

Electronic Supporting Information

Organocatalyzed diastereoselective cyclization of β -alkyl nitroolefins with alkylidene malononitriles: new approach to azetidine nitrones and isoxazoles

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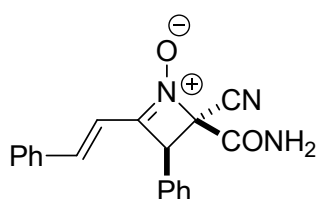
General information: All the reactions were carried out either under an inert atmosphere or air and monitored by TLC using Merck 60 F₂₅₄ pre-coated silica-gel plates and the products were visualized by UV detection. Flash chromatography was carried out using silica-gel (200-300 mesh). ¹H and ¹³C NMR spectra were recorded on 500 MHz and 400 MHz spectrometers. Data for ¹H NMR are reported as a chemical shift (δ ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constant *J* (Hz), integration, and assignment, data for ¹³C are reported as a chemical shift. High resolution mass spectrometry (HRMS) data analysis was carried out using ESI-TOF-MS. Melting points were recorded on an Electro thermal melting points apparatus and are uncorrected.

Starting materials: All the β-alkyl nitroalkenes (**1a-1d**),¹ and alkylidene malononitriles (**2a-z**)² were synthesized by literature known procedures. All the starting materials were known in the literatures. All the catalysts were purchased from commercial suppliers.

General procedure for the synthesis of azetidine nitrone (3):

To a stirred solution of 3-nitroallylarene **1** (0.2 mmol) and alkylidene malononitrile **2** (0.24 mmol) in dry DCM (1.0 mL) under an argon atmosphere was added DABCO (0.02 mmol, 10 mol%) at room temperature. The progress of the reaction was monitored by TLC. After completion of the reaction, the solvent was removed, followed by the extraction with ethyl acetate (3 × 10 mL). The extracted solvent was washed with brine and dried over anhydrous Na₂SO₄. The combined organic phases were concentrated under reduced pressure at room temperature to give the crude product. It was purified by silica gel column chromatography using ethyl acetate/hexane (1:5) as a mixture of solvent to provide a pure solid nitrone product **3**. The yield was calculated based on the pure product with a mixture of diastereomer. The above procedure was followed for synthesizing all the products in Scheme 2. Finally, the purified product with a mixture of diastereomer was partially crystallized by using ethyl acetate/hexane as a mixture of solvent to obtain major isomer which was characterized by its spectroscopic data (¹H, ¹³C NMR and HRMS data).

(2*S,3*R**)-2-Carbamoyl-2-cyano-3-phenyl-4-((*E*)-styryl)-2,3-dihydroazete 1-oxide (3aa):**



White solid; mp 141-143 °C; yield = 82%; dr = 84:16; *R_f* = 0.30 (EtOAc/hexane = 30:70); ¹H NMR (500 MHz, CDCl₃) δ 7.53-7.34 (m, 8H), 7.31-7.29 (m, 2H), 7.13 (s, 1H), 7.12 (d, *J* = 16.4 Hz, 1H), 7.02 (d, *J* = 16.5 Hz, 1H), 5.71 (s, 1H), 4.82 (s, 1H) ppm; ¹³C NMR (125 MHz, CDCl₃) δ 161.2, 154.9, 142.2, 135.7, 131.9, 131.1, 131.0, 130.4,

130.3, 129.9, 129.0, 114.0, 112.1, 77.1, 51.9 ppm; HRMS (ESI) m/z calcd for $C_{19}H_{15}N_3O_2Na^+$ $[M+Na]^+$: 340.1056, found 340.1063.

The relative stereochemistry of major isomer **3aa** was assigned by its single-crystal-X-ray diffraction data.

Crystallographic data: Single crystal X-ray structural of compound **3aa** was measured on the SuperNova, Dual, Mo at home/near, Eos-XRD at 150(2) K using graphite monochromated Mo $K\alpha$ radiation ($\lambda = 0.71073 \text{ \AA}$). The strategy for the Data collection was evaluated by using the CrysAlisPro CCD software. The data were collected by the standard 'phi-omega scan techniques, and were scaled and reduced using CrysAlisPro RED software. The structure was solved by direct methods using SHELXS-97, and refined by full matrix least-squares with SHELXL-97, refining on F^2 . The positions of all the atoms were obtained by direct methods. All non-hydrogen atoms were refined anisotropically. The remaining hydrogen atoms were placed in geometrically constrained positions, and refined with isotropic temperature factors, generally $1.2U_{eq}$ of their parent atoms. The crystal data are summarized in Table S1. The **CCDC** number(**2292044**) can be obtained free of charge via www.ccdc.cam.ac.uk (or from the Cambridge Crystallographic Data Centre, 12 union Road, Cambridge CB21 EZ, UK; Fax: (+44) 1223-336-033; or deposit@ccdc.cam.ac.uk).

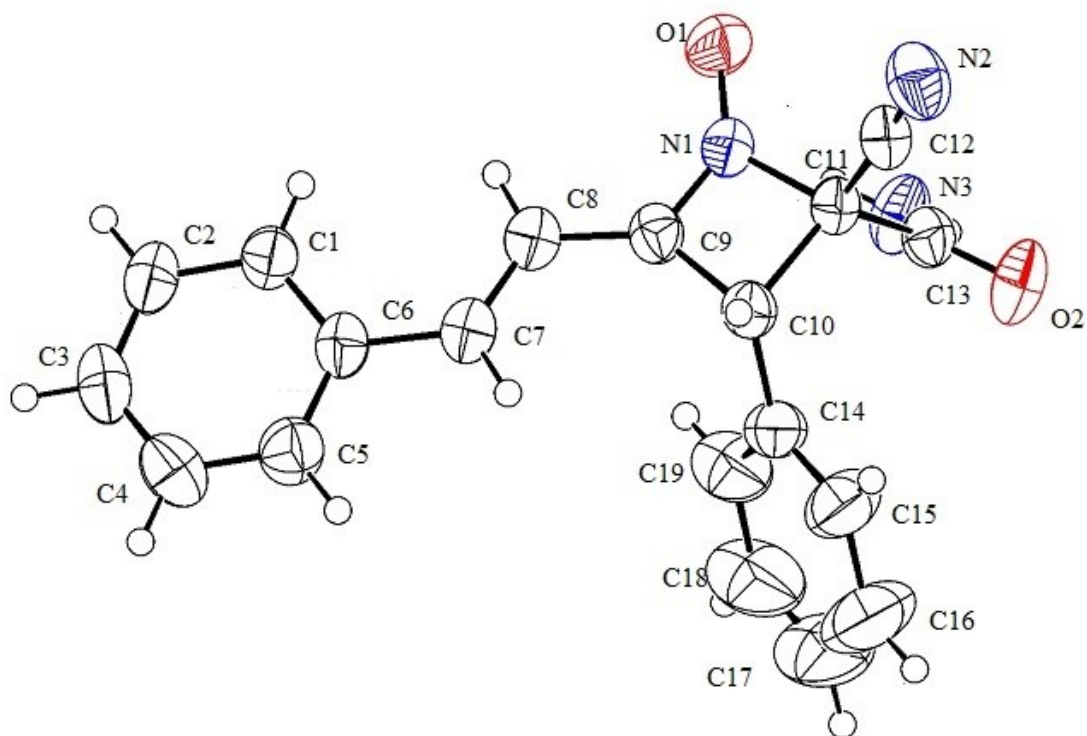


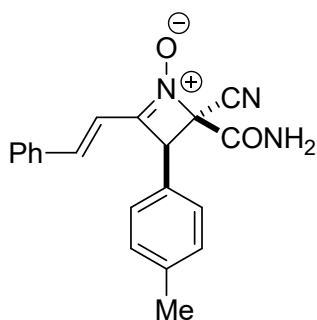
Figure S1. ORTEP diagram of compound **3aa** (CCDC 2292044), thermal ellipsoids drawn at the 50% probability level.

Table S1: Crystal data and structure refinement for compound 3aa.

Compound	3aa
Empirical formula	C ₁₉ H ₁₅ N ₃ O ₂
Formula weight	317.1164
Temperature/K	298K
Wavelength (Å)	0.71073 Å
Crystal system	Monoclinic
Space group	P2 ₁ /c
a/Å	11.8860(8)
b/Å	12.6490(6)
c/Å	12.3805(9)
α/°	90
β/°	114.440(9)
γ/°	90
Volume/Å ³	1694.6(2)
Z	7
ρ _{calc} /g/cm ³	1.244
μ/mm ⁻¹	0.083
F (000)	664.0
Radiation	Mo Kα (λ = 0.71073)
2θ range for data collection/°	6.442 to 58.686

Index ranges	-15 ≤ h ≤ 15, -16 ≤ k ≤ 17, -16 ≤ l ≤ 16
Reflections collected	20440
Independent reflections	4226 [R _{int} = 0.0512, R _{sigma} = 0.0425]
Data/restraints/parameters	4226/0/217
Goodness-of-fit on F ²	1.047
Final R indexes [I >= 2σ (I)]	R ₁ = 0.0619, wR ₂ = 0.1729
Final R indexes [all data]	R ₁ = 0.0888, wR ₂ = 0.1901
Largest diff. peak/hole / e Å ⁻³	0.42/-0.28
CCDC	2292044

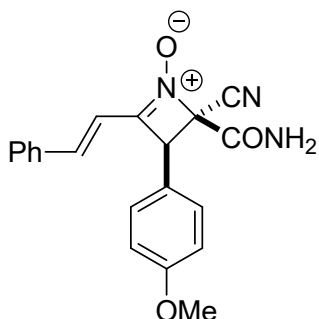
(2*S,3*R**)-2-Carbamoyl-2-cyano-4-((*E*)-styryl)-3-(4-methylphenyl)-2,3-dihydroazete 1-**



oxide (3ab): White solid; mp 152-154 °C; yield = 81%; dr = 84:16; R_f = 0.28 (EtOAc/hexane = 30:70); ¹H NMR (500 MHz, CDCl₃) δ 7.43-7.42 (m, 2H), 7.36-7.35 (m, 3H), 7.19 (br s, 4H), 7.12 (s, 1H), 7.11 (d, *J* = 16.5 Hz, 1H), 7.02 (d, *J* = 16.5 Hz, 1H), 5.73 (s, 1H), 4.79 (s, 1H), 2.35 (s, 3H) ppm; ¹³C NMR (125 MHz, CDCl₃) δ 160.3, 154.0, 141.0, 140.1, 134.7, 130.8, 130.1, 129.2, 128.7, 128.0, 126.9, 113.0, 111.1, 76.2, 50.7, 21.5 ppm;

HRMS (ESI) *m/z* calcd for C₂₀H₁₈N₃O₂⁺ [M+H]⁺: 332.1394 found 332.1375.

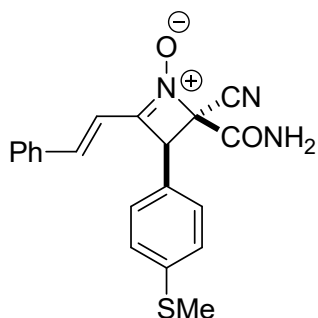
(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(4-methoxyphenyl)-4-((*E*)-styryl)-2,3-dihydroazete 1-**



oxide (3ac): White solid; mp 158-160 °C; yield = 79%; dr = 81:19; R_f = 0.27 (EtOAc/hexane = 30:70); ¹H NMR (500 MHz, CDCl₃) δ 7.45-7.41 (m, 2H), 7.38-7.34 (m, 3H), 7.23 (d, *J* = 8.7 Hz, 2H), 7.12 (s, 1H), 7.11 (d, *J* = 16.4 Hz, 1H), 7.02 (d, *J* = 16.5 Hz, 1H), 6.90 (d, *J* = 8.7 Hz, 2H), 5.64 (s, 1H), 4.79 (s, 1H), 3.80 (s, 3H) ppm; ¹³C NMR (125 MHz, CDCl₃) δ 160.8, 160.2, 154.0, 141.0, 134.7, 130.9, 130.1, 129.2, 128.0, 121.7,

114.8, 113.0, 111.1, 76.2, 55.4, 50.6 ppm; HRMS (ESI) *m/z* calcd for C₂₀H₁₇N₃O₃Na⁺ [M+Na]⁺: 370.1162, found 370.1188.

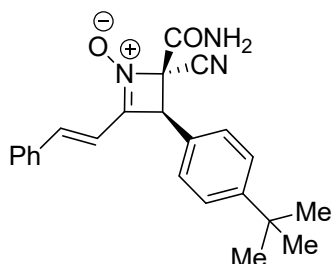
(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(4-(methylthio)phenyl)-4-((*E*)-styryl)-2,3-**



dihydroazete 1-oxide (3ad): White solid; mp 152-154 °C; yield = 77%; dr = 82:18; R_f = 0.28 (EtOAc/hexane = 30:70); ¹H NMR (500 MHz, CDCl₃) δ 7.46-7.41 (m, 2H), 7.38-7.35 (m, 3H), 7.22 (br s, 4H), 7.13 (s, 1H), 7.09 (d, *J* = 16.5 Hz, 1H), 7.02 (d, *J* = 16.5 Hz, 1H), 5.69 (s, 1H), 4.79 (s, 1H), 2.47 (s, 3H) ppm; ¹³C NMR (125 MHz, CDCl₃) δ 160.1, 153.8, 141.4, 141.1, 134.7, 130.9, 129.3,

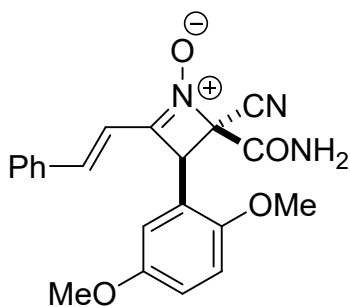
129.1, 128.0, 126.5, 126.2, 112.9, 111.0, 76.1, 50.5, 15.2 ppm; HRMS (ESI) m/z calcd for $C_{20}H_{17}N_3O_2SNa^+[M+Na]^+$: 386.0934, found 386.0962.

(2*S,3*R**)-3-(4-(*tert*-Butyl)phenyl)-2-carbamoyl-2-cyano-4-((*E*)-styryl)-2,3-dihydroazete**



1-oxide (3ae): White solid; mp 167-169 °C; yield = 78%; dr = 86:14; R_f = 0.30 (EtOAc/hexane = 30:70); 1H NMR (500 MHz, $CDCl_3$) δ 7.44 (dd, J = 6.7, 2.7 Hz, 2H), 7.41-7.34 (m, 5H), 7.22 (d, J = 8.3 Hz, 2H), 7.17 (d, J = 16.5 Hz, 1H), 7.10 (s, 1H), 7.00 (d, J = 16.5 Hz, 1H), 5.79 (s, 1H), 4.80 (s, 1H), 1.30 (s, 9H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 160.3, 154.1, 153.1, 141.1, 134.8, 130.8, 129.2, 128.6, 128.0, 126.8, 126.3, 113.1, 111.2, 76.2, 50.6, 34.9, 31.3 ppm; HRMS (ESI) m/z calcd for $C_{23}H_{23}N_3O_2^+[M+H]^+$: 374.1863, found 374.1866.

(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(2,5-dimethoxyphenyl)-4-((*E*)-styryl)-2,3-**



dihydroazete 1-oxide (3af): White solid; yield = 75%; mp 168-170 °C; R_f = 0.2 (EtOAc/ hexane = 30:70); 1H NMR (500 MHz, $CDCl_3$) δ 7.46-7.36 (m, 2H), 7.40-7.34 (m, 3H), 7.15 (d, J = 16.4 Hz, 1H), 7.05 (d, J = 16.5 Hz, 1H), 6.97 (s, 1H), 6.87 (br s, 2H), 6.70 (s, 1H), 5.64 (s, 1H), 5.11 (s, 1H), 3.87 (s, 3H), 3.69 (s, 3H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 160.2, 153.5, 152.7, 140.4, 134.8, 130.7 (2C), 129.2, 127.9, 119.7, 115.6, 114.9, 113.2, 112.0, 111.4, 75.9, 56.4, 55.9, 45.9 ppm; HRMS (ESI) m/z calcd for $C_{21}H_{19}N_3O_4Na^+[M+Na]^+$: 400.1268, found 400.1254.

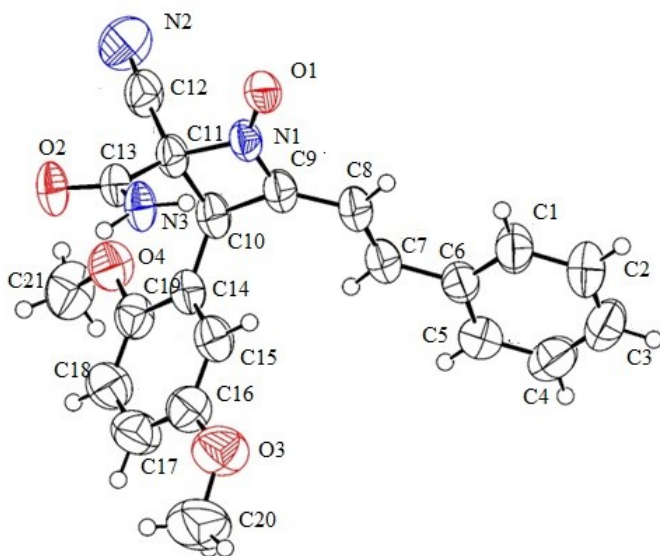


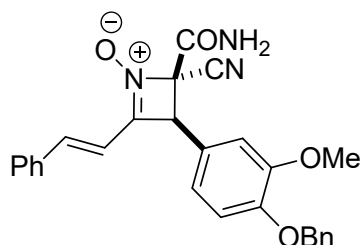
Figure S1. ORTEP diagram of compound **3af** (CCDC 2292045), thermal ellipsoids drawn at the 50% probability level.

Table S2: Crystal data and structure refinement for compound 3af.

Compound	3af
Empirical formula	C ₂₁ H ₁₉ N ₃ O ₄
Formula weight	377.1376
Temperature/K	293 K
Wavelength (Å)	0.71073 Å
Crystal system	Monoclinic
Space group	I2/a
a/Å	16.4422(7)
b/Å	14.3442(5)
c/Å	17.1296(7)
α /°	90
β /°	99.822(4)
γ /°	90
Volume/Å ³	3980.8(3)
Z	8
$\rho_{\text{calc}}/\text{g}/\text{cm}^3$	1.259
μ/mm^{-1}	0.089
F (000)	1584.0
Radiation	Mo K α (λ = 0.71073)
2 θ range for data collection/°	6.35 to 58.162
Index ranges	-22 \leq h \leq 21, -19 \leq k \leq 19, -23 \leq l \leq 20
Reflections collected	25442
Independent reflections	4942 [Rint = 0.0565, Rsigma = 0.0298]
Data/restraints/parameters	4942/0/260
Goodness-of-fit on F ²	1.050

Final R indexes [$I \geq 2\sigma(I)$]	$R_1 = 0.0640$, $wR_2 = 0.1435$
Final R indexes [all data]	$R_1 = 0.0911$, $wR_2 = 0.1665$
Largest diff. peak/hole / $e \text{ \AA}^{-3}$	0.15/-0.26
CCDC	2292045

(2*S,3*R**)-3-(4-(Benzyloxy)-3-methoxyphenyl)-2-carbamoyl-2-cyano-4-((*E*)-styryl)-2,3-**



dihydroazete 1-oxide (3ag): White solid; mp 153-155 °C;

yield = 76%; dr = 80:20; $R_f = 0.2$ (EtOAc/hexane = 30:70); ^1H

NMR (500 MHz, CDCl_3) δ 7.46-7.40 (m, 5H), 7.39-7.32 (m,

6H), 7.32 (d, $J = 7.2$ Hz, 2H), 7.13 (d, $J = 16.5$ Hz, 1H), 7.01

(d, $J = 16.5$ Hz, 1H), 6.86 (d, $J = 8.0$ Hz, 2H), 6.80 (s, 1H),

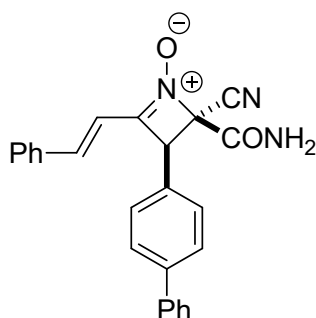
5.65 (s, 1H), 5.12 (s, 2H), 4.76 (s, 1H), 3.85 (s, 3H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ

160.2, 154.0, 150.1, 149.6, 141.1, 136.7, 134.7, 130.9, 129.3, 128.8, 128.2, 128.0, 127.5,

122.5, 121.3, 113.8, 113.1, 112.3, 111.0, 76.3, 71.1, 56.3, 50.9 ppm; HRMS (ESI) m/z calcd

for $\text{C}_{27}\text{H}_{24}\text{N}_3\text{O}_4^+[\text{M}+\text{H}]^+$: 454.1761, found 454.1777.

(2*S,3*R**)-3-([1,1'-Biphenyl]-4-yl)-2-carbamoyl-2-cyano-4-((*E*)-styryl)-2,3-dihydroazete**



1-oxide (3ah): White solid; mp 160-162 °C; yield = 80%; dr =

83:17; $R_f = 0.30$ (EtOAc/hexane = 30:70); ^1H NMR (500 MHz,

CDCl_3) δ 7.60 (d, $J = 7.5$ Hz, 2H), 7.57 (d, $J = 7.8$ Hz, 2H),

7.45-7.42 (m, 4H), 7.40-7.32 (m, 6H), 7.16 (s, 1H), 7.15 (d, $J =$

17.2 Hz, 1H), 7.04 (d, $J = 16.5$ Hz, 1H), 5.83 (s, 1H), 4.86 (s,

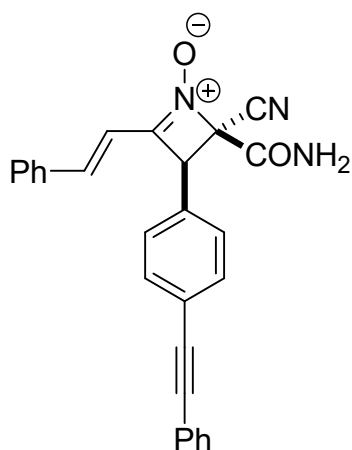
1H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 160.2, 153.9, 142.8,

141.1, 140.0, 134.7, 130.9, 129.3(2C), 129.2, 129.0, 128.9,

128.0, 127.9, 127.2, 113.0, 111.0, 76.2, 50.6 ppm; HRMS (ESI) m/z calcd for $\text{C}_{25}\text{H}_{19}\text{N}_3\text{O}_2\text{Na}^+$

$[\text{M}+\text{Na}]^+$: 416.1376, found 416.1375.

(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(4-(phenylethynyl)phenyl)-4-((*E*)-styryl)-2,3-**



dihydroazete 1-oxide (3ai): White solid; mp 155-157 °C; yield

= 78%; dr = 85:15; $R_f = 0.30$ (EtOAc/hexane = 30:70); ^1H

NMR (400 MHz, CDCl_3) δ 7.60-7.43 (m, 4H), 7.46-7.25 (m,

10H), 7.20-7.10 (m, 3H), 5.80 (s, 1H), 4.84 (s, 1H) ppm; ^{13}C

NMR (100 MHz, CDCl_3) δ 160.0, 153.6, 141.1, 134.6, 132.5,

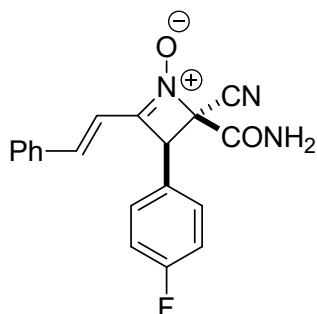
131.8, 131.0, 130.0, 129.3, 128.9, 128.8, 128.6, 128.0, 125.2,

122.9, 112.9, 110.9, 91.4, 88.5, 76.1, 50.5 ppm; HRMS (ESI)

m/z calcd for $\text{C}_{27}\text{H}_{20}\text{N}_3\text{O}_2\text{N}^+[\text{M}+\text{H}]^+$: 418.1550, found

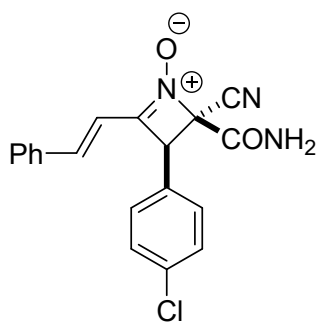
418.1559.

(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(4-fluorophenyl)-4-((*E*)-styryl)-2,3-dihydroazete 1-oxide (3aj):** White solid; mp 150-152 °C; yield = 82%; dr = 85:15; R_f = 0.30 (EtOAc/hexane



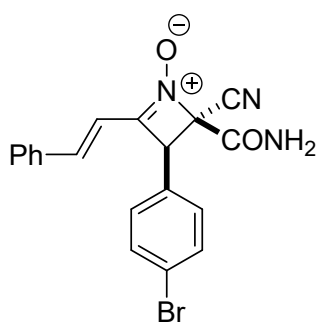
= 30:70); ^1H NMR (500 MHz, DMSO- d_6) δ 7.93 (s, 2H), 7.62-7.55 (m, 2H), 7.47-7.42 (m, 2H), 7.41-7.34 (m, 3H), 7.21 (t, J = 8.7 Hz, 2H), 7.15 (d, J = 16.5 Hz, 1H), 7.06 (d, J = 16.5 Hz, 1H), 5.28 (s, 1H) ppm; ^{13}C NMR (125 MHz, DMSO- d_6) 162.4(d, $J_{\text{C-F}}$ = 244 Hz), 159.7, 152.1, 137.8, 135.0, 131.79 (d, J = 8.6 Hz), 130.0, 129.1, 127.7, 127.0, 115.4 (d, $J_{\text{C-F}}$ = 21.4 Hz), 114.2, 112.1, 78.7, 47.6 ppm; ^{19}F NMR (470 MHz, DMSO- d_6) δ (major isomer) -112.8 ppm; δ (minor isomer) -113.8 ppm; HRMS (ESI) m/z calcd for $\text{C}_{29}\text{H}_{19}\text{FN}_3\text{O}_2\text{Na}^+$ [$\text{M}+\text{Na}$] $^+$: 358.0962, found 358.0958.

(2*S,3*R**)-2-Carbamoyl-3-(4-chlorophenyl)-2-cyano-4-((*E*)-styryl)-2,3-dihydroazete 1-oxide (3ak):** White solid; mp 158-160 °C; yield = 84%; dr =



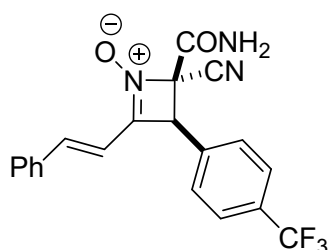
82:18; R_f = 0.33 (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, CDCl_3) δ 7.45-7.41 (m, 2H), 7.39-7.34 (m, 5H), 7.27-7.23 (m, 2H), 7.15 (s, 1H), 7.07 (d, J = 16.5 Hz, 1H), 7.00 (d, J = 16.5 Hz, 1H), 5.72 (s, 1H), 4.79 (s, 1H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 159.9, 153.4, 141.1, 136.8, 134.5, 131.0, 130.1, 129.7, 129.3, 128.6, 128.0, 112.8, 110.8, 75.9, 50.0 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{14}\text{ClN}_3\text{O}_2\text{Na}^+$ [$\text{M}+\text{Na}$] $^+$: 374.0667, found 374.0669.

(2*S,3*R**)-3-(4-Bromophenyl)-2-carbamoyl-2-cyano-4-((*E*)-styryl)-2,3-dihydroazete 1-oxide (3al):** White solid; mp 166-168 °C; yield = 80%; dr = 81:19;



R_f = 0.31 (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, CDCl_3) δ 7.60 (d, J = 7.9 Hz, 2H), 7.51 (d, J = 6.5 Hz, 2H), 7.45 (br s, 3H), 7.26 (d, J = 7.9 Hz, 2H), 7.23 (s, 1H), 7.15 (d, J = 16.5 Hz, 1H), 7.08 (d, J = 16.5 Hz, 1H), 5.75 (s, 1H), 4.86 (s, 1H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 159.9, 153.3, 141.2, 134.5, 132.7, 131.0, 130.4, 129.2, 129.1, 128.0, 124.4, 112.8, 110.8, 75.7, 50.1 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{14}^{79}\text{BrN}_3\text{O}_2\text{Na}^+$ [$\text{M}+\text{Na}$] $^+$: 418.0162, found 418.0166.

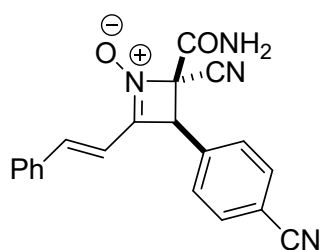
(2*S,3*R**)-2-Carbamoyl-2-cyano-4-((*E*)-styryl)-3-(4-(trifluoromethyl)-phenyl)-2,3-**



dihydroazete 1-oxide (3am): White solid; mp 174-176 °C; yield = 81%; dr = 82:18; R_f = 0.30 (EtOAc/hexane = 30:70); ^1H

NMR (500 MHz, DMSO-*d*₆) δ 7.98 (d, *J* = 4.5 Hz, 2H), 7.77 (d, *J* = 8.2 Hz, 2H), 7.66-7.58 (m, 4H), 7.41-7.33 (m, 3H), 7.19 (d, *J* = 16.5 Hz, 1H), 7.11 (d, *J* = 16.5 Hz, 1H), 5.42 (s, 1H) ppm; ¹³C NMR (125 MHz, DMSO-*d*₆) δ 159.5, 151.8, 137.9, 135.6, 135.0, 130.5, 130.0, 129.5, 129.4, 129.2, 127.7, 125.3 (q), 114.0, 112.1, 78.4, 47.6 ppm; HRMS (ESI) *m/z* calcd for C₂₀H₁₅F₃N₃O₂⁺ [M+H]⁺: 386.1111, found 386.1123.

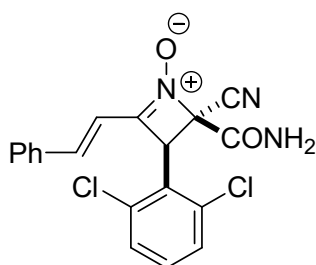
(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(4-cyanophenyl)-4-((*E*)-styryl)-2,3-dihydroazete 1-**



oxide (3an): White solid; mp 180-182 °C; yield = 79%; dr = 83:17; *R_f* = 0.26 (EtOAc/hexane = 30:70); ¹H NMR (500 MHz, DMSO-*d*₆) δ 7.97 (s, 2H), 7.88 (d, *J* = 8.2 Hz, 2H), 7.65-7.55 (m, 4H), 7.43-7.31 (m, 3H), 7.17 (d, *J* = 16.5 Hz, 1H), 7.07 (d, *J* = 16.5 Hz, 1H), 5.41 (s, 1H) ppm; ¹³C NMR (125 MHz, DMSO-

*d*₆) δ 159.9, 152.1, 138.4, 136.9, 135.4, 132.7, 131.1, 130.5, 129.5, 128.2, 118.9, 114.4, 112.5, 112.2, 78.8, 48.1 ppm; HRMS (ESI) *m/z* calcd for C₂₀H₁₄N₄O₂Na⁺ [M+Na]⁺: 363.1009, found 363.1041

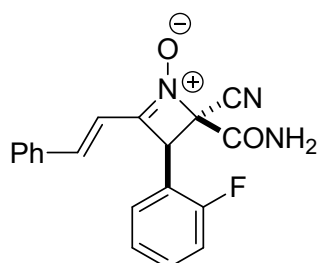
(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(2,6-dichlorophenyl)-4-((*E*)-styryl)-2,3-dihydroazete**



1-oxide (3ao): White solid; mp 167-169 °C; yield = 68%; dr = 93:7; *R_f* = 0.30 (EtOAc/hexane = 30:70); ¹H NMR (500 MHz, CDCl₃) δ 7.51 (d, *J* = 6.4 Hz, 1H), 7.43-7.41 (m, 2H), 7.40 (d, *J* = 6.6 Hz, 1H), 7.38-7.31 (m, 4H), 7.21 (s, 1H), 7.05-6.97 (m, 2H), 6.01 (s, 1H), 5.61 (s, 1H) ppm; ¹³C NMR (125 MHz, CDCl₃) δ

161.2, 154.2, 139.1, 134.8, 131.5, 130.8, 130.6, 129.5, 129.2, 127.9, 125.8, 112.5, 110.9, 76.9, 44.5 ppm; HRMS (ESI) *m/z* calcd for C₁₉H₁₄Cl₂N₃O₂⁺ [M+H]⁺: 386.0458, found 386.0463.

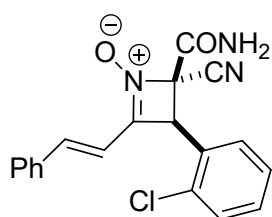
((2*S,3*R**)-2-Carbamoyl-2-cyano-3-(2-fluorophenyl)-4-((*E*)-styryl)-2,3-dihydroazete 1-**



oxide (3ap): White solid; mp 152-154 °C; yield = 76%; dr = 87:13; *R_f* = 0.30 (EtOAc/hexane = 30:70); ¹H NMR (500 MHz, CDCl₃) δ 7.46-7.44 (m, 2H), 7.42-7.40 (m, 1H), 7.37-7.35 (m, 5H), 7.04 (d, *J* = 16.5 Hz, 1H), 5.72 (s, 1H), 5.09 (s, 1H) ppm; ¹³C NMR (125 MHz, CDCl₃) 161.8 (d, *J_{C-F}* = 249.18 Hz), 159.9, 152.6, 140.8, 134.7, 131.93 (d, *J_{C-F}* = 8.4 Hz), 130.9, 129.3, 128.0, 124.8 (d, *J_{C-F}* = 3.7 Hz), 117.89 (d, *J_{C-F}* = 13.6

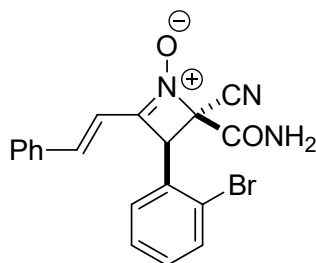
Hz), 116.4, 116.2, 112.7, 111.1, 75.2, 44.31 (d, *J_{C-F}* = 4.3 Hz) ppm; HRMS (ESI) *m/z* calcd for C₁₉H₁₅FN₃O₂⁺ [M+H]⁺: 336.1143, found 336.1141.

(2*S,3*R**)-2-Carbamoyl-3-(2-chlorophenyl)-2-cyano-4-((*E*)-styryl)-2,3-dihydroazete 1-**



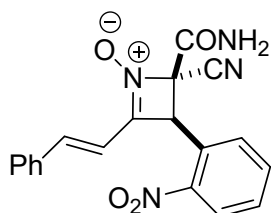
oxide (3aq): White solid; mp 170-172 °C; yield = 75%; dr = 86:14; $R_f = 0.30$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, DMSO- d_6) δ 7.95 (s, 1H), 7.89 (s, 1H), 7.65-7.59 (m, 2H), 7.55 (d, $J = 7.8$ Hz, 1H), 7.43-7.37 (m, 5H), 7.33 (t, $J = 7.2$ Hz, 1H), 7.23 (d, $J = 16.6$ Hz, 1H), 7.18 (d, $J = 16.7$ Hz, 1H), 5.45 (s, 1H) ppm; $^{13}\text{C NMR}$ (125 MHz, DMSO- d_6) δ 159.2, 151.4, 138.1, 135.1, 134.4, 130.9, 130.6, 130.0, 129.4, 129.0, 128.9, 127.7, 127.0, 114.0, 112.4, 78.3, 46.3 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{15}\text{ClN}_3\text{O}_4^+$ $[\text{M}+\text{H}]^+$: 352.0847, found 352.0845.

(2*S,3*R**)-3-(2-Bromophenyl)-2-carbamoyl-2-cyano-4-((*E*)-styryl)-2,3-dihydroazete 1-**



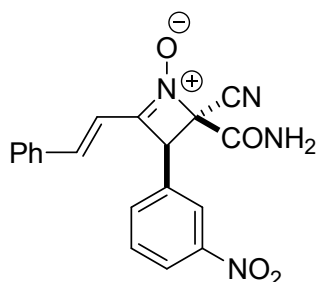
oxide (3ar): White solid; mp 161-163 °C; yield = 73%, dr = 88:12; $R_f = 0.30$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, DMSO- d_6) δ 7.95 (s, 1H), 7.87 (s, 1H), 7.71 (d, $J = 7.7$ Hz, 1H), 7.65-7.58 (m, 2H), 7.45-7.29 (m, 6H), 7.23 (d, $J = 16.5$ Hz, 1H), 7.17 (d, $J = 16.5$ Hz, 1H), 5.40 (s, 1H) ppm; $^{13}\text{C NMR}$ (125 MHz, DMSO- d_6) δ 159.1, 151.6, 138.1, 135.1, 132.7, 131.2, 130.8, 130.5, 130.0, 129.1, 127.7, 127.5, 125.1, 114.0, 112.4, 78.2, 48.7 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{15}^{79}\text{BrN}_3\text{O}_2^+$ $[\text{M}+\text{H}]^+$: 396.0342, found 396.0338; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{15}^{81}\text{BrN}_3\text{O}_2^+$ $[\text{M}+\text{H}]^+$: 398.0322, found 396.0342.

(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(2-nitrophenyl)-4-((*E*)-styryl)-2,3-dihydroazete 1-**



oxide (3as): White solid; mp 156-158 °C; yield = 74%; dr = 86:14; $R_f = 0.29$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, DMSO- d_6) δ 8.28-8.21 (m, 1H), 7.95 (s, 1H), 7.83 (s, 1H), 7.76 (t, $J = 7.2$ Hz, 1H), 7.68 (t, $J = 7.3$ Hz, 1H), 7.62-7.54 (m, 3H), 7.45-7.35 (m, 3H), 7.26-7.11 (m, 2H), 5.68 (s, 1H) ppm; $^{13}\text{C NMR}$ (125 MHz, DMSO- d_6) δ 159.2, 151.0, 148.3, 138.3, 135.1, 134.0, 132.1, 130.5, 130.0, 129.1, 127.7, 126.8, 125.3, 114.1, 112.1, 79.0, 45.8 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{15}\text{N}_4\text{O}_4^+$ $[\text{M}+\text{H}]^+$: 363.1088, found 363.1080.

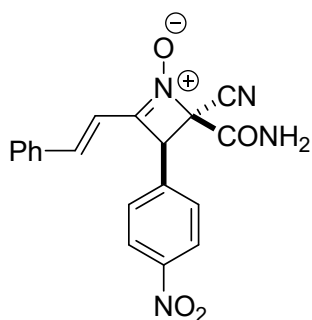
(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(3-nitrophenyl)-4-((*E*)-styryl)-2,3-dihydroazete 1-**



oxide (3at): White solid; mp 166-168 °C; yield = 79%; dr = 87:13; $R_f = 0.30$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ 8.28 (d, $J = 7.9$ Hz, 1H), 8.19 (s, 1H), 7.69 (d, $J = 7.5$ Hz, 1H), 7.62 (t, $J = 7.9$ Hz, 1H), 7.44 (d, $J = 7.1$ Hz, 2H), 7.38 (t, $J = 6.4$

Hz, 3H), 7.10 (d, $J = 16.5$ Hz, 1H), 7.03 (d, $J = 16.5$ Hz, 1H), 5.67 (s, 1H), 4.94 (s, 1H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 159.6, 152.7, 148.8, 141.3, 134.9, 134.4, 132.6, 131.2, 130.6, 129.3, 128.1, 125.0, 123.5, 112.4, 110.6, 75.5, 49.6 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{15}\text{N}_4\text{O}_3^+ [\text{M}+\text{H}]^+$: 363.1088, found 363.1087.

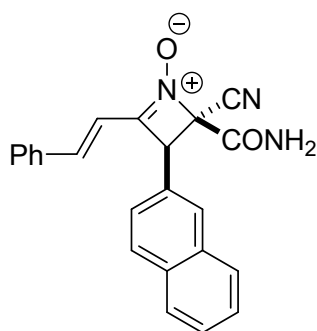
(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(4-nitrophenyl)-4-((*E*)-styryl)-2,3-dihydroazete 1-**



oxide (3at'): White solid; yield; mp 175-176 °C; dr = 81:19 $R_f = 0.27$ (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, $\text{DMSO}-d_6$) δ 8.24 (d, $J = 8.5$ Hz, 2H), 8.00 (s, 1H), 7.97 (s, 1H), 7.68 (d, $J = 8.5$ Hz, 2H), 7.62-7.56 (m, 2H), 7.42-7.32 (m, 3H), 7.20 (d, $J = 16.5$ Hz, 1H), 7.08 (d, $J = 16.5$ Hz, 1H), 5.49 (s, 1H) ppm; ^{13}C NMR (125 MHz, $\text{DMSO}-d_6$) δ 159.4, 151.8, 147.8, 138.4, 138.0, 135.0, 131.1, 130.1, 129.1, 127.8, 123.4, 113.9, 112.0, 78.3, 47.3 ppm;

HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{15}\text{N}_4\text{O}_3^+ [\text{M}+\text{H}]^+$: 363.1088, found 363.1072.

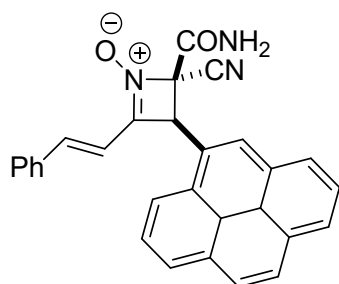
(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(naphthalen-2-yl)-4-((*E*)-styryl)-2,3-dihydroazete 1-**



oxide (3au): White solid; mp 160-162 °C; yield = 79%; dr = 86:14; $R_f = 0.28$ (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, $\text{DMSO}-d_6$) δ 7.97 (s, 1H), 7.95-7.87 (m, 4H), 7.86 (s, 1H), 7.60-7.48 (m, 5H), 7.38-7.34 (m, 3H), 7.23 (d, $J = 16.5$ Hz, 1H), 7.11 (d, $J = 16.5$ Hz, 1H), 5.44 (s, 1H) ppm; ^{13}C NMR (125 MHz, $\text{DMSO}-d_6$) δ 159.6, 152.3, 137.8, 135.0, 133.0, 132.5, 130.0, 129.1, 129.0, 128.3, 128.0, 127.9, 127.7(2C), 127.6, 126.8,

126.5, 114.3, 112.3, 78.7, 48.6 ppm; HRMS (ESI) m/z calcd for $\text{C}_{23}\text{H}_{17}\text{N}_3\text{O}_2\text{Na}^+ [\text{M}+\text{Na}]^+$: 390.1213, found 390.1218.

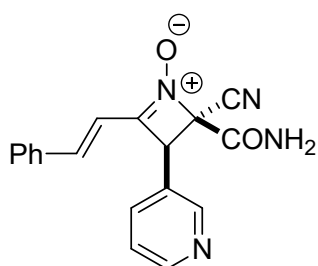
(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(pyren-1-yl)-4-((*E*)-styryl)-2,3-dihydroazete 1-oxide**



(3av): White solid; mp 165-167 °C; yield = 71%; dr = 80:20; $R_f = 0.25$ (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, $\text{DMSO}-d_6$) δ 8.43-8.34 (m, 4H), 8.25 (dd, $J = 8.3, 3.6$ Hz, 2H), 8.20-8.12 (m, 2H), 8.09 (d, $J = 7.7$ Hz, 1H), 7.92 (s, 1H), 7.69 (s, 1H), 7.61 (d, $J = 3.3$ Hz, 2H), 7.38-7.34 (m, 4H), 7.22 (d, $J = 16.4$ Hz, 1H), 6.44 (s, 1H) ppm; ^{13}C NMR (125 MHz, $\text{DMSO}-d_6$) δ 159.6,

152.5, 138.1, 135.1, 131.2, 130.7, 130.2, 130.0, 129.8, 129.1, 128.4, 128.1, 127.7, 127.4, 127.2, 126.6, 125.9, 125.8, 124.4, 124.2, 124.0, 123.6, 122.8, 114.4, 112.7, 79.0, 46.2 ppm; HRMS (ESI) m/z calcd for $\text{C}_{29}\text{H}_{20}\text{N}_3\text{O}_2^+ [\text{M}+\text{H}]^+$: 442.1550, found 442.1538.

(2*S,3*R**)-2-Carbamoyl-2-cyano-3-(pyridin-3-yl)-4-((*E*)-styryl)-2,3-dihydroazete 1-oxide**

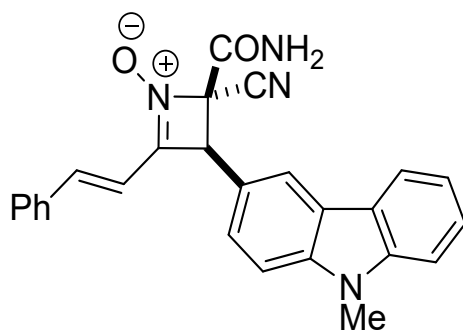


(3aw): White solid; mp 153-155 °C; yield = 80%; dr = 90:10; R_f = 0.15 (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, DMSO- d_6) δ 8.61 (d, J = 1.9 Hz, 1H), 8.56 (dd, J = 4.7, 1.3 Hz, 1H), 8.01 (s, 1H), 7.99 (s, 1H), 7.77 (d, J = 7.9 Hz, 1H), 7.59 (dd, J = 6.4, 2.7 Hz, 2H), 7.43-7.35 (m, 4H), 7.18 (d, J = 16.5 Hz, 1H), 7.08 (d, J = 16.5 Hz, 1H), 5.35 (s, 1H) ppm; ^{13}C NMR (125 MHz, DMSO- d_6)

δ 159.6, 151.7, 150.5, 150.0, 137.9, 137.0, 135.0, 130.1, 129.1, 127.7, 126.9, 123.4, 114.0, 112.1, 78.5, 45.8 ppm; HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{14}\text{N}_4\text{O}_2\text{Na}^+$ $[\text{M}+\text{Na}]^+$: 341.1009, found 341.1025.

(*E*)-2-Carbamoyl-2-cyano-3-(9-methyl-9H-carbazol-3-yl)-4-styryl-2,3-dihydroazete 1-oxide (3ax):

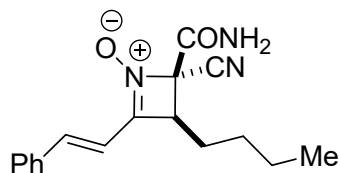
Orange solid; mp 120-122 °C; yield = 75%; dr = 77:23; R_f = 0.30 (EtOAc/Hexane = 30/70); ^1H NMR (400 MHz, CDCl_3) δ (mixture of diastereomers) 8.15-



8.01 (m, 2.0H), 7.53-7.46 (m, 2H), 7.43-7.33 (m, 8H), 7.19-7.07 (m, 3H), 5.98 (s, 0.25H), 5.69 (s, 0.75H), 5.04 (s, 0.75H), 4.99 (s, 0.25H), 3.87 (s, 0.75H), 3.84 (s, 2.25H) ppm; ^{13}C NMR (125 MHz, CDCl_3) (mixture of diastereomer) 160.4 (161.9), 154.6 (154.1), 141.6*, 141.5*, 141.1 (140.9), 134.7 (134.8), 130.8 (130.7), 129.2*, 128.0 (127.9), 126.6

(126.57), 126.0 (125.8), 123.4 (123.6), 122.3 (122.4), 120.9 (121.0), 120.7 (120.8), 119.8*, 119.61 (119.59), 113.2*, 111.16 (111.24), 109.4 (109.5), 108.91 (108.87), 76.8 (60.6), 51.7 (49.3), 31.1 (29.3) ppm; HRMS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{21}\text{N}_4\text{O}_2^+$ $[\text{M}+\text{H}]^+$: 421.1659, found 421.1670. * Indicates overlap peaks; In parentheses indicate the peaks of minor isomer.

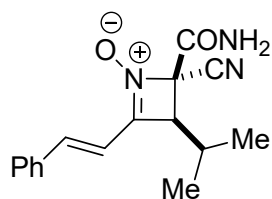
(2*S,3*R**)-3-Butyl-2-carbamoyl-2-cyano-4-((*E*)-styryl)-2,3-dihydroazete 1-oxide (3ay):**



White solid; mp 146-148 °C; yield = 51%; dr = 78:22; R_f = 0.20 (EtOAc/ hexane = 30:70); ^1H NMR (500 MHz, CDCl_3) δ 7.61 (d, J = 16.4 Hz, 1H), 7.51 (d, J = 3.8 Hz, 2H), 7.43-7.36 (m, 4H), 6.79 (d, J = 16.5 Hz, 1H), 5.95 (s, 1H), 3.61 (t, J = 6.8 Hz, 1H), 2.00-1.87 (m, 1H), 1.85-1.74 (m, 1H), 1.60-1.44 (m,

3H), 1.39 (m, 2H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 161.4, 155.4, 141.1, 134.9, 130.8, 129.3, 127.9, 113.2, 111.6, 73.7, 46.6, 29.2, 27.6, 22.7, 13.9 ppm; HRMS (ESI) m/z calcd for $\text{C}_{17}\text{H}_{19}\text{N}_3\text{O}_2\text{Na}^+$ $[\text{M}+\text{Na}]^+$: 330.1369, found 330.1361.

(2*S,3*R**)-2-Carbamoyl-2-cyano-3-isopropyl-4-((*E*)-styryl)-2,3-dihydroazete 1-oxide**

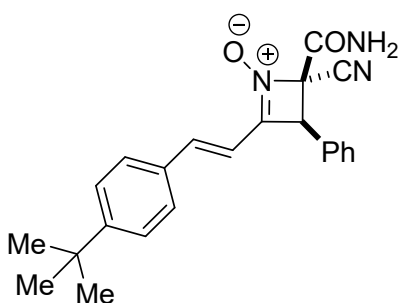


(3az): White solid; mp 131-133 °C; yield = 49%; dr = 78:22; R_f = 0.2

(EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ 7.51 (d, J = 6.1 Hz, 2H), 7.45-7.37 (m, 3H), 7.07 (d, J = 16.6 Hz, 1H), 6.95 (d, J = 16.5 Hz, 1H), 6.66 (s, 1H), 5.86 (s, 1H), 3.97 (d, J = 2.0 Hz, 1H), 2.42-2.33 (m, 1H), 1.15 (d, J = 6.5 Hz, 3H), 0.91 (d, J = 6.5 Hz, 3H)

ppm; $^{13}\text{C NMR}$ (125 MHz, $\text{DMSO-}d_6$) δ 162.9, 161.9, 141.3, 135.0, 129.7, 128.9, 127.5, 118.2, 115.8, 84.5, 60.3, 27.3, 22.0, 18.3 ppm; HRMS (ESI) m/z calcd for $\text{C}_{16}\text{H}_{17}\text{N}_3\text{O}_2\text{Na}^+$ $[\text{M}+\text{Na}]^+$: 306.1213, found 306.1204.

