMR400\203} nmr 45





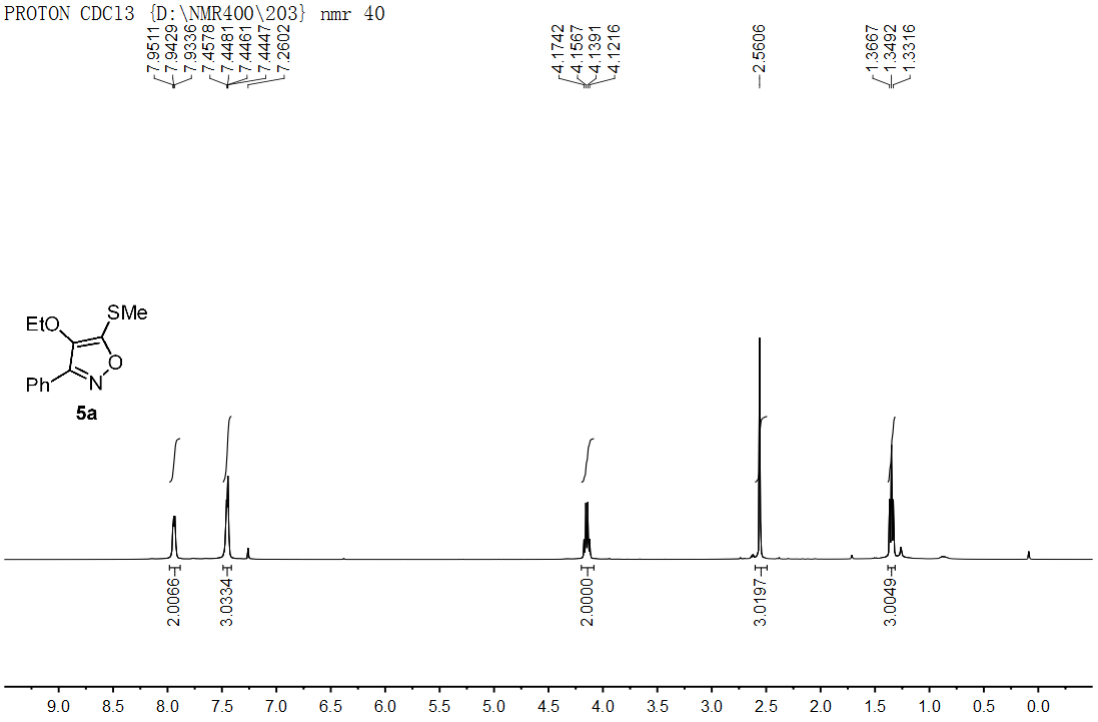
4v





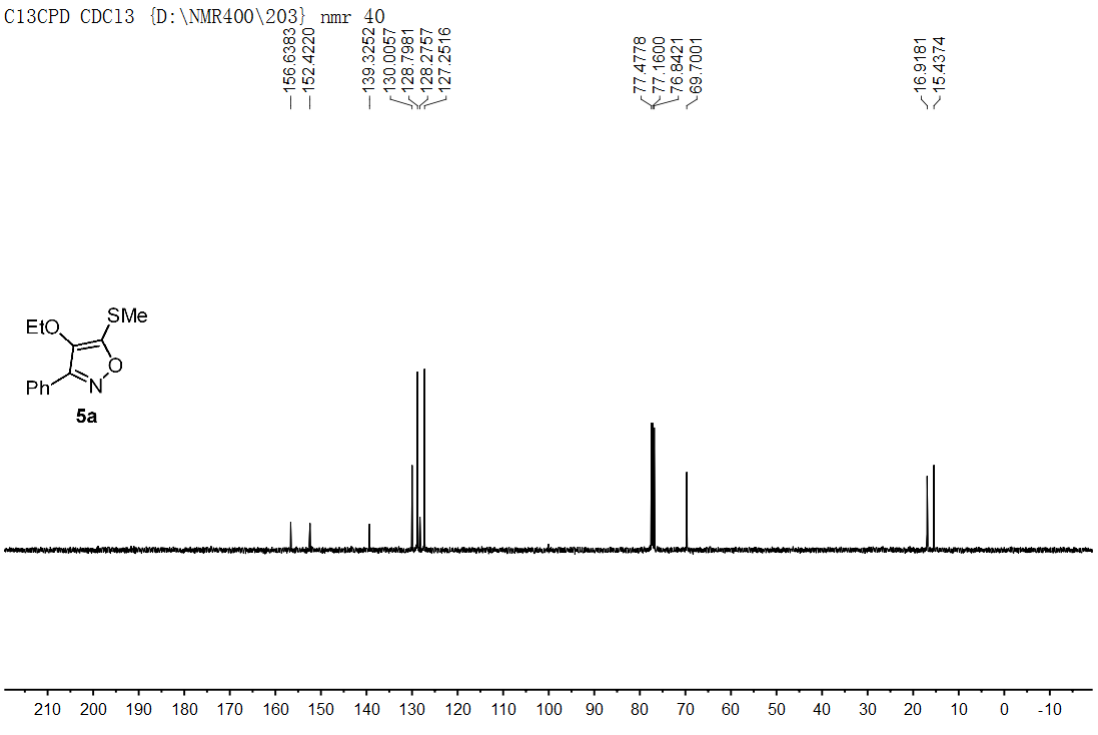
LZQ-512

PROTON CDC13 {D:\NMR400\203} nmr 40