(2*S,3*R**)-4-((*E*)-4-(*tert*-Butyl)styryl)-2-carbamoyl-2-cyano-3-phenyl-2,3-dihydroazete**

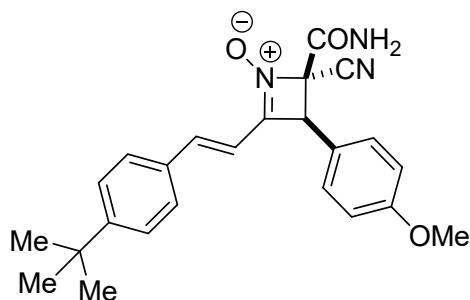


1-oxide (3ba): White solid; mp 166-168 °C; yield = 81%; dr

= 85:15; R_f = 0.30 (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ 7.40-7.33 (m, 7H), 7.32-7.28 (m, 2H), 7.15 (s, 1H) 7.07 (d, J = 16.5 Hz, 1H), 7.00 (d, J = 16.5 Hz, 1H), 5.78 (s, 1H), 4.82 (s, 1H), 1.31 (s, 9H) ppm; $^{13}\text{C NMR}$ (125 MHz, CDCl_3) δ 160.3, 154.8, 154.1, 141.1, 131.9, 130.1,

130.0, 129.3, 128.9, 127.9, 126.3, 113.0, 110.2, 75.9, 50.8, 35.1, 31.2 ppm; HRMS (ESI) m/z calcd for $\text{C}_{23}\text{H}_{24}\text{N}_3\text{O}_2^+$ $[\text{M}+\text{H}]^+$: 374.1863, found 374.1875.

(2*S,3*R**)-4-((*E*)-4-(*tert*-Butyl)styryl)-2-carbamoyl-2-cyano-3-(4-methoxyphenyl)-2,3-**

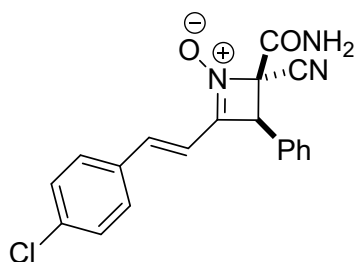


dihydroazete 1-oxide (3bc): White solid; mp 170-

172 °C; yield = 78%; dr = 87:13; R_f = 0.22 (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ 7.38 (br s, 4H), 7.22 (d, J = 8.7 Hz, 2H), 7.14 (s, 1H), 7.06 (d, J = 16.4 Hz, 1H), 7.00 (d, J = 16.4 Hz, 1H), 6.89 (d, J = 8.7 Hz, 2H), 5.71 (s, 1H),

4.79 (s, 1H), 3.80 (s, 3H), 1.31 (s, 9H); $^{13}\text{C NMR}$ (125 MHz, CDCl_3) δ 160.9, 160.3, 154.8, 154.1, 141.0, 132.2, 130.2, 127.9, 126.3, 122.0, 114.9, 113.2, 110.4, 76.3, 55.5, 50.8, 35.2, 31.3 ppm; HRMS (ESI) m/z calcd for $\text{C}_{24}\text{H}_{25}\text{N}_3\text{O}_3\text{Na}^+$ $[\text{M}+\text{Na}]^+$: 426.1788, found 426.1772.

(2*S,3*R**)-2-Carbamoyl-4-((*E*)-4-chlorostyryl)-2-cyano-3-phenyl-2,3-dihydroazete 1-**

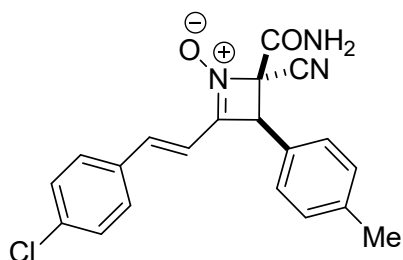


oxide (3ca): White solid; mp 156-158 °C; yield = 79%; dr =

83:17; R_f = 0.30 (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ 7.41 (d, J = 5.6 Hz, 3H), 7.39-7.29 (m, 6H), 7.11 (s, 1H), 7.10 (d, J = 16.0 Hz), 6.97 (d, J = 16.4 Hz, 1H),

5.65 (s, 1H), 4.82 (s, 1H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 159.9, 153.5, 139.5, 136.8, 133.2, 130.1, 130.0, 129.6, 129.4, 129.1, 128.8, 112.9, 111.4, 76.2, 50.9 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{15}\text{ClN}_3\text{O}_2^+[\text{M}+\text{H}]^+$: 352.0847, found 352.0859.

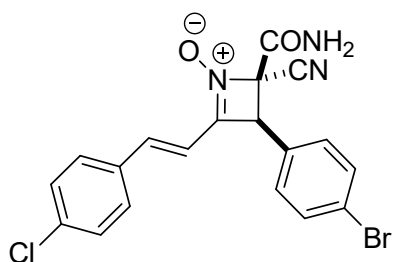
(2*S,3*R**)-2-Carbamoyl-4-((*E*)-4-chlorostyryl)-2-cyano-3-(4-methylphenyl)-2,3-**



dihydroazete 1-oxide (3cb): White solid; mp 153-155 °C; yield = 77%; dr = 80:20; R_f = 0.26 (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, CDCl_3) δ 7.36 (d, J = 8.7 Hz, 2H), 7.33 (d, J = 8.7 Hz, 2H), 7.19 (br s, 4H), 7.09 (s, 1H) 7.08 (d, J = 16.4 Hz), 6.96 (d, J = 16.5 Hz, 1H), 5.76 (s, 1H), 4.78 (s, 1H), 2.35 (s, 3H) ppm; ^{13}C NMR (125 MHz,

CDCl_3) δ 160.1, 153.7, 140.2, 139.4, 136.8, 133.2, 130.1, 129.5, 129.0, 128.7, 126.8, 112.9, 111.5, 76.3, 50.7, 21.5 ppm; HRMS (ESI) m/z calcd for $\text{C}_{20}\text{H}_{17}\text{ClN}_3\text{O}_2^+ [\text{M}+\text{H}]^+$: 366.1004, found 366.1015.

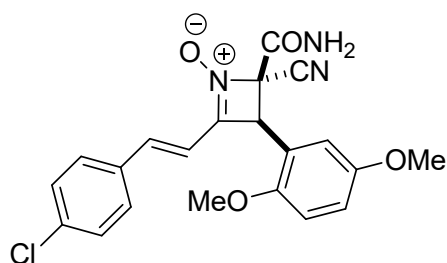
(2*S,3*R**)-3-(4-Bromophenyl)-2-carbamoyl-4-((*E*)-4-chlorostyryl)-2-cyano-2,3-**



dihydroazete 1-oxide (3cl): White solid; mp 165-167 °C; yield = 76%; dr = 88:12; R_f = 0.30 (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, $\text{DMSO}-d_6$) δ 7.94 (s, 1H), 7.93 (s, 1H), 7.64 (d, J = 8.2 Hz, 2H), 7.58 (d, J = 8.0 Hz, 2H), 7.42 (d, J = 8.0 Hz, 2H), 7.33 (d, J = 8.1 Hz, 2H), 7.17 (d, J = 16.5 Hz, 1H), 7.07 (d, J = 16.5 Hz, 1H), 5.26 (s, 1H) ppm; ^{13}C

NMR (125 MHz, $\text{DMSO}-d_6$) δ 159.5, 151.8, 136.3, 134.4, 134.0, 131.7, 131.4, 130.1, 129.4, 129.1, 122.5, 114.0, 112.9, 78.5, 47.7 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{14}^{79}\text{BrClN}_3\text{O}_2^+[\text{M}+\text{H}]^+$: 329.9952, found 329.9963.

(2*S,3*R**)-2-Carbamoyl-4-((*E*)-4-chlorostyryl)-2-cyano-3-(2,5-dimethoxyphenyl)-2,3-**

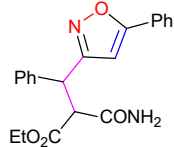


dihydroazete 1-oxide (3cf): White solid; mp 169-171 °C; yield = 73%; yield = 76%; dr = 87:13; R_f = 0.20 (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, CDCl_3) δ 7.38 (d, J = 8.5 Hz, 2H), 7.33 (d, J = 8.5 Hz, 2H), 7.13 (d, J = 16.4 Hz, 1H), 6.99 (d, J = 16.5 Hz, 1H), 6.92 (s, 1H), 6.89-6.84 (m, 2H), 6.69 (d, J = 2.0 Hz,

1H), 5.76 (s, 1H), 5.09 (s, 1H), 3.85 (s, 3H), 3.69 (s, 3H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 160.1, 153.5, 153.1, 152.7, 138.8, 136.6, 133.4, 129.5, 129.0, 119.6, 115.6, 114.9, 113.1,

112.0, 111.9, 76.0, 56.4, 55.9, 45.9 ppm; HRMS (ESI) m/z calcd for $C_{21}H_{19}ClN_3O_4^+[M+H]^+$: 412.1059, found 412.1056.

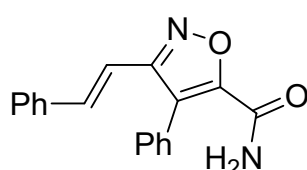
Ethyl 3-amino-3-oxo-2-[phenyl(5-phenylisoxazol-3-yl)methyl]propanoate (3aaa): White



Solid, Yield = 28%; mp = 160 °C; R_f = 0.30 (Ethyl acetate/hexane = 40:60); dr = 60:40; 1H NMR (500 MHz, DMSO) δ (major isomer) 7.78 – 7.74 (m, 2H), 7.55-7.44 (m, 3H), 7.40 – 7.21 (m, 6H), 7.17 (s, 1H), 6.98 (s, 1H), 4.79 (d, J = 12.0 Hz, 1H), 4.32 (d, J = 12.0 Hz, 1H), 3.88 (q, 6.9 Hz, 2H), 0.91 (t, J = 7.0 Hz, 3H); 1H NMR (500 MHz, DMSO) δ (mixture of diastereomer = 66:34) 7.78 -7.71 (m, 2H), 7.65 (s, 0.34H), 7.54-7.45 (m, 2.66H), 7.43-7.26 (m, 5H), 7.25-7.22 (m, 1H), 7.16 (s, 0.66H), 7.00 (s, 0.34H), 6.98 (s, 0.66H), 6.90 (s, 0.34H), 4.84-4.72 (m, 1H), 4.38 (d, J = 12.2 Hz, 0.34 H), 4.32 (d, J = 12.2 Hz, 0.66H), 4.05 (q, J = 6.1 Hz, 0.68H), 3.88 (q, J = 6.5, 1.32H), 1.09 (t, J = 6.7 Hz, 1.02H), 0.91 (t, J = 6.8 Hz, 1.98H) ppm; ^{13}C NMR (125 MHz, DMSO) δ (major isomer) 168.6, 167.8, 167.2, 164.9, 138.9, 130.4, 129.3, 128.6, 128.3, 127.3, 126.7, 125.4, 100.2, 60.6, 56.1, 42.9, 13.7 ppm; HRMS (ESI) m/z calcd for $C_{21}H_{20}N_2O_4Na^+[M+Na]^+$: 387.1315, found 387.1288.

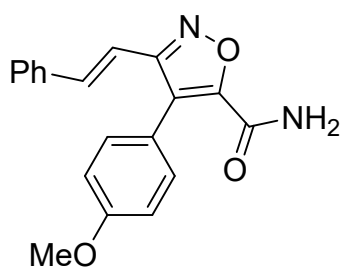
One-pot sequential synthesis of isoxazole 4: To a stirred solution of 3-nitroallylarene **1** (0.2 mmol) and alkylidene malononitrile **2** (0.24 mmol) in dry DCM (1.0 mL) under an argon atmosphere was added DABCO (0.03 mmol, 10 mol%) at room temperature. The progress of the reaction was monitored by TLC. After completion of the reaction, pTSA (50 mol%) was added to the above reaction mixture and stirring was continued for 12-16h. Afterwards, the reaction mixture was extracted with ethyl acetate (3 \times 10 mL), washed with saturated $NaHCO_3$ solution, brine and dried over anhydrous Na_2SO_4 . Evaporation of the solvent left the crude product which was purified by silica gel column chromatography using ethyl acetate/hexane (1:9) as an eluent, leading to a pure isoxazole **4**. All the products in Scheme 3 were synthesized by the above procedure and characterized by their spectroscopic data (1H , ^{13}C NMR and HRMS data).

(E)-4-Phenyl-3-styrylisoxazole-5-carboxamide (4a): White solid; yield = 82%; mp 151-154



°C; R_f = 0.35 (EtOAc/hexane = 30:70); 1H NMR (500 MHz, $CDCl_3$) δ 7.52-7.42 (m, 8H), 7.39-7.31 (m, 3H), 6.84 (d, J = 16.5 Hz, 1H), 6.67 (s, 1H), 5.68 (s, 1H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 166.5, 160.9, 155.5, 135.9, 135.5, 130.5, 129.6, 129.0, 128.6, 128.4, 127.4, 117.8, 111.7 ppm; HRMS (ESI) m/z calcd for $C_{18}H_{14}N_2O_2Na^+[M+Na]^+$: 313.0947, found 313.0953.

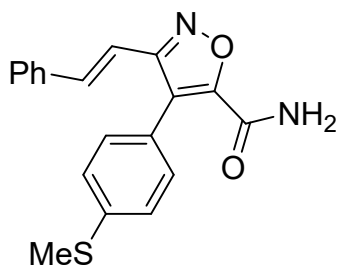
(E)-4-(4-Methoxyphenyl)-3-styrylisoxazole-5-carboxamide(4b): White solid; yield = 80%; mp 154-156 °C; $R_f = 0.30$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, DMSO- d_6) δ



8.25 (s, 1H), 7.89 (s, 1H), 7.64 (d, $J = 7.1$ Hz, 2H), 7.51 (d, $J = 16.4$ Hz, 1H), 7.40-7.30 (m, 5H), 7.05 (d, $J = 8.3$ Hz, 2H), 6.99 (d, $J = 16.5$ Hz, 1H), 3.81 (s, 3H) ppm; $^{13}\text{C NMR}$ (125 MHz, DMSO- d_6) δ 163.5, 161.4, 159.2, 158.1, 135.2, 135.0, 130.8, 129.4, 128.9, 127.4, 120.3, 116.0, 114.2, 111.6, 55.2 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{16}\text{N}_2\text{O}_3\text{Na}^+$ [$\text{M}+\text{Na}$] $^+$:

343.1053, found 343.1064.

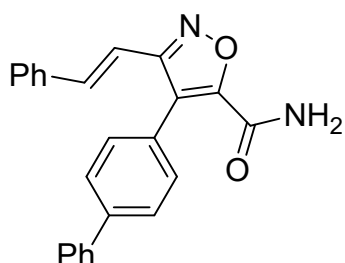
(E)-4-(4-Methylthiophenyl)-3-styrylisoxazole-5-carboxamide (4c): White solid; mp 165-167 °C; yield = 80%, $R_f = 0.33$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ



7.53-7.46 (m, 3H), 7.38-7.31 (m, 7H), 6.83 (d, $J = 16.4$ Hz, 1H), 6.68 (s, 1H), 5.63 (s, 1H), 2.53 (s, 3H) ppm; $^{13}\text{C NMR}$ (125 MHz, CDCl_3) δ 166.4, 160.9, 155.4, 139.4, 135.9, 135.5, 130.9, 129.6, 129.101, 127.4, 126.2, 124.8, 117.3, 111.6, 15.6 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{16}\text{N}_2\text{O}_2\text{SNa}^+$ [$\text{M}+\text{Na}$] $^+$:

359.0825, found 359.0827.

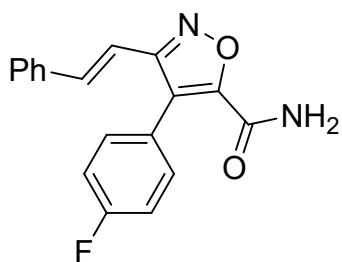
(E)-4-([1,1'-1'-Biphenyl]-4-yl)-3-styrylisoxazole-5-carboxamide (4d): White solid; mp 199-201 °C; yield = 81%; $R_f = 0.34$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ



7.71-7.64 (m, 3H), 7.55-7.44 (m, 7H), 7.40-7.32 (m, 5H), 6.89 (d, $J = 16.4$ Hz, 1H), 6.71 (s, 1H), 5.67 (s, 1H) ppm; $^{13}\text{C NMR}$ (125 MHz, CDCl_3) δ 166.5, 160.9, 155.5, 141.4, 140.7, 136.0, 135.6, 130.9, 129.6, 129.1, 129.0, 128.4, 127.7, 127.5, 127.3, 127.1, 117.5, 111.7 ppm;

HRMS (ESI) m/z calcd for $\text{C}_{24}\text{H}_{18}\text{N}_2\text{O}_2\text{Na}^+$ [$\text{M}+\text{Na}$] $^+$: 389.1260, found 389.1261.

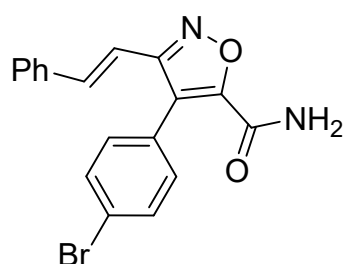
(E)-4-(4-Fluorophenyl)-3-styrylisoxazole-5-carboxamide (4e): White solid; mp 174-176 °C; yield = 83%, $R_f = 0.35$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, DMSO- d_6) δ



8.27 (s, 1H), 7.92 (s, 1H), 7.66 (d, $J = 7.1$ Hz, 2H), 7.58-7.45 (m, 3H), 7.42-7.32 (m, 5H), 6.99 (d, $J = 16.5$ Hz, 1H) ppm; $^{13}\text{C NMR}$ (125 MHz, DMSO- d_6) δ 164.2, 163.0, 162.0 (d, $J_{\text{C-F}} = 243.86$ Hz), 157.8, 135.5, 135.1, 131.8 (d, $J_{\text{C-F}} = 8.4$ Hz), 129.5, 128.9, 127.6, 124.6 (d, $J_{\text{C-F}} = 3.2$ Hz),

115.5 (d, $J_{\text{C-F}} = 21.35$ Hz), 115.3, 111.3 ppm; $^{19}\text{F NMR}$ (470 MHz, DMSO- d_6) δ -113.78 ppm; HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{13}\text{FN}_2\text{O}_2\text{Na}^+$ [$\text{M}+\text{Na}$] $^+$: 331.0853, found 331.0862.

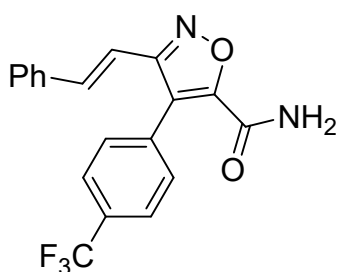
(E)-4-(4-Bromophenyl)-3-styrylisoxazole-5-carboxamide (4f): White solid; yield = 81%;



mp 208-210 °C; R_f = 0.35 (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, $\text{DMSO-}d_6$) δ 8.28 (s, 1H), 7.92 (s, 1H), 7.68 (d, J = 8.3 Hz, 4H), 7.54 (d, J = 16.4 Hz, 1H), 7.45-7.32 (m, 5H), 7.01 (d, J = 16.4 Hz, 1H) ppm; $^{13}\text{C NMR}$ (125 MHz, $\text{DMSO-}d_6$), δ 164.3, 161.0, 157.7, 135.8, 135.1, 131.7(2C), 131.5, 129.5, 128.9, 127.6, 121.6, 115.2, 111.2 ppm; HRMS (ESI)

m/z calcd for $\text{C}_{18}\text{H}_{13}\text{N}_2\text{O}_2^{79}\text{BrNa}^+[\text{M}+\text{Na}]^+$: 391.0053, found 391.0056; HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{13}\text{N}_2\text{O}_2^{81}\text{BrNa}^+[\text{M}+\text{Na}]^+$: 393.0032, found 393.0034.

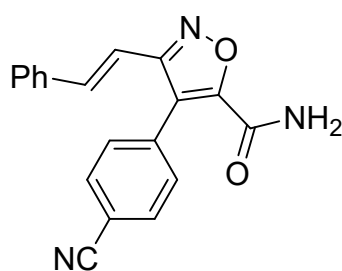
(E)-3-Styryl-4-(4-(trifluoromethyl)phenyl)isoxazole-5-carboxamide (4g): White solid; mp 207-209 °C; yield = 77%; R_f = 0.35; (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz,



CDCl_3) δ 7.72 (d, J = 8.1 Hz, 2H), 7.58 (d, J = 8.1 Hz, 2H), 7.54 (d, J = 16.4 Hz, 1H), 7.50-7.46 (m, 2H), 7.40-7.35 (m, 3H), 6.79 (d, J = 16.4 Hz, 1H), 6.74 (s, 1H), 5.65 (s, 1H) ppm; $^{13}\text{C NMR}$ (125 MHz, CDCl_3) δ 166.9, 160.6, 155.2, 136.9, 135.2, 132.3, 130.9, 129.9, 129.1, 127.5, 125.5 (q), 125.3, 123.1, 116.5, 110.9 ppm; HRMS (ESI) m/z calcd for

$\text{C}_{19}\text{H}_{13}\text{F}_3\text{N}_2\text{O}_2\text{Na}^+[\text{M}+\text{Na}]^+$: 381.0821, found 381.0830.

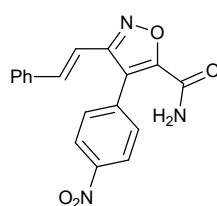
(E)-4-(4-Cyanophenyl)-3-styrylisoxazole-5-carboxamide (4h): White solid; mp 209-211



°C; yield = 80%; R_f = 0.30 (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ 7.75 (d, J = 8.5 Hz, 2H), 7.60-7.56 (m, 2H), 7.54 (d, J = 16.4 Hz, 1H), 7.48 (dd, J = 7.7, 1.6 Hz, 2H), 7.41-7.36 (m, 3H), 6.75 (d, J = 16.4 Hz, 1H), 6.75 (s, 1H), 5.65 (s, 1H) ppm; $^{13}\text{C NMR}$ (125 MHz, $\text{DMSO-}d_6$) δ 164.9, 160.8, 157.5, 136.4, 135.0, 133.5, 132.4, 130.6, 129.7, 128.9, 127.8,

118.7, 114.9, 111.0, 110.7 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{13}\text{N}_3\text{O}_2\text{Na}^+[\text{M}+\text{Na}]^+$: 338.0900, found 338.0898.

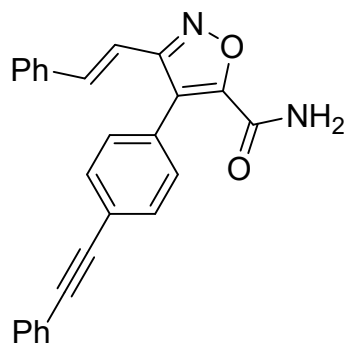
(E)-2-Carbamoyl-2-cyano-3-(4-nitrophenyl)-4-styryl-2,3-dihydroazete oxide (4i): White



solid; yield = 78%; mp 175-176 °C; R_f = 0.27; (EtOAc/hexane = 40:60); $^1\text{H NMR}$ (500 MHz, $\text{DMSO-}d_6$) δ 8.24 (d, J = 8.5 Hz, 2H), 8.00 (s, 1H), 7.97 (s, 1H), 7.68 (d, J = 8.5 Hz, 2H), 7.62-7.56 (m, 2H), 7.42-7.32 (m, 3H), 7.20 (d, J = 16.5 Hz, 1H), 7.08 (d, J = 16.5 Hz, 1H), 5.49 (s, 1H) ppm; $^{13}\text{C NMR}$ (125 MHz, $\text{DMSO-}d_6$) δ 159.4, 151.8, 147.8, 138.4,

138.0, 135.0, 131.1, 130.1, 129.1, 127.8, 123.4, 113.9, 112.0, 78.3, 47.3 ppm; HRMS (ESI) m/z calcd for $C_{19}H_{14}N_4O_4Na^+$ $[M+Na]^+$: 358.0798, found 358.0805.

(E)-4-(4-(Phenylethynyl)phenyl)-3-styrylisoxazole-5-carboxamide (4j): White solid; mp

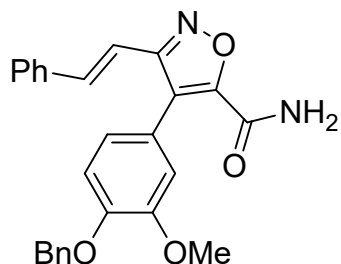


194-196 °C; yield = 79%; R_f = 0.34; (EtOAc/hexane = 30:70);

1H NMR (500 MHz, DMSO- d_6) δ 8.31 (s, 1H), 7.95 (s, 1H), 7.72-7.55 (m, 3H), 7.55-7.48 (m, 3H), 7.55-7.48 (m, 2H), 7.47 – 7.32 (m, 7H), 7.05(d, J = 16.4 Hz, 1H) ppm; ^{13}C NMR (125 MHz, DMSO- d_6) δ 164.3, 161.1, 157.9, 135.9, 135.1, 131.6, 131.5, 130.0, 129.6, 129.0, 128.95, 128.90, 128.7, 127.7, 122.2 122.0, 115.6, 111.3, 90.3, 89.1 ppm; HRMS (ESI) m/z calcd for

$C_{26}H_{18}N_2O_2Na^+$ $[M+Na]^+$: 413.1260, found 413.1254.

(E)-4-(4-(Benzyloxy)-3-methoxyphenyl)-3-styrylisoxazole-5-carboxamide(4k): White

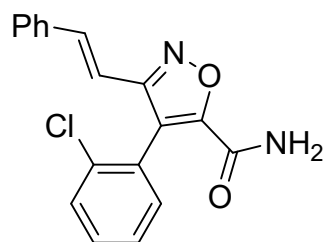


solid; mp 179-181 °C; yield = 76%, R_f = 0.30 (EtOAc/hexane =

30:70); 1H NMR (500 MHz, DMSO- d_6) δ 8.25 (s, 1H), 7.91 (s, 1H), 7.66 (d, J = 7.3 Hz, 2H), 7.55–7.28 (m, 9H), 7.15 (d, J = 8.2 Hz, 1H), 7.10 (s, 1H), 7.05 (d, J = 16.5 Hz, 1H), 6.98 (d, J = 7.9 Hz, 1H), 5.14 (s, 2H), 3.79 (s, 3H) ppm; ^{13}C NMR (125 MHz,

DMSO- d_6) δ 163.5, 161.5, 158.3, 148.8, 147.9, 137.0, 135.2, 135.0, 129.4, 128.9, 128.5, 128.0, 127.9, 127.5, 122.0, 120.9, 116.1, 113.6, 113.4, 111.7, 69.9, 55.6 ppm; HRMS (ESI) m/z calcd for $C_{26}H_{22}N_2O_4Na^+$ $[M+Na]^+$: 449.1472, found 449.1477.

(E)-4-(2-Chlorophenyl)-3-styrylisoxazole-5-carboxamide (4l): White solid; mp 174-176

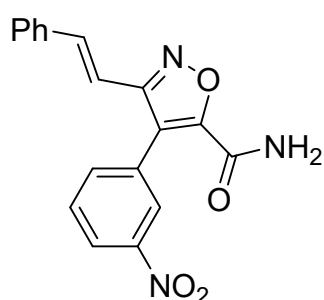


°C; yield = 77%; R_f = 0.35 (EtOAc/hexane = 30:70); 1H

NMR (500 MHz, DMSO- d_6) δ 8.18 (s, 1H), 7.78 (s, 1H), 7.66-7.54 (m, 3H), 7.52-7.42 (m, 4H), 7.38-7.30 (m, 3H), 6.81 (d, J = 16.5 Hz, 1H) ppm; ^{13}C NMR (125 MHz, DMSO- d_6) δ 165.3, 160.3, 157.8, 135.5, 134.9, 133.6, 132.4, 130.2, 129.6, 129.4, 128.9, 127.7, 127.5, 127.2, 114.0, 111.3 ppm;

HRMS (ESI) m/z calcd for $C_{19}H_{15}ClN_3O_4^+$ $[M+Na]^+$: 347.0588, found 347.0536

(E)-4-(3-Nitrophenyl)-3-styrylisoxazole-5-carboxamide (4m): White solid; mp 191-193



°C; yield = 78%; R_f = 0.33 (EtOAc/hexane = 30:70); 1H NMR

(500 MHz, DMSO- d_6) δ 8.39-8.20 (m, 3H), 7.91 (d, J = 7.4 Hz, 1H), 7.77 (t, J = 8.2 Hz, 1H), 7.69 (d, J = 6.9 Hz, 2H), 7.58 (d, J = 16.4 Hz, 1H), 7.46-7.30 (m, 3H), 7.07 (d, J = 16.4 Hz, 1H)

ppm; ^{13}C NMR (125 MHz, DMSO- d_6) δ 165.2, 160.7, 157.3, 147.8, 136.5, 136.4, 135.1, 130.1, 130.0, 129.7, 128.9, 127.7, 124.6, 122.9, 114.4, 111.0 ppm; HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{13}\text{N}_3\text{O}_4\text{Na}^+[\text{M}+\text{Na}]^+$: 358.0798 found 358.0779.

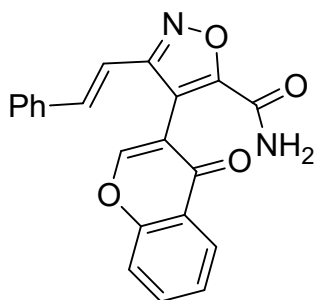
(E)-3-Styryl-4-(thiophen-2-yl)isoxazole-5-carboxamide (4n): White solid; mp 166-168 °C;



yield = 76%; R_f = 0.36 (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, CDCl_3) δ 7.54-7.50 (m, 3H), 7.48-7.43 (m, 1H), 7.42-7.32 (m, 4H), 7.15 (dd, J = 5.1, 3.6 Hz, 1H), 7.05 (d, J = 16.4 Hz, 1H), 6.66 (s, 1H), 5.73 (s, 1H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 166.8, 160.7, 155.4, 136.5, 135.5, 130.0, 129.7,

129.1, 128.2, 127.6 (2C), 127.5, 111.7, 111.1 ppm; HRMS (ESI) m/z calcd for $\text{C}_{16}\text{H}_{12}\text{N}_2\text{O}_2\text{SNa}^+[\text{M}+\text{Na}]^+$: 319.0512 found 319.0488.

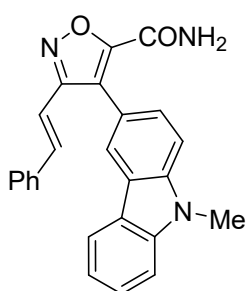
(E)-4-(4-Oxo-4H-chromen-3-yl)-3-styrylisoxazole-5-carboxamide (4o): White solid; mp



190-192 °C; yield = 74%; R_f = 0.26 (EtOAc/hexane = 30:70); ^1H NMR (400 MHz, DMSO- d_6) δ 8.54 (s, 1H), 8.13 (s, 1H), 8.09 (d, J = 8.0 Hz, 1H), 7.86 (t, J = 7.5 Hz, 1H), 7.78-7.66 (m, 4H), 7.60-7.45 (m, 2H), 7.42-7.32 (m, 3H), 7.21 (d, J = 16.4 Hz, 1H) ppm; ^{13}C NMR (100 MHz, DMSO- d_6) δ 174.8, 165.8, 160.6, 158.5, 156.0, 155.8, 135.3, 134.9, 134.4, 129.4, 128.8, 127.7, 125.7,

125.4, 123.3, 118.5, 113.8, 111.9, 107.7 ppm; HRMS (ESI) m/z calcd for $\text{C}_{21}\text{H}_{14}\text{N}_2\text{O}_4\text{Na}^+[\text{M}+\text{Na}]^+$: 381.0845, found 381.0824.

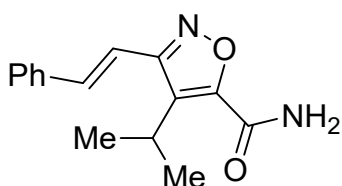
(E)-4-(9-Methyl-9H-carbazol-3-yl)-3-styrylisoxazole-5-carboxamide (4p): White solid;



mp = 170-172 °C; yield = 76%; R_f = 0.30; (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, CDCl_3) δ 8.20-8.04 (m, 2H), 7.58-7.41 (m, 7H), 7.35-7.21 (m, 4H), 6.88 (d, J = 16.4 Hz, 1H), 6.65 (s, 1H), 5.72 (s, 1H), 3.90 (s, 3H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 166.4, 161.1, 155.9, 141.5, 141.0, 135.7, 135.4, 129.4, 129.0, 128.3, 127.4, 126.2, 123.1, 122.7, 122.4, 120.7, 119.3, 118.6, 118.5, 112.0, 108.8, 108.7,

29.4 ppm; HRMS (ESI) m/z calcd for $\text{C}_{25}\text{H}_{20}\text{N}_3\text{O}_2^+[\text{M}+\text{H}]^+$: 394.1550, found 394.1580.

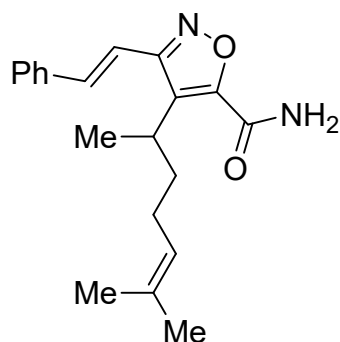
(E)-4-Isopropyl-3-styrylisoxazole-5-carboxamide (4q): White solid; mp 135-137 °C; yield



= 53%; R_f = 0.40 (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, CDCl_3) δ 7.54 (d, J = 7.5 Hz, 2H), 7.41-7.32 (m, 4H), 7.02 (d, J = 16.3 Hz, 1H), 6.86 (s, 1H), 6.05 (s, 1H), 3.56-3.47 (m, 1H), 1.37 (d, J = 7.1 Hz, 6H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ

165.2, 162.1, 155.6, 135.8, 134.4, 129.3, 129.0, 127.2, 122.7, 112.3, 23.2, 22.5 ppm; HRMS (ESI) m/z calcd for $C_{15}H_{16}N_2O_2Na^+$ $[M+Na]^+$: 279.1104, found 279.1104.

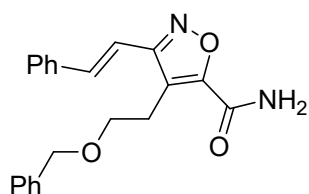
(E)-4-(6-Methylhept-5-en-2-yl)-3-styrylisoxazole-5-carboxamide (4r): White solid; yield =



60%; mp 168-170 °C; R_f = 0.4 (EtOAc/hexane = 30:70); 1H NMR (500 MHz, $CDCl_3$) δ 7.53 (d, J = 7.4 Hz, 2H), 7.43-7.32 (m, 4H), 6.95 (d, J = 16.3 Hz, 1H), 6.76 (s, 1H), 5.59 (s, 1H), 5.07 (t, J = 6.0 Hz, 1H), 3.32-3.24 (m, 1H), 1.94-1.85 (m, 3H), 1.77-1.67 (m, 1H), 1.64 (s, 3H), 1.47 (s, 3H), 1.35 (d, J = 7.1 Hz, 3H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 165.8, 161.8, 156.3, 135.8, 134.3, 132.0, 129.3, 129.1, 127.2, 124.3, 121.3, 112.1,

36.1, 28.1, 26.5, 25.9, 20.8, 17.8 ppm; HRMS (ESI) m/z calcd for $C_{20}H_{24}N_2O_2Na^+$ $[M+Na]^+$: 347.1730, found 347.1707.

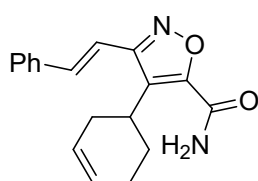
(E)-4-(2-(Benzyloxy)ethyl)-3-styrylisoxazole-5-carboxamide (4s): White solid; mp 120-



122 °C; yield = 64%; R_f = 0.34 (EtOAc/hexane = 30:70); 1H NMR (500 MHz, $CDCl_3$) δ 7.47 (d, J = 6.9 Hz, 2H), 7.42 (d, J = 16.5 Hz, 1H), 7.38-7.33 (m, 3H), 7.26-7.23 (m, 3H), 7.21 (d, J = 5.2 Hz, 2H), 7.01 (d, J = 16.4 Hz, 1H), 6.79 (s, 1H), 5.61 (s, 1H), 4.49 (s, 2H), 3.73 (t, J = 6.0 Hz, 2H), 3.10 (t, J = 6.0 Hz, 2H) ppm; ^{13}C

NMR (125 MHz, $CDCl_3$) δ 167.7, 161.7, 155.8, 138.4, 135.8, 134.6, 129.2, 129.0, 128.4, 127.6, 127.5, 127.4, 114.2, 112.1, 73.1, 70.0, 23.5 ppm; HRMS (ESI) m/z calcd for $C_{21}H_{20}N_2O_3Na^+$ $[M+Na]^+$: 371.1366, found 371.1364.

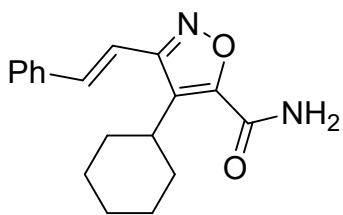
(E)-4-(Cyclohex-3-en-1-yl)-3-styrylisoxazole-5-carboxamide (4t): White solid; mp 165-



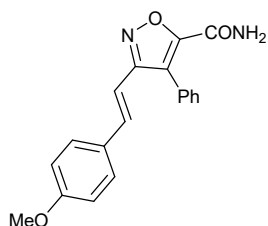
167 °C; yield = 66%; R_f = 0.36 (EtOAc/hexane = 30:70); 1H NMR (500 MHz, $CDCl_3$) δ 7.53 (d, J = 7.3 Hz, 2H), 7.43-7.36 (m, 3H), 7.36-7.31 (m, 1H), 7.01 (d, J = 16.3 Hz, 1H), 6.82 (s, 1H), 5.90 (s, 1H), 5.83-5.72 (m, 2H), 3.45-3.37 (m, 1H), 2.49-2.41 (m, 1H), 2.23-

2.12 (m, 4H), 1.86-1.83 (m, 1H) ppm; ^{13}C NMR (125 MHz, $CDCl_3$) δ 165.7, 162.0, 156.1, 135.8, 134.6, 129.3, 129.0, 127.3, 127.1, 126.6, 121.3, 112.3, 31.6, 29.3, 28.2, 25.9 ppm; HRMS (ESI) m/z calcd for $C_{18}H_{18}N_2O_2Na^+$ $[M+Na]^+$: 317.1260, found 317.1262.

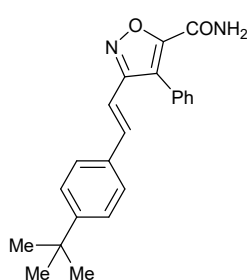
(E)-4-Cyclohexyl-3-styrylisoxazole-5-carboxamide (4u): White solid; mp 168-170 °C; yield = 62%; $R_f = 0.4$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ 7.56-7.51 (m, 2H), 7.44-7.32 (m, 4H), 7.04 (d, $J = 16.3$ Hz, 1H), 6.77 (s, 1H), 5.72 (s, 1H), 3.19-3.07 (m, 1H), 1.89-1.70 (m, 7H), 1.48-1.28 (m, 3H) ppm; $^{13}\text{C NMR}$ (125 MHz, CDCl_3) δ 165.4, 162.1, 156.1, 135.9, 134.4, 129.3, 129.0, 127.3, 121.9, 112.6, 33.4, 32.6, 27.0, 26.0 ppm; HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{20}\text{N}_2\text{O}_2\text{Na}^+[\text{M}+\text{Na}]^+$: 319.1417, found 319.1402.



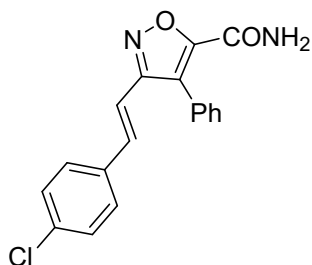
(E)-3-(4-Methoxystyryl)-4-phenylisoxazole-5-carboxamide (4v): White solid; yield = 80%; mp 184-185 °C; $R_f = 0.25$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ 7.47-7.36 (m, 8H), 6.88 (d, $J = 8.5$ Hz, 2H), 6.70 (d, $J = 16.5$ Hz, 1H), 6.68 (s, 1H), 5.75 (s, 1H), 3.83 (s, 3H) ppm; $^{13}\text{C NMR}$ (125 MHz, CDCl_3) δ 166.8, 161.1, 160.8, 155.5, 135.5, 130.5, 128.9, 128.6, 128.5, 128.4, 128.3, 116.9, 114.5, 109.6, 55.5 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{16}\text{N}_2\text{O}_3\text{Na}^+[\text{M}+\text{Na}]^+$: 343.1053, found 343.1045.



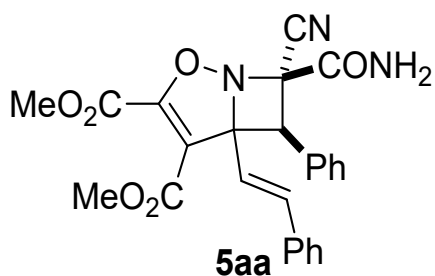
(E)-3-(4-(tert-Butyl)styryl)-4-phenylisoxazole-5-carboxamide (4w): White solid; yield; mp 145-146 °C; yield = 82%; $R_f = 0.27$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ 7.49-7.37 (m, 10H), 6.80 (d, $J = 16.4$ Hz, 1H), 6.67 (s, 1H), 5.67 (s, 1H), 1.32 (s, 9H) ppm; $^{13}\text{C NMR}$ (125 MHz, CDCl_3) δ 166.7, 160.9, 155.5, 153.1, 135.8, 132.8, 130.5, 128.54, 128.50, 128.48, 127.3, 126.0, 117.4, 110.9, 35.0, 31.3 ppm; HRMS (ESI) m/z calcd for $\text{C}_{22}\text{H}_{22}\text{N}_2\text{O}_2\text{Na}^+[\text{M}+\text{Na}]^+$: 369.1573, found 369.1550.



(E)-3-(4-Chlorostyryl)-4-phenylisoxazole-5-carboxamide (4x): White solid; yield = 78%; mp 180-182 °C; $R_f = 0.30$ (EtOAc/hexane = 30:70); $^1\text{H NMR}$ (500 MHz, CDCl_3) δ 7.48-7.29 (m, 10H), 6.80 (d, $J = 16.4$ Hz, 1H), 6.67 (s, 1H), 5.67 (s, 1H) ppm; $^{13}\text{C NMR}$ (125 MHz, CDCl_3) δ 166.1, 160.78, 155.6, 135.3, 134.5, 134.0, 130.5, 129.3, 128.7, 128.61, 128.59, 128.3, 118.1, 112.9 ppm; HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{12}\text{ClN}_2\text{O}_2\text{Na}^+[\text{M}+\text{Na}]^+$: 347.0558, found 347.0567.



Compound **5aa**: White solid; mp = 153-155 °C; yield = 90%; dr = 99:1; R_f = 0.30



(EtOAc/hexane = 30/70); ^1H NMR (500 MHz, CDCl_3) δ 7.37–7.08 (m, 8H), 7.21 (d, J = 7.05 Hz, 2H), 7.18 (s, 1H), 6.76 (d, J = 16.3 Hz, 1H), 6.10 (s, 1H), 5.97 (d, J = 16.3 Hz, 1H), 4.92 (s, 1H), 3.99 (s, 3H), 3.82 (s, 3H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 163.7, 161.1, 158.0, 151.5, 135.5, 133.5, 130.9, 130.4, 129.3,

128.8(2C), 128.7, 126.9, 124.5, 115.4, 114.4, 81.6, 70.9, 58.4, 53.9, 52.8 ppm; HRMS (ESI) m/z calcd for $\text{C}_{25}\text{H}_{21}\text{N}_3\text{O}_6\text{Na}^+$ $[\text{M}+\text{Na}]^+$: 482.1323, found 482.1329.

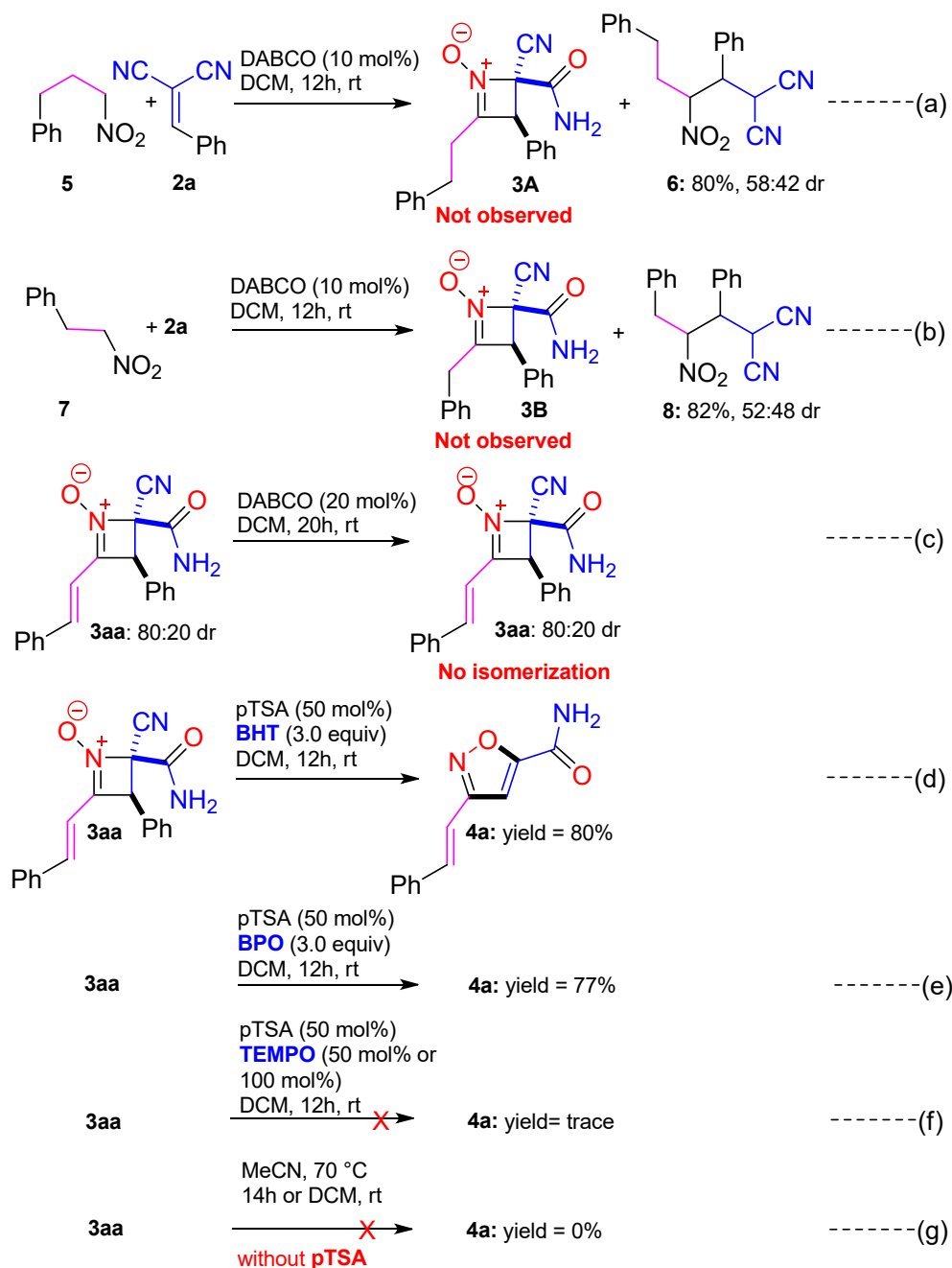
Hydrogenation reaction of 4a: To a stirred solution of compound **4a** (0.1 mmol) in dry THF (5.0 mL) was added Pd/C(10 mg), followed by degassing three times. Afterwards, the reaction mixture was hydrogenated at 10 °C under an H_2 -balloon for 3h. After completion of the reaction, the reaction mixture was passed through a short plug silica-gel and washed with ethyl acetate. Next, the solvent was evaporated under reduced pressure to give the crude product, which was purified by column chromatography over silica-gel to deliver the **6aa**.

3-Phenethyl-4-phenylisoxazole-5-carboxamide (6aa): Colorless solid; yield = 86% (25.1 mg); mp = 80-81 °C; R_f = 0.35 (EtOAc/hexane = 30:70); ^1H NMR (500 MHz, CDCl_3) δ 7.36-7.31 (m, 3H), 7.27-7.17 (m, 3H), 7.12-7.03 (m, 4H), 6.61 (s, 1H), 5.98 (s, 1H), 3.07-2.97 (m, 4H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 170.8, 161.2, 155.2, 139.8, 130.0, 128.7, 128.5, 128.43, 128.36, 128.2, 126.7, 117.6, 33.7, 27.7 ppm; HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{16}\text{N}_2\text{O}_2\text{Na}^+$ $[\text{M}+\text{Na}]^+$: 315.1104, found 315.1085.

Synthesis of 3-(1-hydroxy-3-oxobutyl)-4-phenylisoxazole-5-carboxamide (7aa): To a stirred solution of compound **4a** (0.1 mmol) in acetone/ H_2O (5.0 mL, 9:1) was added KMnO_4 (2.0 equiv) at room temperature for 4h. After completion of the reaction, the reaction mixture was quenched with AcOH (0.15 mL), followed by evaporation of the solvent under reduced pressure to provide crude mass. Then, it was directly purified by column chromatography over silica-gel to give **7aa** in 51% yield.

3-(1-Hydroxy-3-oxobutyl)-4-phenylisoxazole-5-carboxamide (7aa): Colorless solid; yield = 51% (14.0 mg); mp = 78-80 °C; R_f = 0.28 (EtOAc/hexane = 50:50); ^1H NMR (400 MHz, DMSO) δ 8.26 (s, 1H), 7.86 (s, 1H), 7.42 (br s, 5H), 5.98 (d, J = 5.1 Hz, 1H), 5.08-5.0 (m, 1H), 3.11 (dd, J = 16.8, 7.8 Hz, 1H), 2.96 (dd, J = 16.9, 5.1 Hz, 1H), 2.08 (s, 3H) ppm; ^{13}C NMR (125 MHz, DMSO) δ 205.6, 169.6, 161.3, 157.4, 129.5, 128.41, 128.35, 127.9, 115.4,

59.6, 47.8, 30.3 ppm; HRMS (ESI) m/z calcd for $C_{14}H_{14}N_2O_4Na^+$ $[M+Na]^+$: 297.0846, found 297.0828.

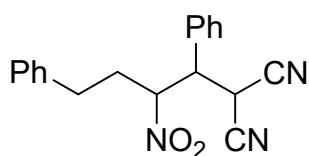


Scheme S1. Control experiment

Synthesis of compound 6 (Scheme S1a): To a stirred solution of 3-nitropropyl benzene (**5**; 0.2 mmol) and compound **2a** (0.24 mmol) in dry DCM (1.0 mL) at room temperature was added DABCO (0.02 mmol) under an argon atmosphere for 12 h. After completion of the reaction, the reaction mixture was purified by column chromatography to give the pure

Michael adduct **6**. The product was characterized by its spectroscopic data (^1H , ^{13}C NMR and HRMS).

2-(2-Nitro-1,4-diphenylbutyl)malononitrile (6): Gummy liquid; yield = 80%; R_f = 0.60

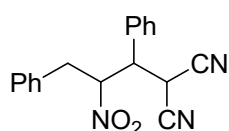


(EtOAc/hexane = 10:90); dr = 58:42; ^1H NMR (400 MHz, CDCl_3) δ (**major isomer**) 7.48-7.38 (m, 3H), 7.29-7.19 (m, 5H), 6.97 (d, J = 6.9 Hz, 2H), 5.17-5.05 (m, 1H), 4.02 (d, J = 4.3 Hz, 1H), 3.78-3.70 (m, 1H), 2.73-2.60 (m, 1H), 2.54-2.42 (m, 1H), 2.24-2.07 (m, 1H), 1.92-1.80 (m, 1H) ppm; ^{13}C NMR (100 MHz, CDCl_3) δ (**major isomer**) 138.5, 131.3, 130.5, 130.1, 128.9, 128.6, 128.5, 127.0, 110.5, 110.1, 87.7, 48.6, 33.9, 31.5, 27.7 ppm.

Minor isomer: R_f = 0.58 (EtOAc/hexane = 10:90); ^1H NMR (500 MHz, CDCl_3) δ 7.47-7.39 (m, 3H), 7.35 (t, J = 7.4 Hz, 2H), 7.30-7.26 (m, 1H), 7.21-7.14 (m, 4H), 5.11-5.04 (m, 1H), 4.38 (d, J = 8.1 Hz, 1H), 3.69 (t, J = 7.4 Hz, 1H), 2.82-2.73 (m, 1H), 2.73-2.65 (m, 1H), 2.42-2.31 (m, 1H), 2.15-2.04 (m, 1H) ppm; ^{13}C NMR (100 MHz, CDCl_3) δ 138.7, 131.3, 130.6, 129.9, 129.1, 128.5, 128.0, 127.2, 111.0, 110.8, 87.0, 49.3, 33.2, 32.0, 26.9 ppm; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{17}\text{N}_3\text{O}_2\text{Na}^+$ [$\text{M}+\text{Na}$] $^+$: 342.1213, found 342.1235.

Synthesis of compound 8 (Scheme S1b): The above procedure has been followed for the synthesis of Michael adduct **8** from 2-nitroethyl benzene (**7**) and **2a**.

2-(2-Nitro-1,3-diphenylpropyl)malononitrile (8): yield = 82%; R_f = 0.62; (EtOAc/hexane =



10:90); dr = 52:48; ^1H NMR (500 MHz, CDCl_3) δ (**major isomer**) 7.60-7.52 (m, 3H), 7.51-7.46 (m, 2H), 7.32-7.26 (m, 3H), 7.0-6.95 (m, 2H), 5.38-5.30 (m, 1H), 4.07 (t, J = 3.9 Hz, 1H), 3.82-3.76 (m, 1H), 3.13-2.91 (m, 2H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ (**major isomer**) 133.7, 131.4, 130.7, 130.3, 129.4, 128.8, 128.7, 128.3, 110.4, 110.2, 90.1, 48.6, 38.4, 27.8 ppm.

Minor isomer: R_f = 0.60; (EtOAc/hexane = 10/90); ^1H NMR (500 MHz, CDCl_3) δ 7.49-7.43 (m, 3H), 7.42-7.32 (m, 3H), 7.24-7.18 (m, 4H), 5.39-5.33 (m, 1H), 4.52 (d, J = 9.0 Hz, 1H), 3.70 (dd, J = 9.0, 5.7 Hz, 1H), 3.36 (dd, J = 14.5, 8.2 Hz, 1H), 3.10 (dd, J = 14.5, 6.7 Hz, 1H) ppm; ^{13}C NMR (125 MHz, CDCl_3) δ 133.7, 131.0, 130.7, 130.0, 129.6, 129.0, 128.4, 128.2, 111.2, 111.0, 88.0, 48.5, 37.0, 27.2 ppm; HRMS (ESI) m/z calcd for $\text{C}_{18}\text{H}_{15}\text{N}_3\text{O}_2\text{Na}^+$ [$\text{M}+\text{Na}$] $^+$: 328.1056, found 328.1030.

Isomerization reaction (Scheme S1c). A mixture of compound **3aa** (0.1 mmol, dr = 80:20) and DABCO (20 mol%) in DCM (0.5 mL) was stirred at room temperature for 20h. After

usual workup, we have taken ^1H NMR of the isolated crude product. The data indicated that no isomerization took place.

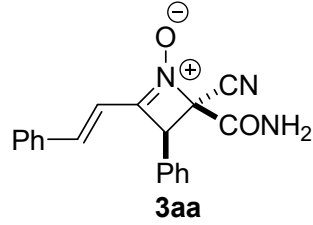
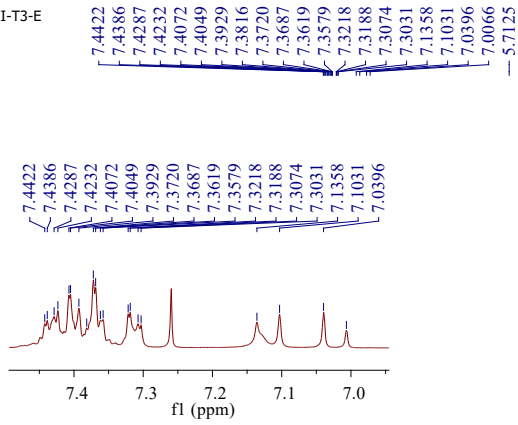
BHT and BPO mediated reactions (Schemes S1d and 1e): To a stirred solution of **3aa** (0.1 mmol) and pTSA (50 mol%) in dry DCM (2.0 mL) under an argon atmosphere was added BHT or BPO (0.3 mmol, 3.0 equiv) at room temperature for 12h. After usual work-up, the reaction mixture was purified by column chromatography to afford a pure product **4a** in 80% yield (BHT) and 77% yield (BPO).

TEMPO mediated reaction (Scheme S1f). To a stirred solution of **3aa** (0.1 mmol) and pTSA (50 mol%) in dry DCM (2.0 mL) under an argon atmosphere was added TEMPO (50 mol%) at room temperature for 12h. The TLC and ^1H NMR of crude mixture showed that a trace amount of desired product **4a** was formed.

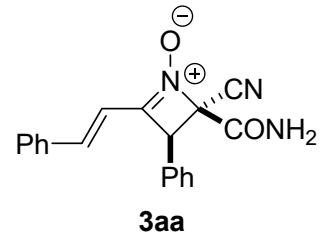
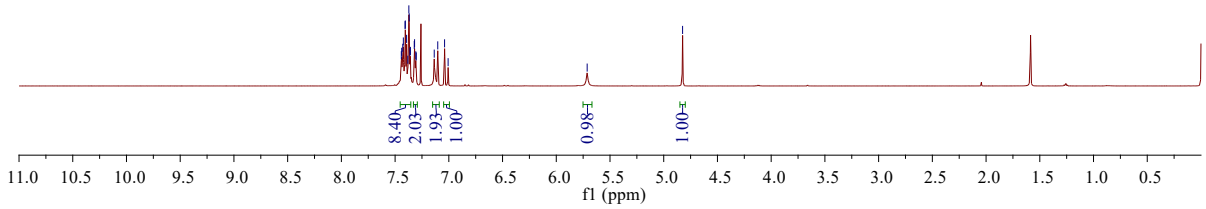
References:

1. (a) C. Zheng, S. Huang, Y. Liu, C. Jiang, W. Zhang, G. Fang and J. Hong, *Org. Lett.*, 2020, **22**, 4868. (b) R. Pedrosa, C. Andrés and J. M. Iglesias, *J. Org. Chem.*, 2001, **66**, 243.
2. (a) G. Bertuzzi, M. K. Thøgersen, M. Giardinetti, A. Vidal-Albalat, A. Simon, K. N. Houk and K. A. Joergensen, *J. Am. Chem. Soc.*, 2019, **141**, 3288. (b) A. A. Mousawi, P. Garra, F. Dumur, T. T. Bui, F. Goubard, J. Toufaily, T. Hamieh, B. Graff, D. Gigmes, J. P. Fouassier and J. Lalevée, *Molecules*, 2017, **22**, 2143. (c) K.-D. Warzecha, J. Leitich and M. Demuth, *J. Photochem. Photobiol. A*, 2002, **152**, 103. (d) R.V. Hangarge, S.A. Sonwane, D.A. Jarikote and M. S. Shingare, *Green Chemistry*, 2001, **3**, 310. (e) N. Salaverri, B. Carli, Gratal, B. Patrici, L. Marzo and J. Aleman, *Adv. Synth. Catal.*, 2022, **364**, 1689. (f) M.B. Plutschack, P. H. Seeberger and K. Gilmore, *Org. Lett.*, 2017, **19**, 30. D. Zhang, M. Lian, J. Liu, S. Tang, G. Liu, C. Ma, Q. Meng, H. Peng and D. Zhu, *Org. Lett.*, 2019, **21**, 2597.

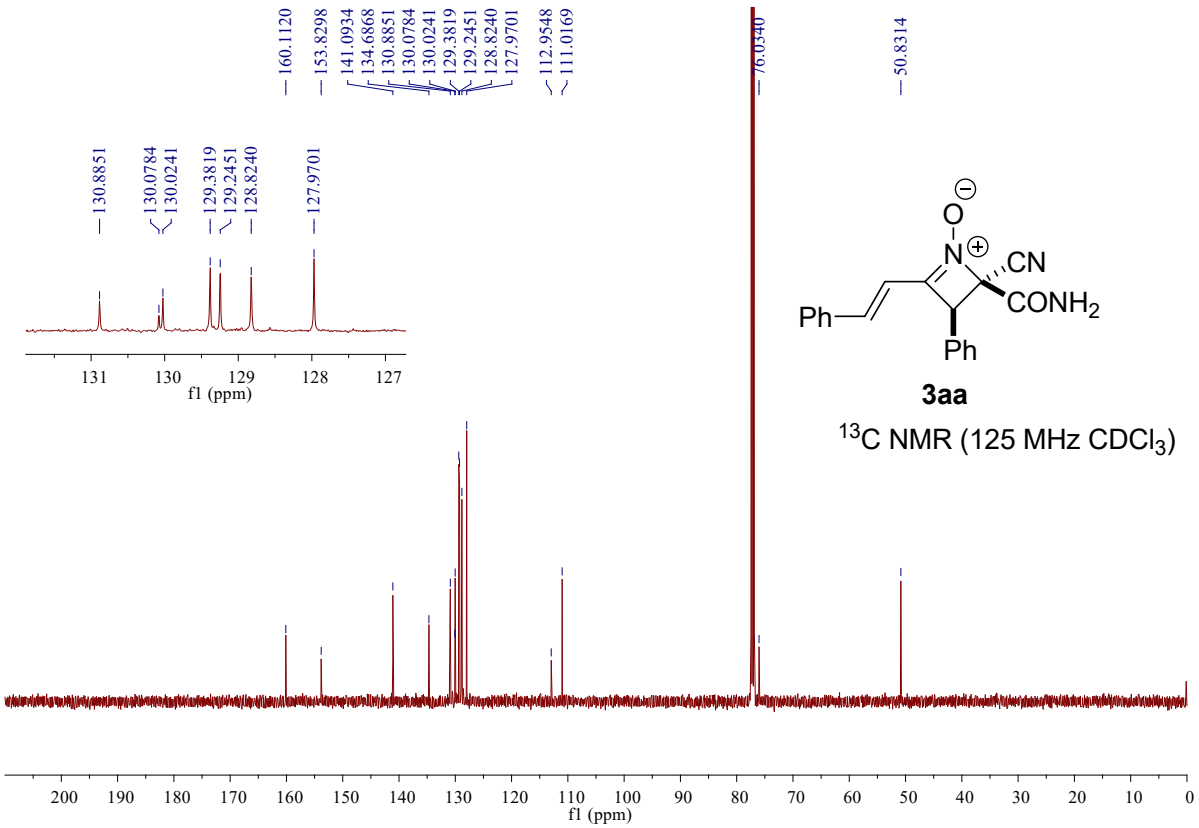
SS-SSR-II-T3-E

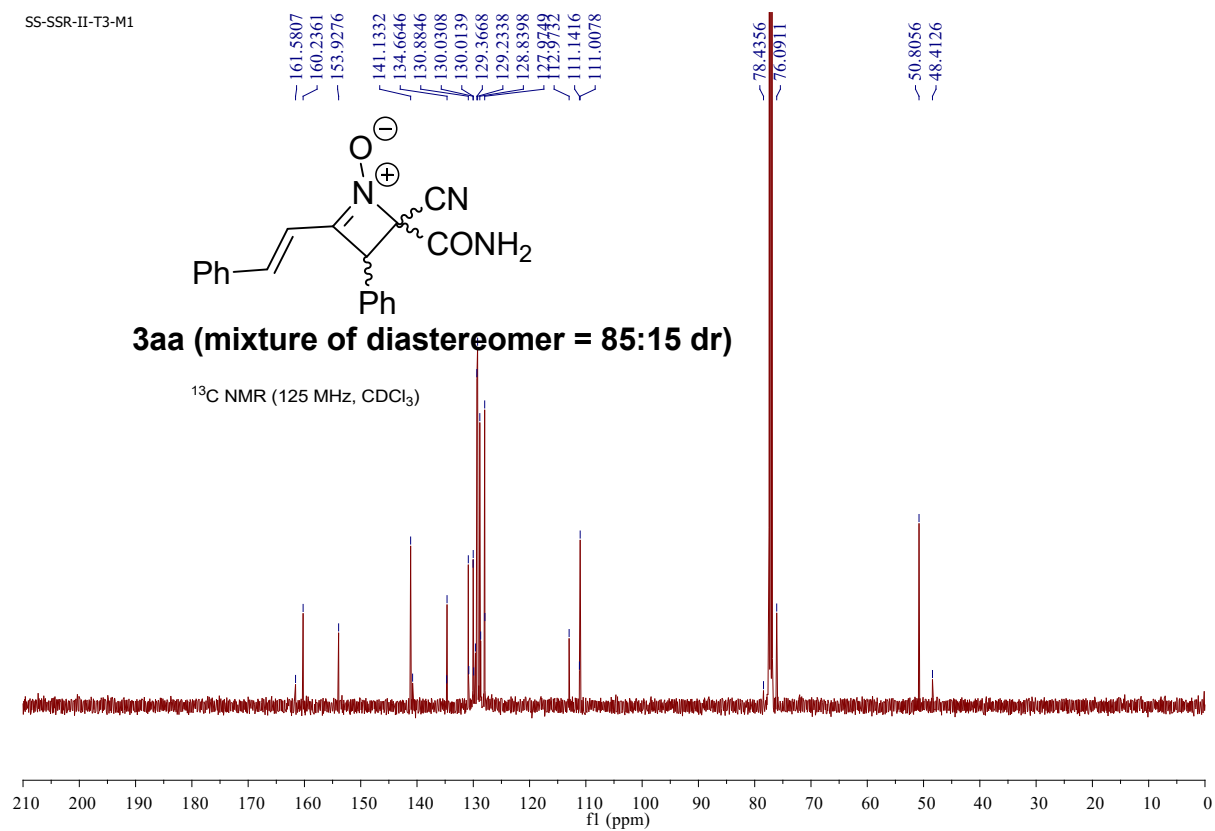
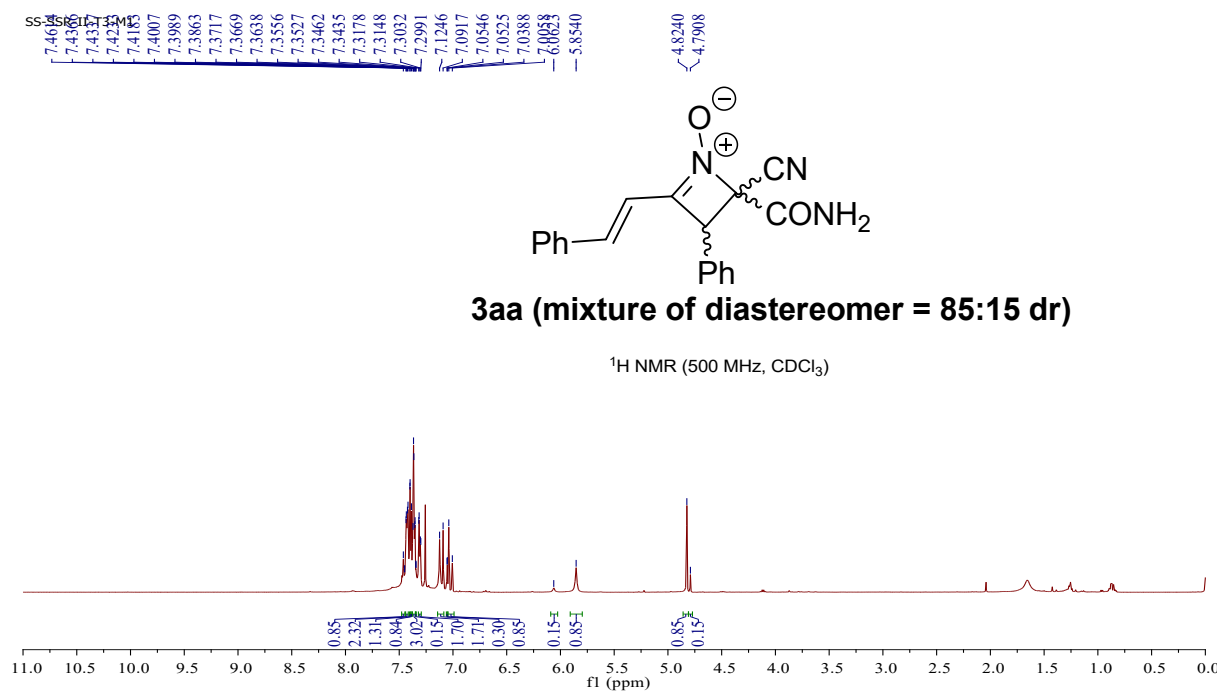


¹H NMR (500 MHz CDCl₃)

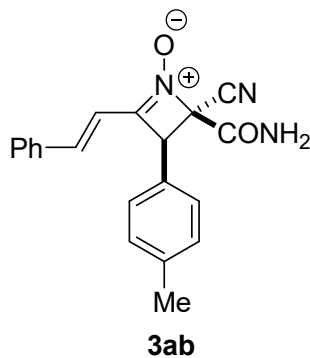
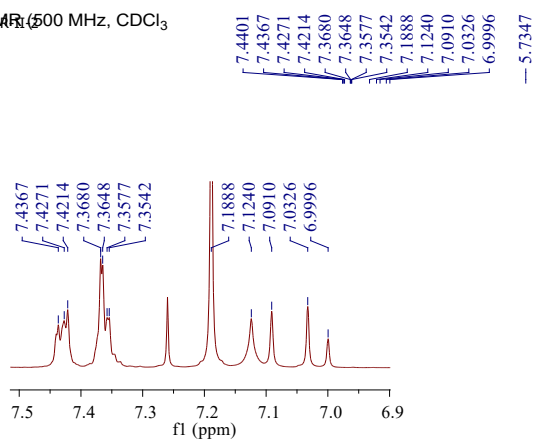


¹³C NMR (125 MHz CDCl₃)

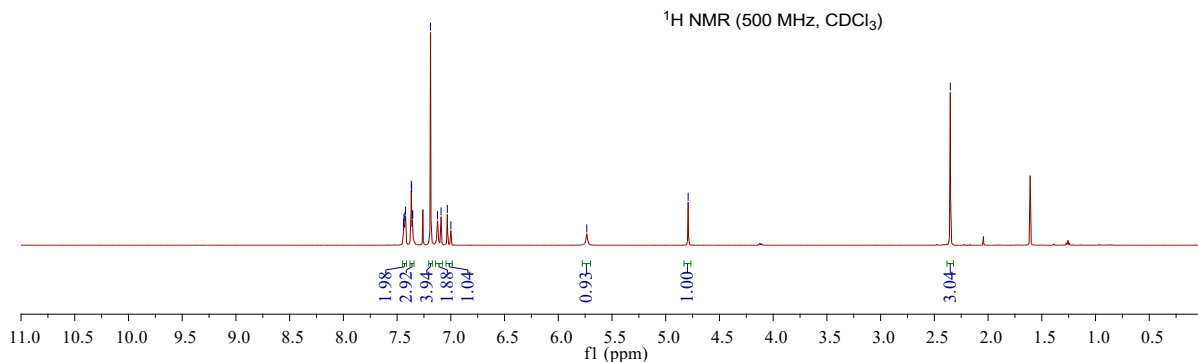




¹H NMR (500 MHz, CDCl₃)

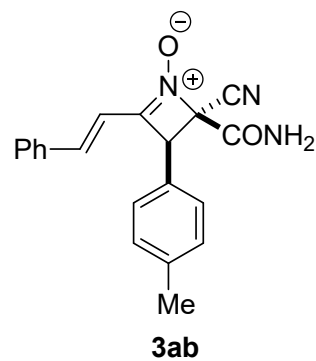
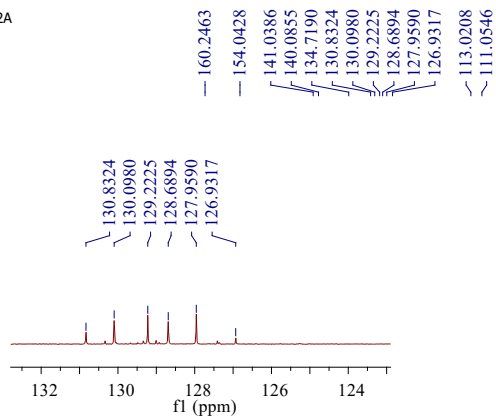


¹³C NMR (125 MHz, CDCl₃)

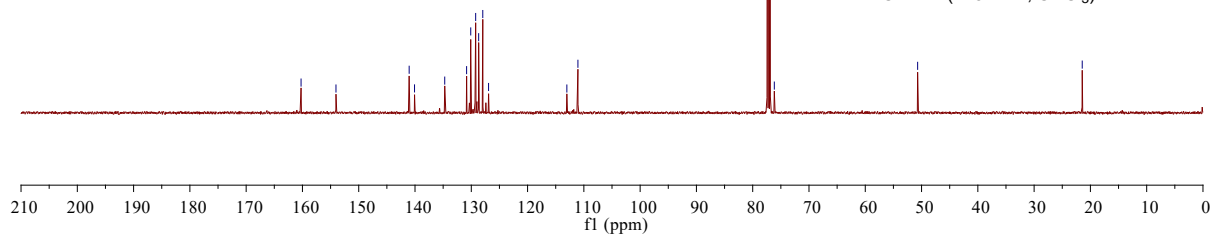


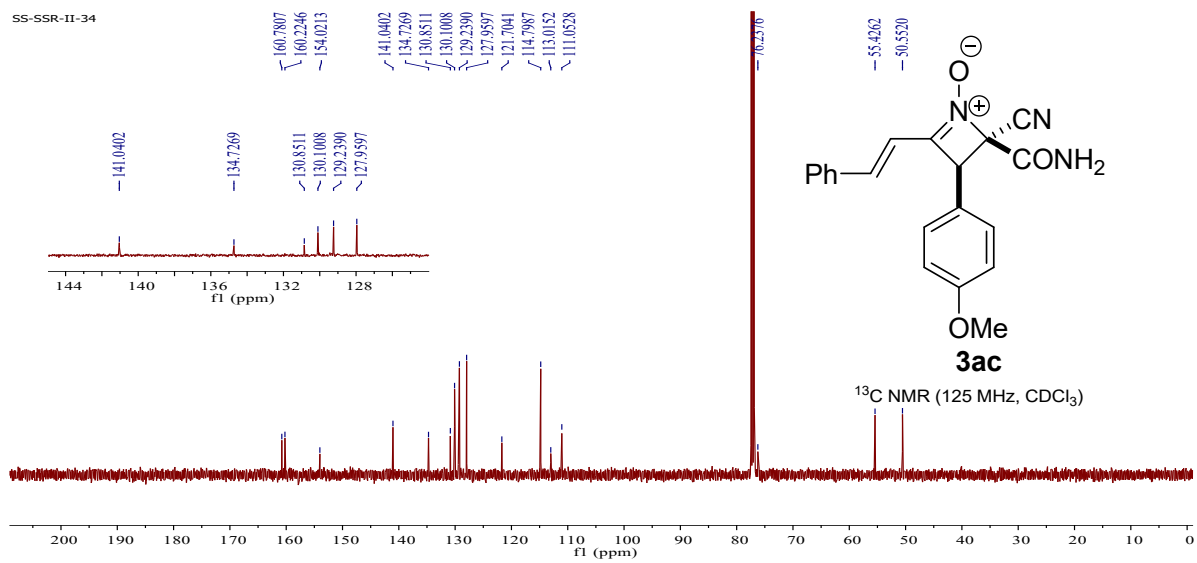
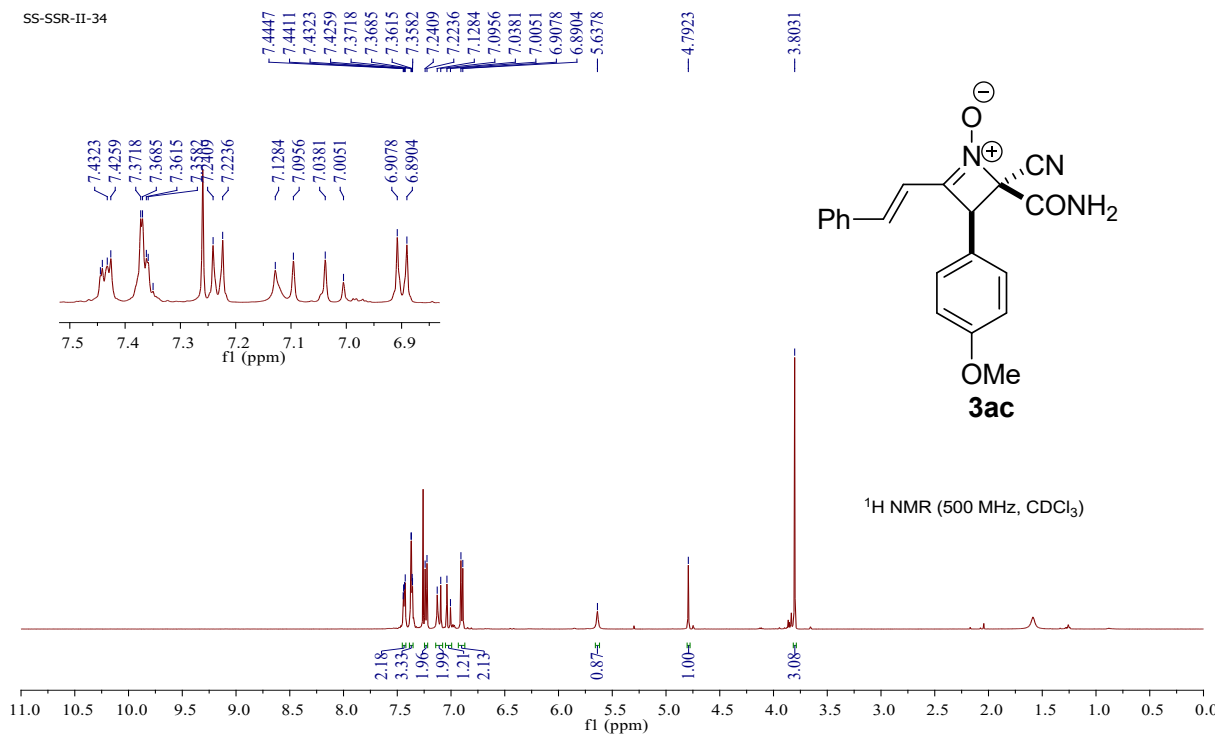
¹H NMR (500 MHz, CDCl₃)

SS-SSR-II-2A



¹³C NMR (125 MHz, CDCl₃)

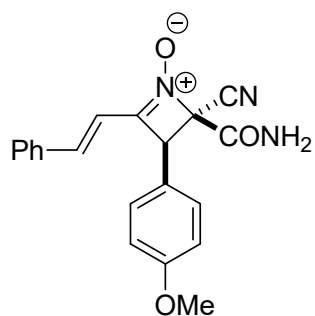




SS-SSR-II-M34

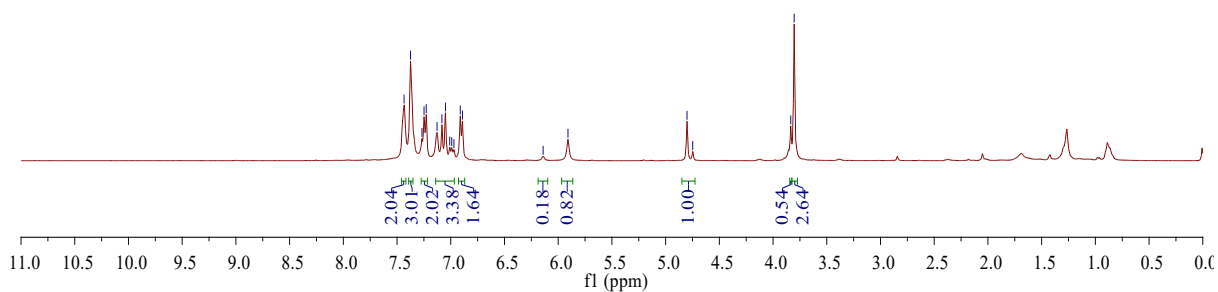
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7.4345
7.3742
7.2680
7.2486
7.2283
7.1276
7.0822
7.0496
7.0094
6.9907
6.9705
6.9116
6.8914
6.1403
5.9089
4.8009
4.7478
3.8352
3.8035

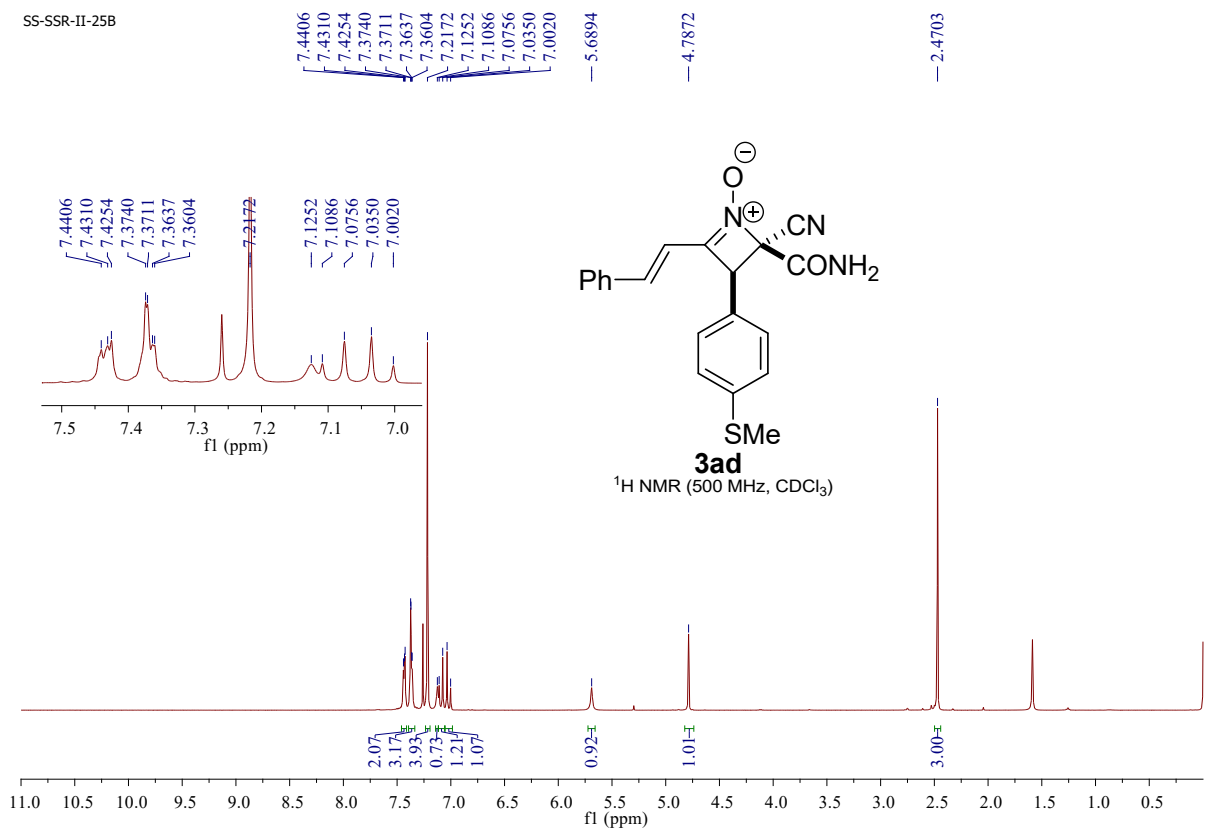


3c (mixture of diastereomer = 82:18 dr)

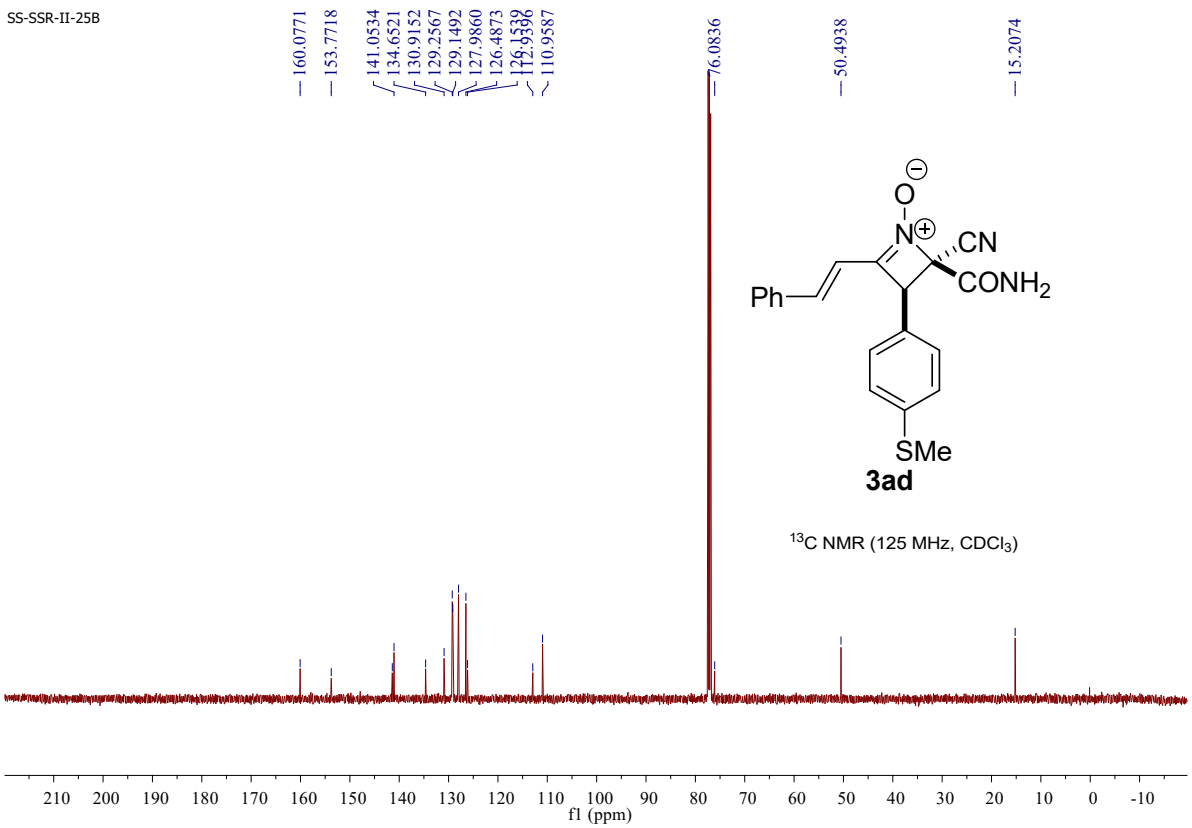
¹H NMR (500 MHz, CDCl₃)



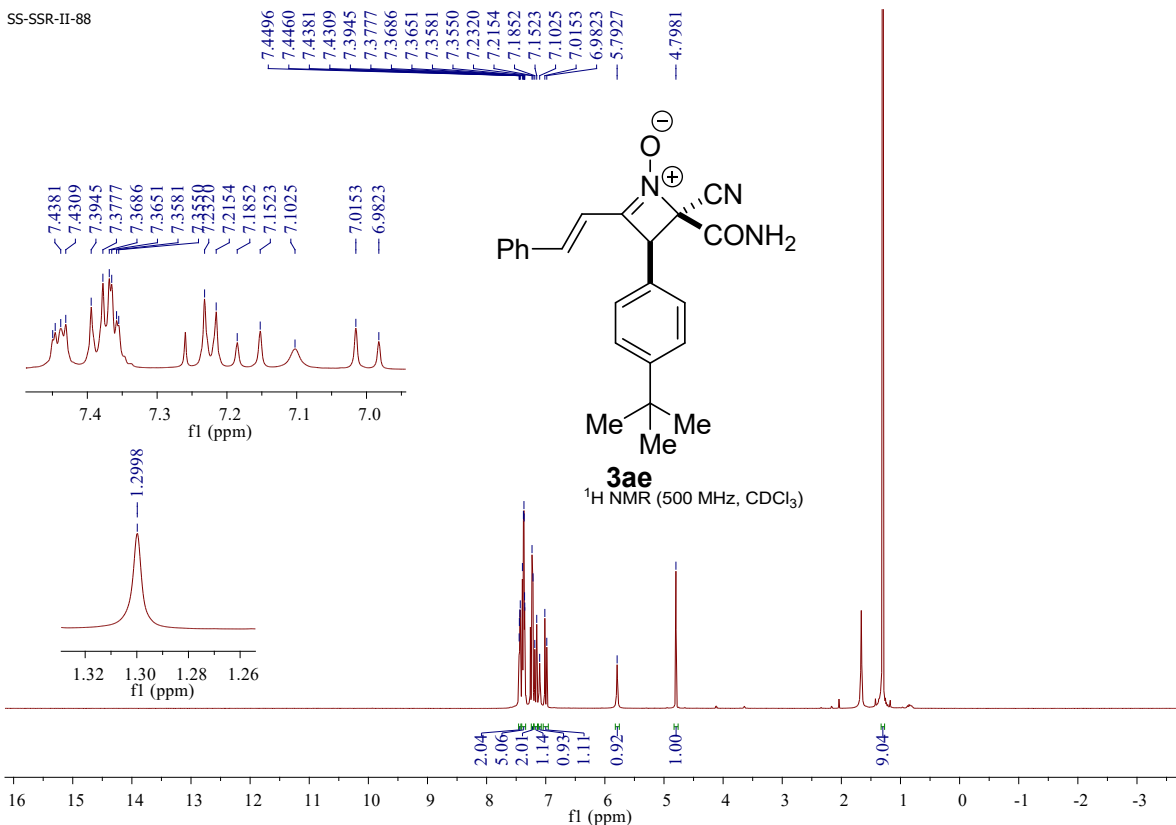
SS-SSR-II-25B



SS-SSR-II-25B

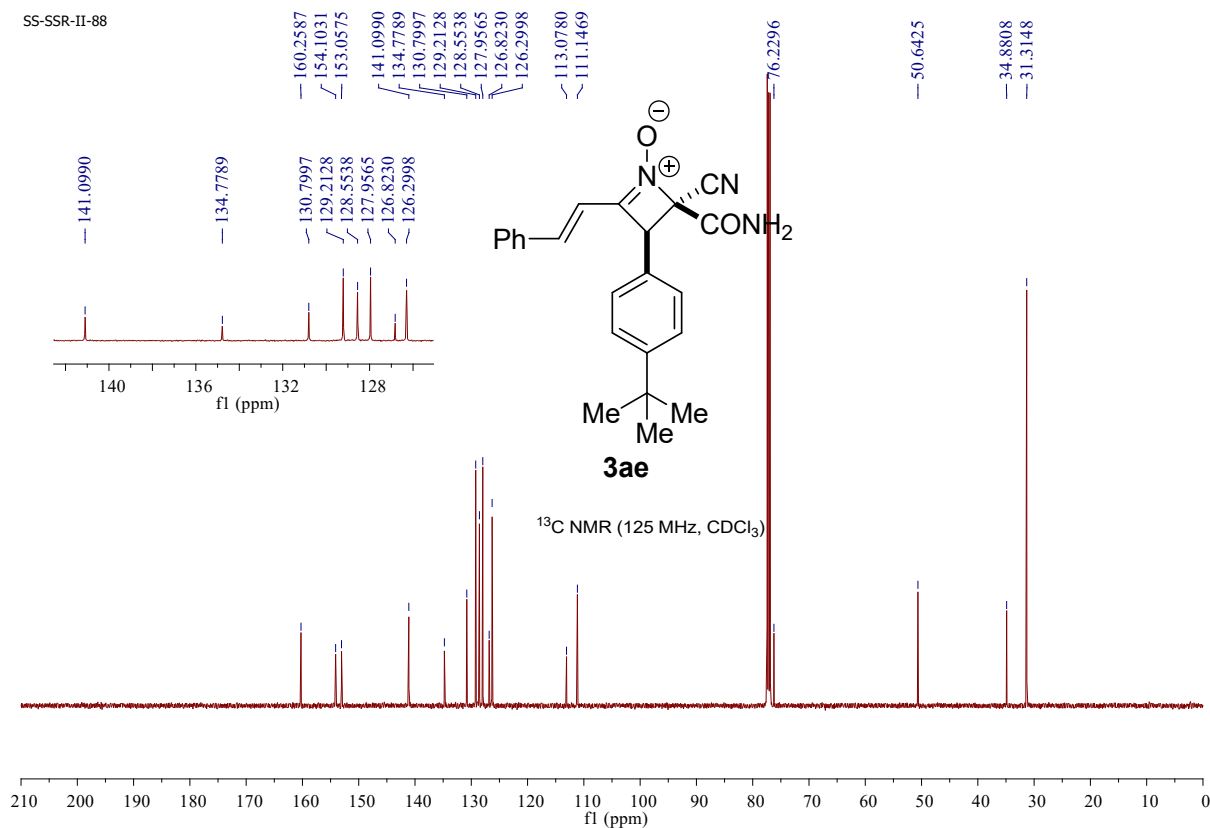


SS-SSR-II-88

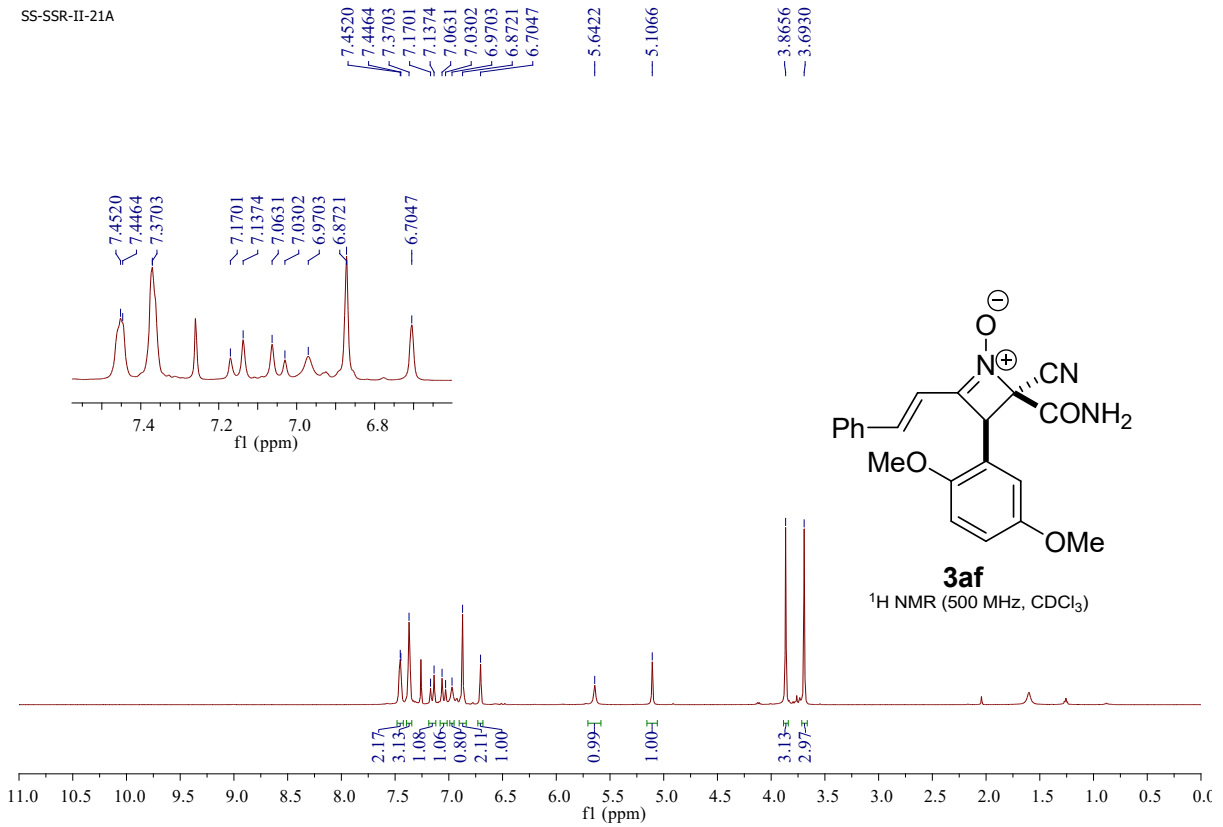


1

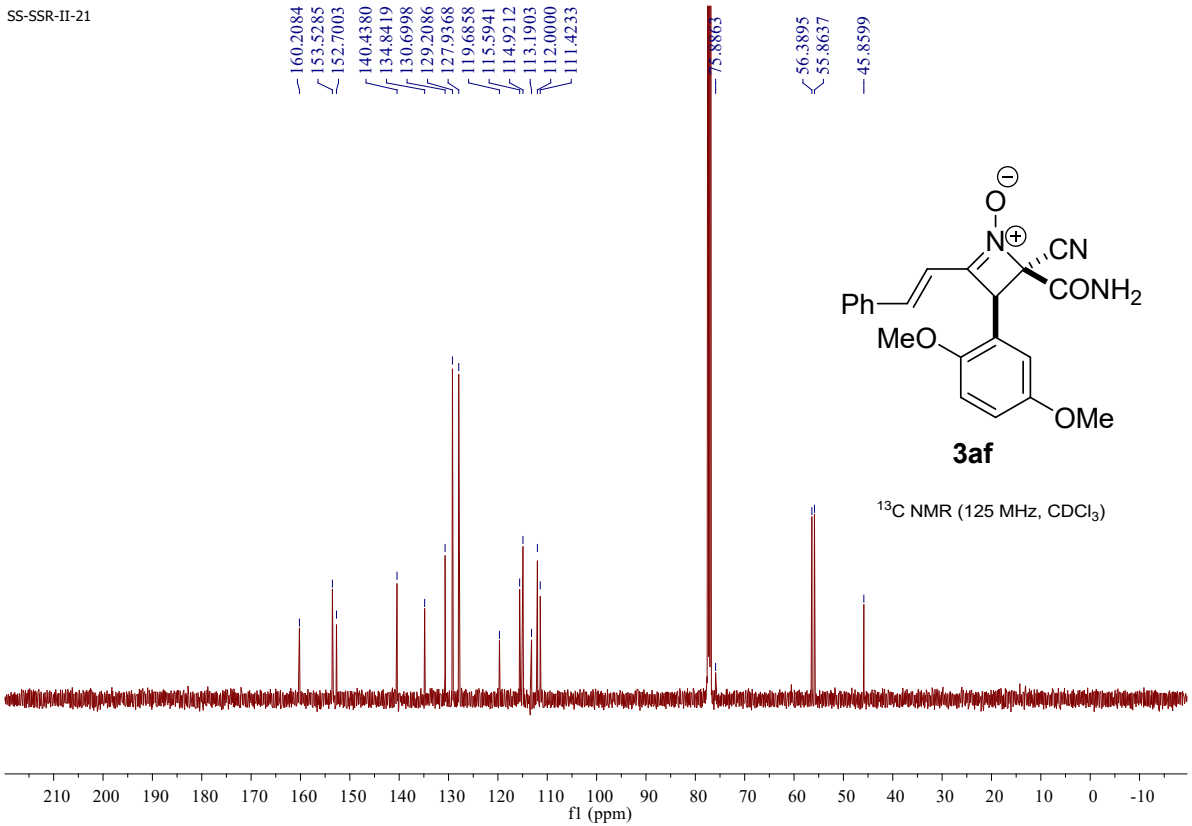
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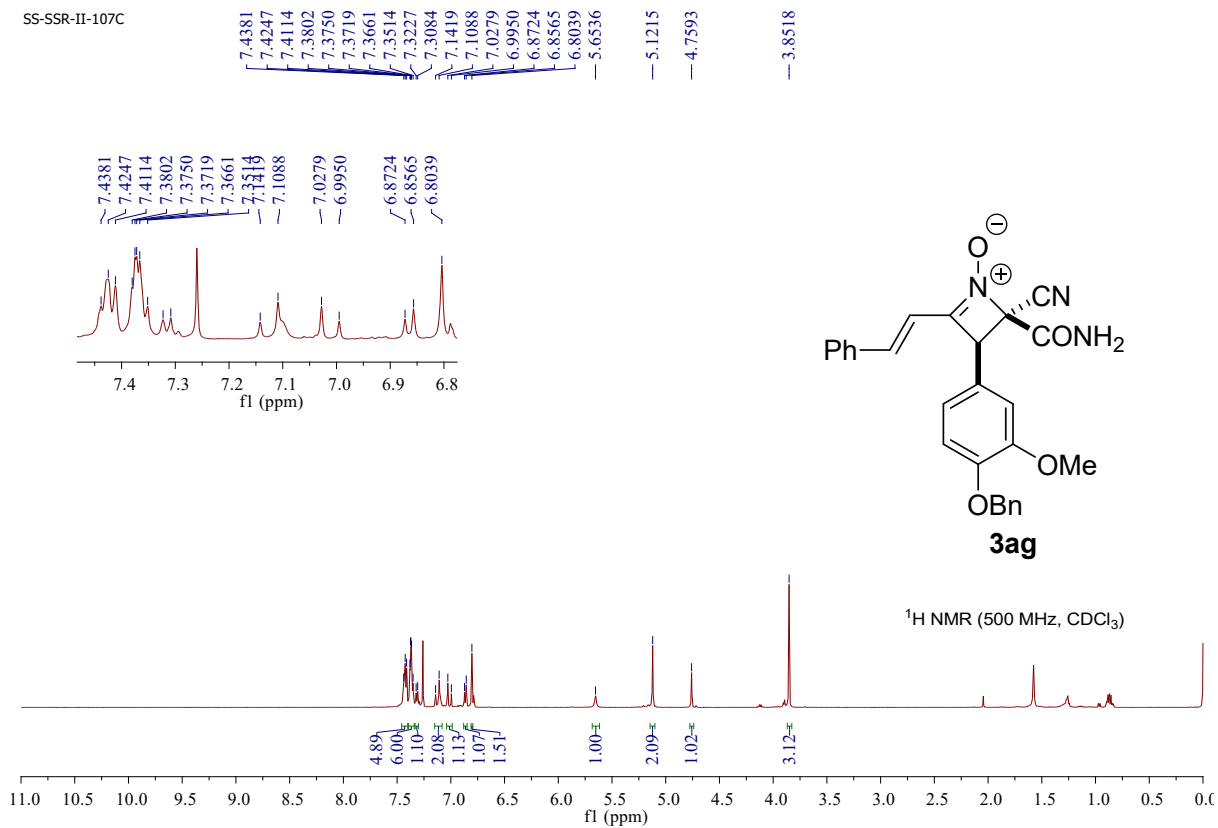
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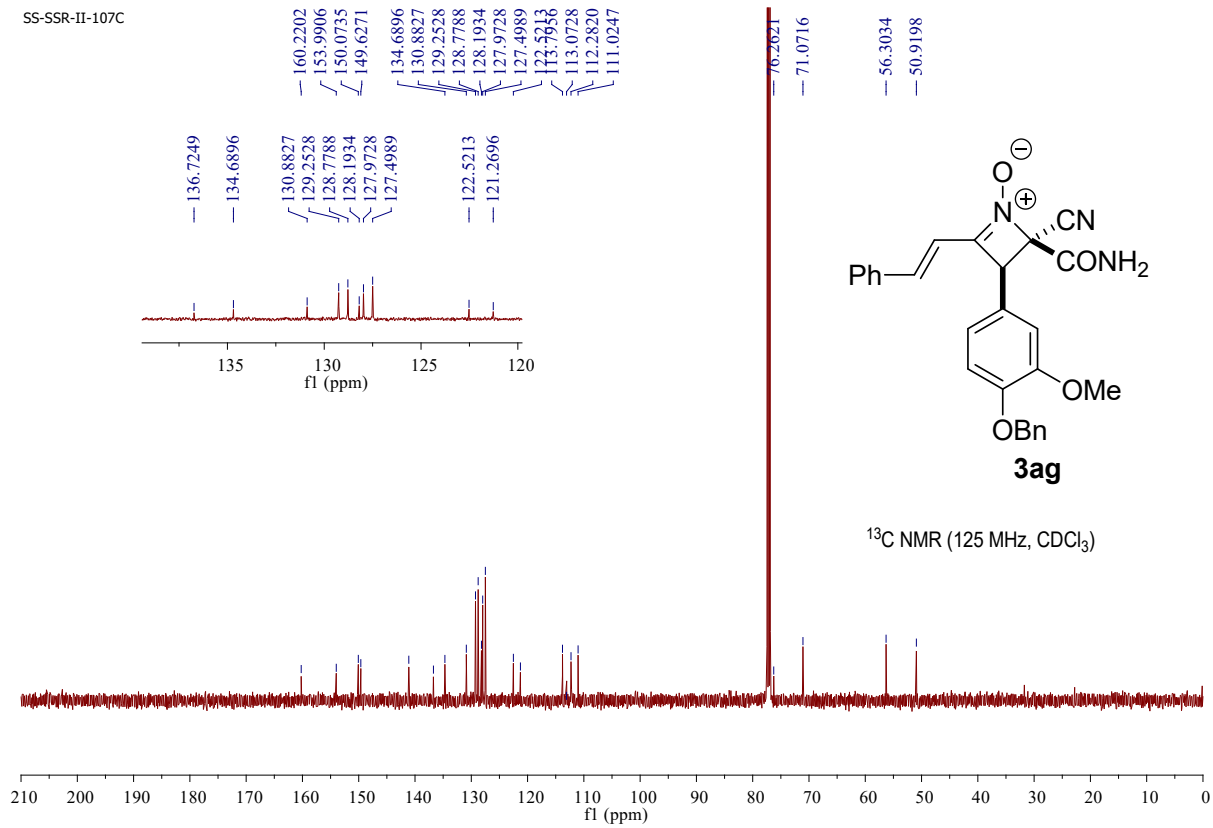
SS-SSR-II-21