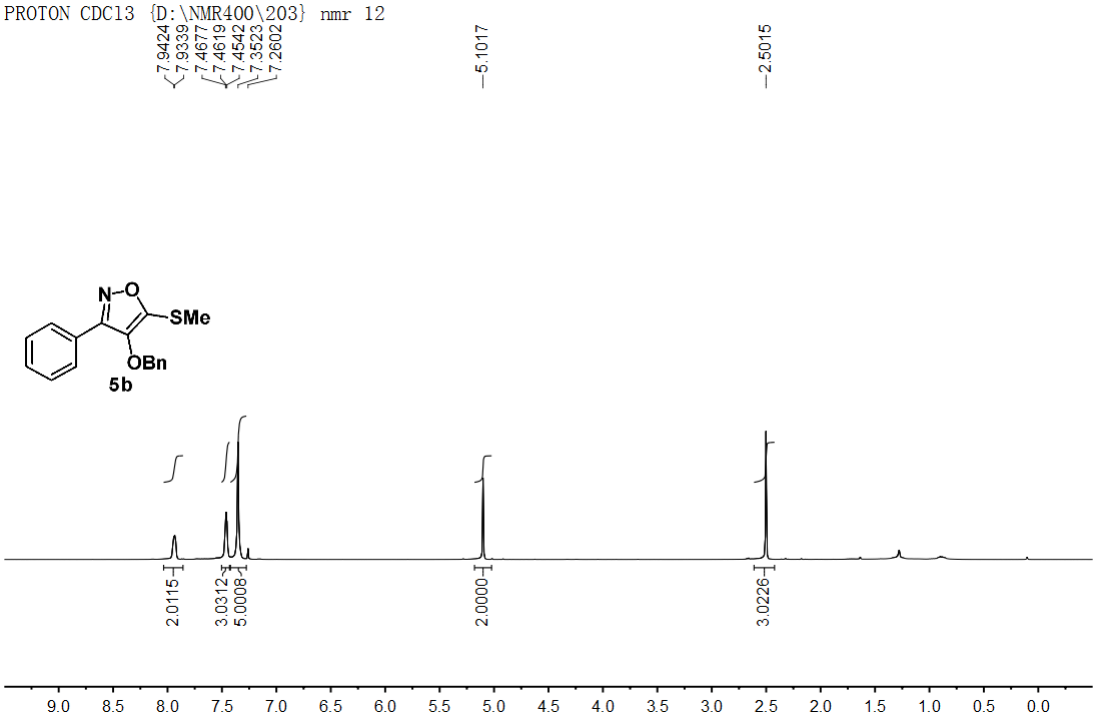
LZQ-512

C13CPD CDC13 {D:\NMR400\203} nmr 40



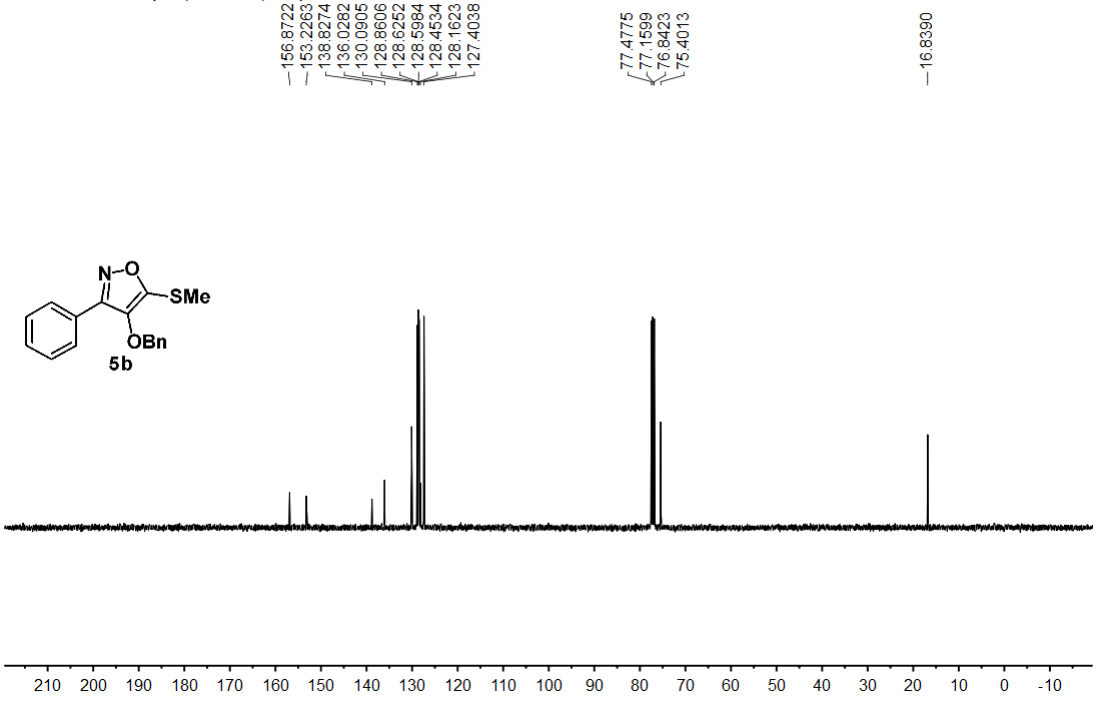
LZQ-513

PROTON CDCl3 {D:\NMR400\203} nmr 12