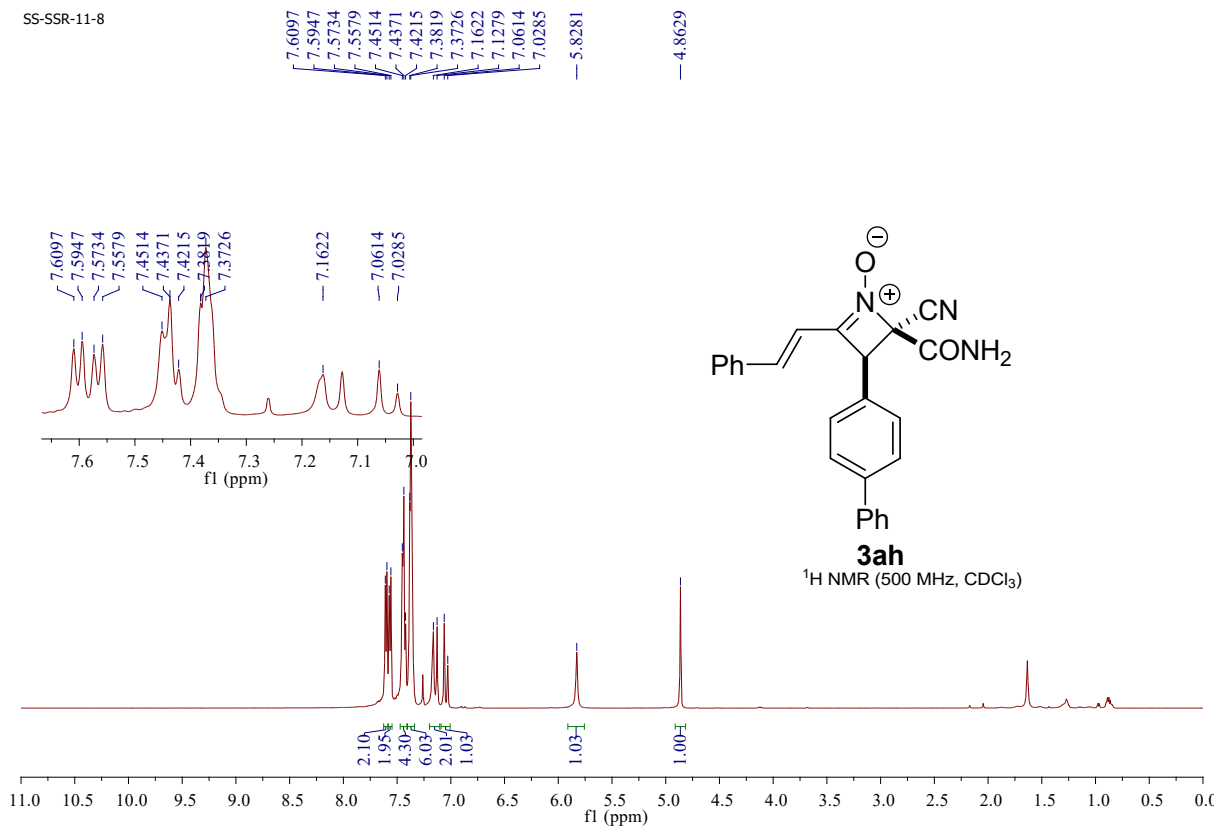
SS-SSR-II-107C



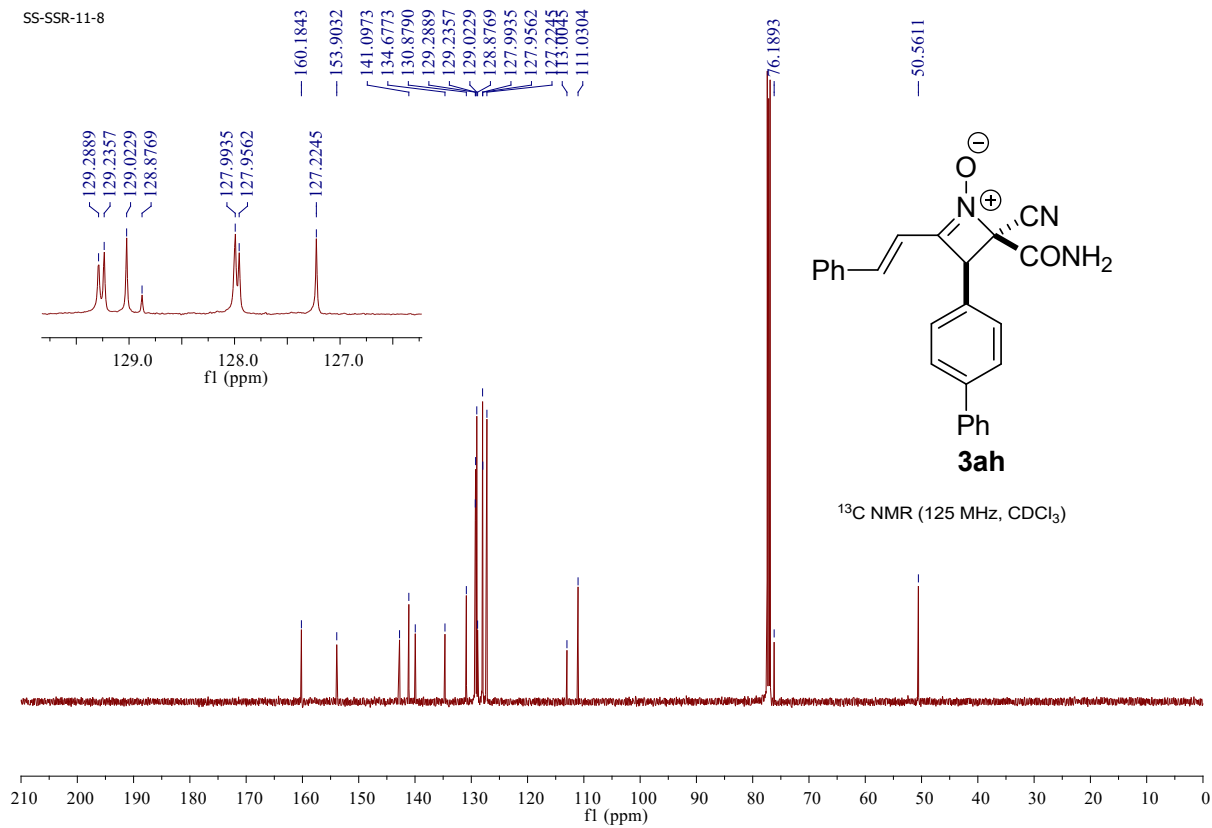
SS-SSR-II-107C



SS-SSR-11-8



SS-SSR-11-8

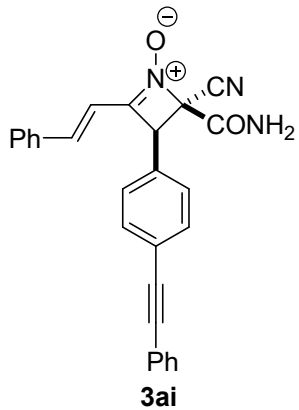


SS-SSR-II-189

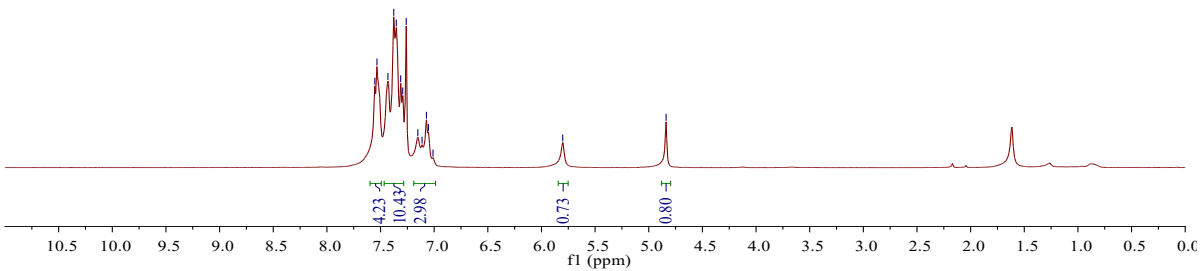
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7.5531
7.5335
7.4312
7.3768
7.3533
7.3121
7.2932
7.2604
7.1524
7.1130
7.0721
7.0532
7.0107
5.8014

4.8384



¹H NMR (400 MHz, CDCl₃)



SS-SSR-II-189

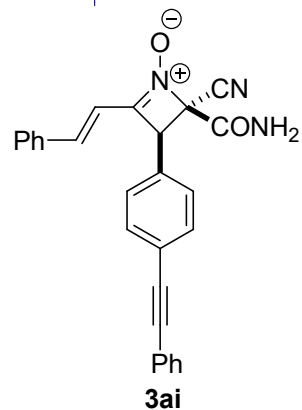
C13CPD CDCl₃ {H:\OneDrive - IIT Indore\Sampak}

139.9747
136.6267
135.1275
134.5941
133.4647
133.8084
130.9614
129.2632
128.8784
128.7754
128.5327
128.8163
110.8985

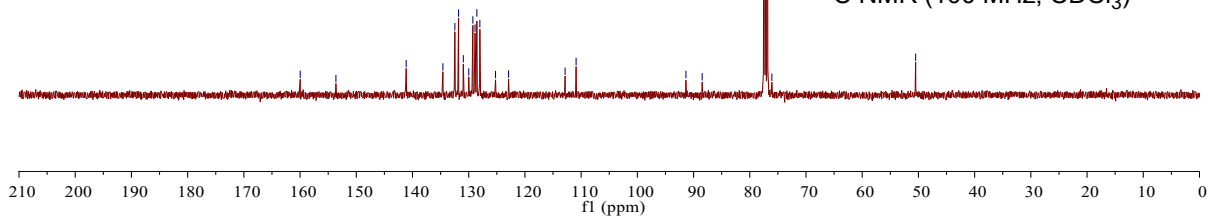
91.3600
88.4711

76.0721

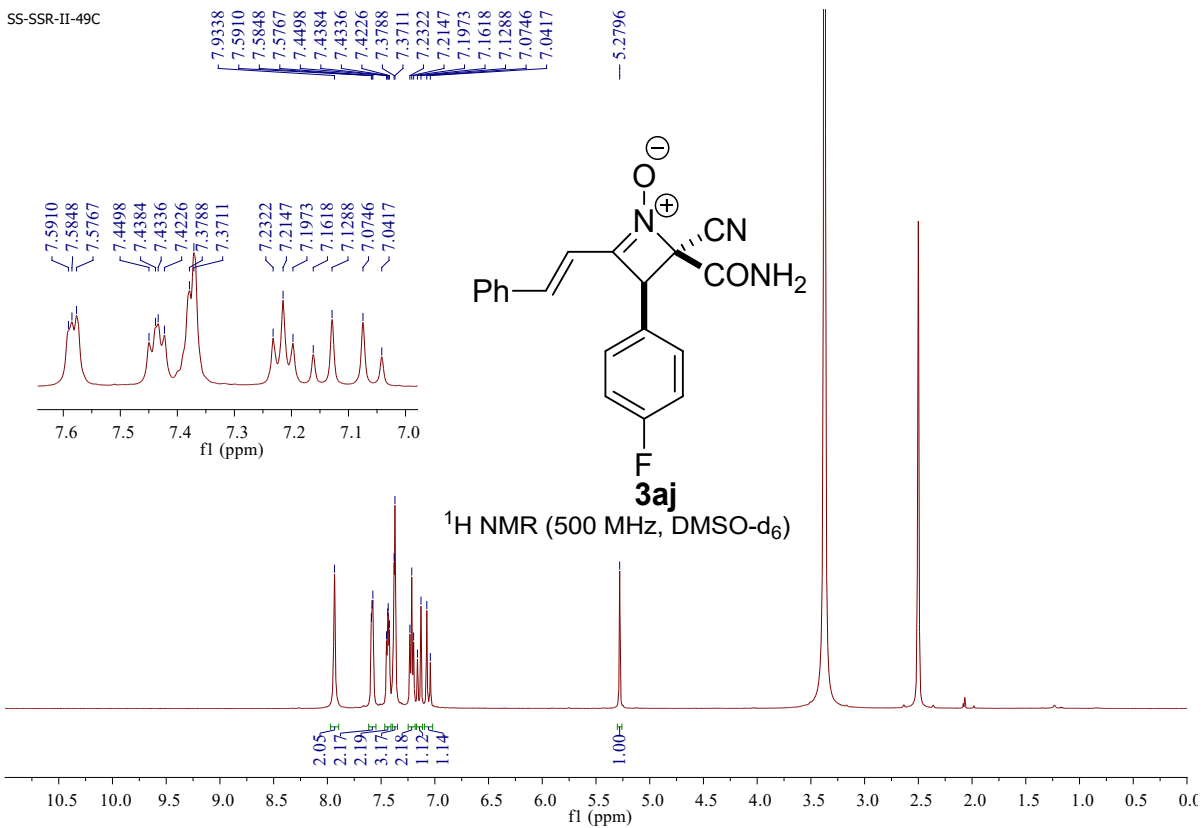
50.4939



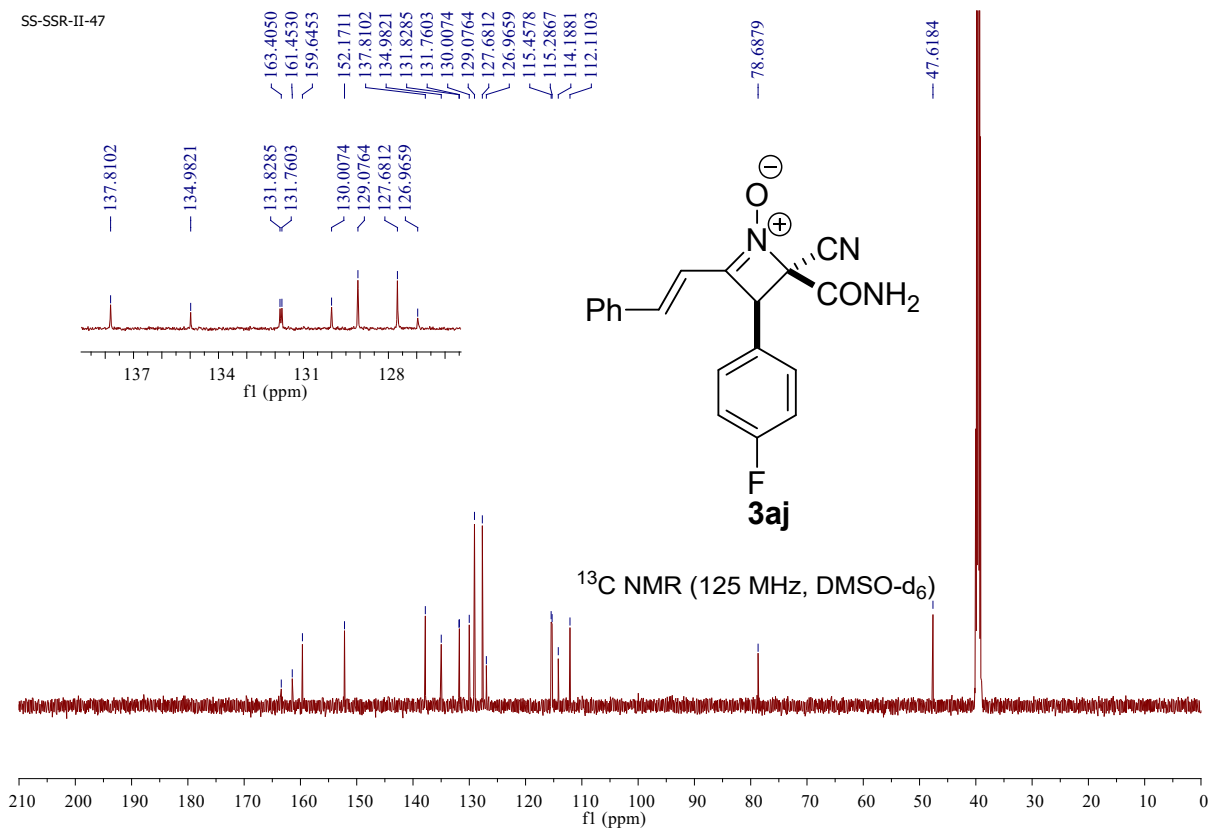
¹³C NMR (100 MHz, CDCl₃)



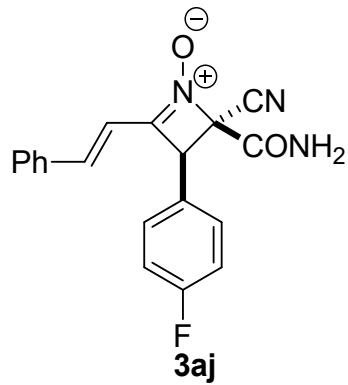
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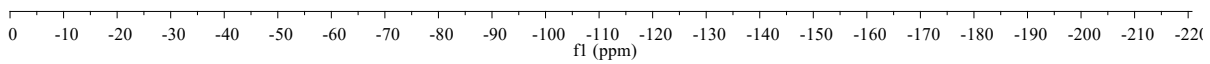
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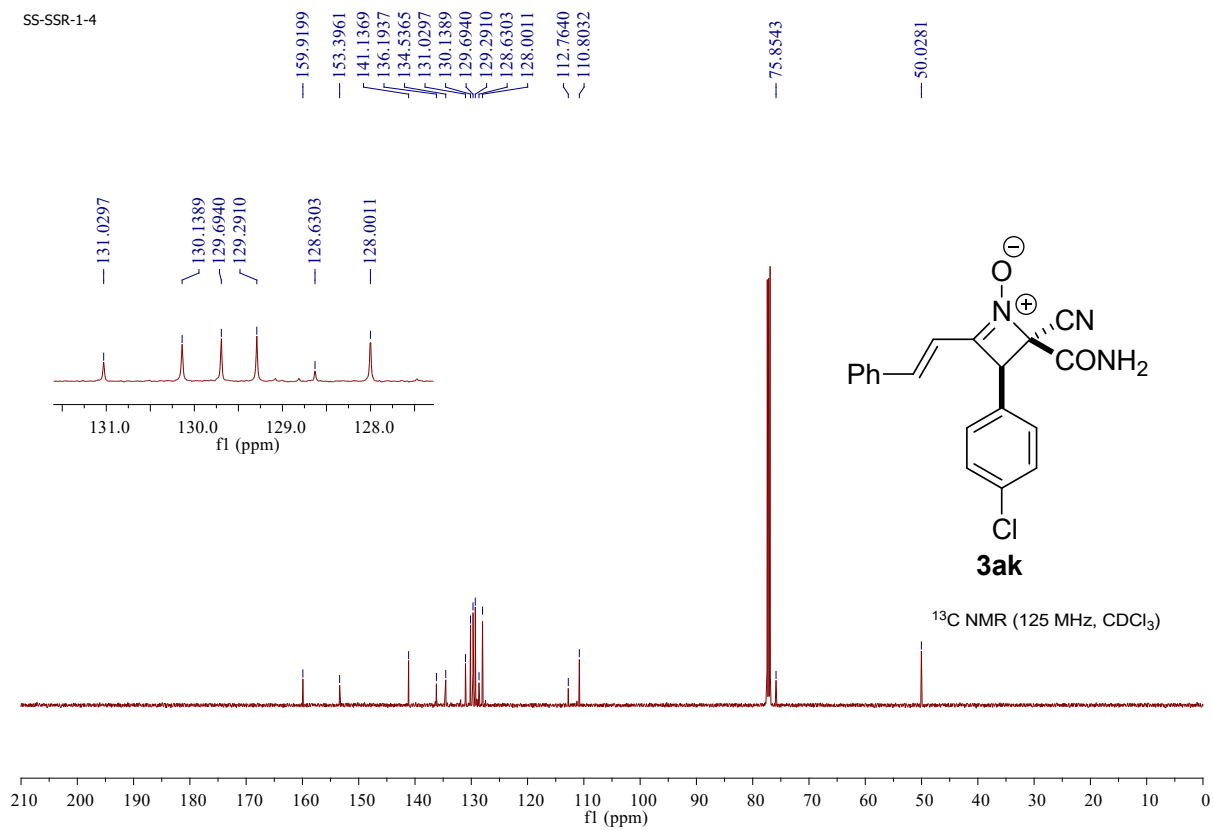
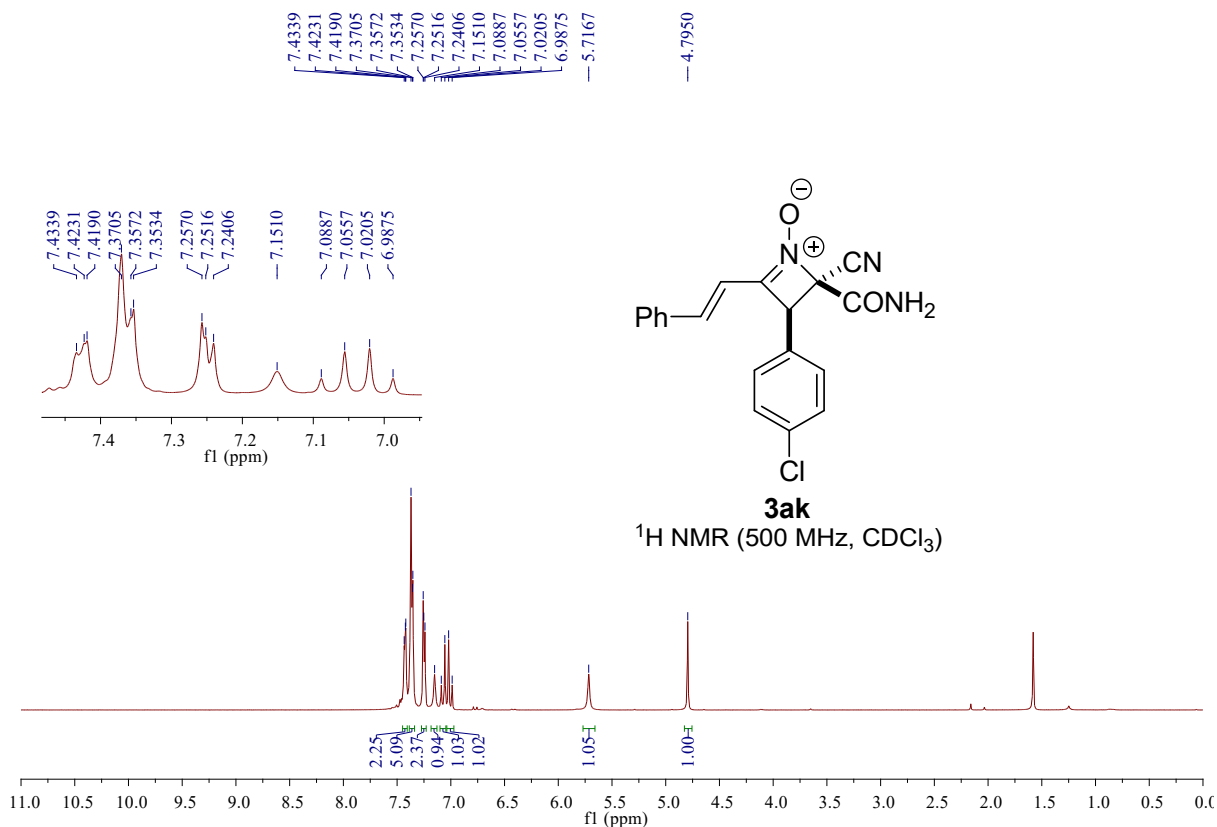


-112.8253
-113.7824

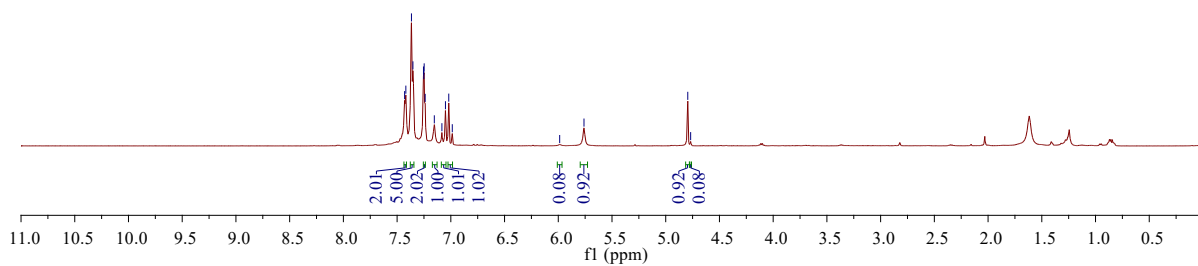
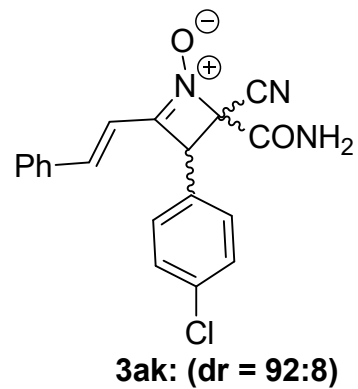
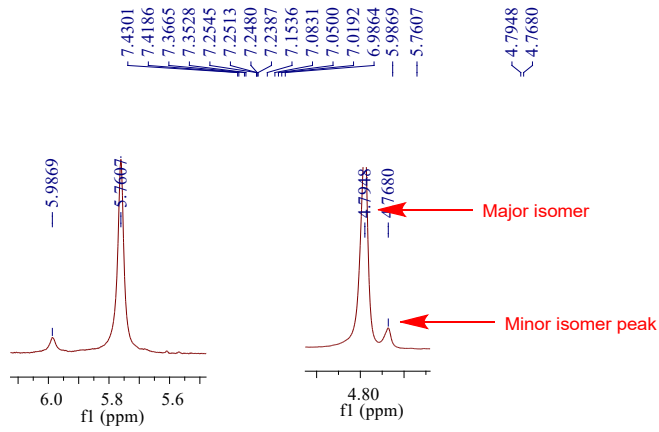


¹⁹F NMR (470 MHz, DMSO-d₆)

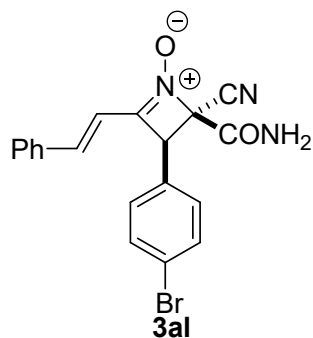
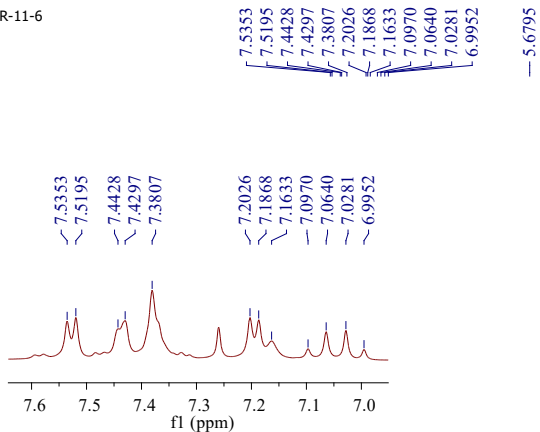




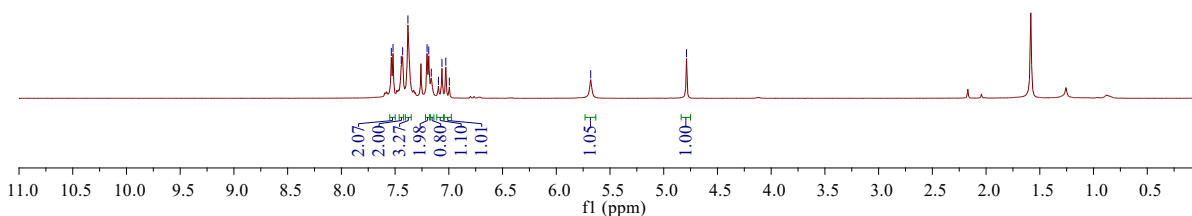
SS-SSR-II-M6-B



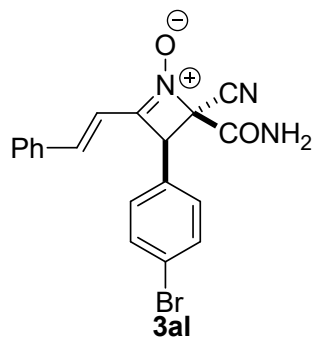
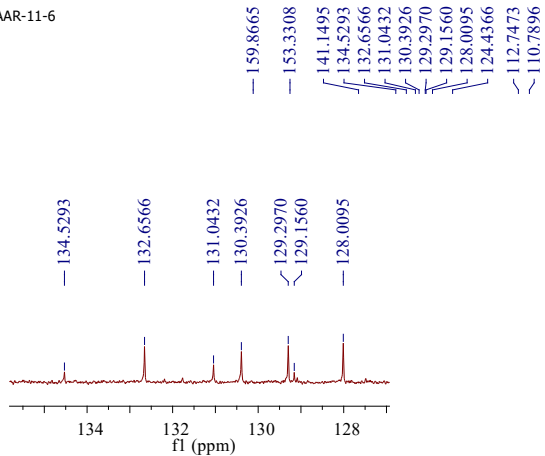
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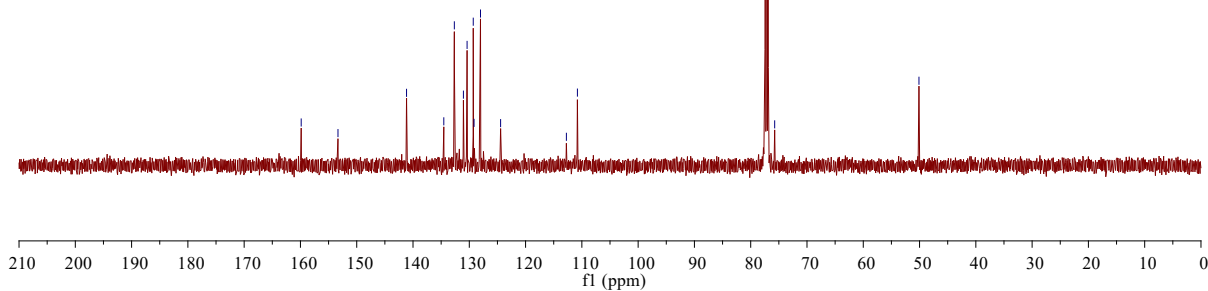
¹H NMR (500 MHz, CDCl₃)

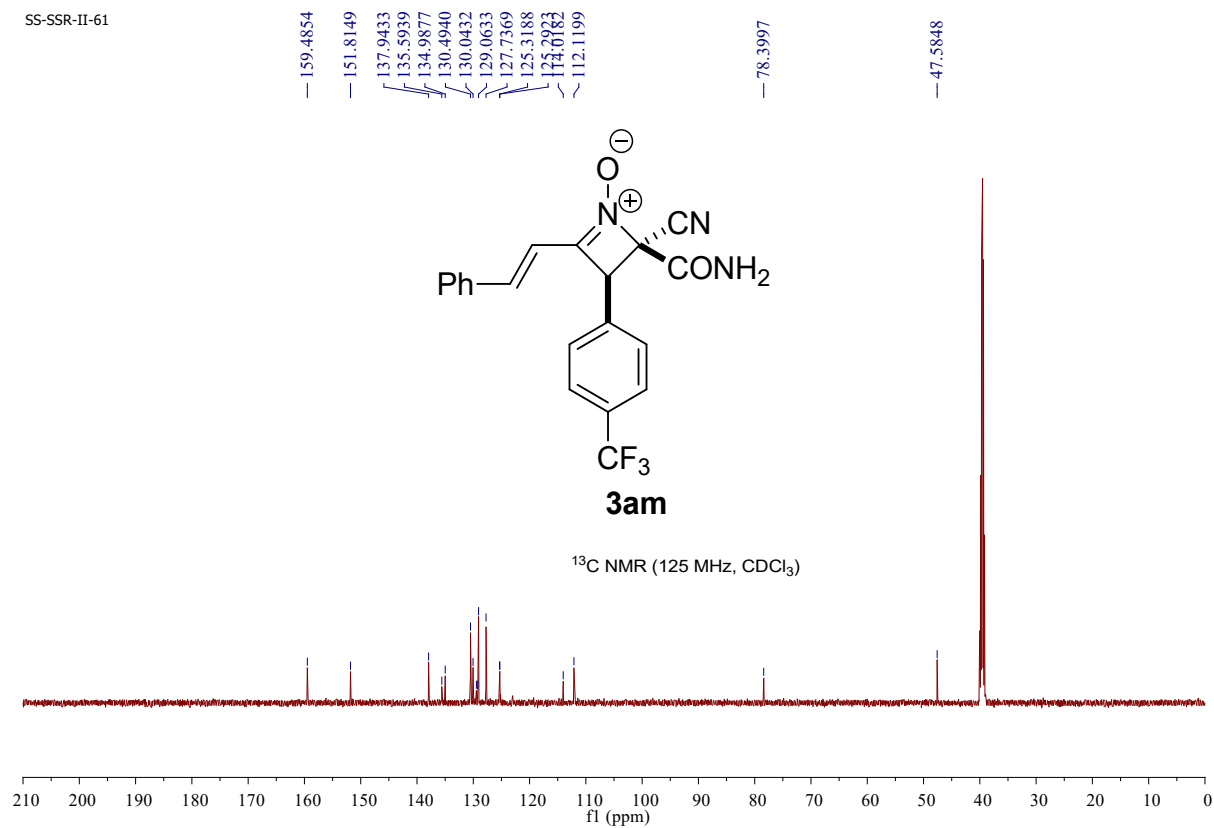
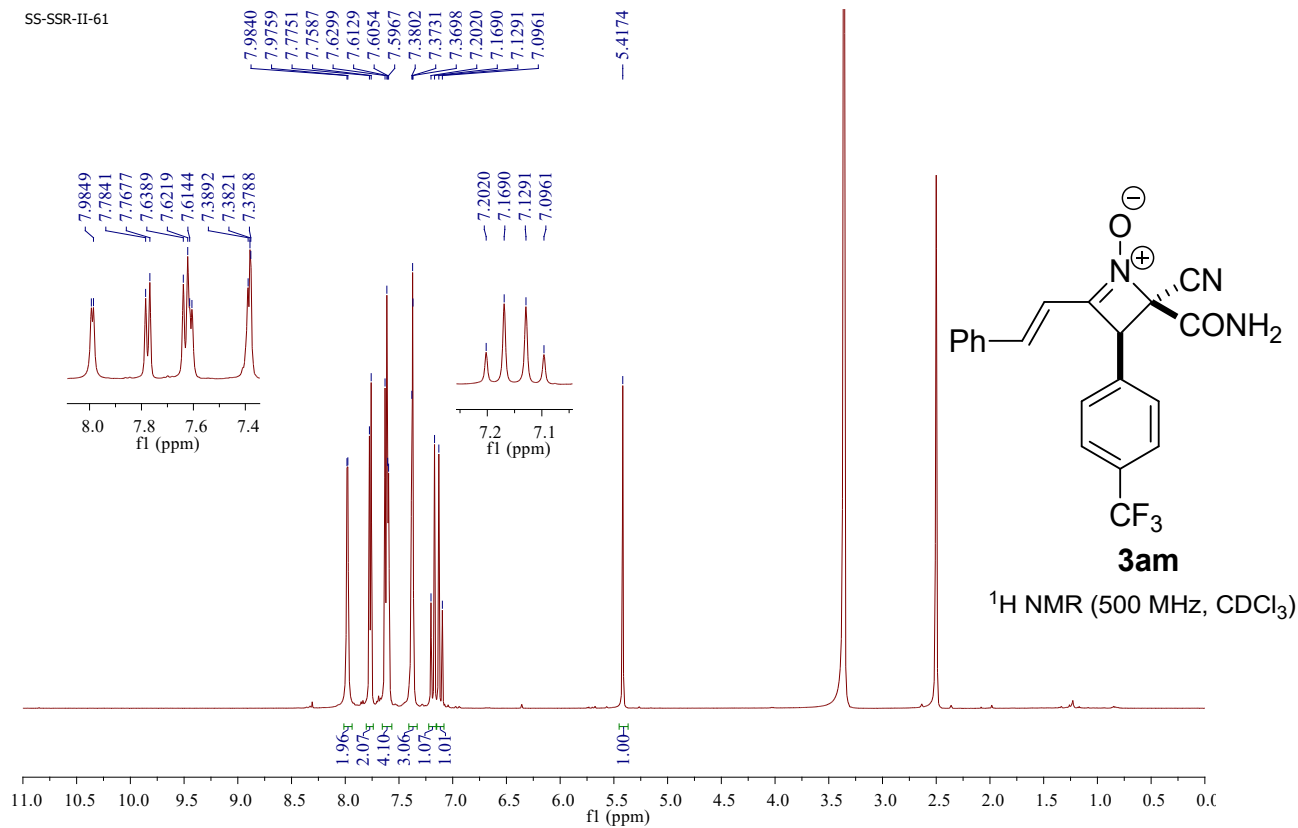


SS-AAR-11-6

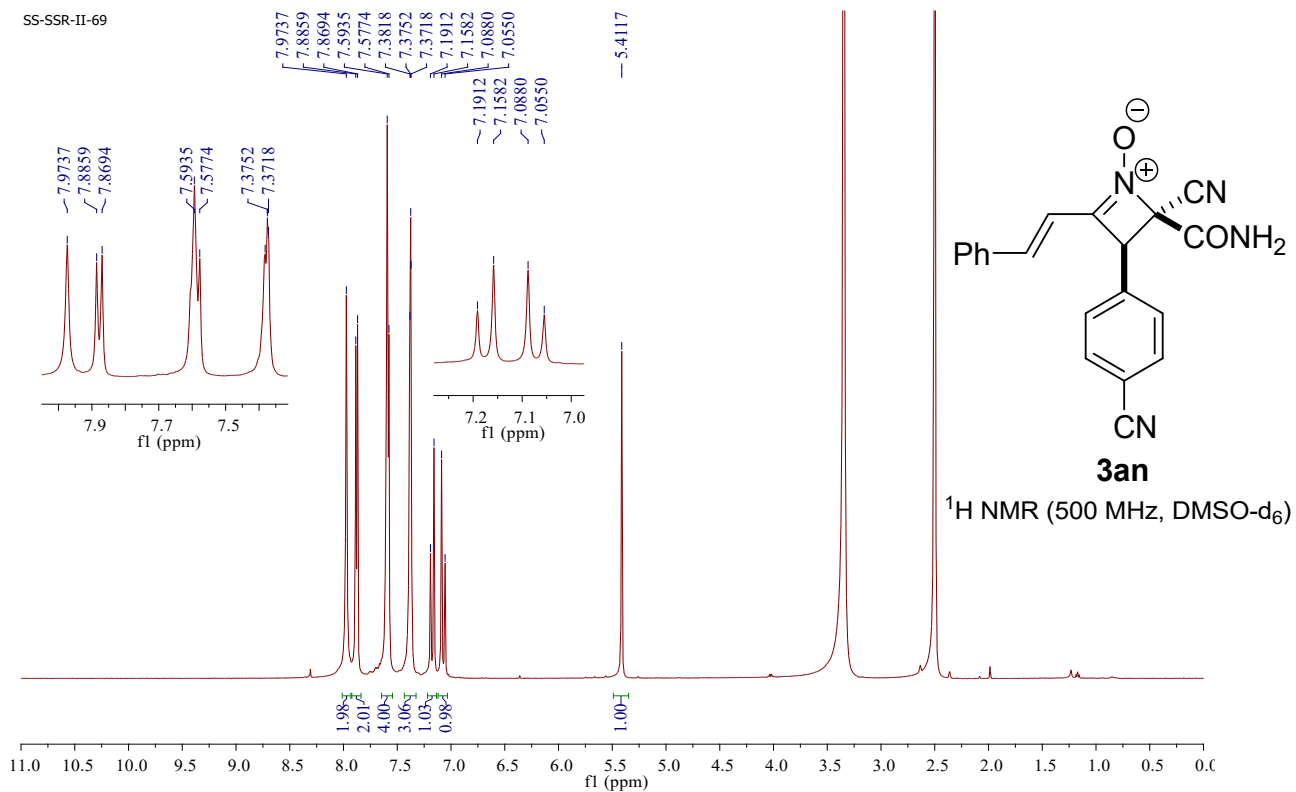


¹³C NMR (125 MHz, CDCl₃)

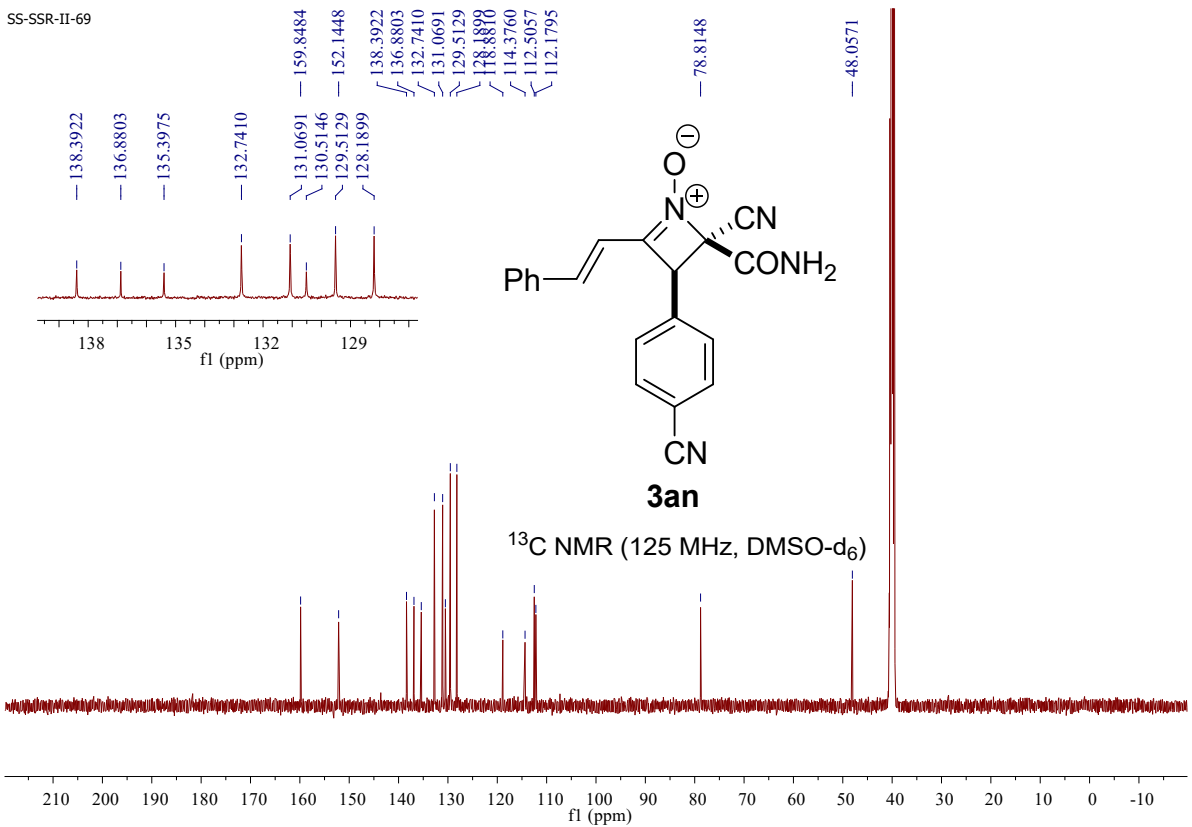




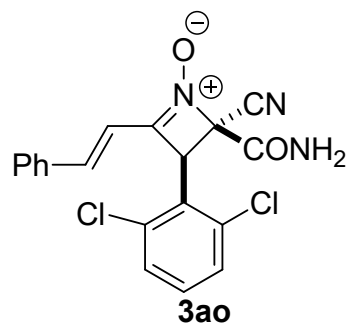
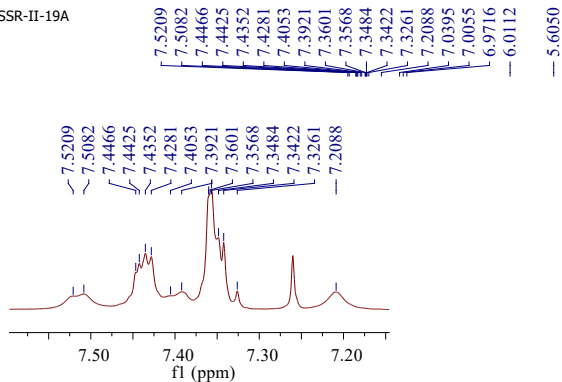
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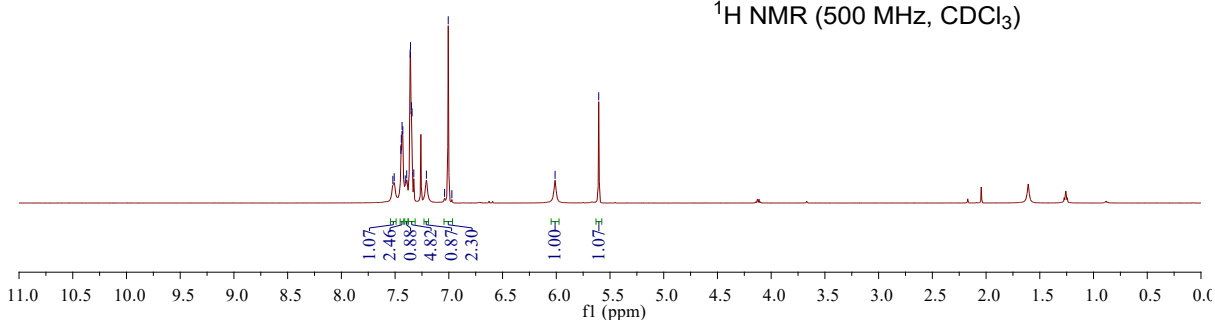
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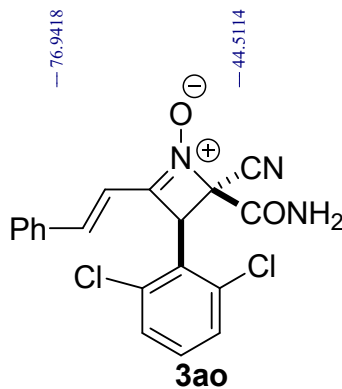
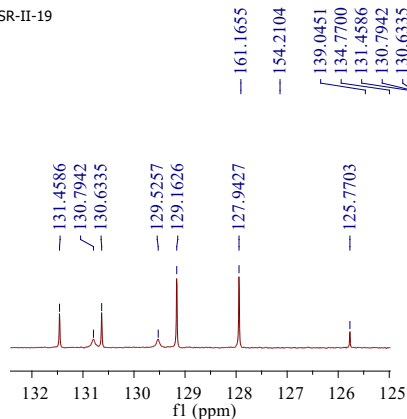
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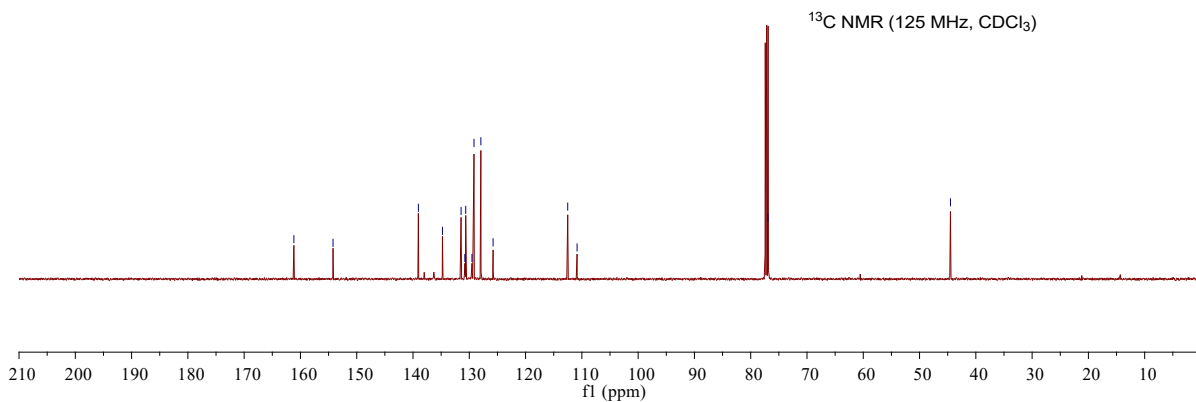
¹H NMR (500 MHz, CDCl₃)



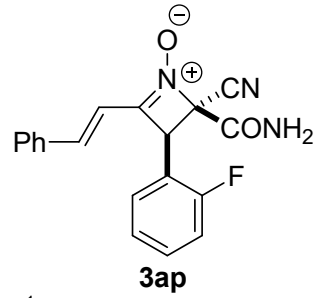
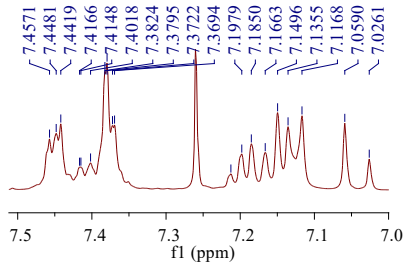
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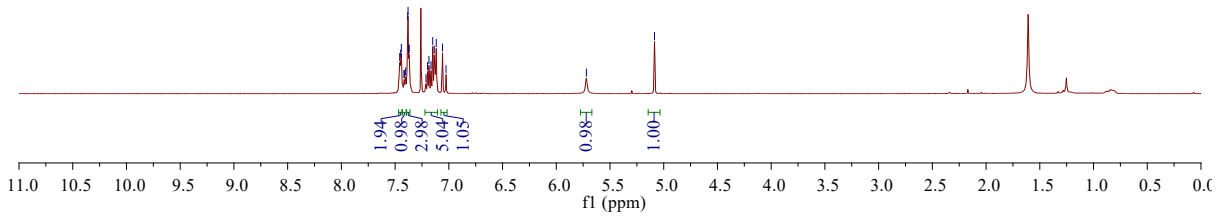
¹³C NMR (125 MHz, CDCl₃)



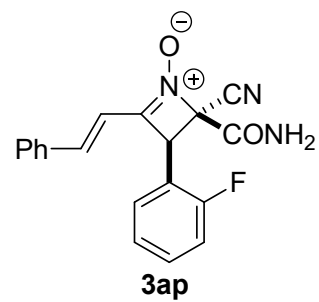
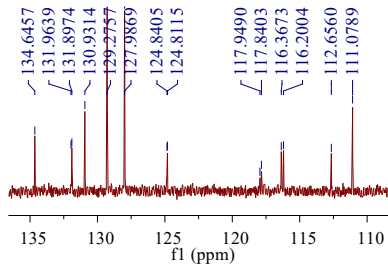
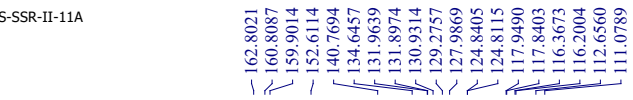
SS-SSR-II-14B



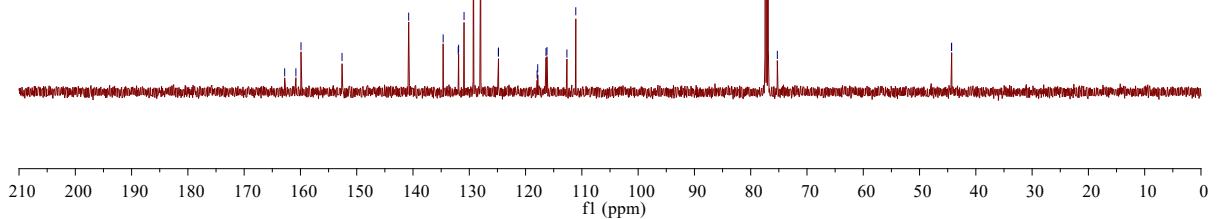
^1H NMR (500 MHz, CDCl_3)



SS-SSR-II-11A

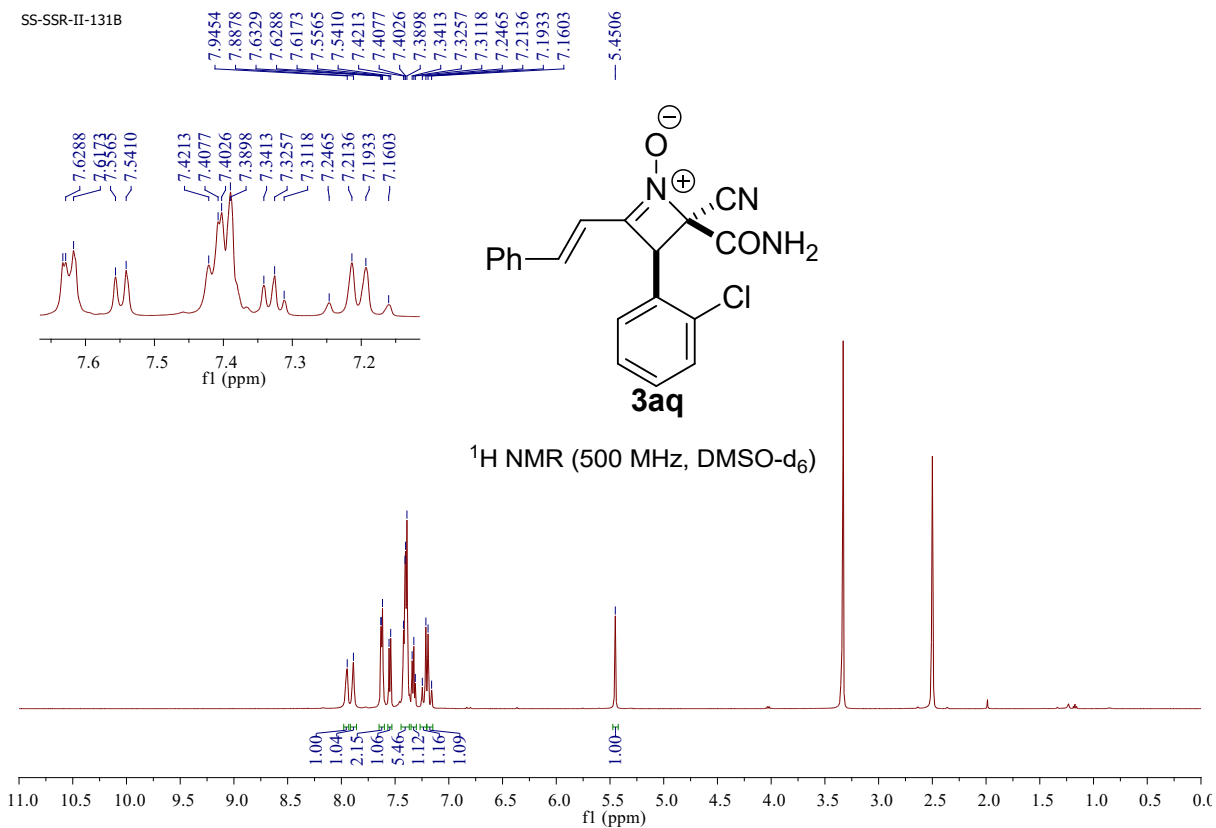


^{13}C NMR (125 MHz, CDCl_3)

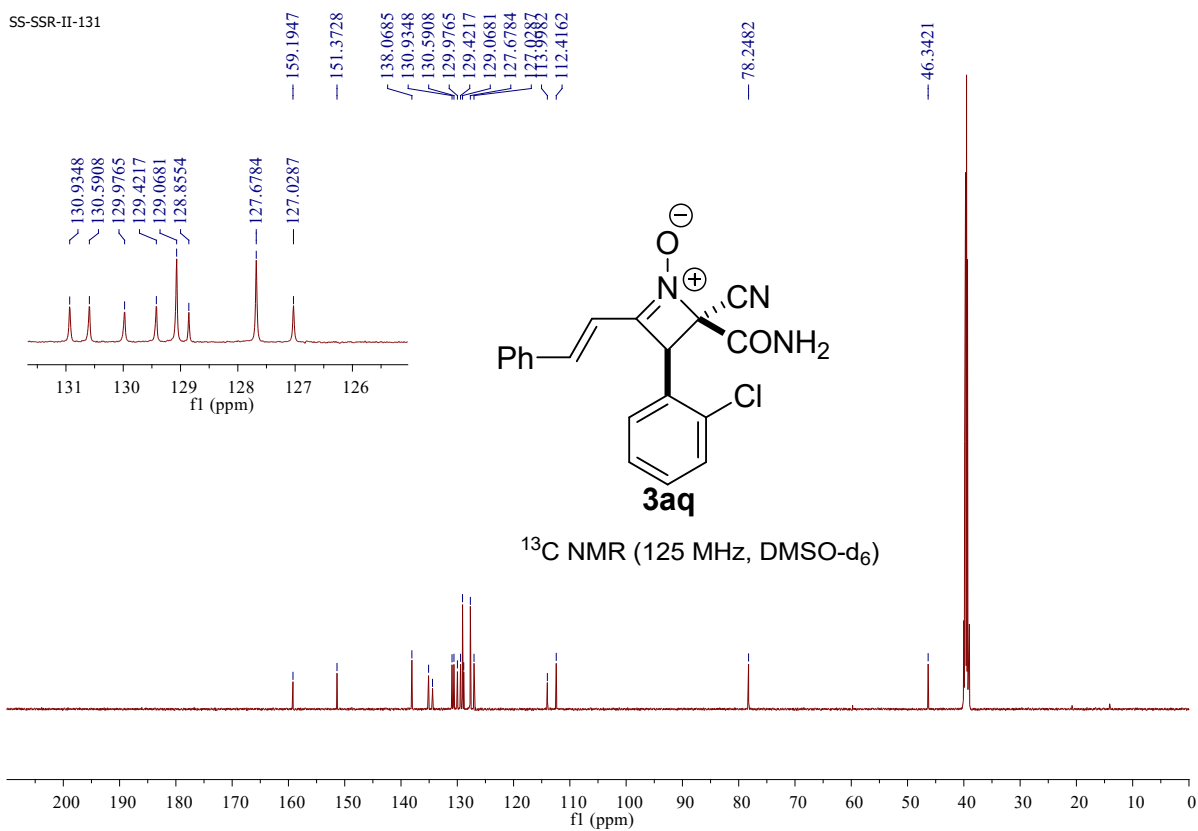


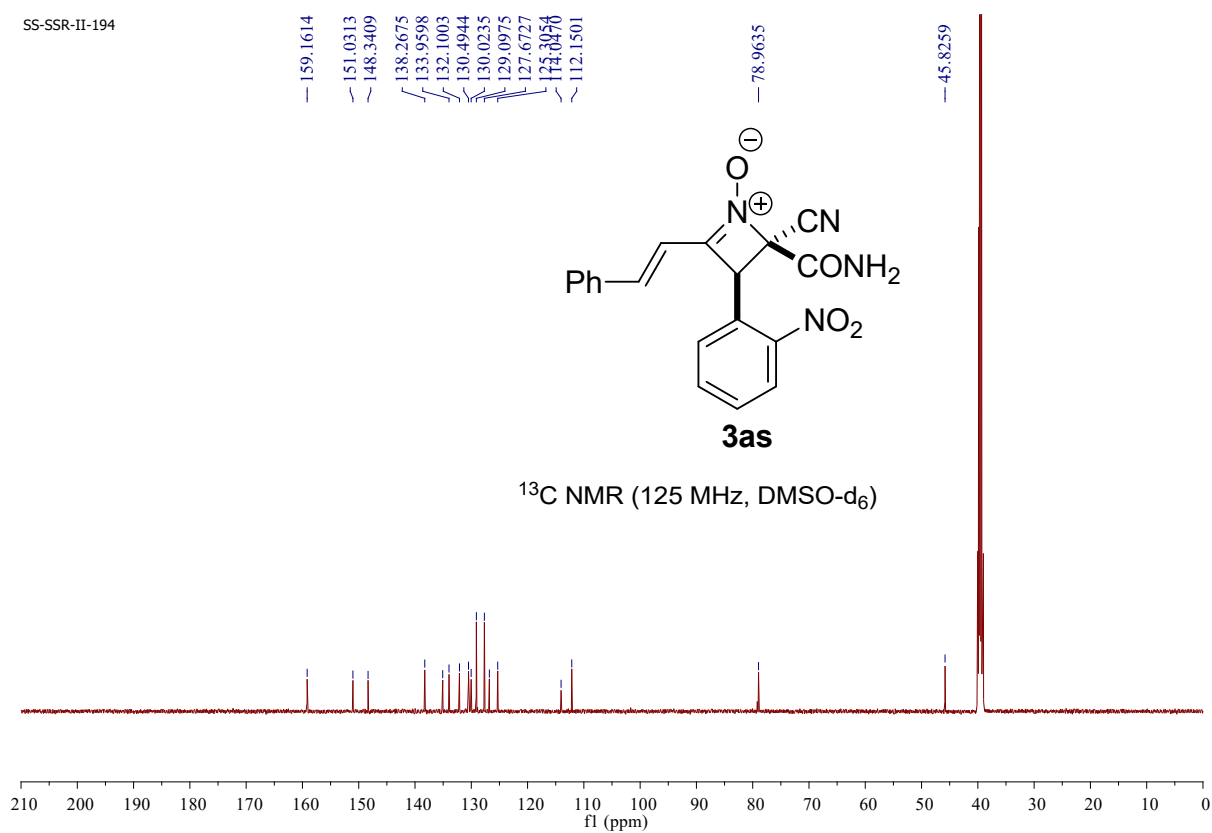
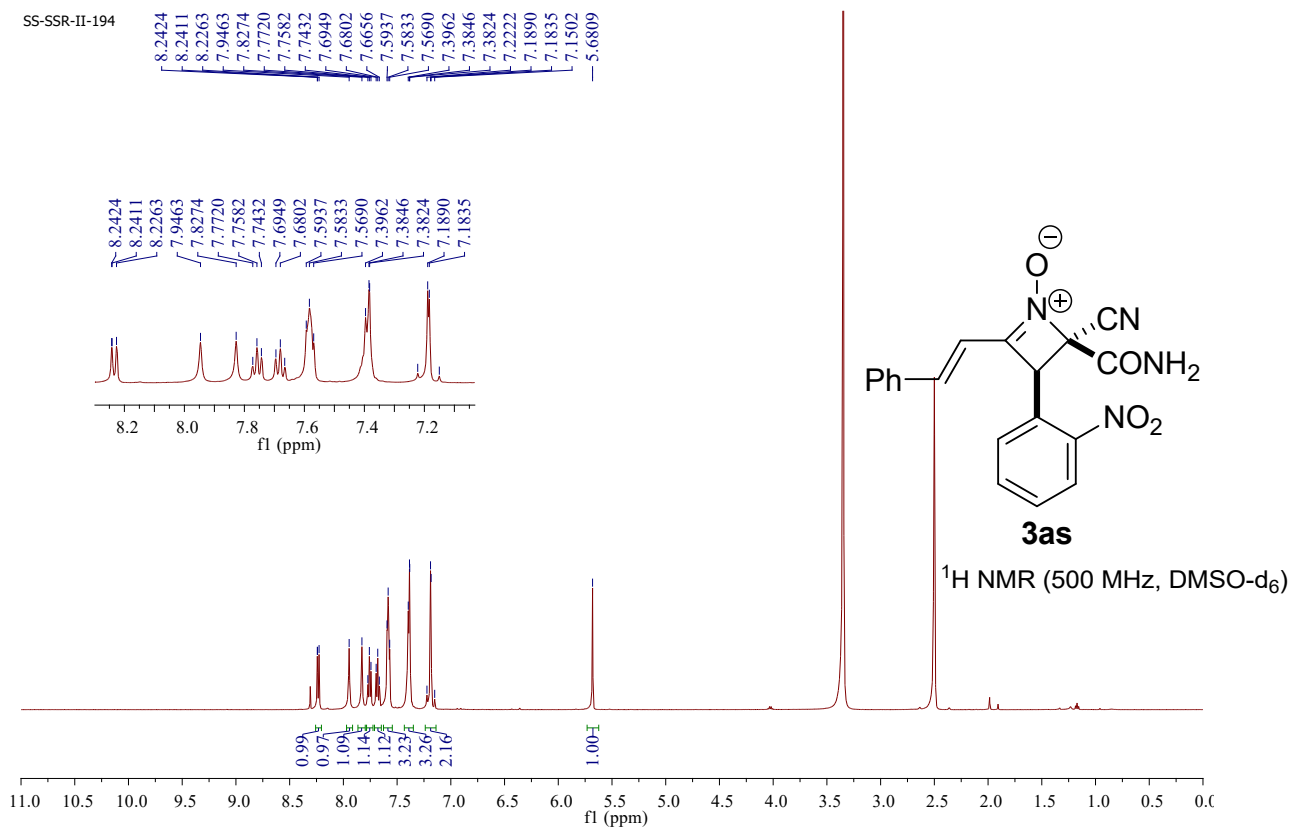
II

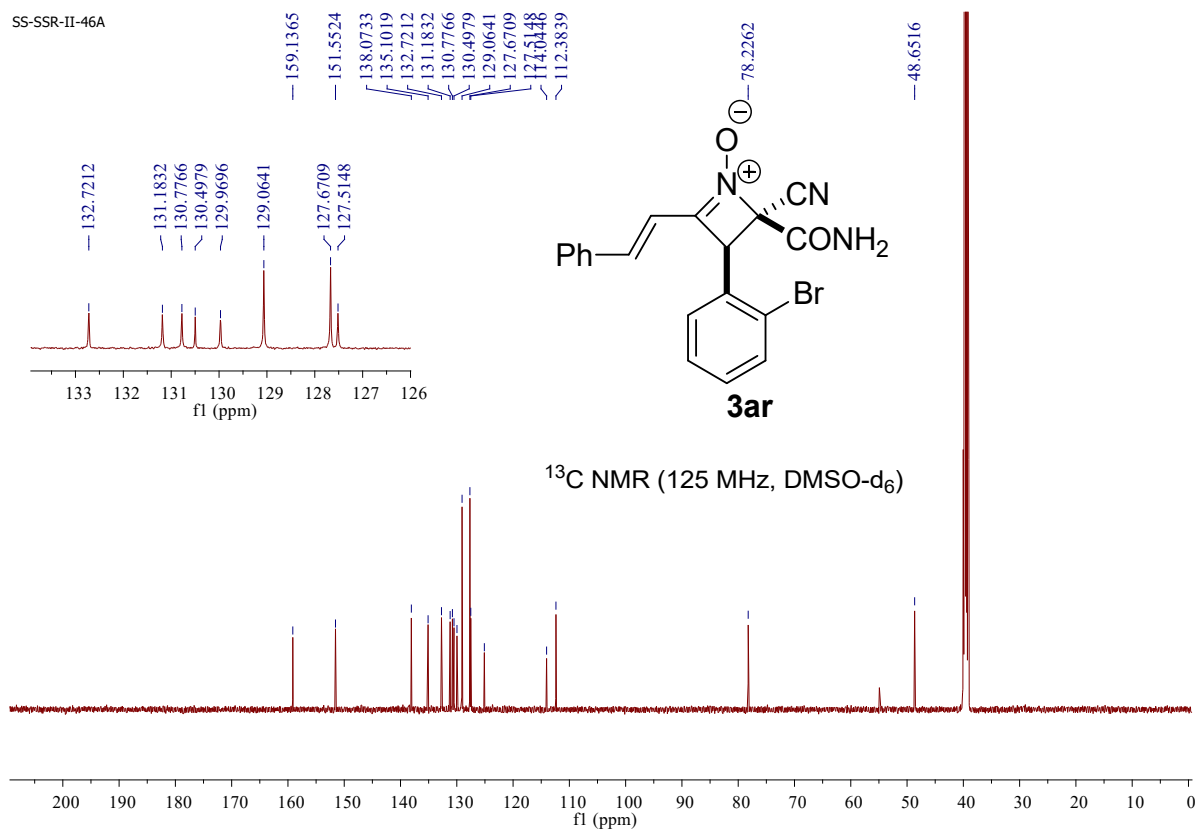
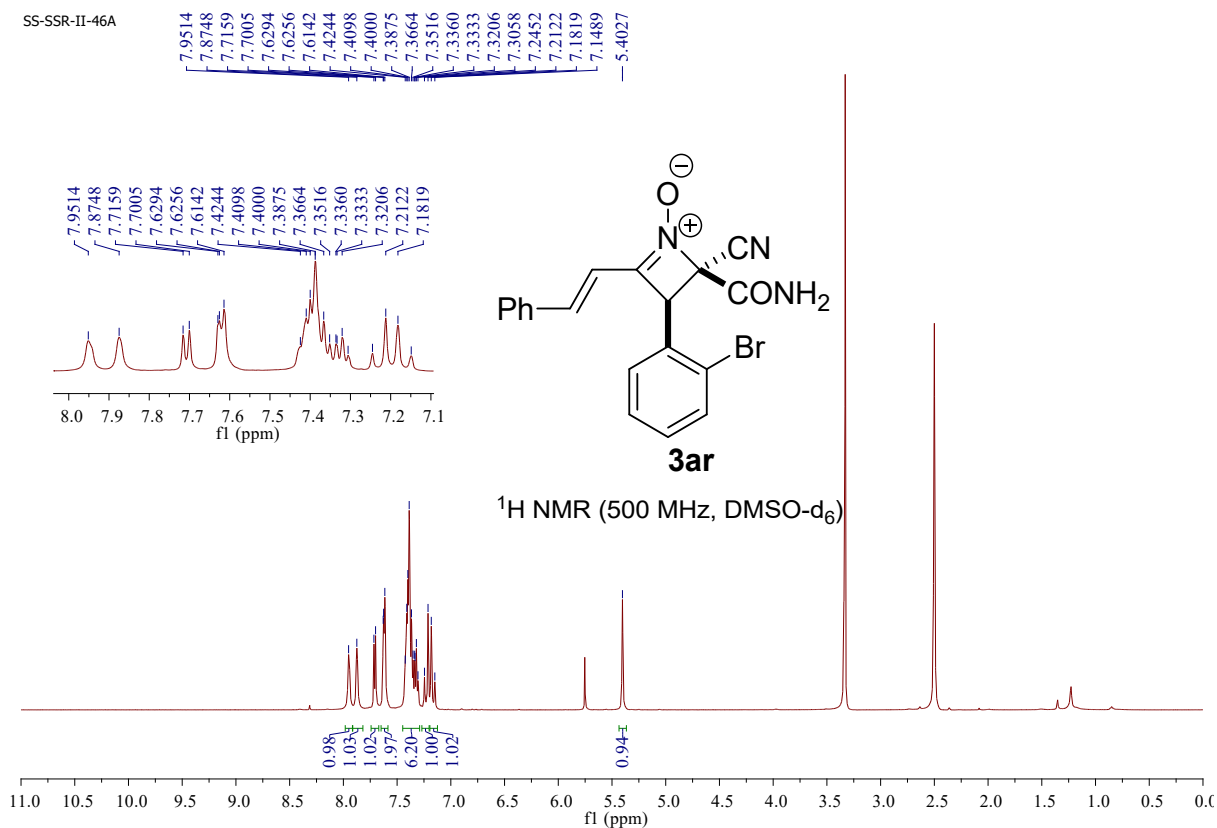
SS-SSR-II-131B



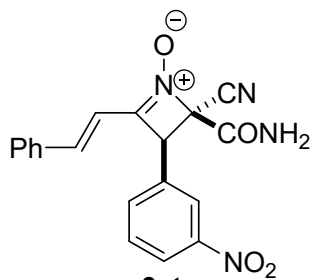
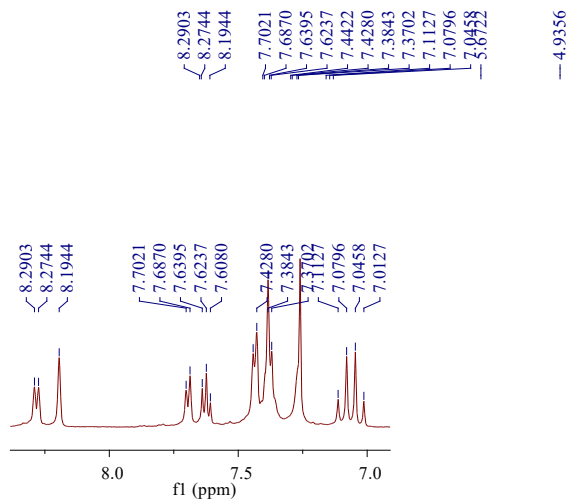
SS-SSR-II-131



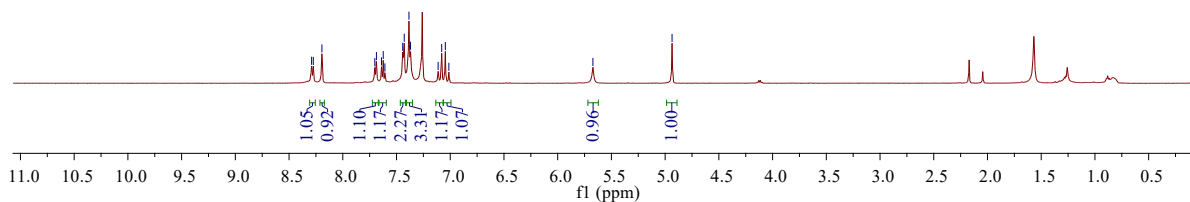




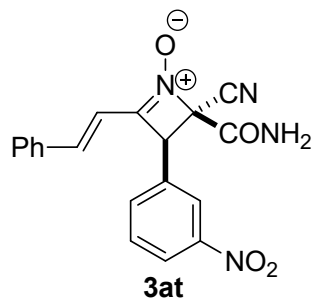
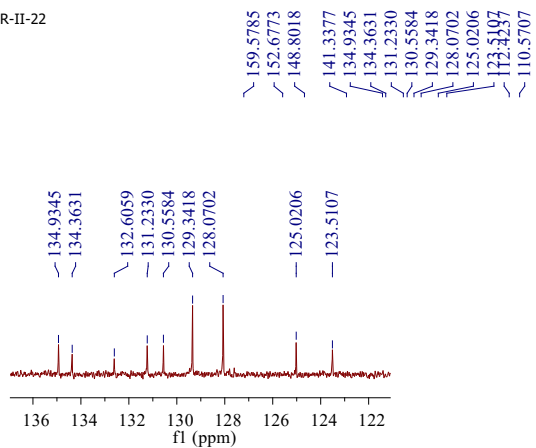
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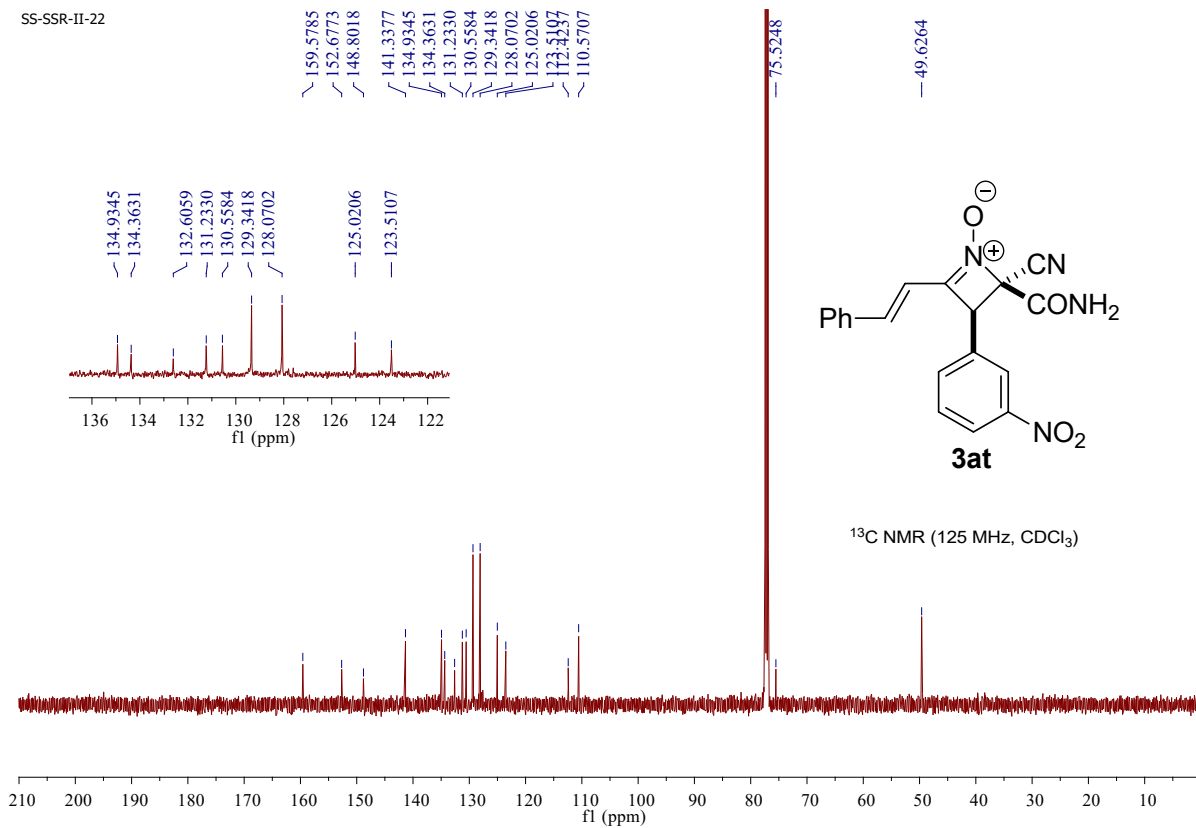
¹H NMR (500 MHz, CDCl₃)



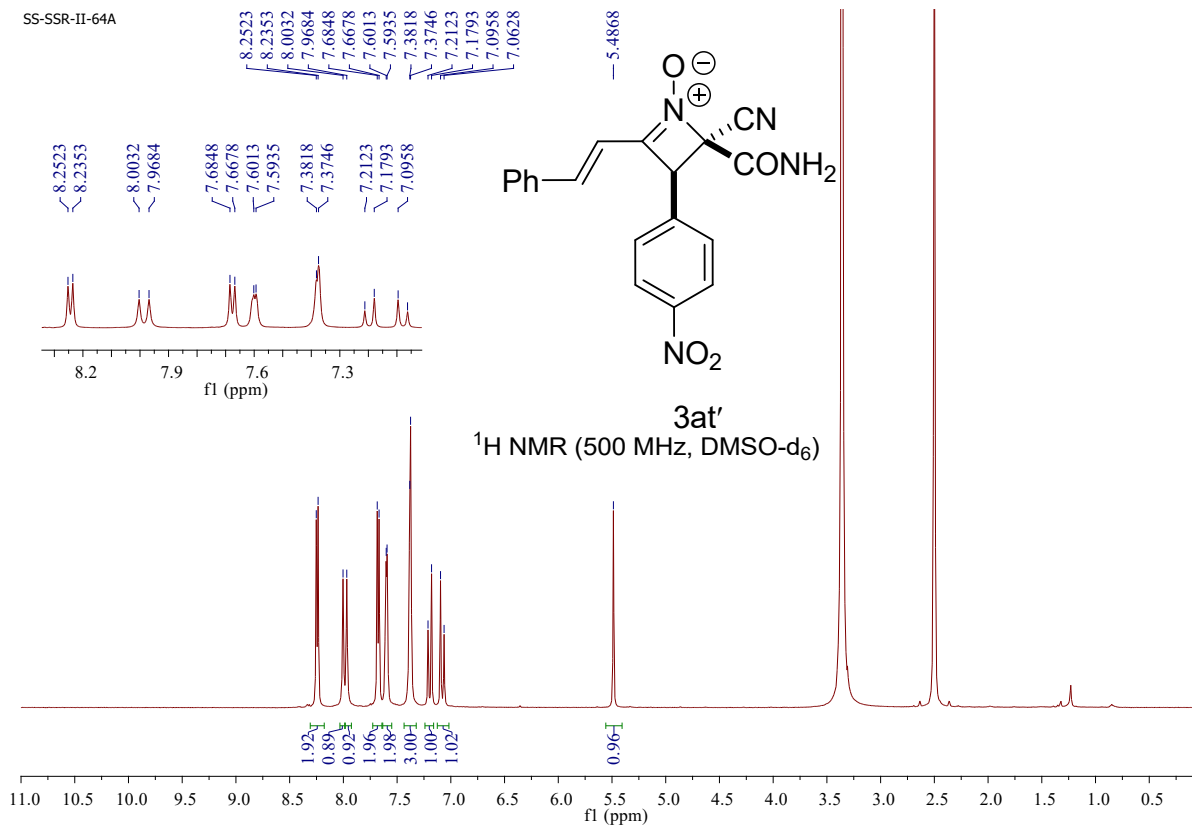
SS-SSR-II-22



¹³C NMR (125 MHz, CDCl₃)

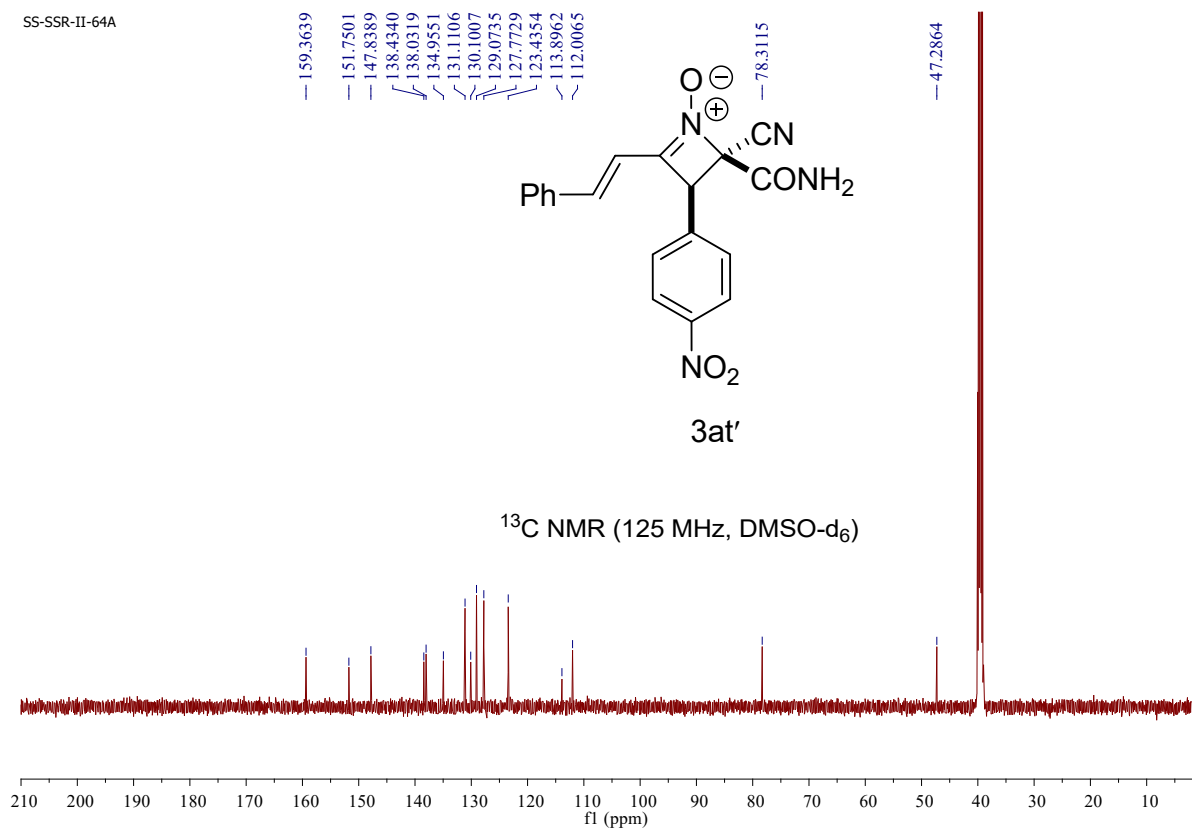


SS-SSR-II-64A

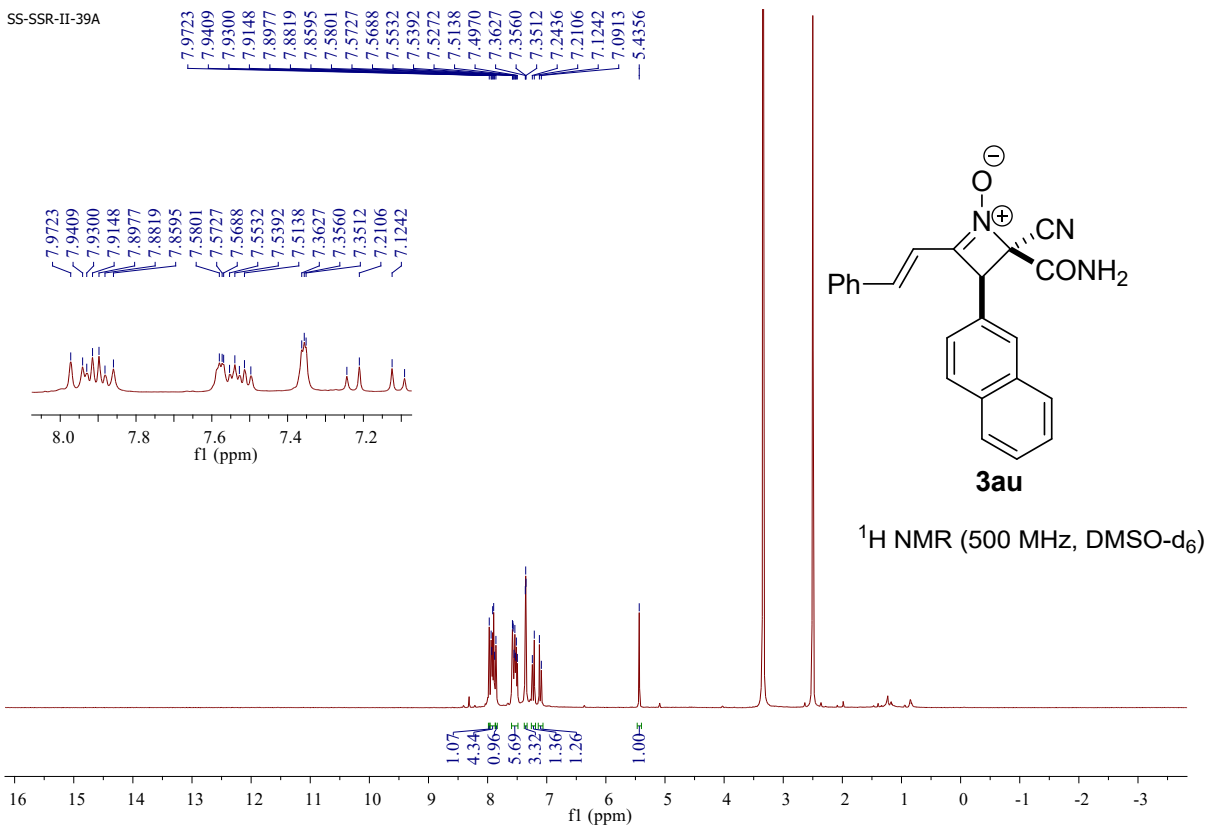


2

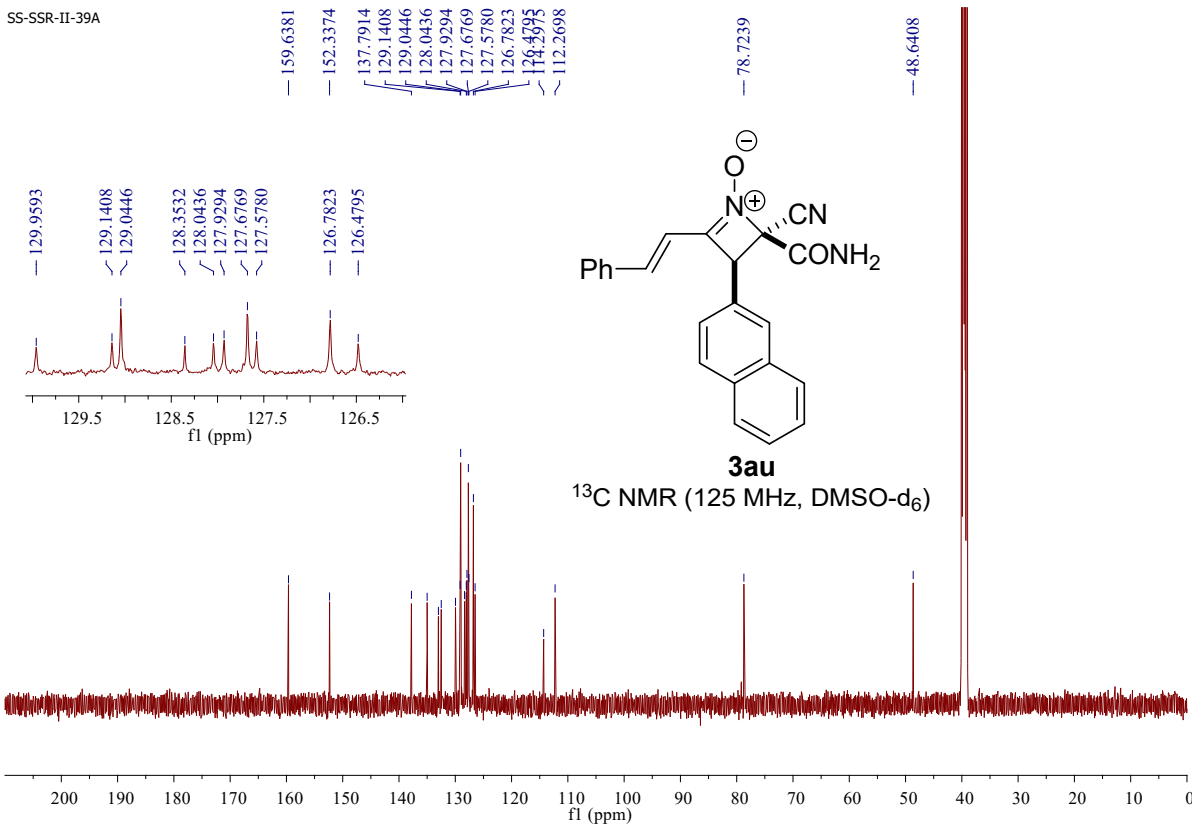
SS-SSR-II-64A



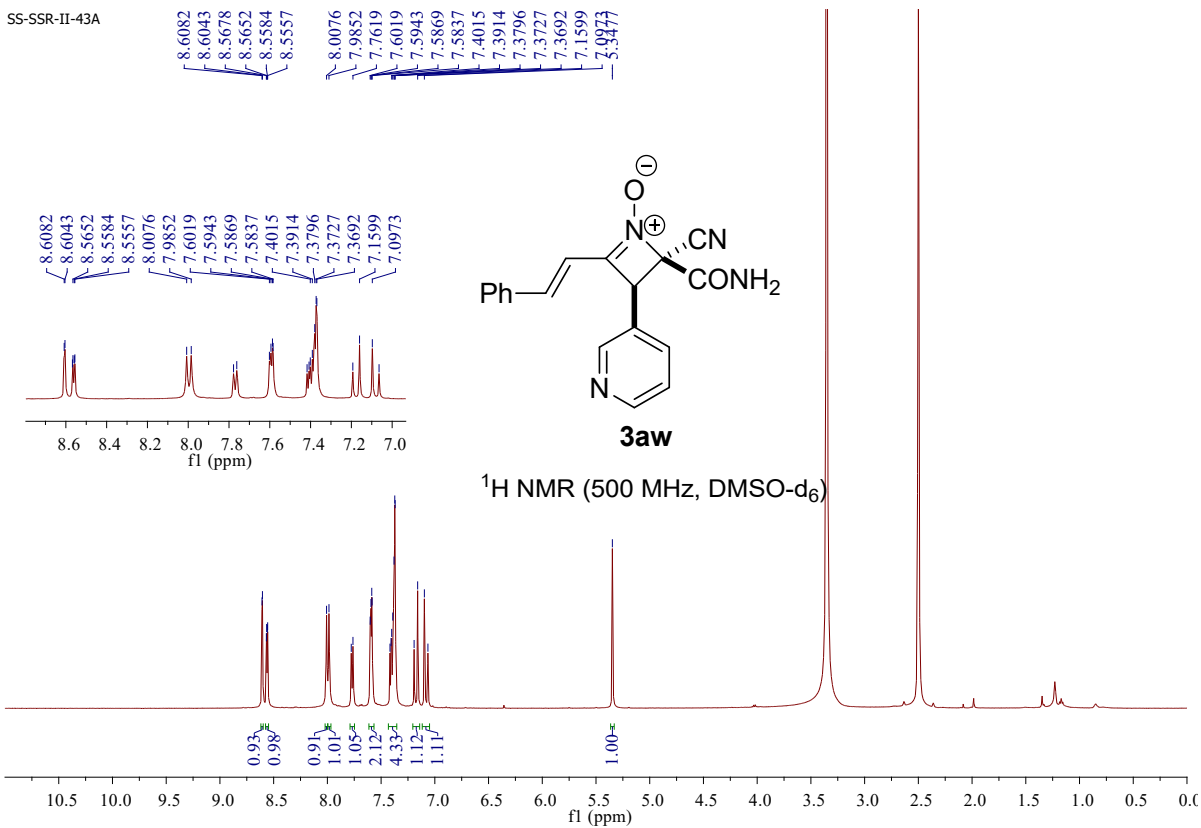
SS-SSR-II-39A



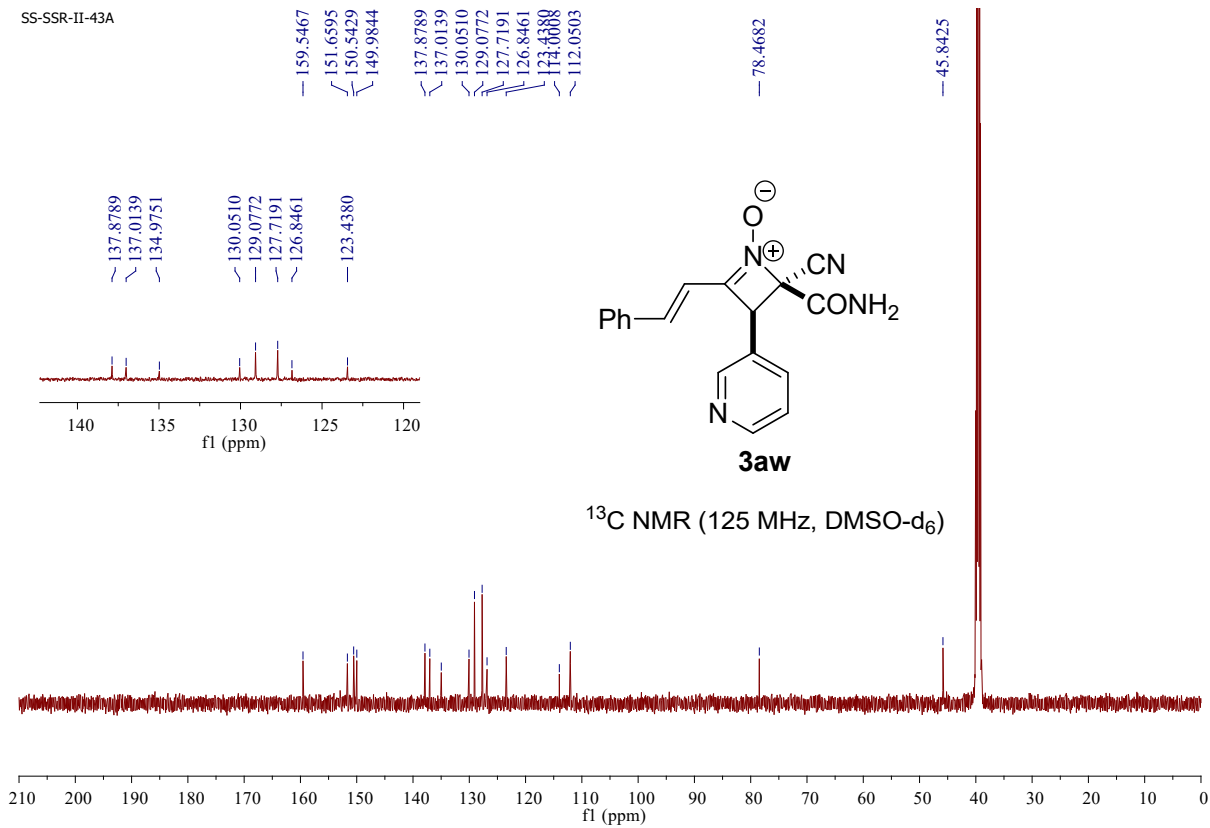
SS-SSR-II-39A



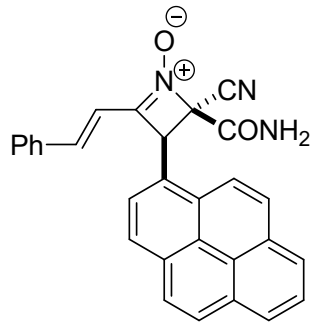
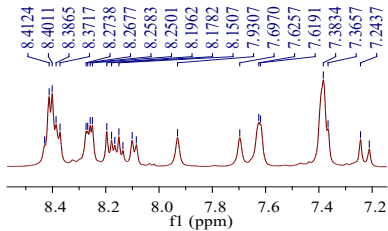
SS-SSR-II-43A



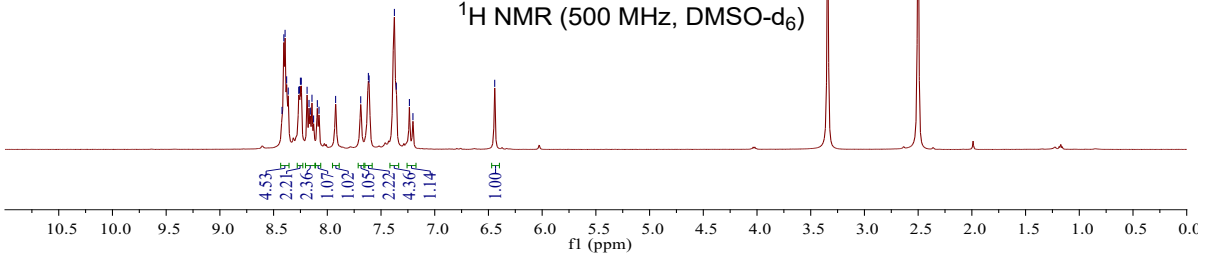
SS-SSR-II-43A



8.4216
8.4081
8.3954
8.3785
8.3637
8.3658
8.2597
8.2503
8.2421
8.1882
8.1702
8.1580
8.1427
8.0928
8.0773
7.9227
7.6890
7.6177
7.6111
7.5754
7.3577
7.2029
7.3417

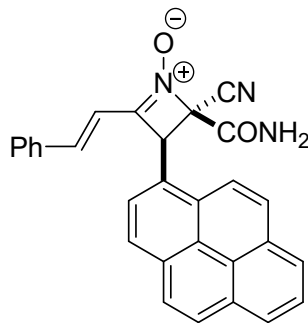
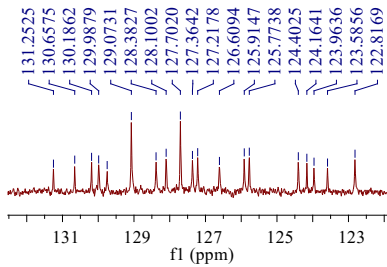


3av
 $^1\text{H NMR}$ (500 MHz, DMSO-d_6)