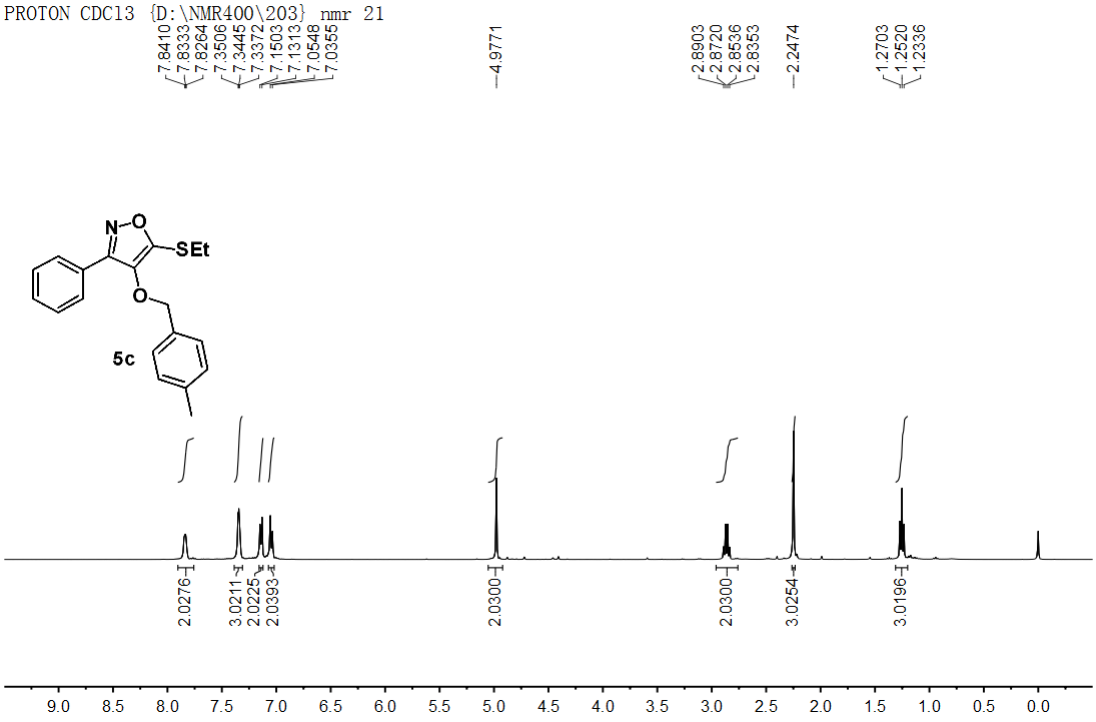
LZQ-513

C13CPD CDCl3 {D:\NMR400\203} nmr 12



lzq-514-s

PROTON CDCl3 {D:\NMR400\203} nmr 21



lzq-514-s

C13CPD CDCl3 {D:\NMR400\203} nmr 21