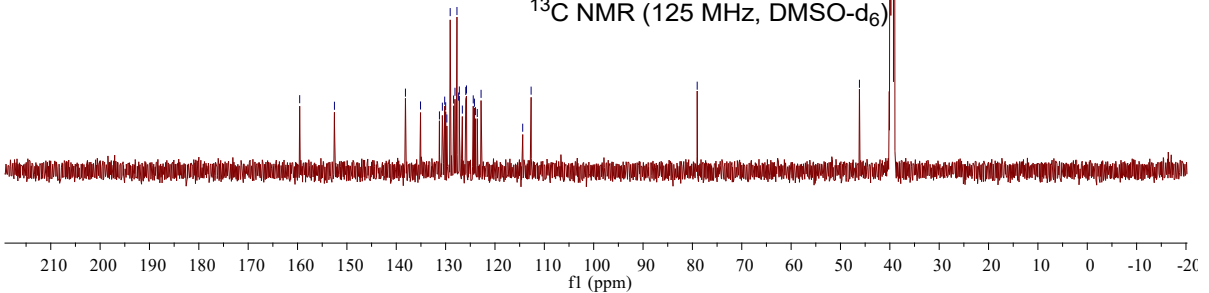
SS-SSR-II-54

159.5663
152.5249
138.1382
129.0731
128.1002
127.7020
127.2178
125.9147
125.7738
124.8169
124.4025
124.1641
123.9636
123.5856
122.8169
79.0291
46.1574

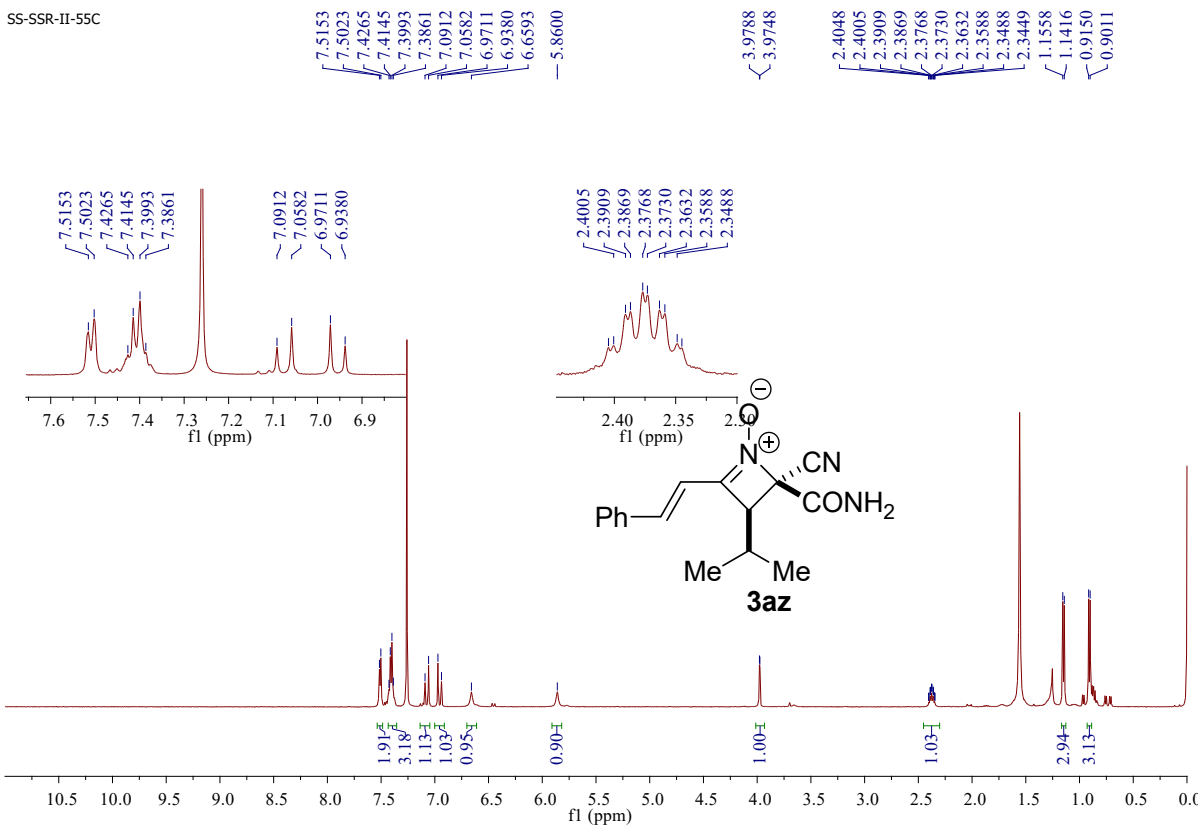


3av

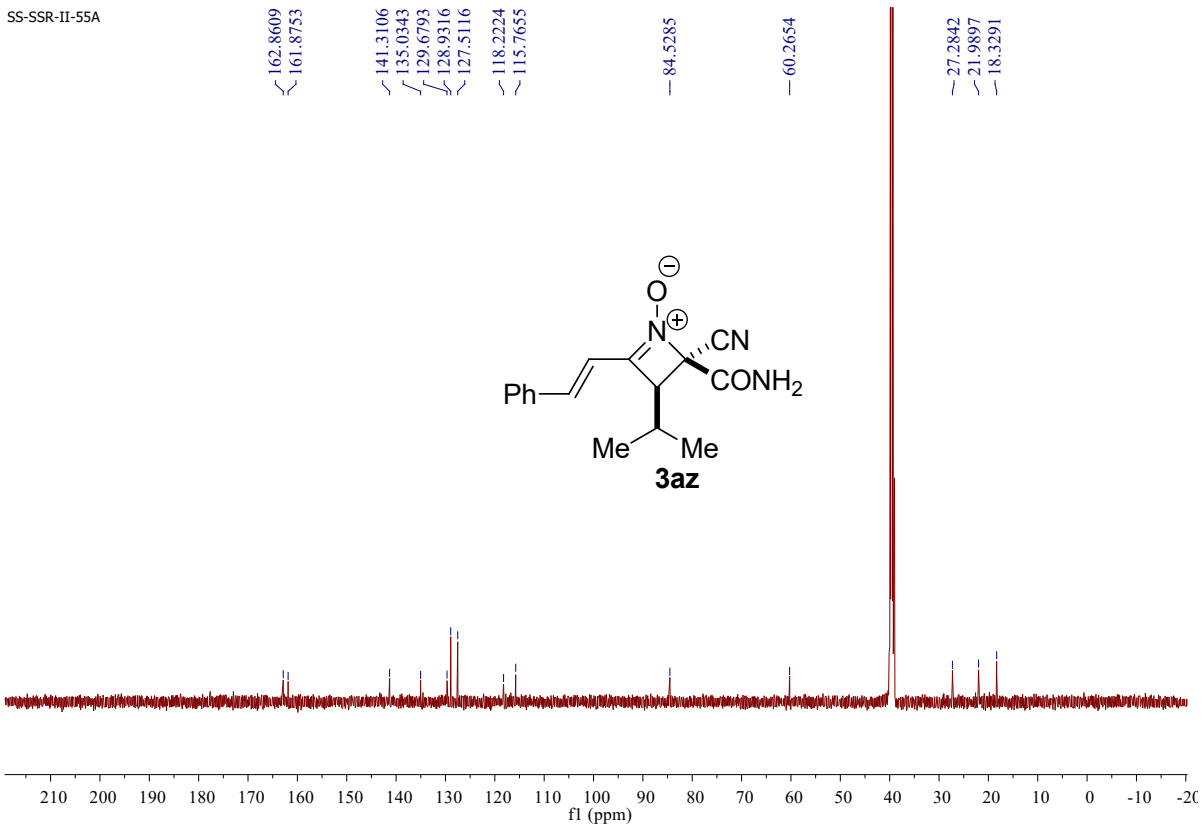
$^{13}\text{C NMR}$ (125 MHz, DMSO-d_6)



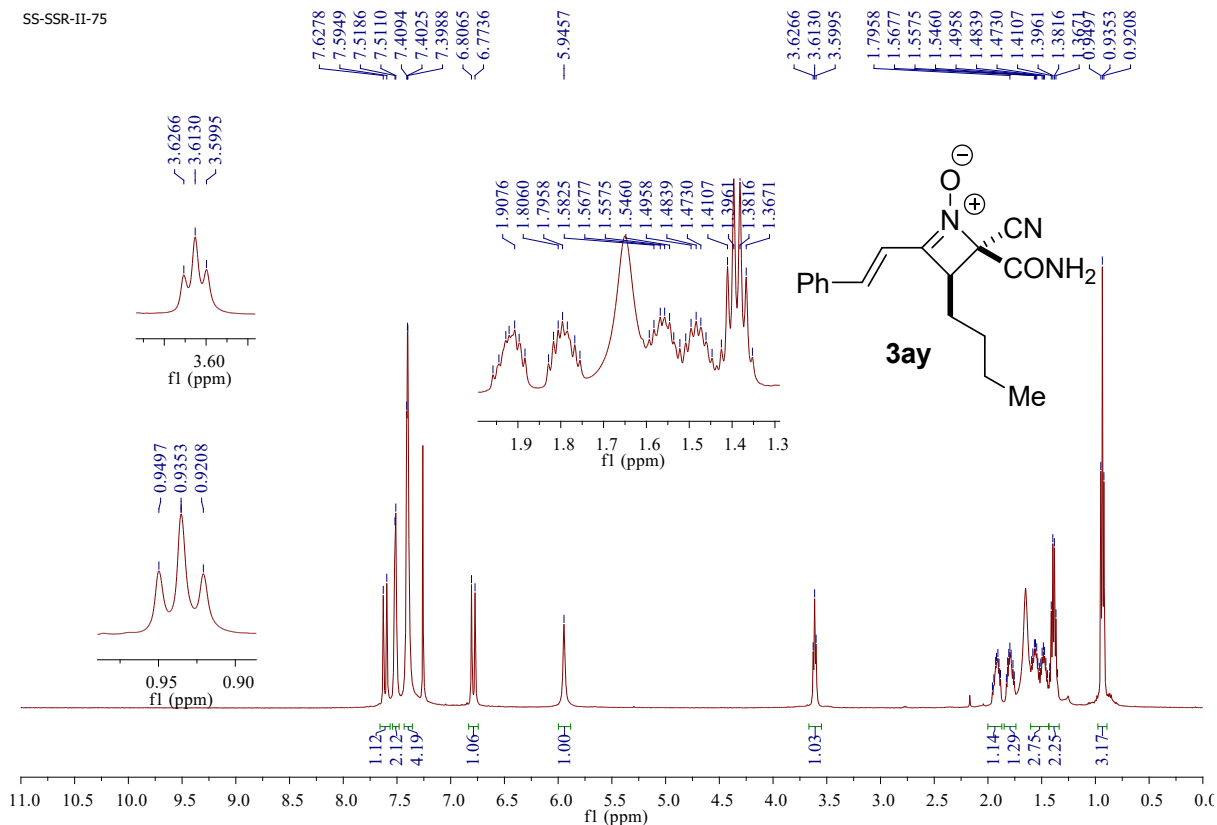
SS-SSR-II-55C



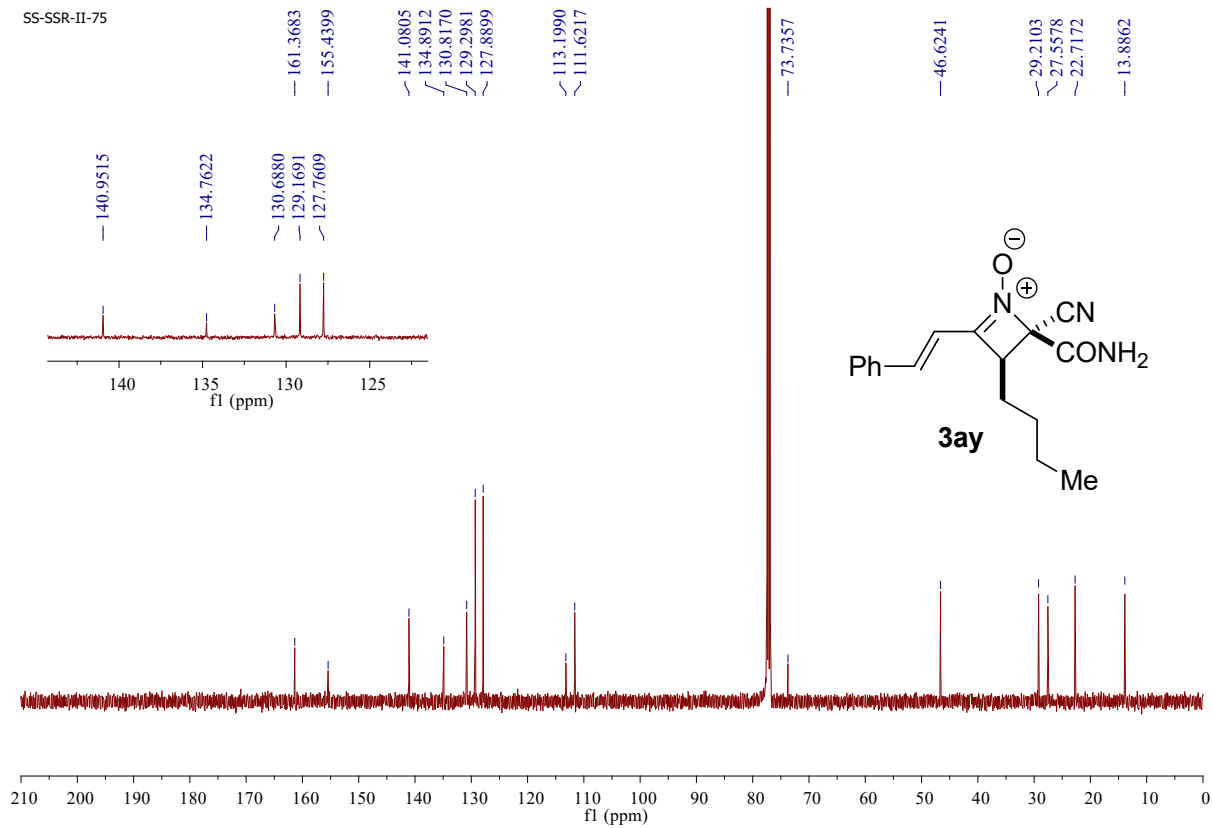
SS-SSR-II-55A



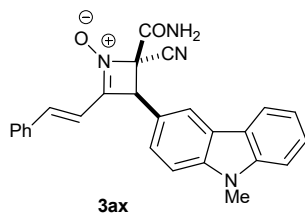
SS-SSR-II-75



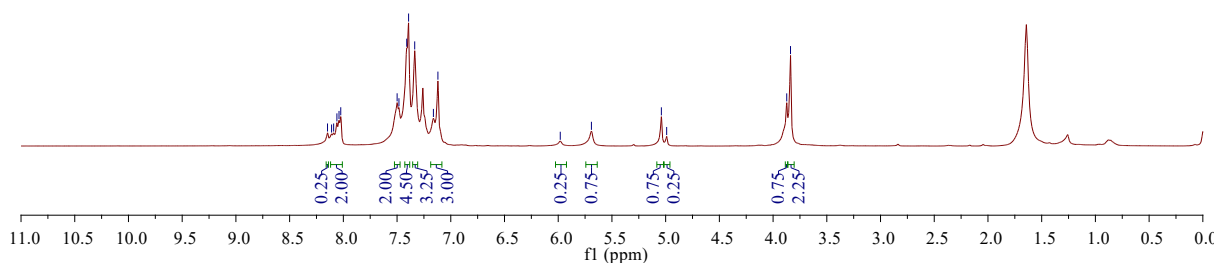
SS-SSR-II-75



8.1473
8.1095
8.0903
8.0599
8.0402
8.0241
7.4994
7.4824
7.4100
7.3927
7.3358
7.1617
7.1197
— 5.9809
— 5.6909
5.0398
4.9906
3.8729
3.8378

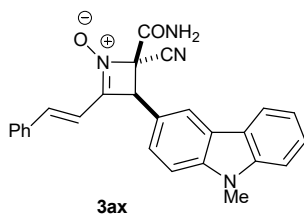


¹H NMR (400 MHz, CDCl₃)

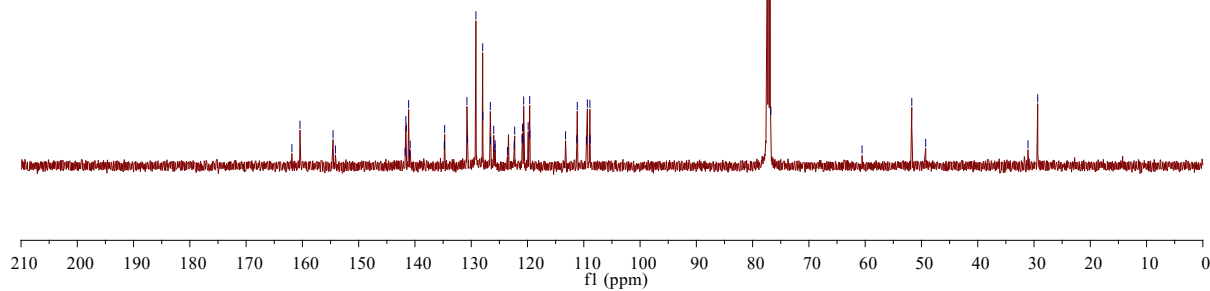


SS-SSR-II-235A

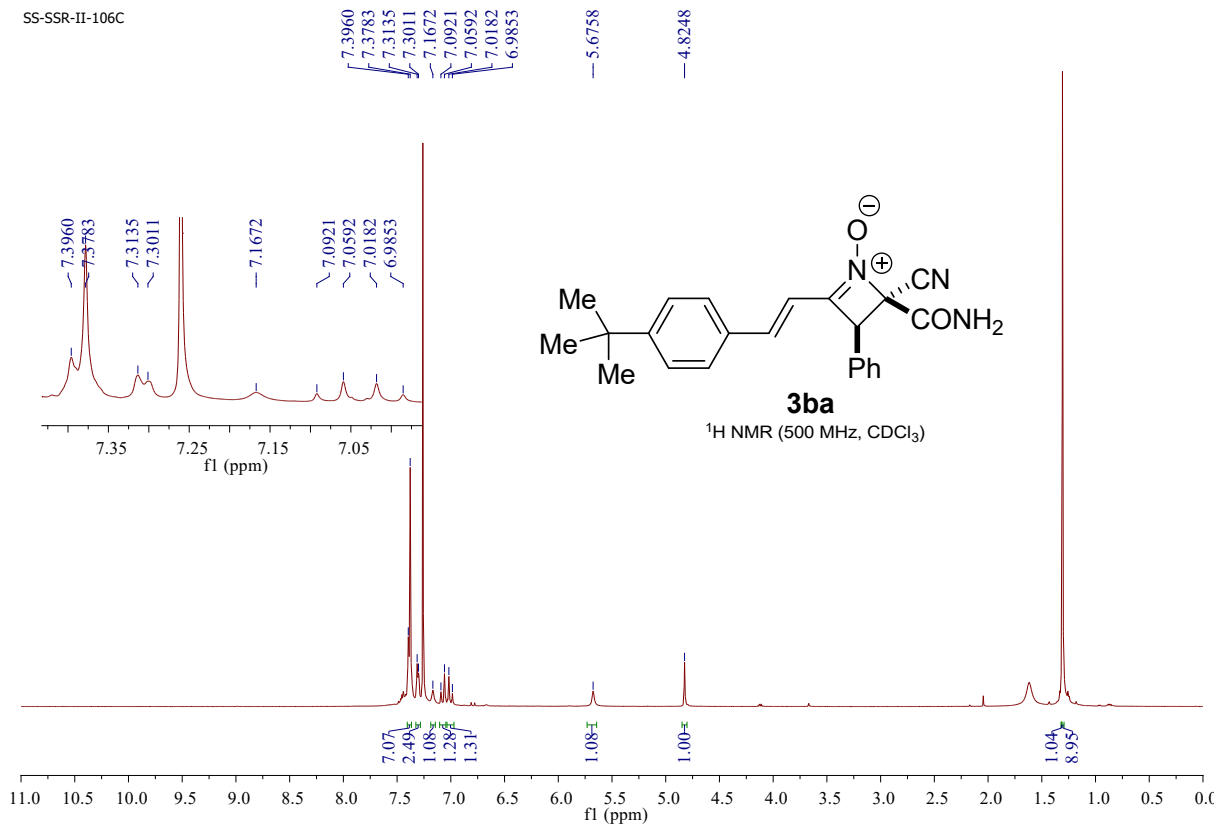
161.8677
160.4359
154.5555
154.1353
141.6152
141.5426
141.1273
134.7281
130.7633
129.1682
127.9682
127.9367
126.6081
126.0020
122.2790
120.8953
120.6834
119.8826
119.6123
119.5930
111.1612
109.3654
108.9185
107.9588
— 60.5574
51.7191
49.2501
31.0649
29.3411



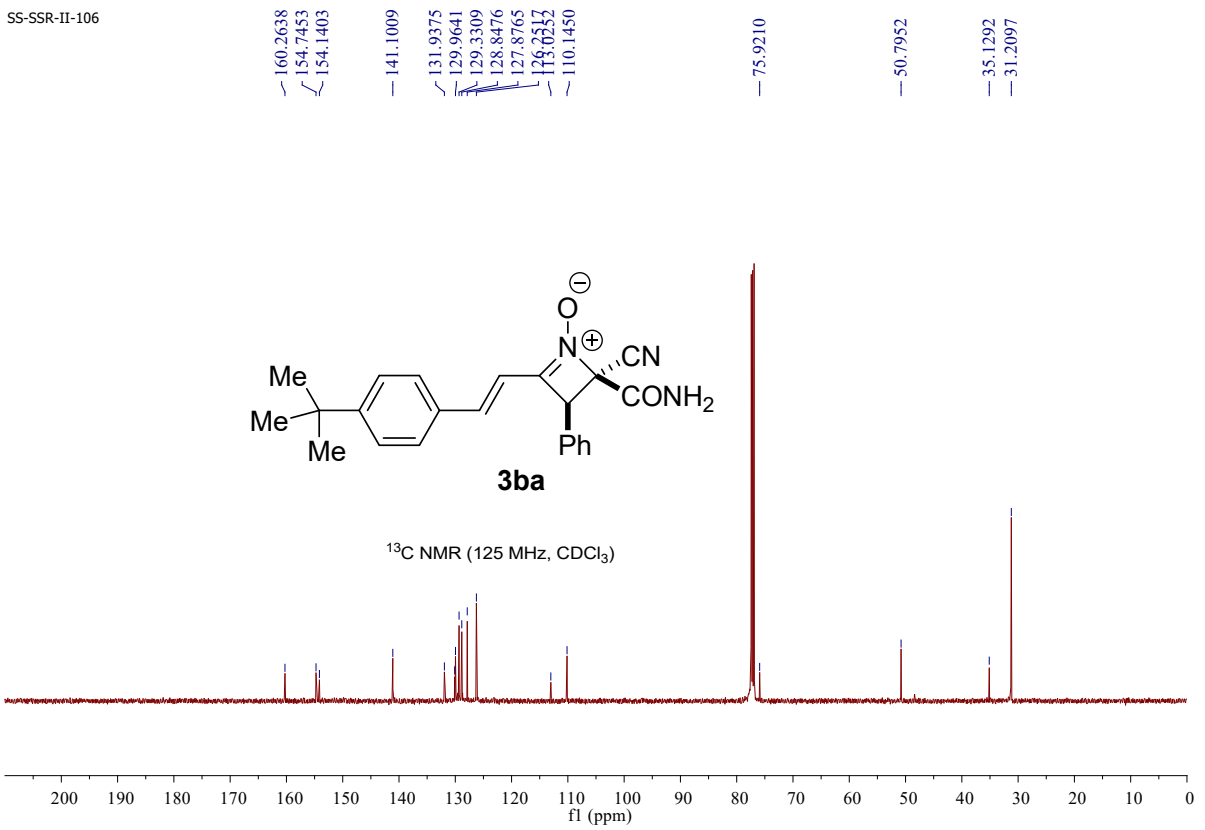
¹³C NMR (125 MHz, CDCl₃)



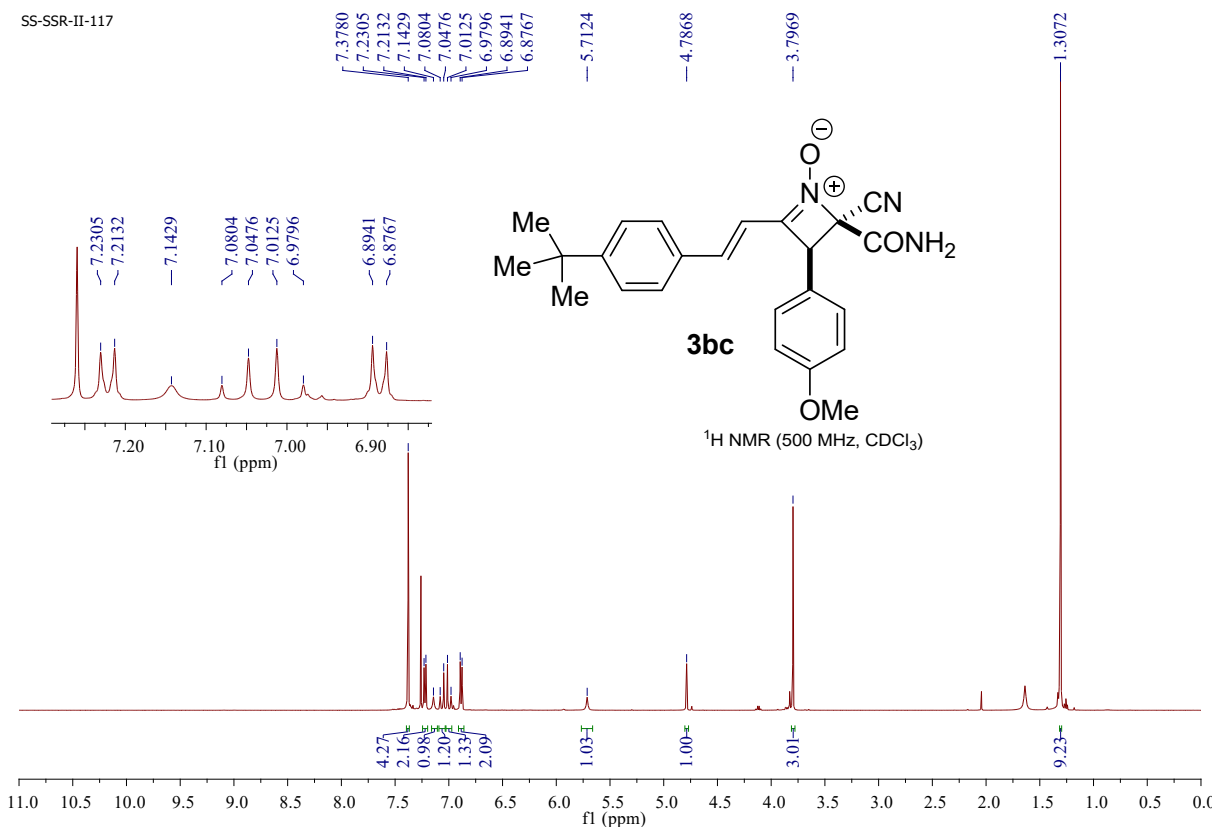
SS-SSR-II-106C



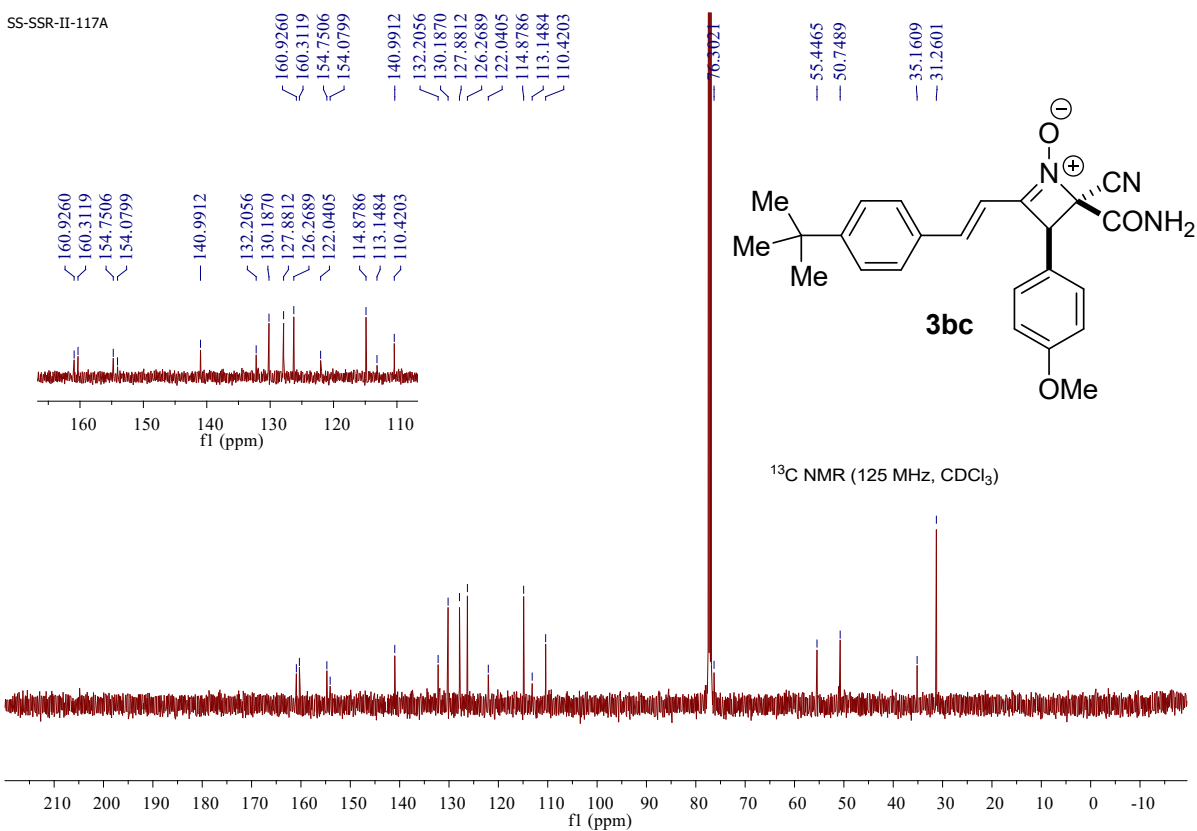
SS-SSR-II-106



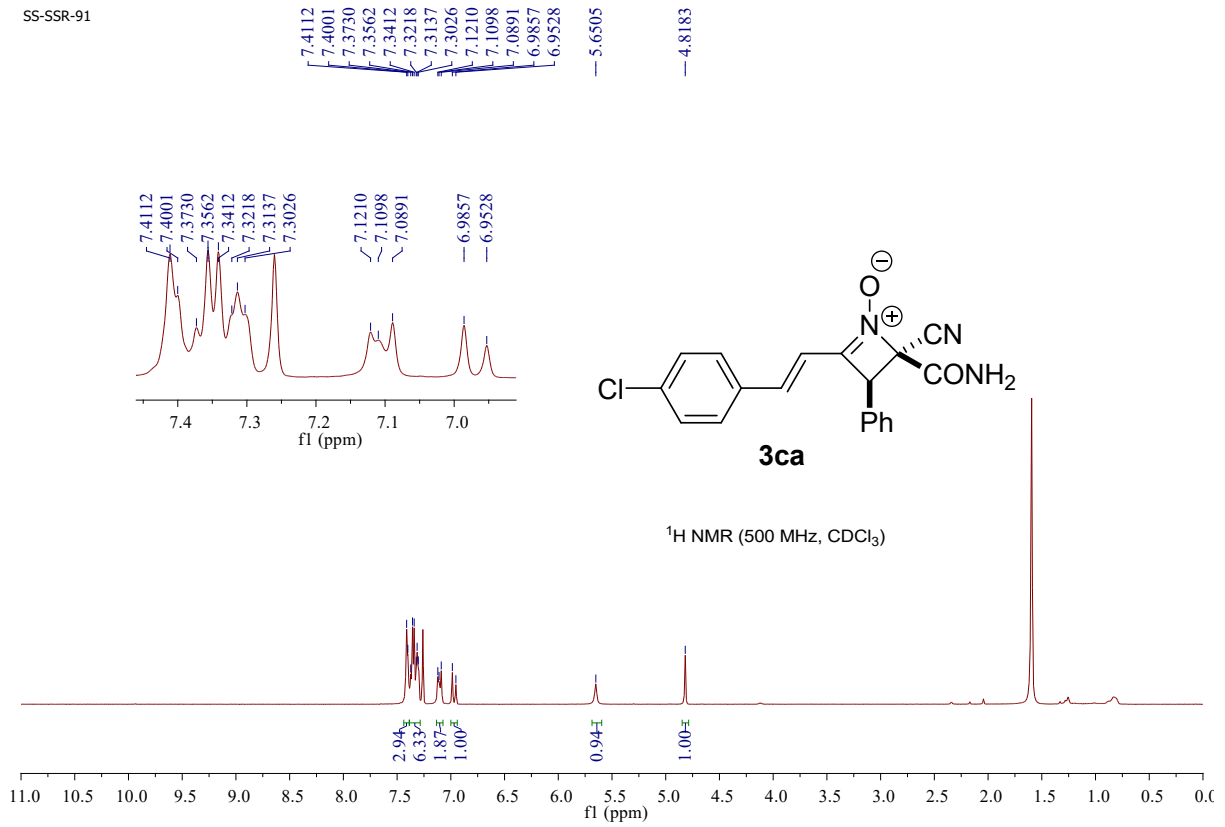
SS-SSR-II-117



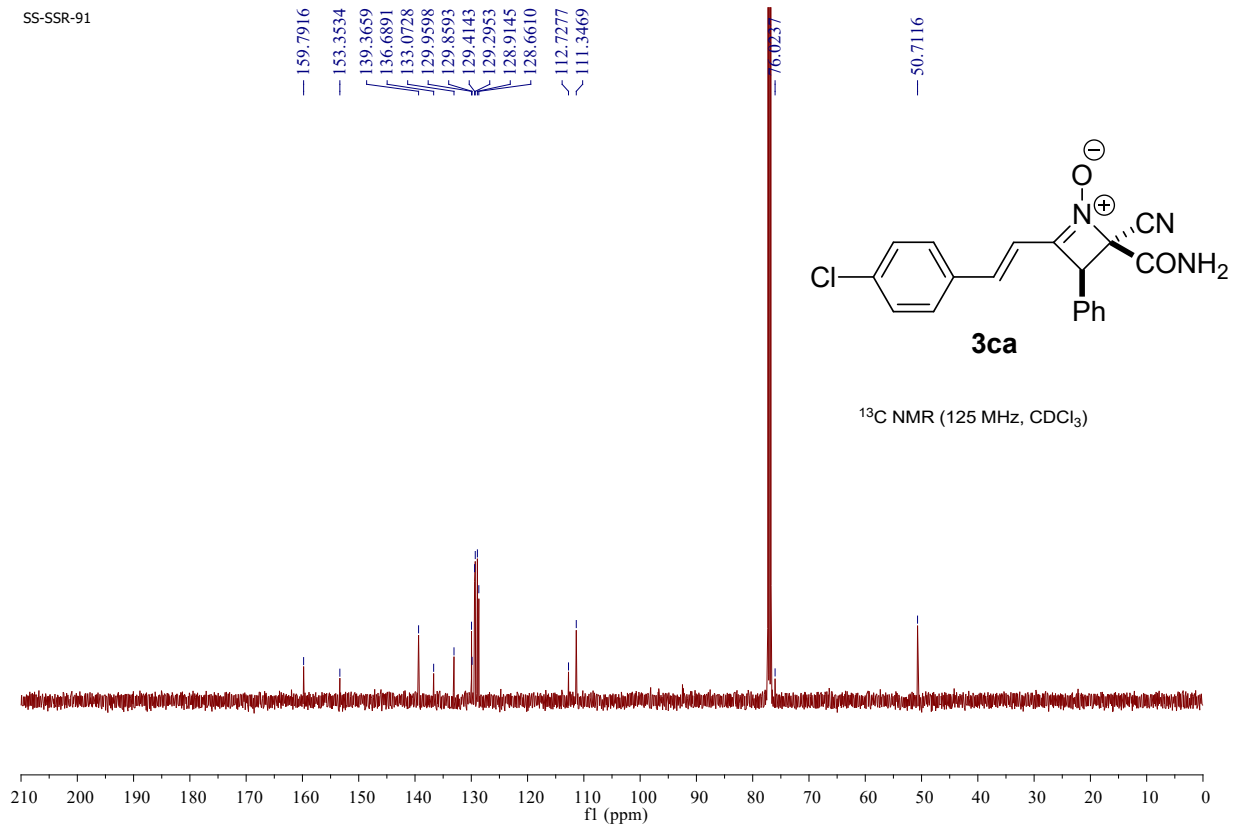
SS-SSR-II-117A



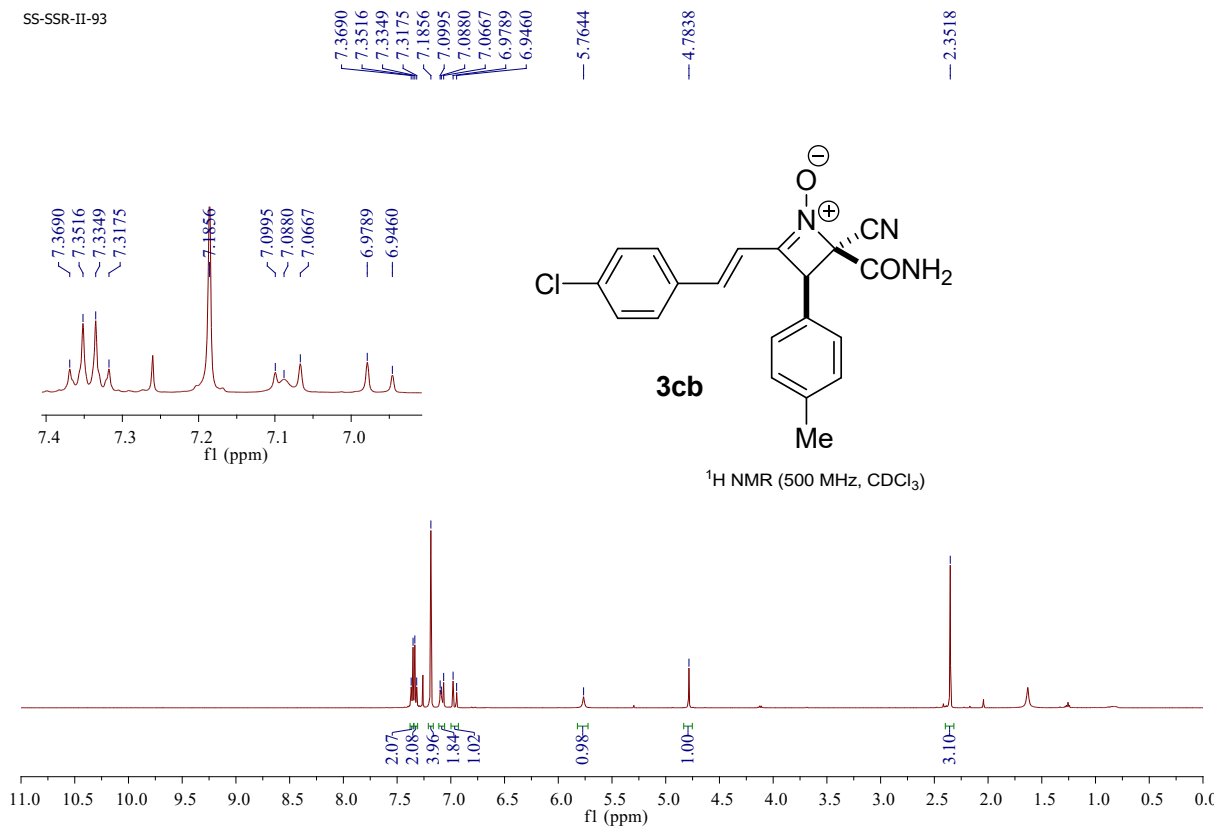
SS-SSR-91



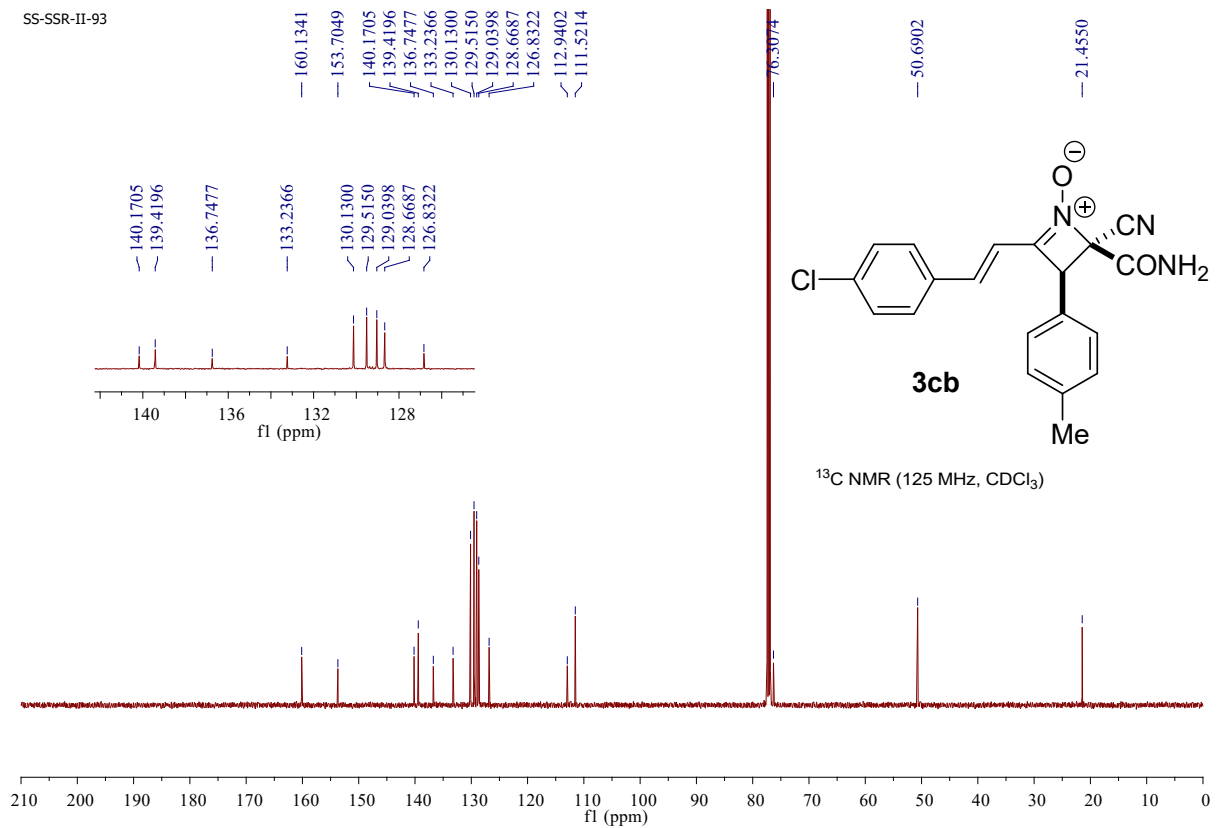
SS-SSR-91



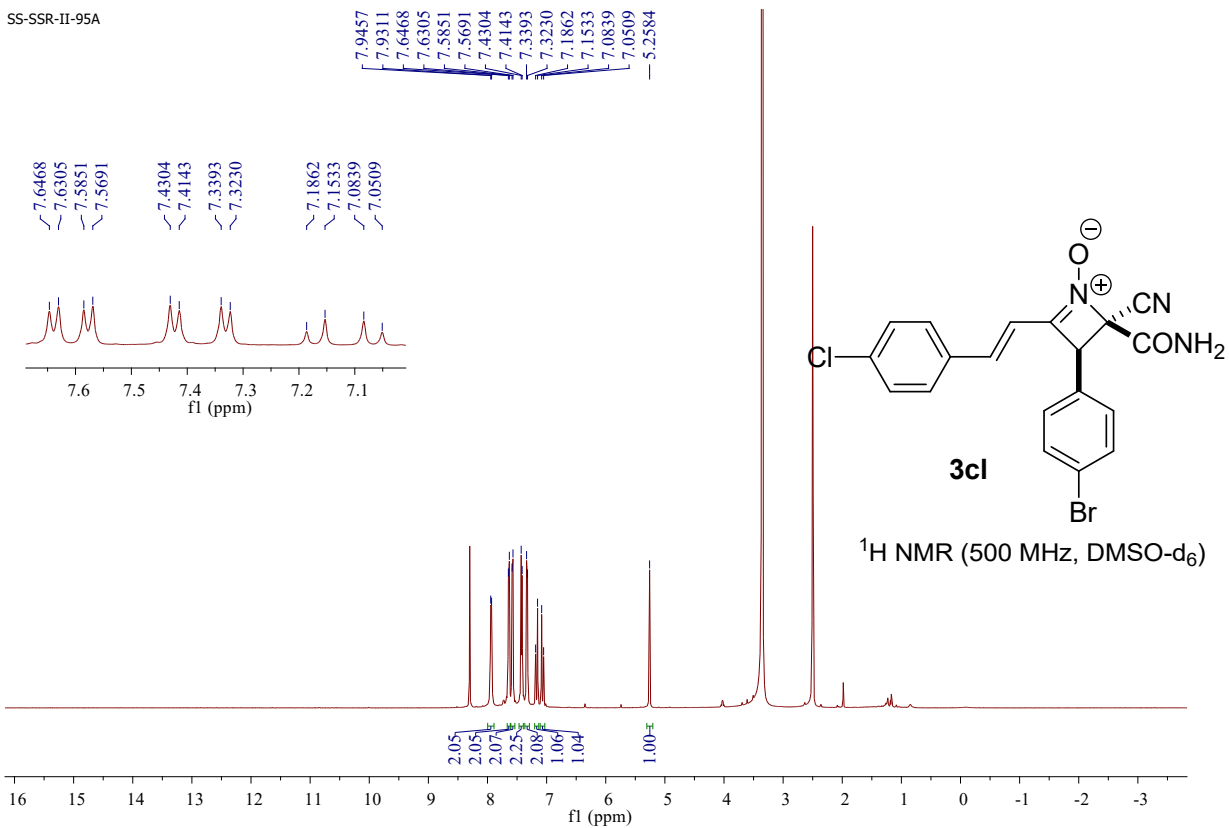
SS-SSR-II-93



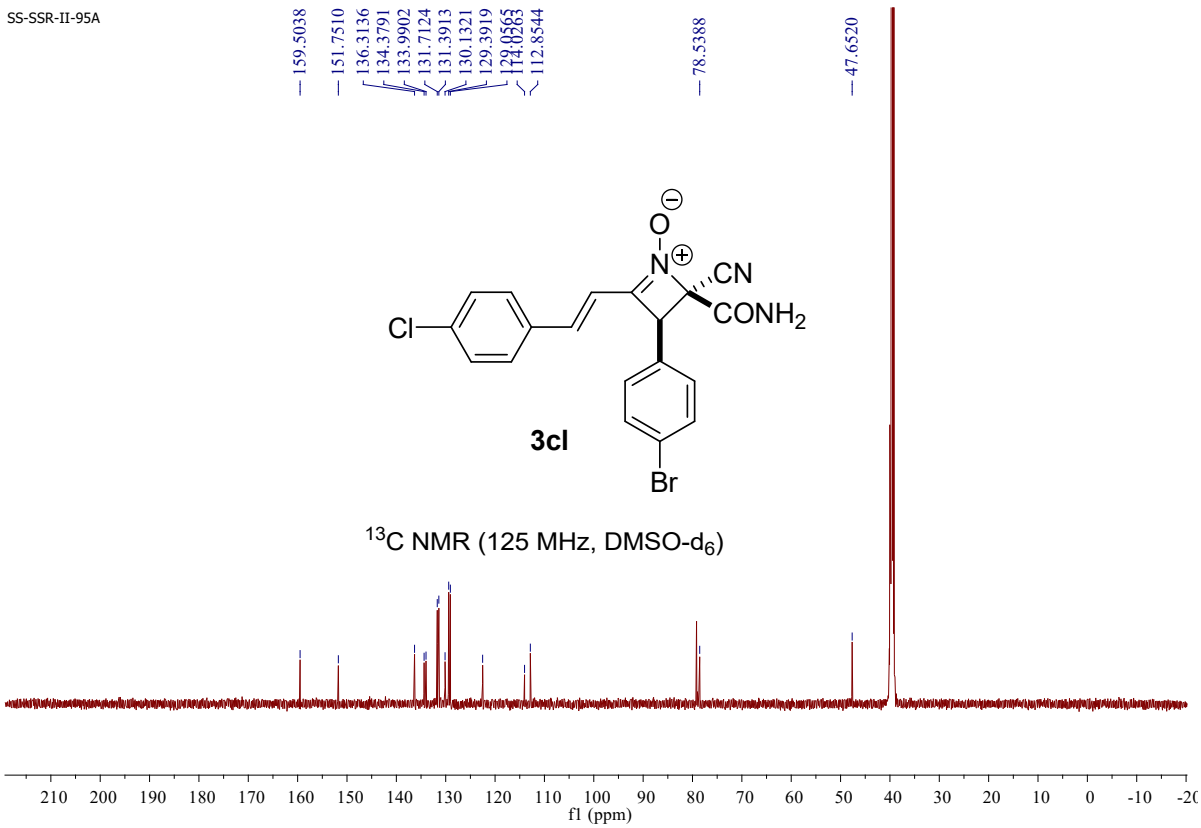
SS-SSR-II-93



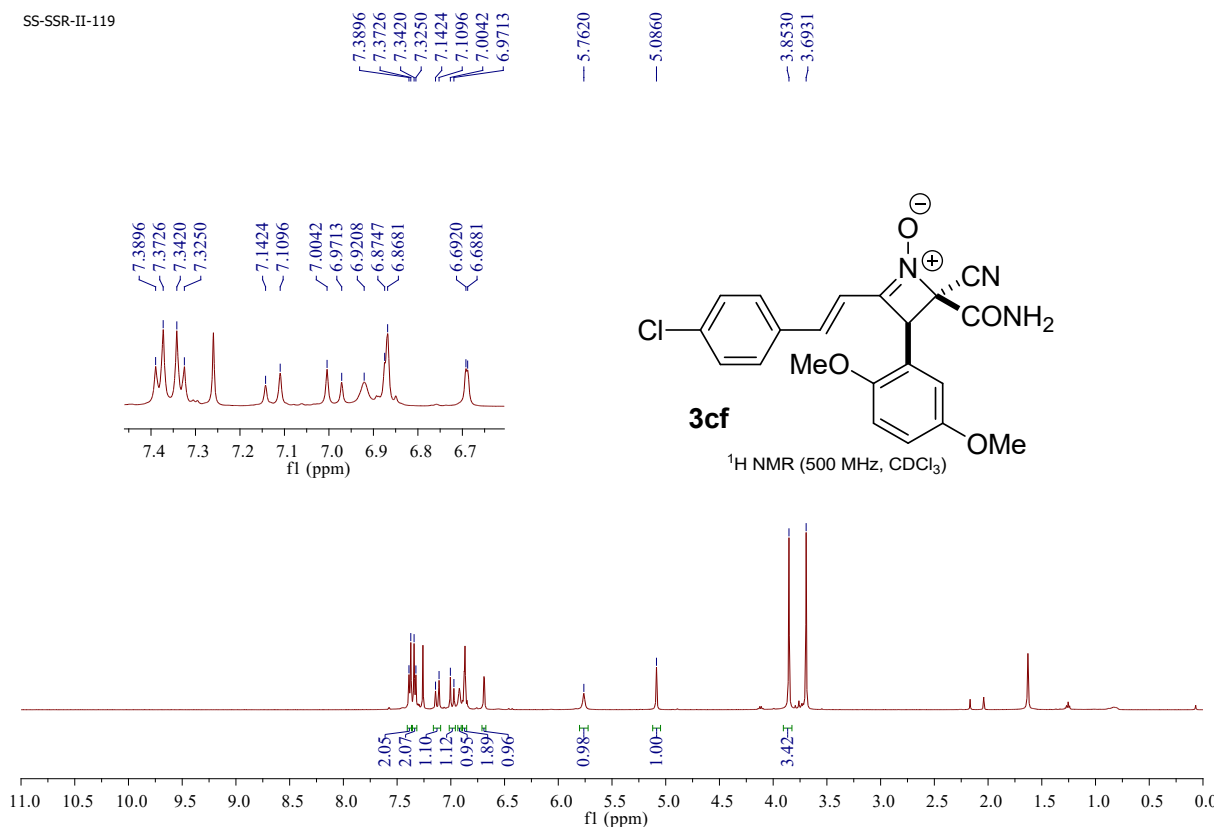
SS-SSR-II-95A



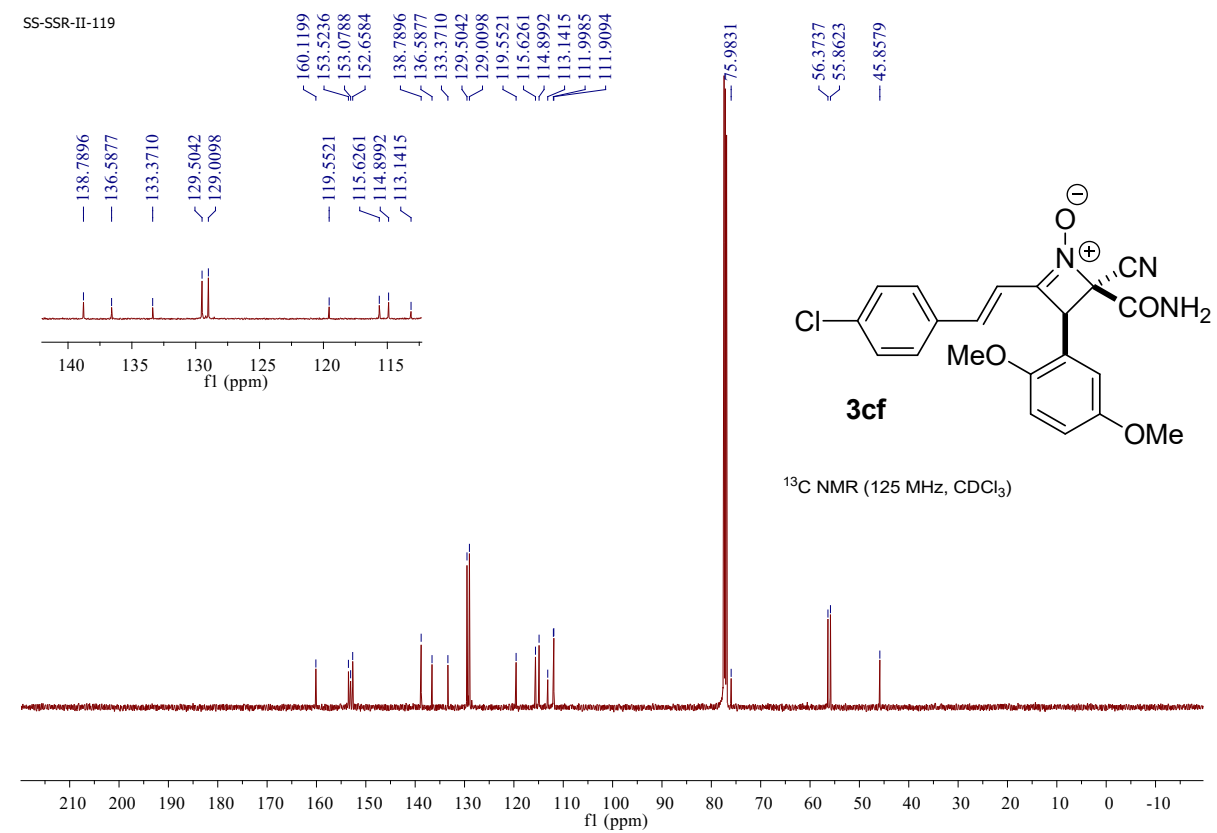
SS-SSR-II-95A



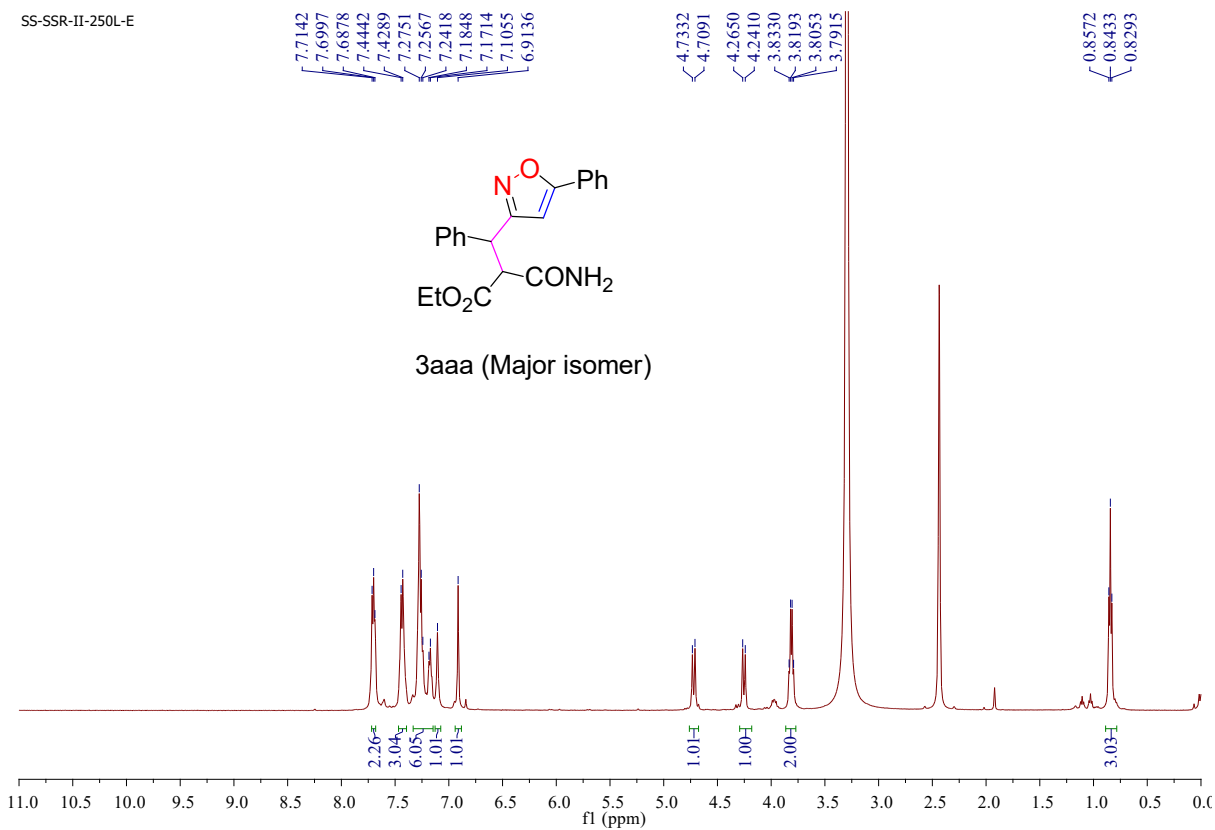
SS-SSR-II-119



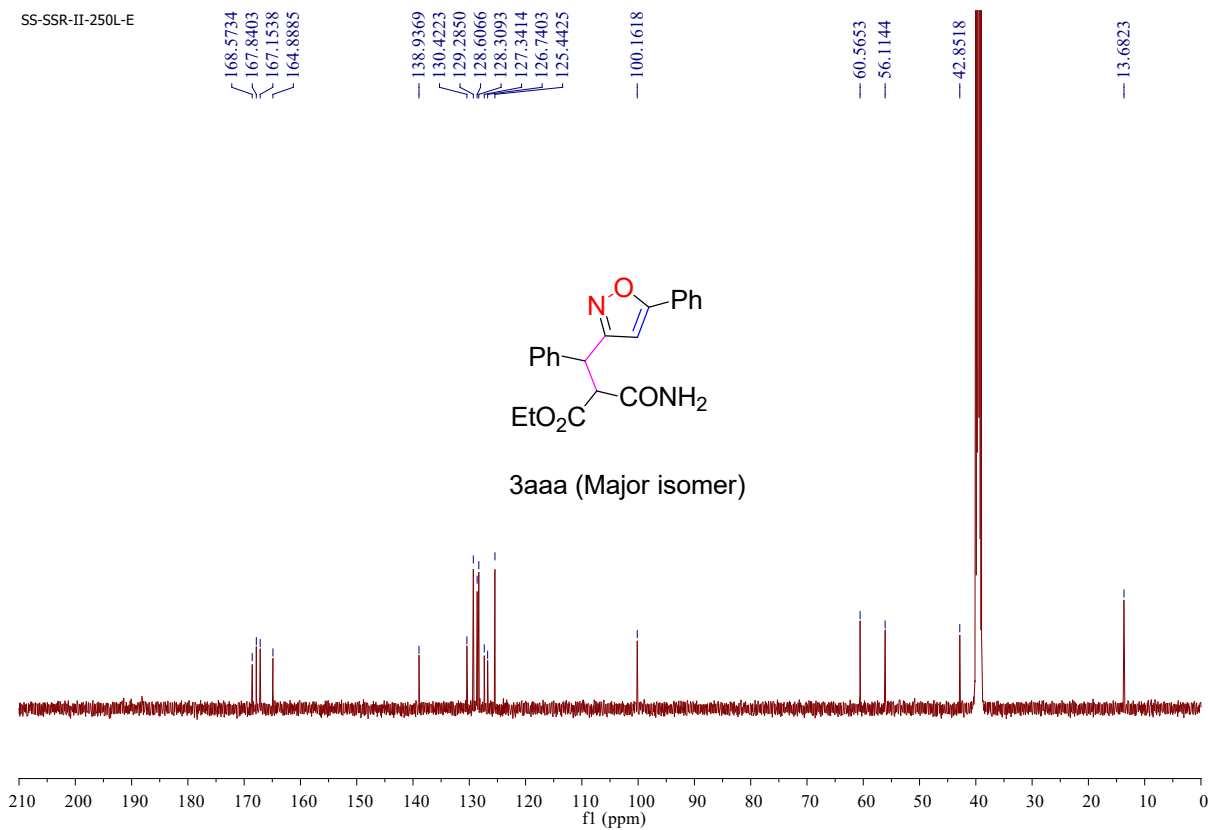
SS-SSR-II-119



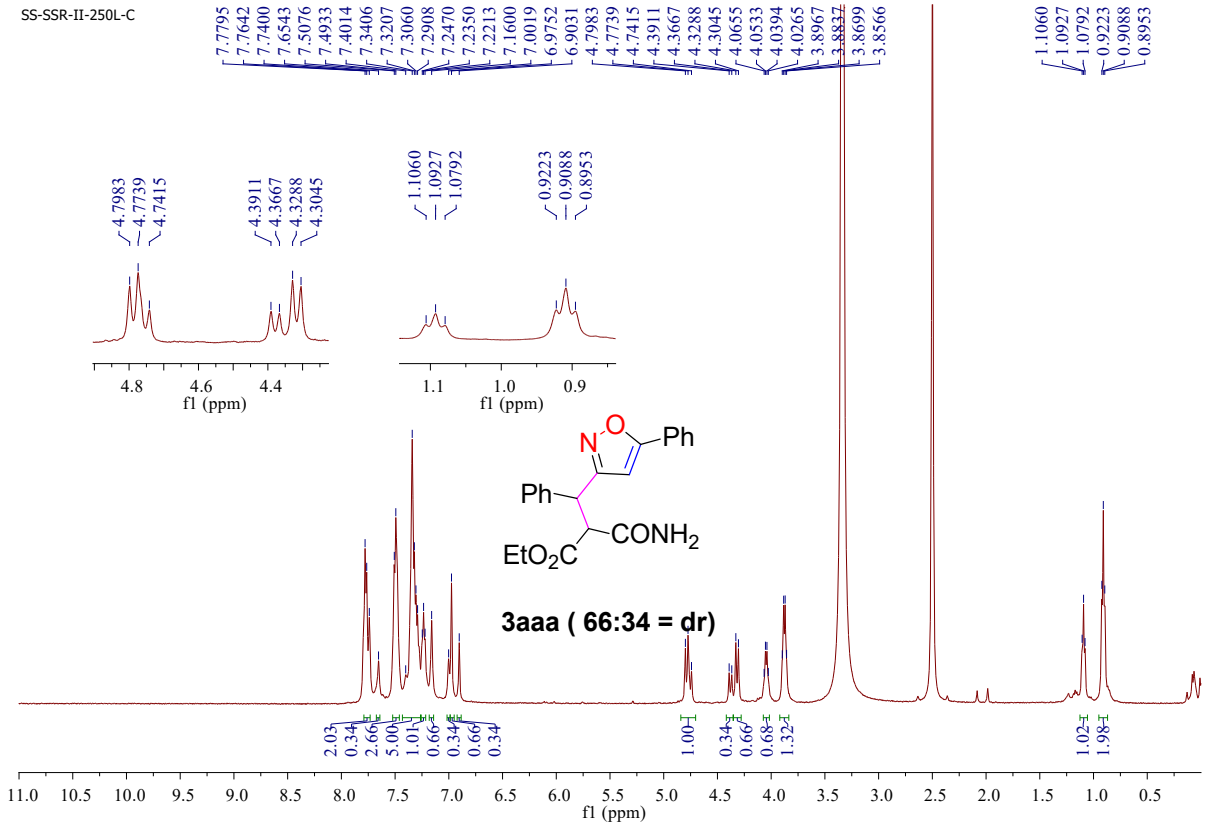
SS-SSR-II-250L-E

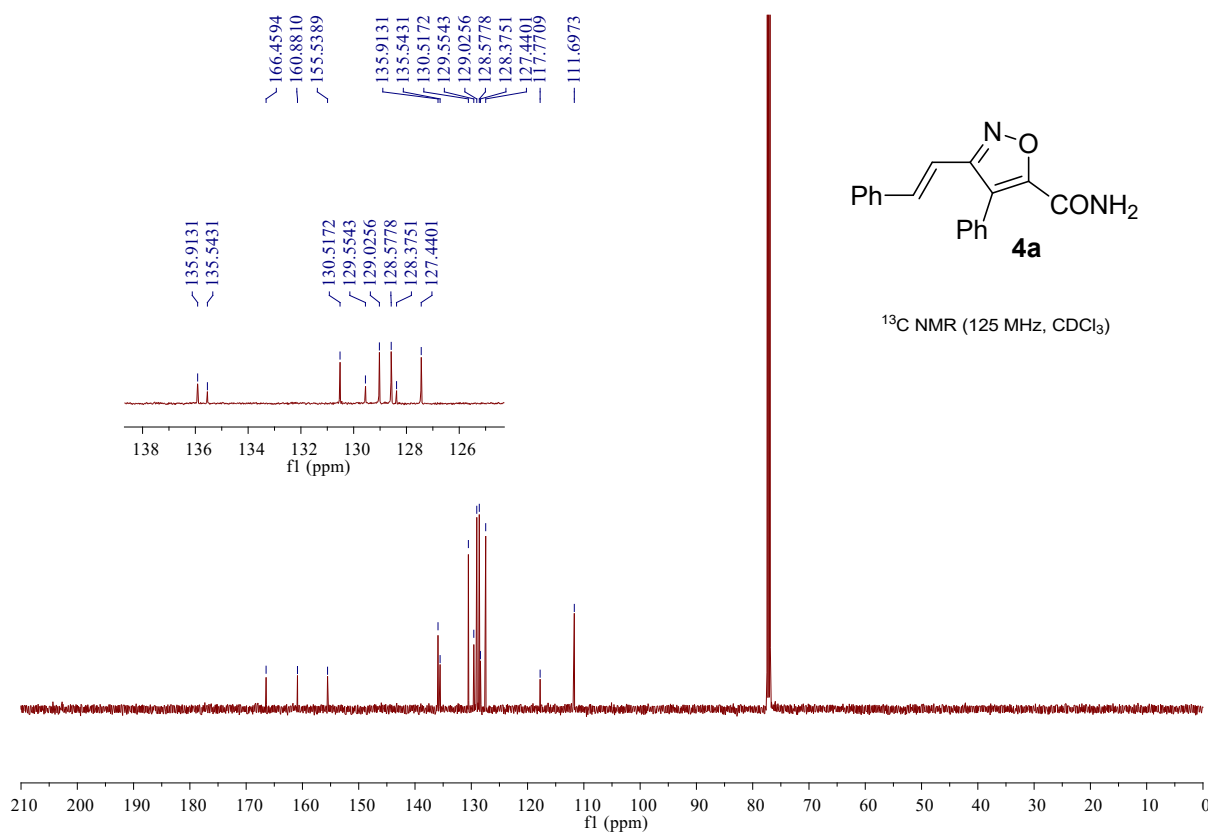
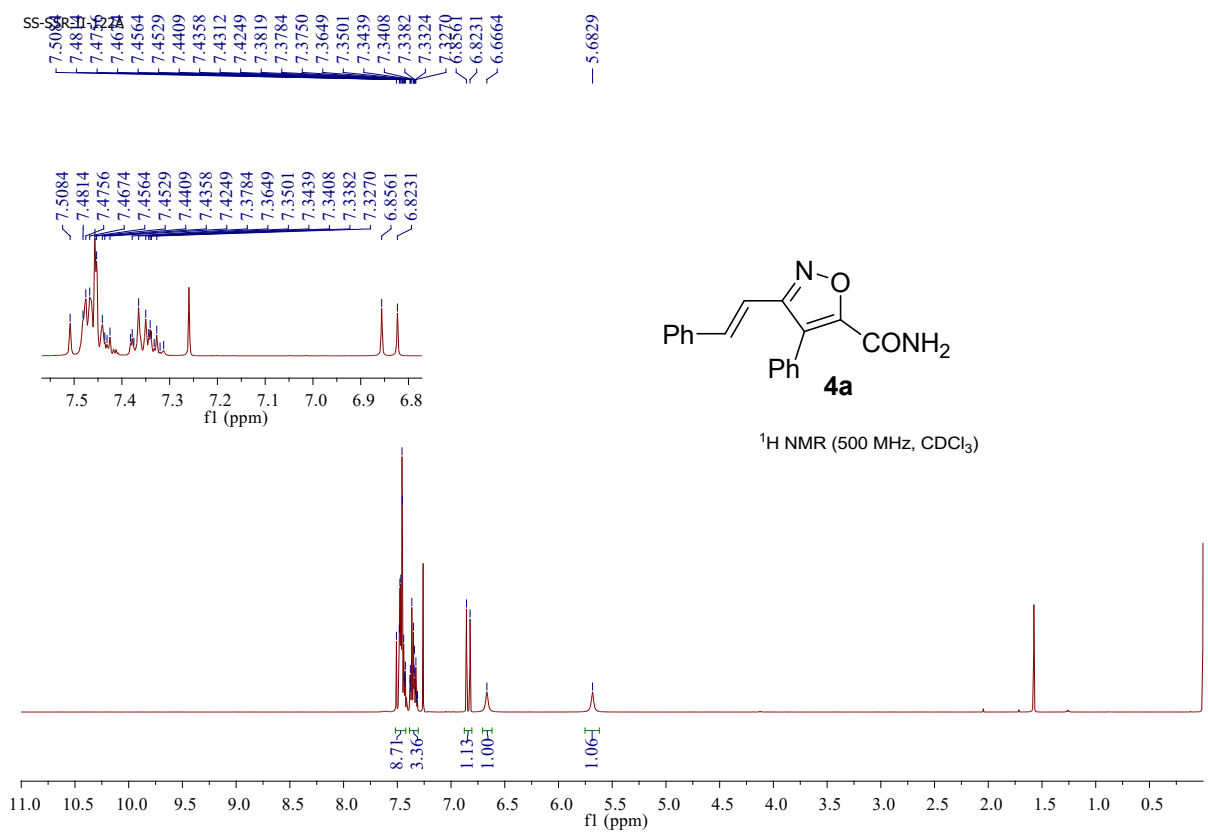


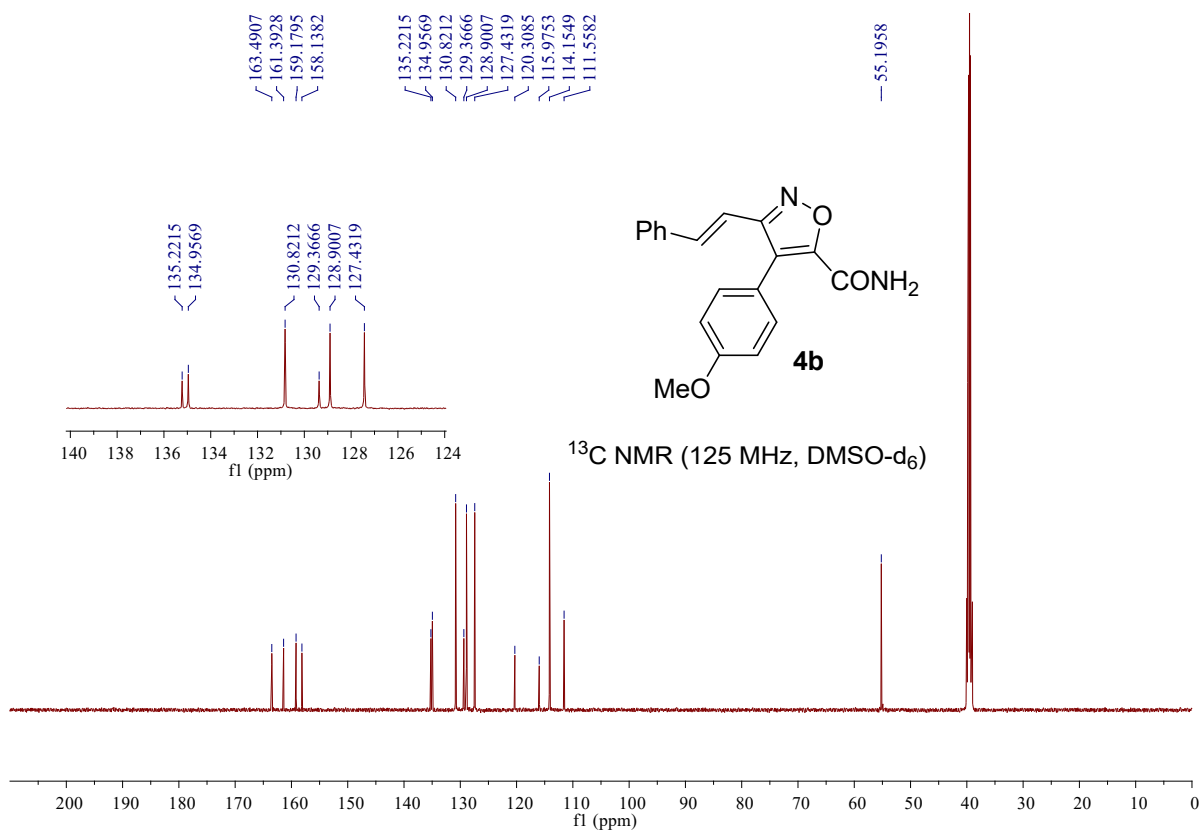
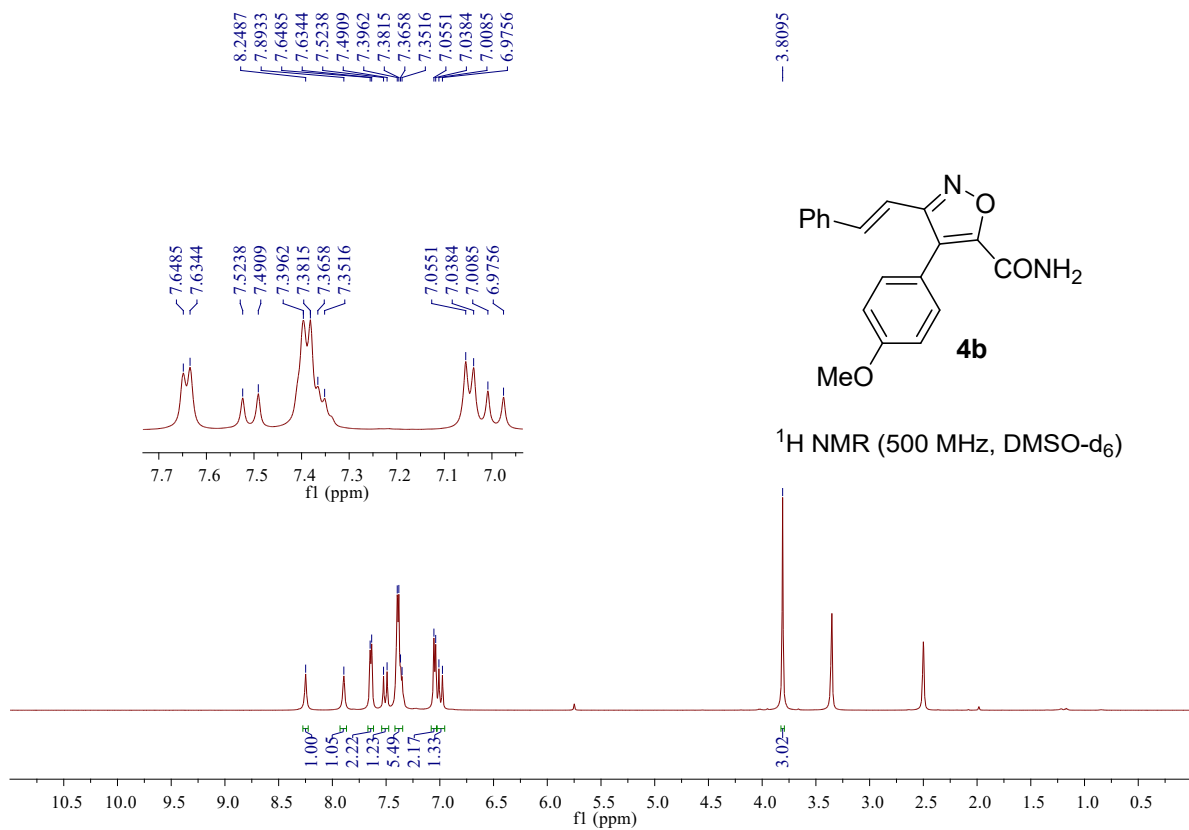
SS-SSR-II-250L-E

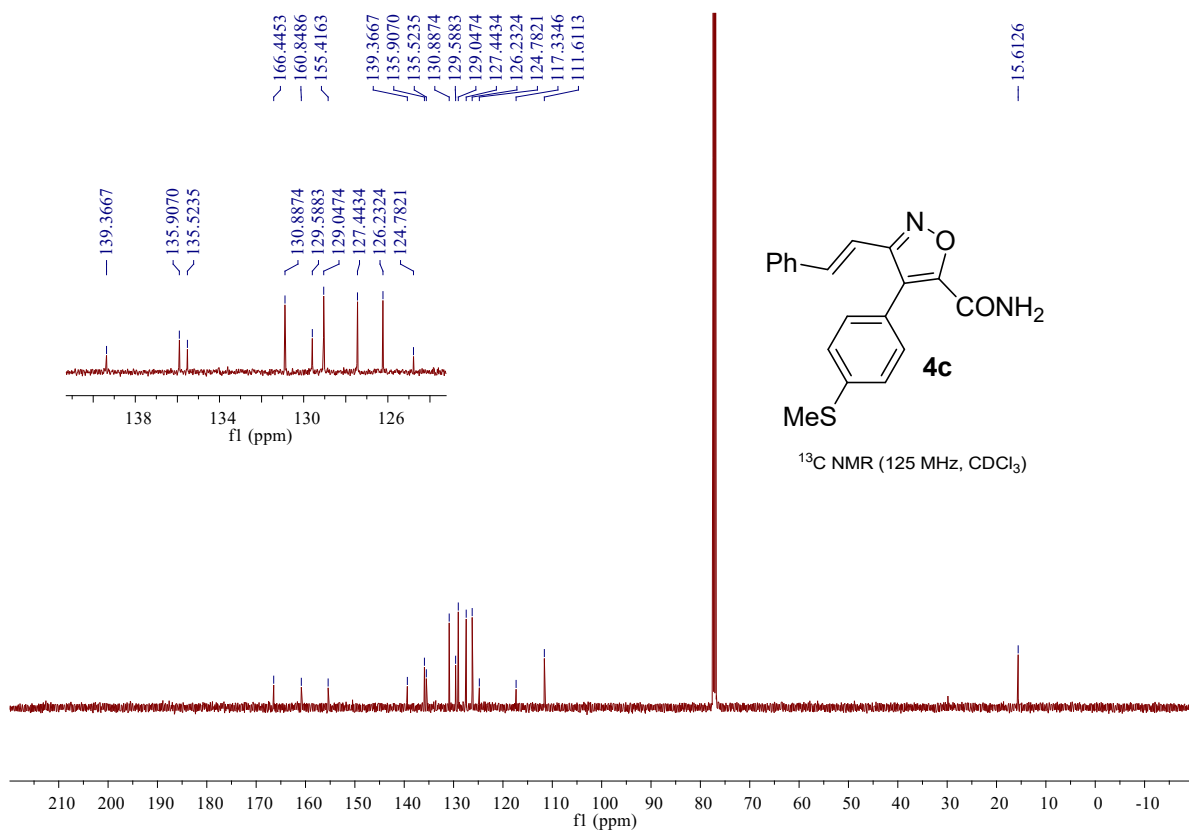
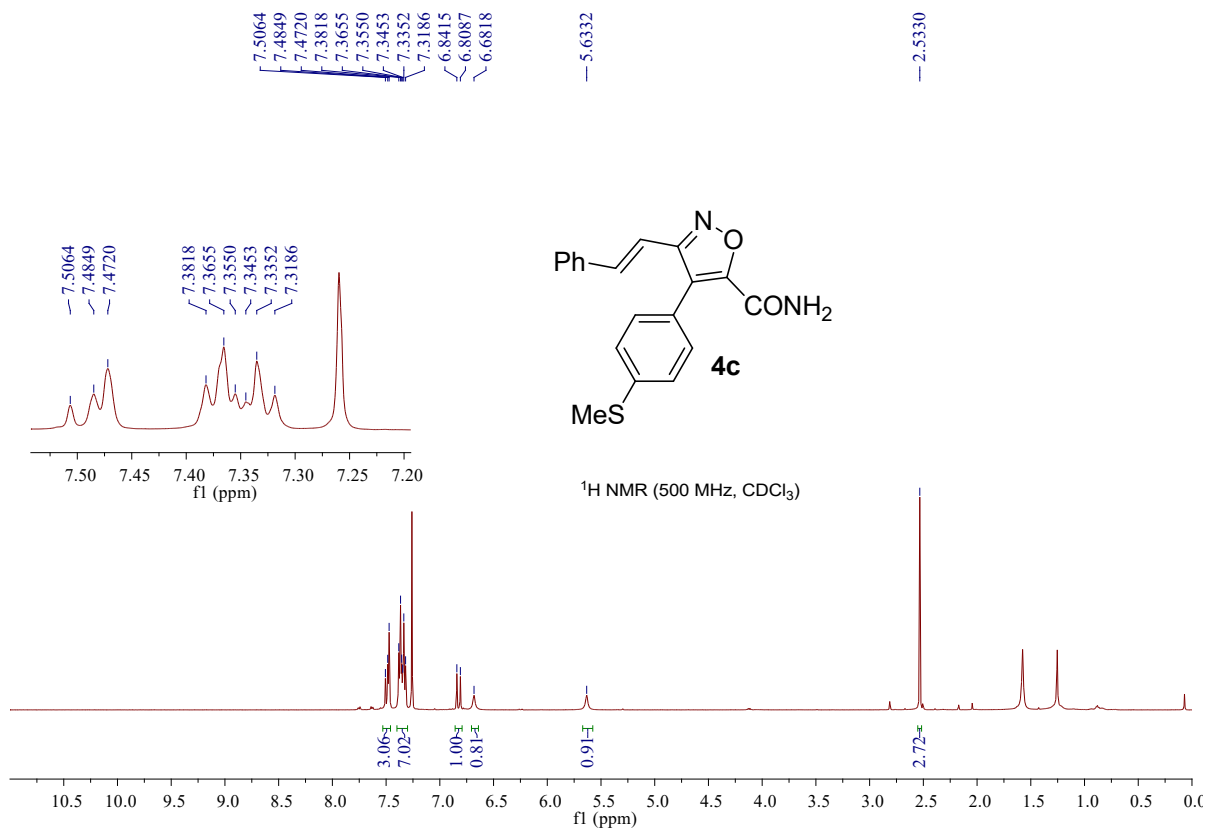


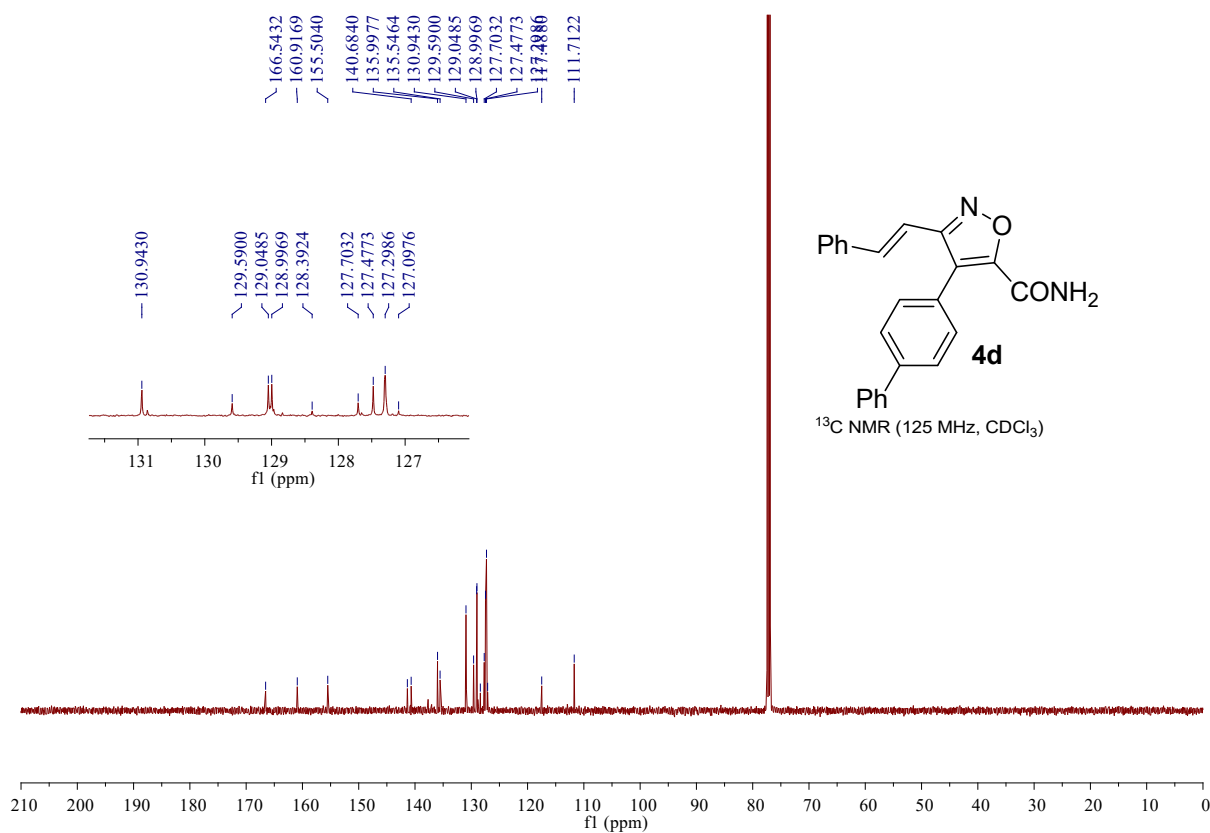
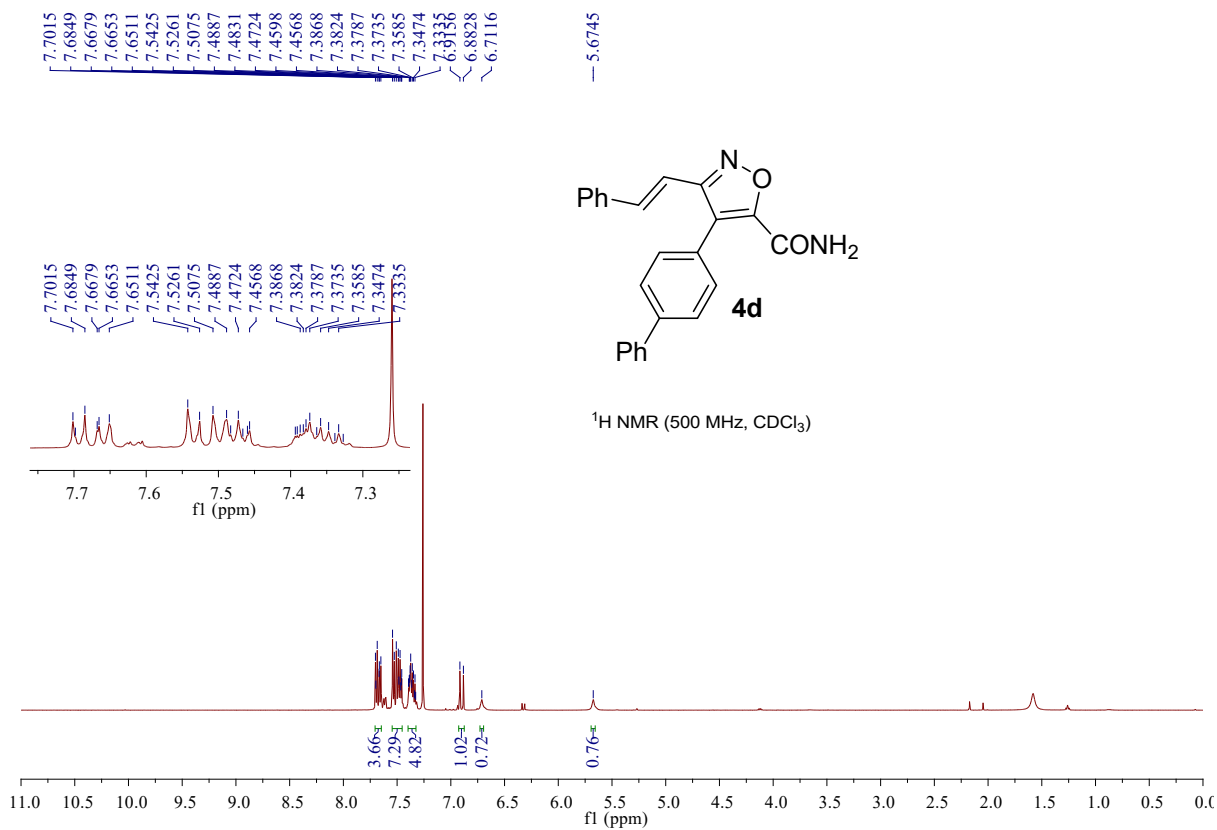
SS-SSR-II-250L-C



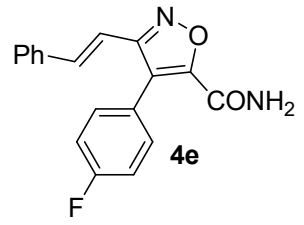
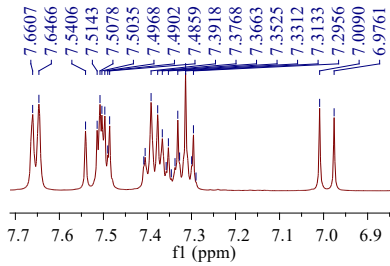




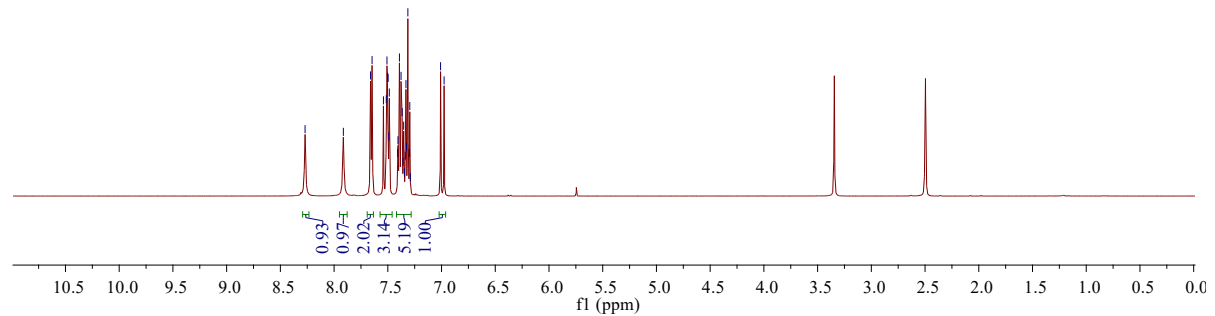




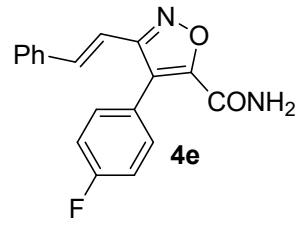
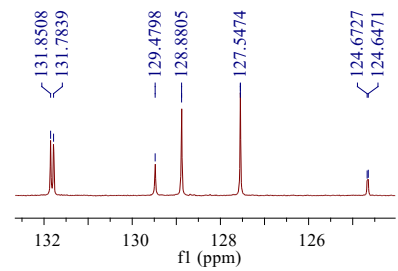
8.2701
7.9138
7.6607
7.6466
7.5406
7.5143
7.5078
7.4968
7.5035
7.4902
7.4902
7.4859
7.4083
7.4053
7.3918
7.3768
7.3663
7.3576
7.3525
7.3458
7.3375
7.3312
7.3270
7.3133
7.2997
7.2956
7.2898
7.0090
6.9761



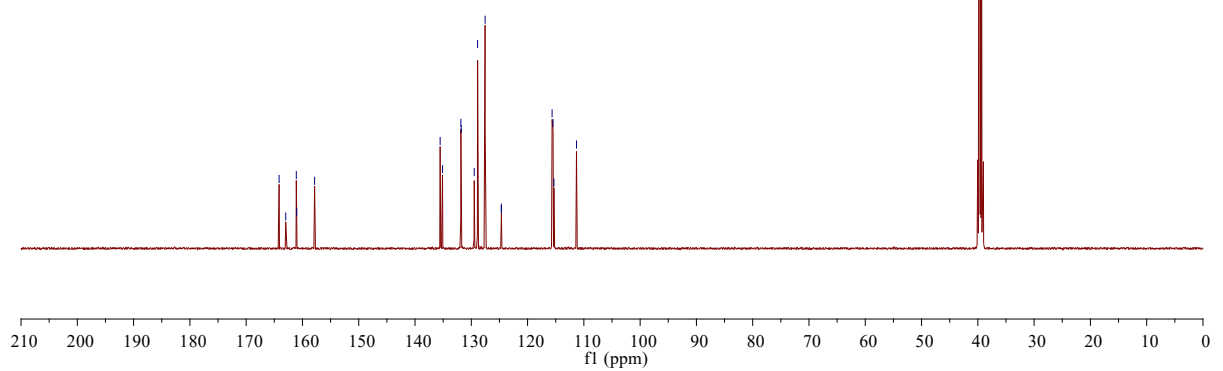
¹H NMR (500 MHz, DMSO-d₆)

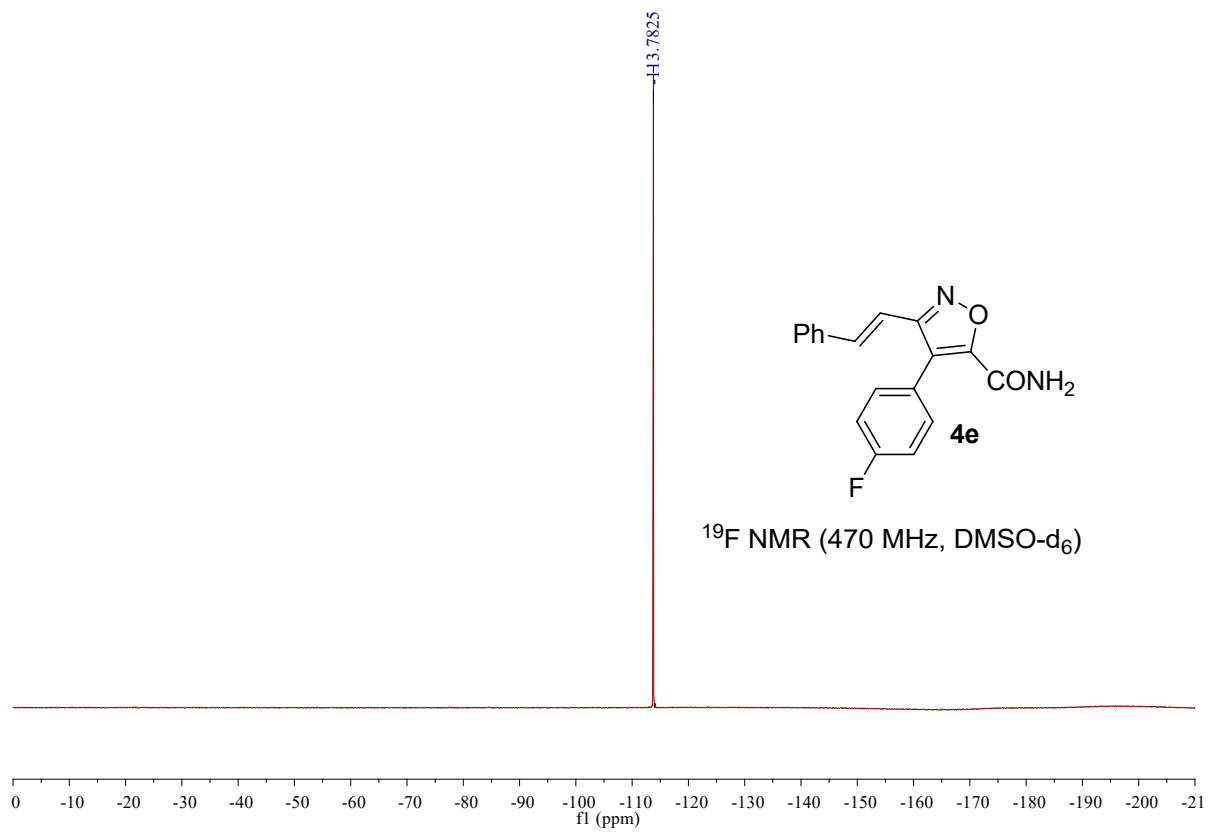


164.1464
162.9698
161.0912
161.0189
157.8389
135.5345
135.1104
131.8508
131.7839
129.4798
128.8805
127.5474
124.6727
124.6471
115.4725
115.3135
111.3102

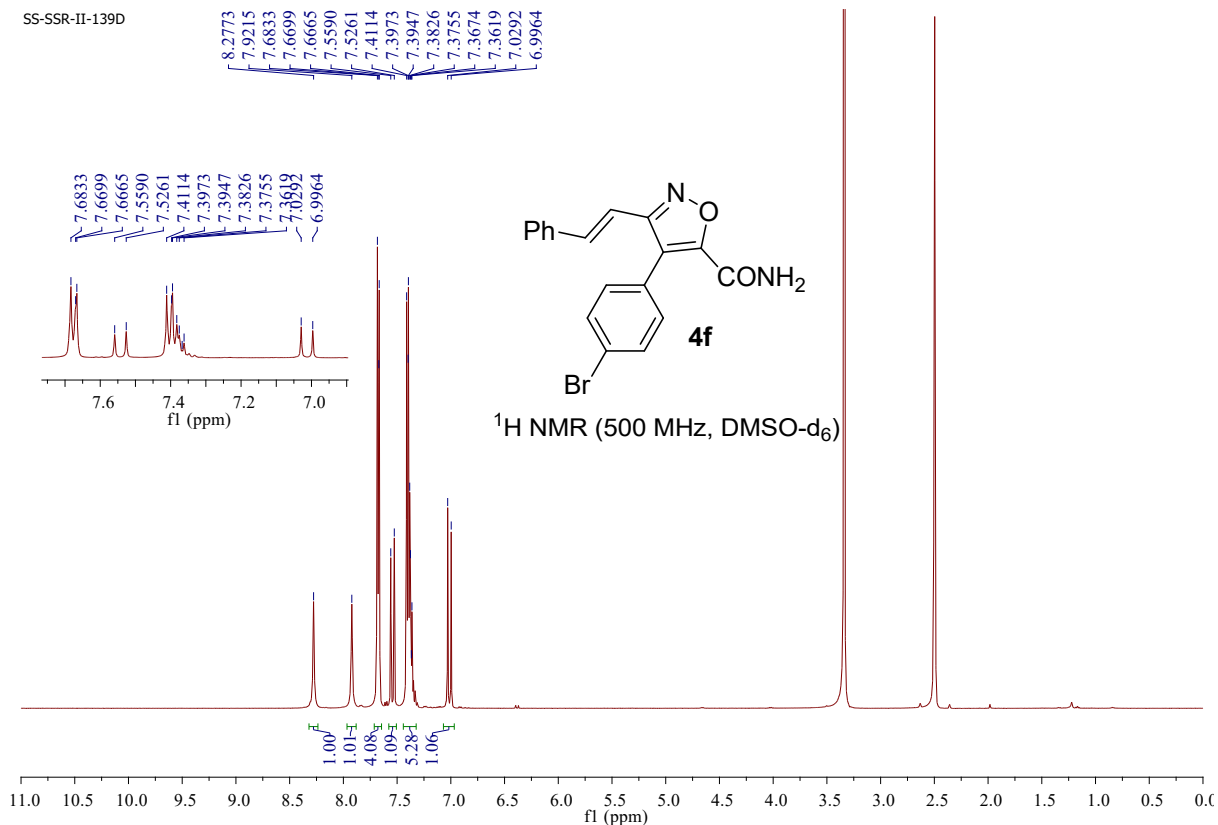


¹³C NMR (125 MHz, DMSO-d₆)

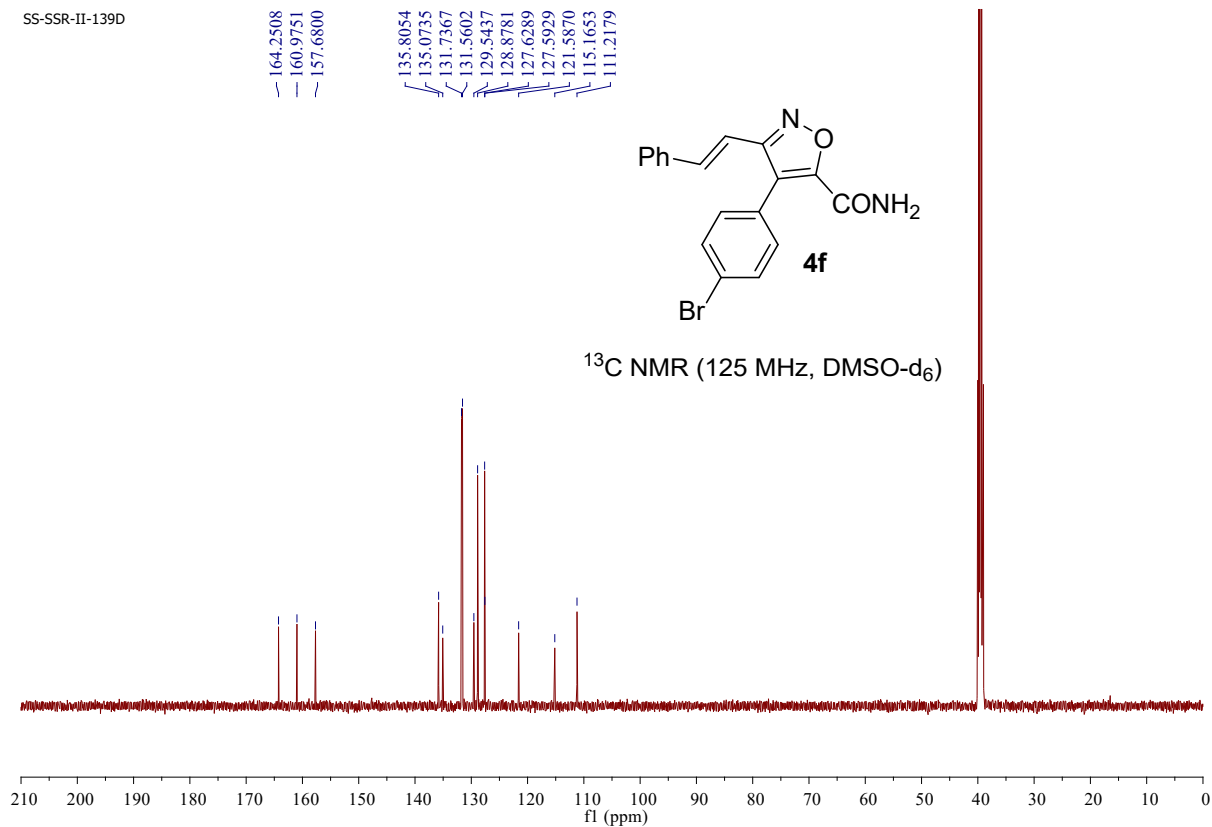


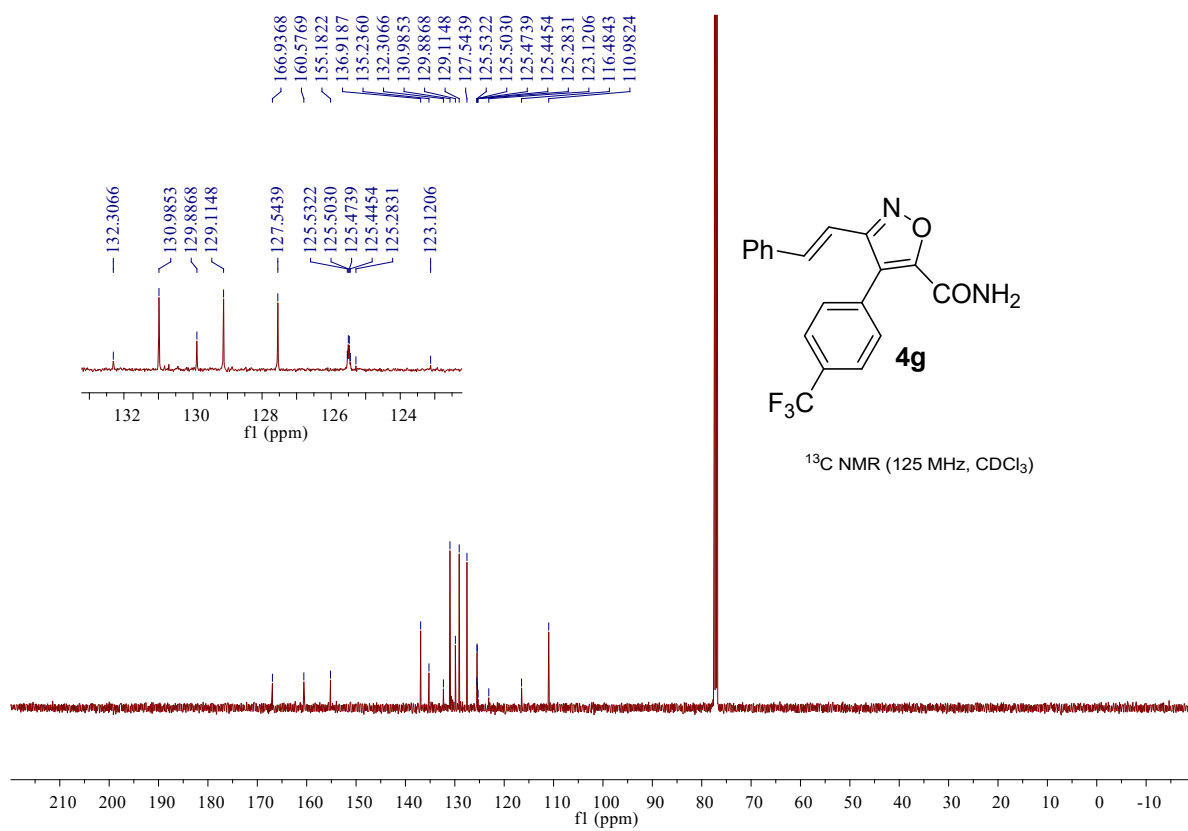
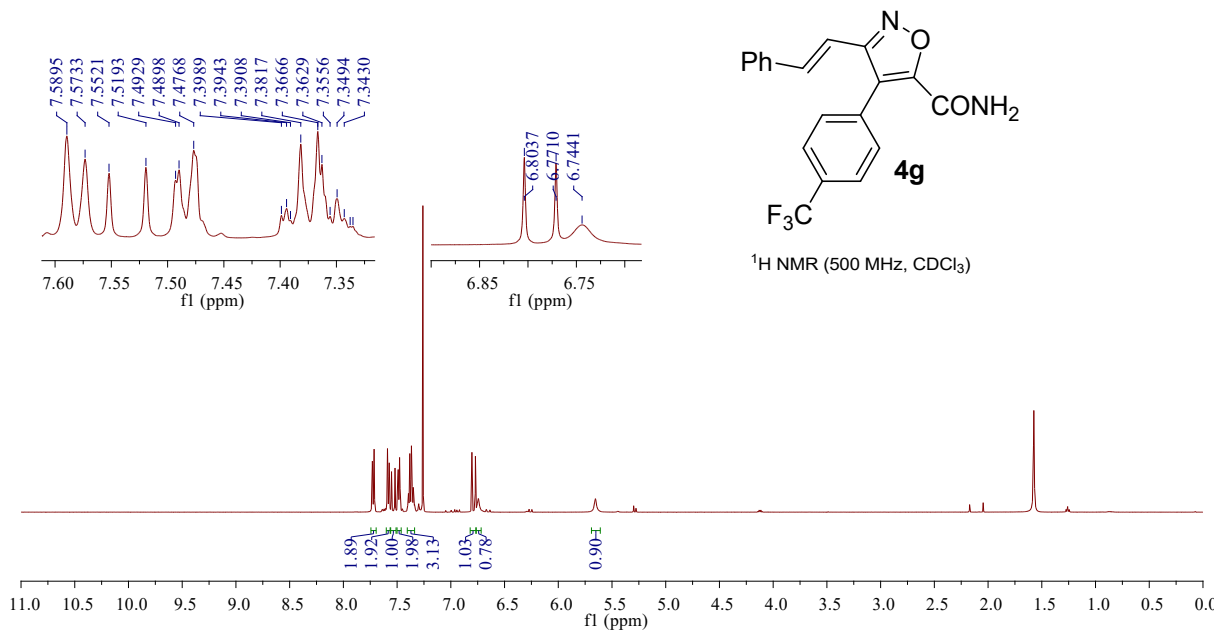


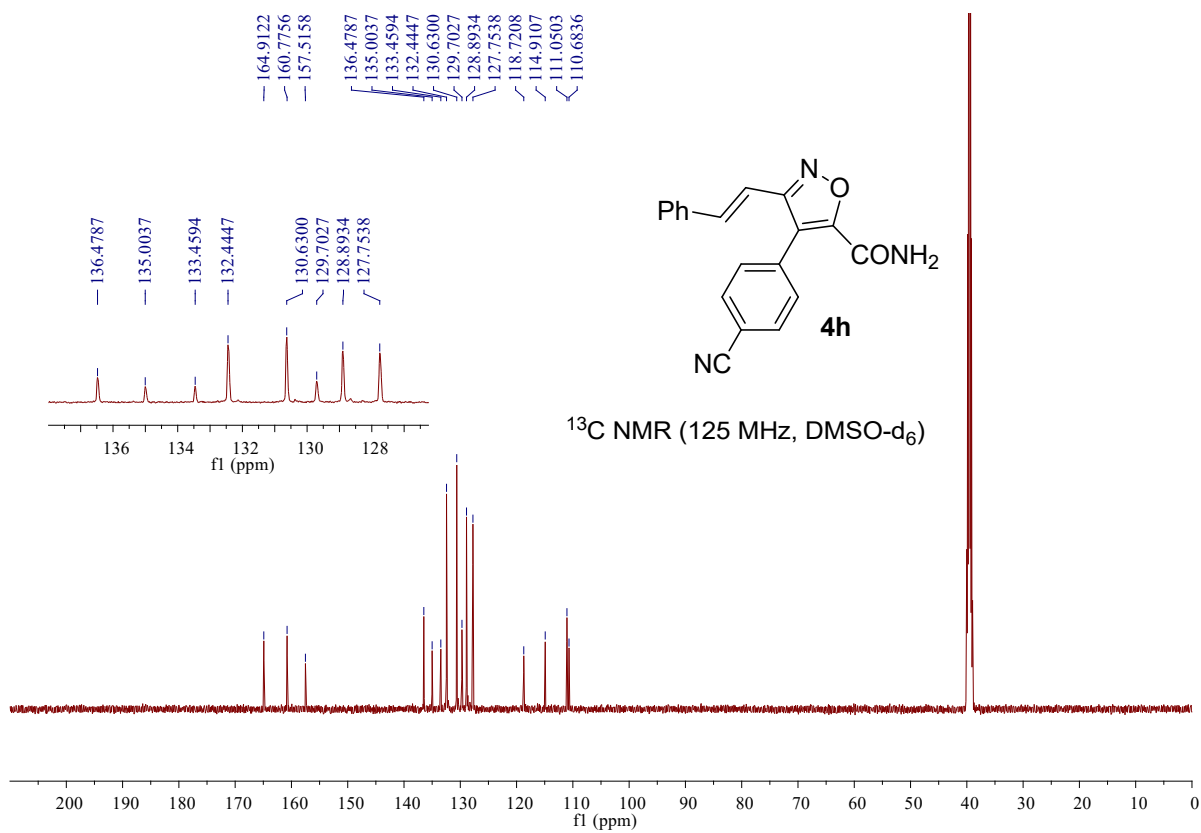
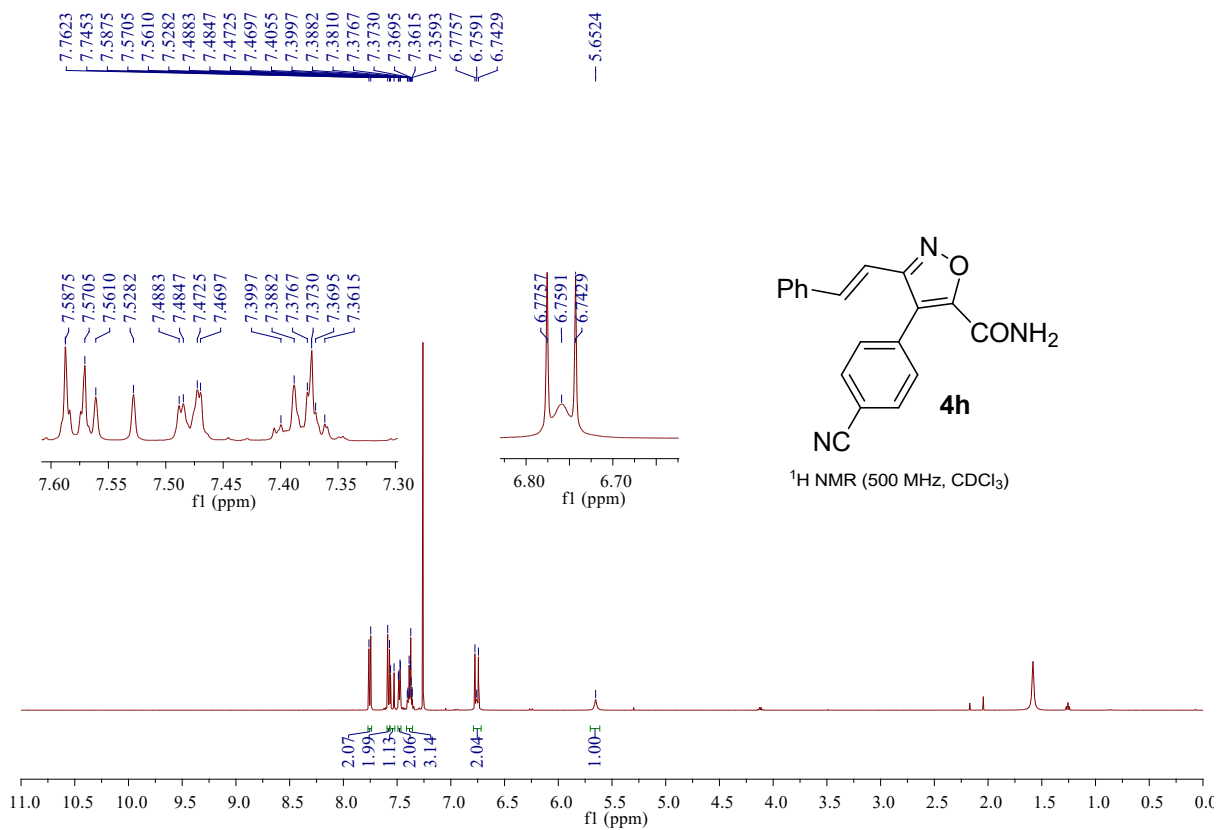
SS-SSR-II-139D



SS-SSR-II-139D

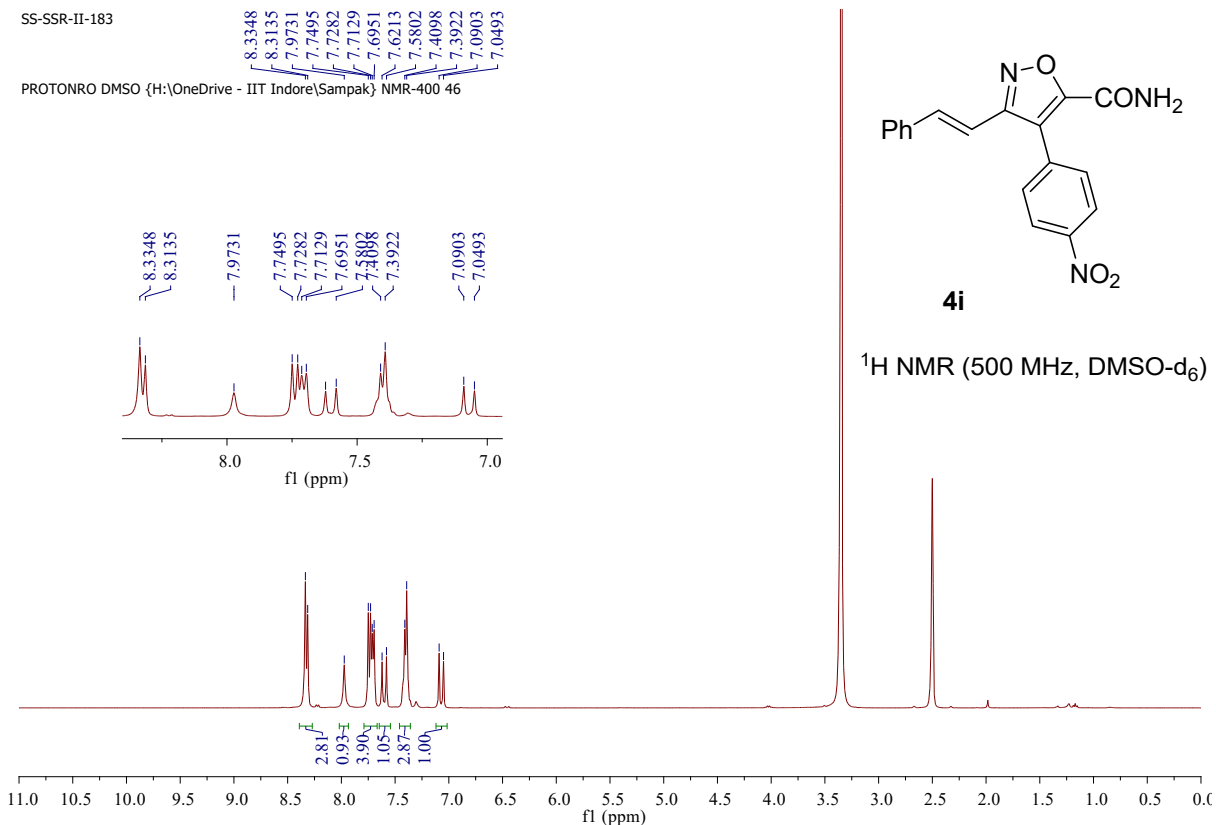






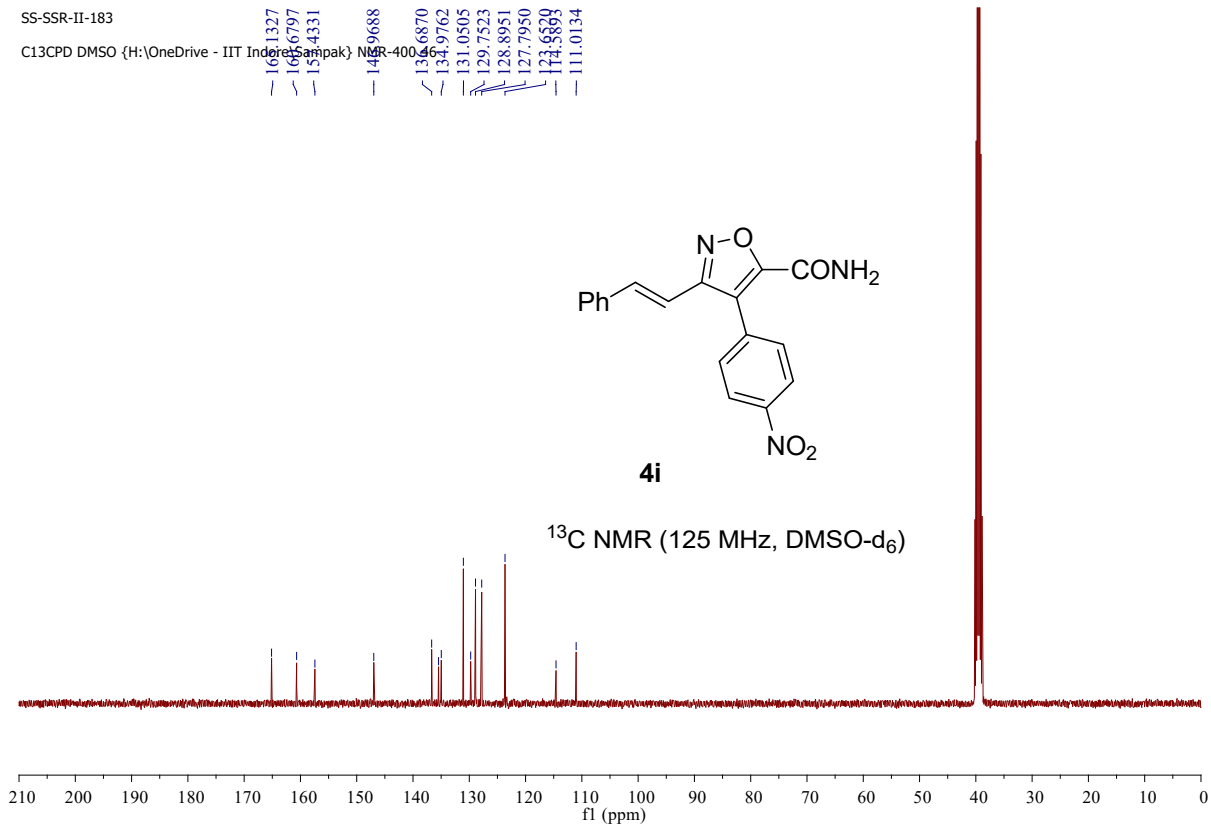
SS-SSR-II-183

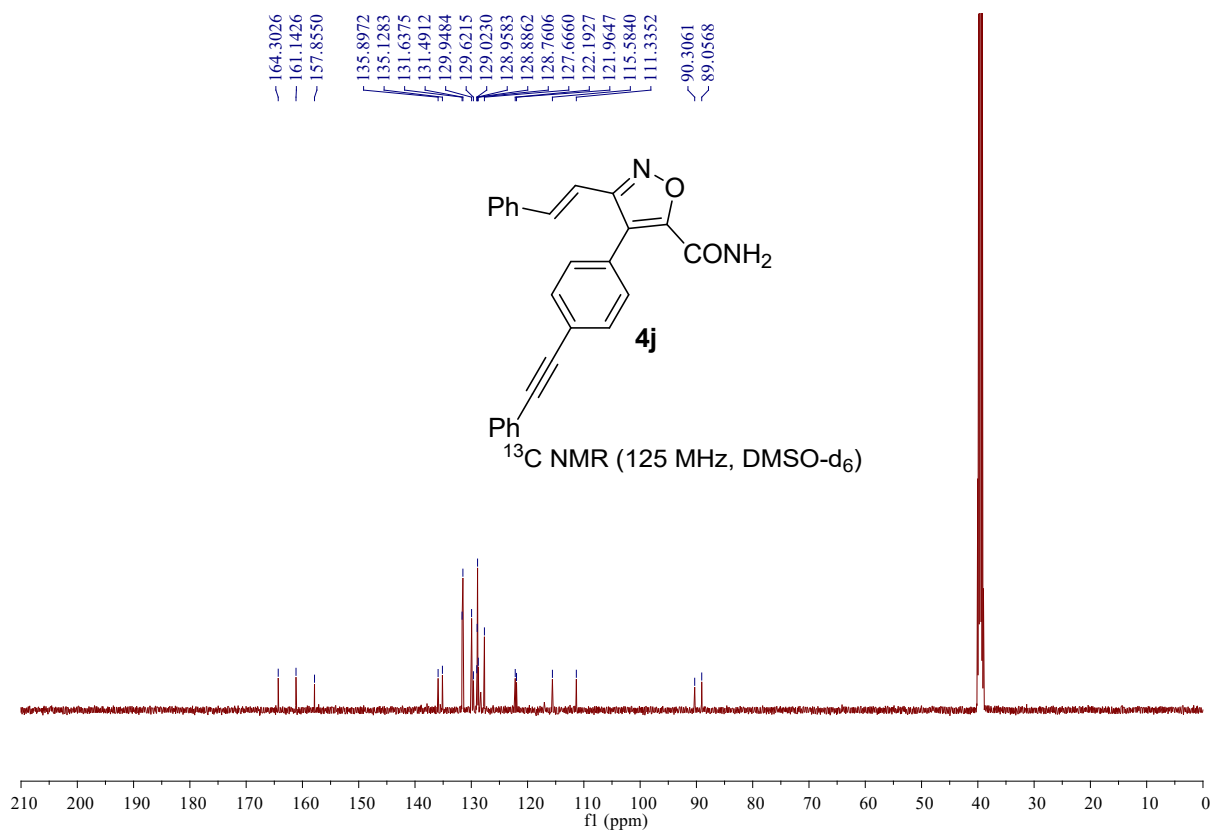
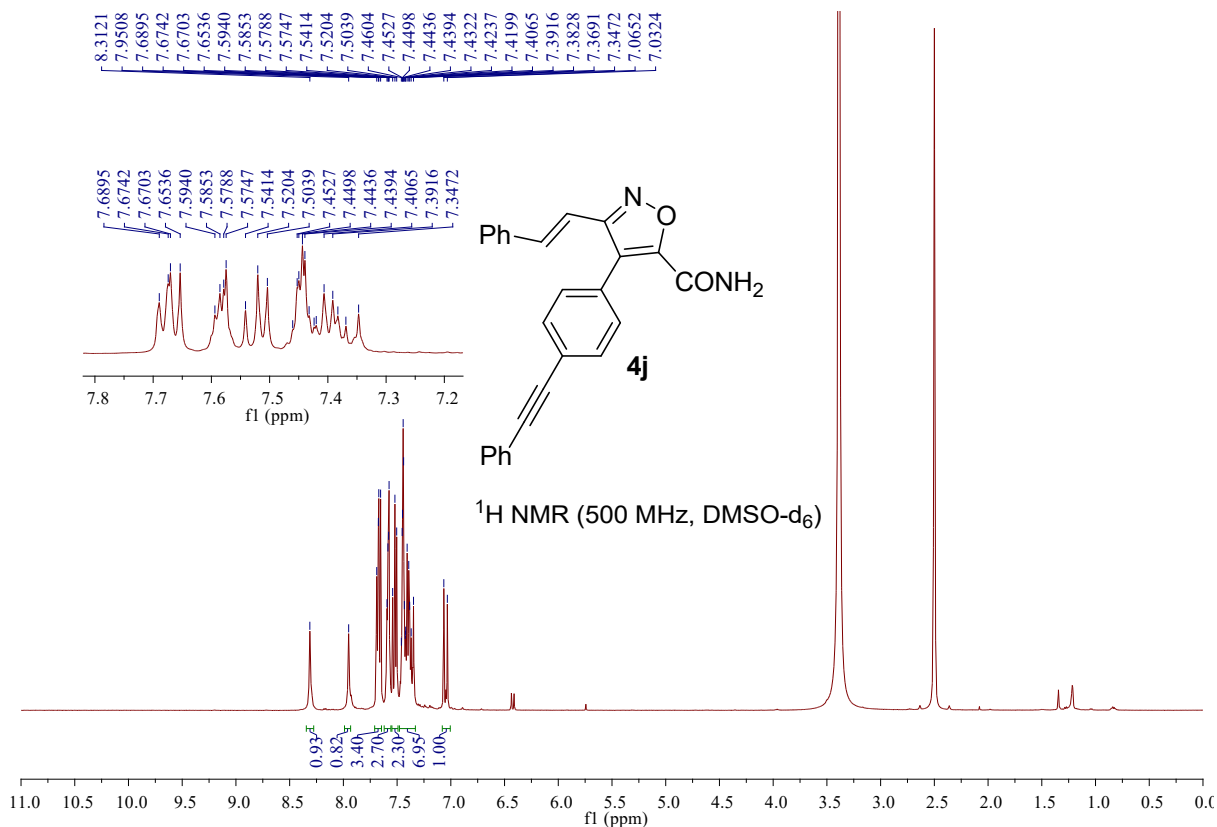
PROTONRO DMSO {H:\OneDrive - IIT Indore\Sampak} NMR-400 46

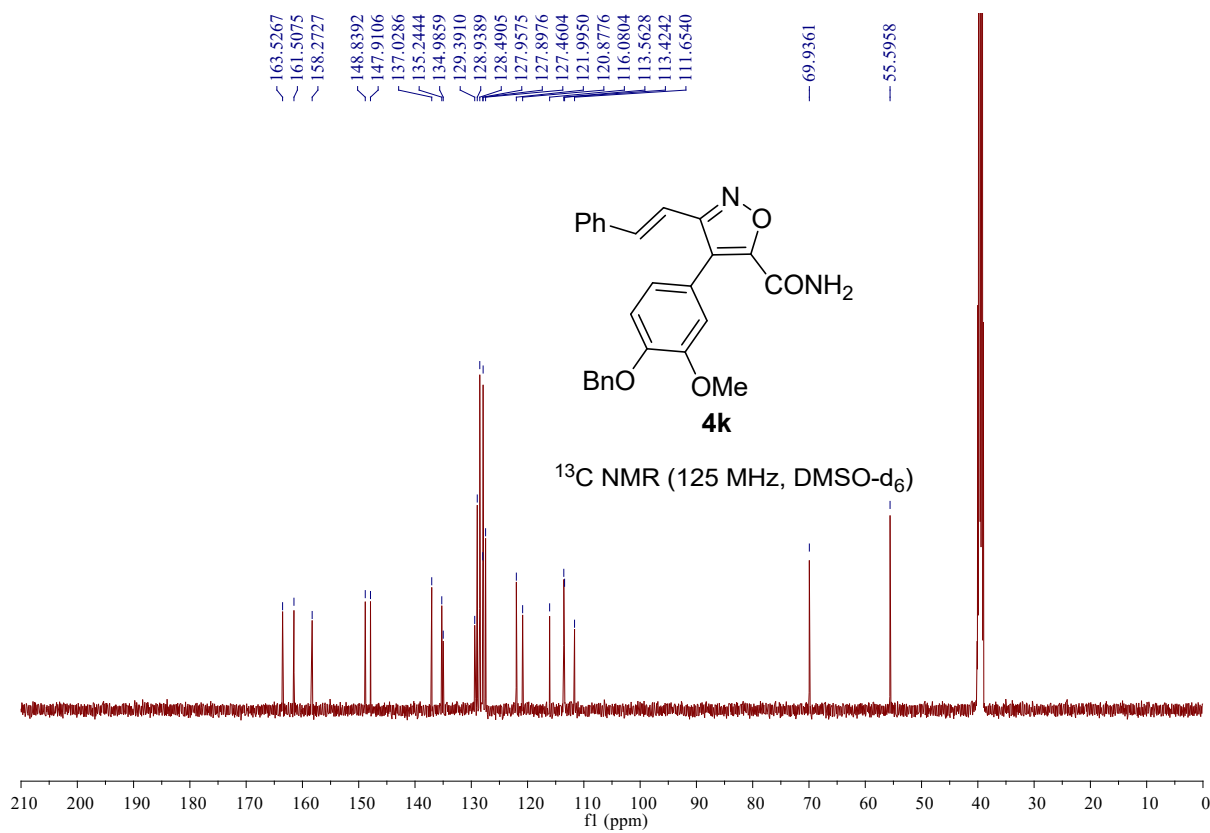
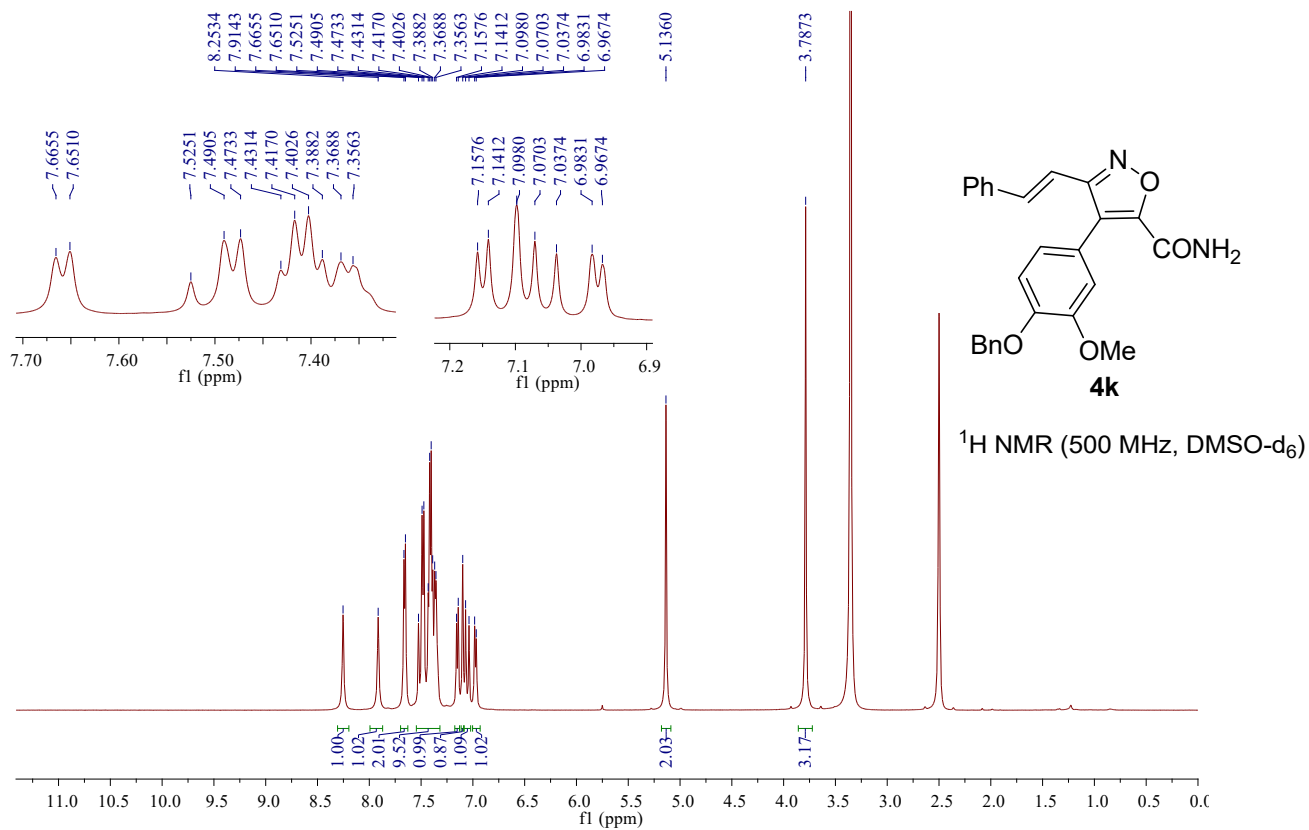


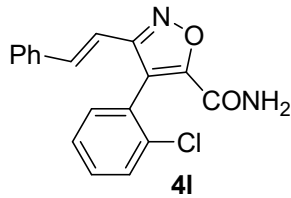
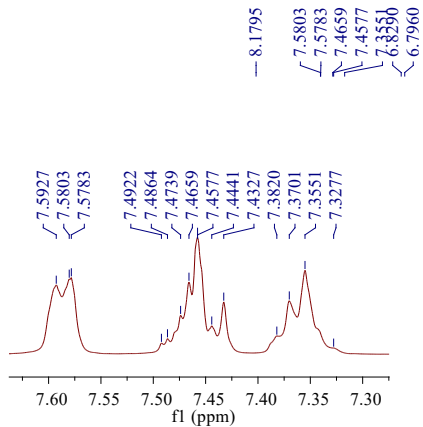
SS-SSR-II-183

C13CPD DMSO {H:\OneDrive - IIT Indore\Sampak} NMR-400 46

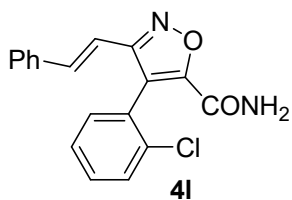
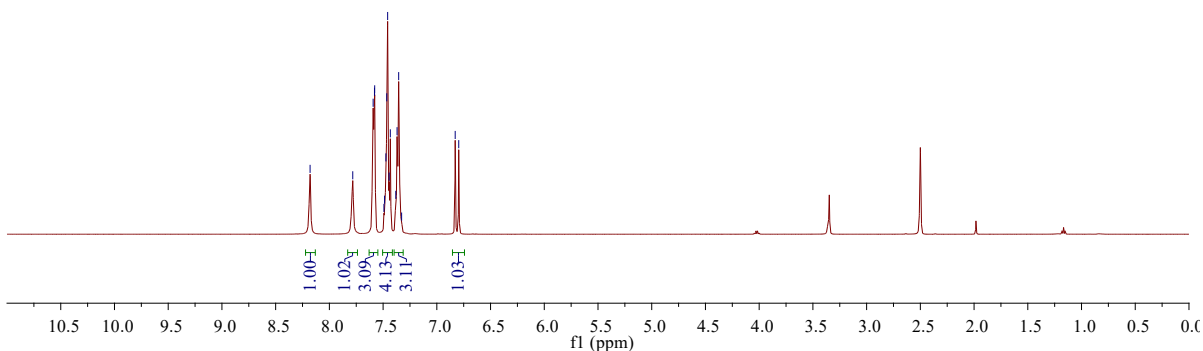




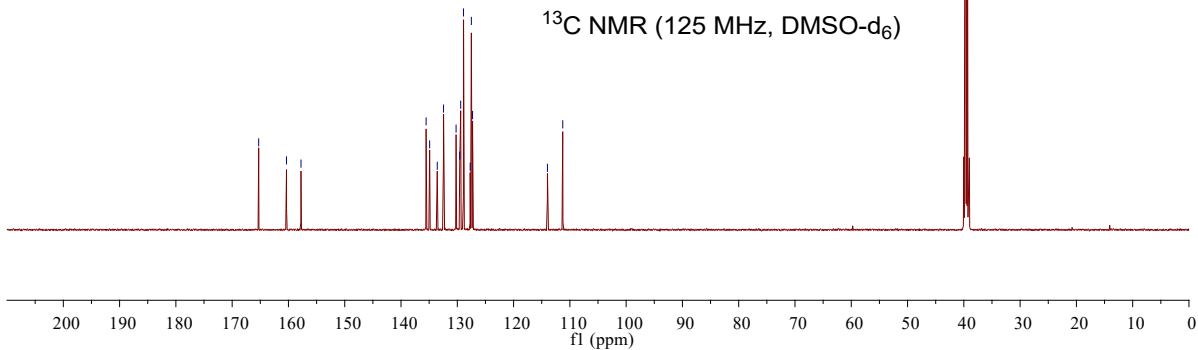




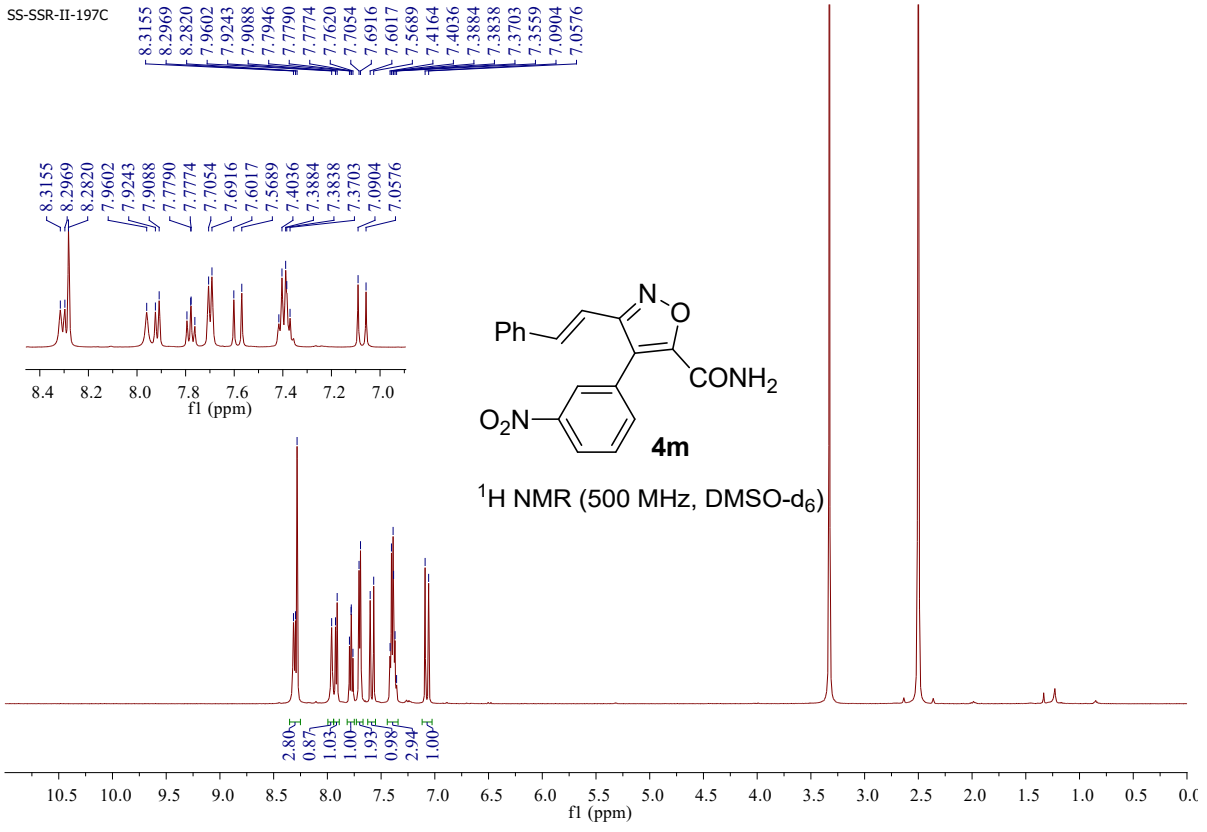
¹H NMR (500 MHz, DMSO-d₆)



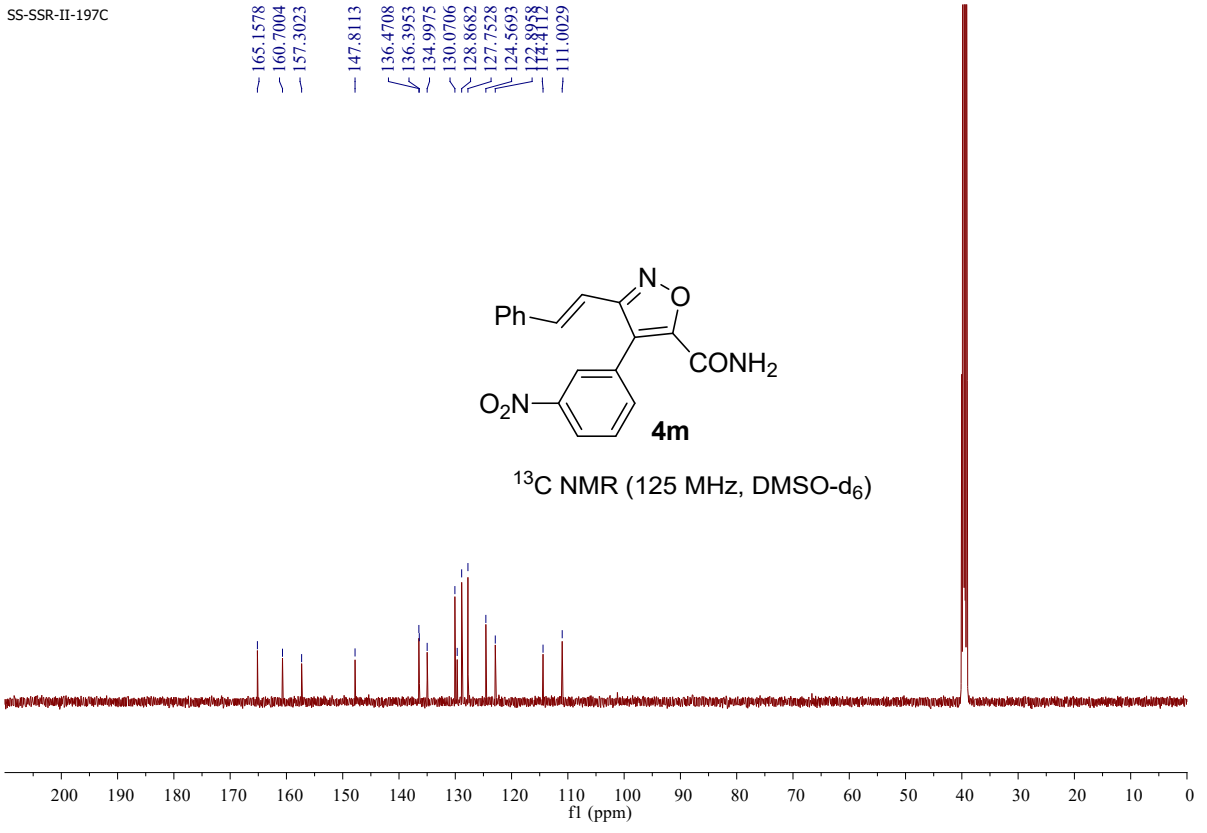
¹³C NMR (125 MHz, DMSO-d₆)



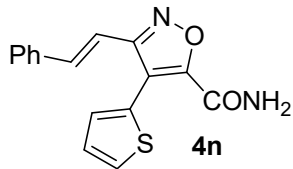
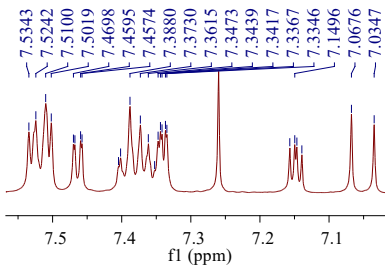
SS-SSR-II-197C



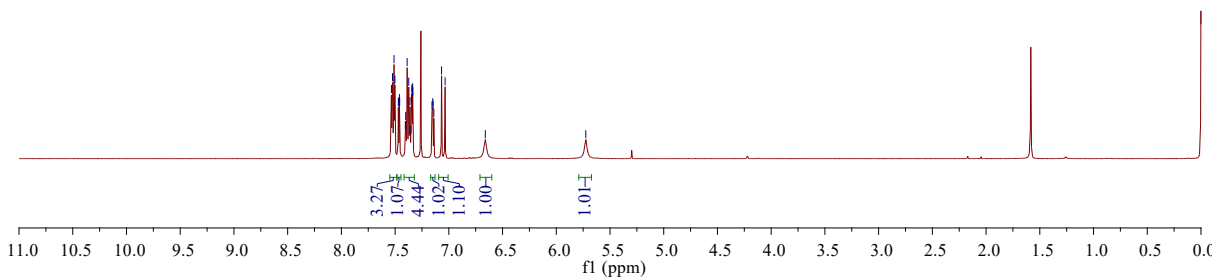
SS-SSR-II-197C



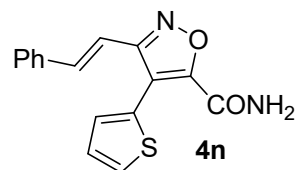
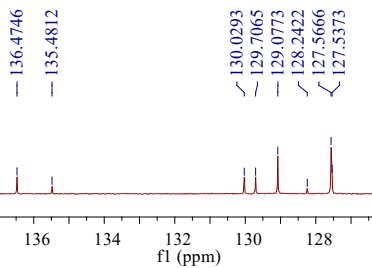
7.5343
7.5242
7.5100
7.5019
7.4698
7.4677
7.4595
7.4574
7.4046
7.4016
7.3880
7.3730
7.3615
7.3524
7.3473
7.3439
7.3417
7.3367
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7.1568
7.1496
7.1465
7.1393
7.0676
7.0347
6.6604
5.7252



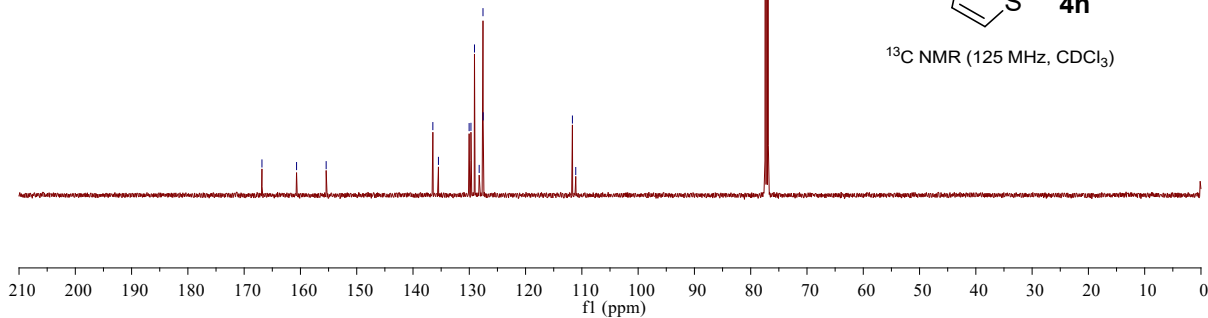
¹H NMR (500 MHz, CDCl₃)

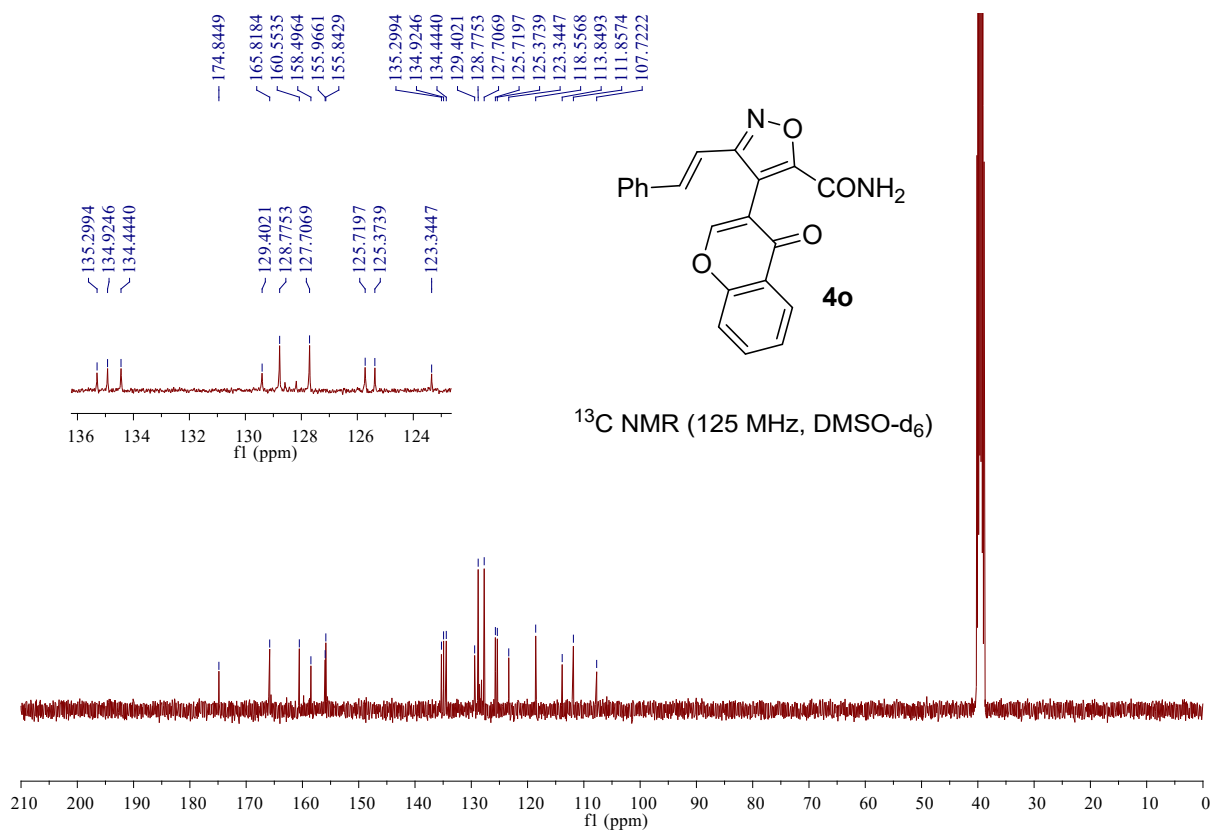
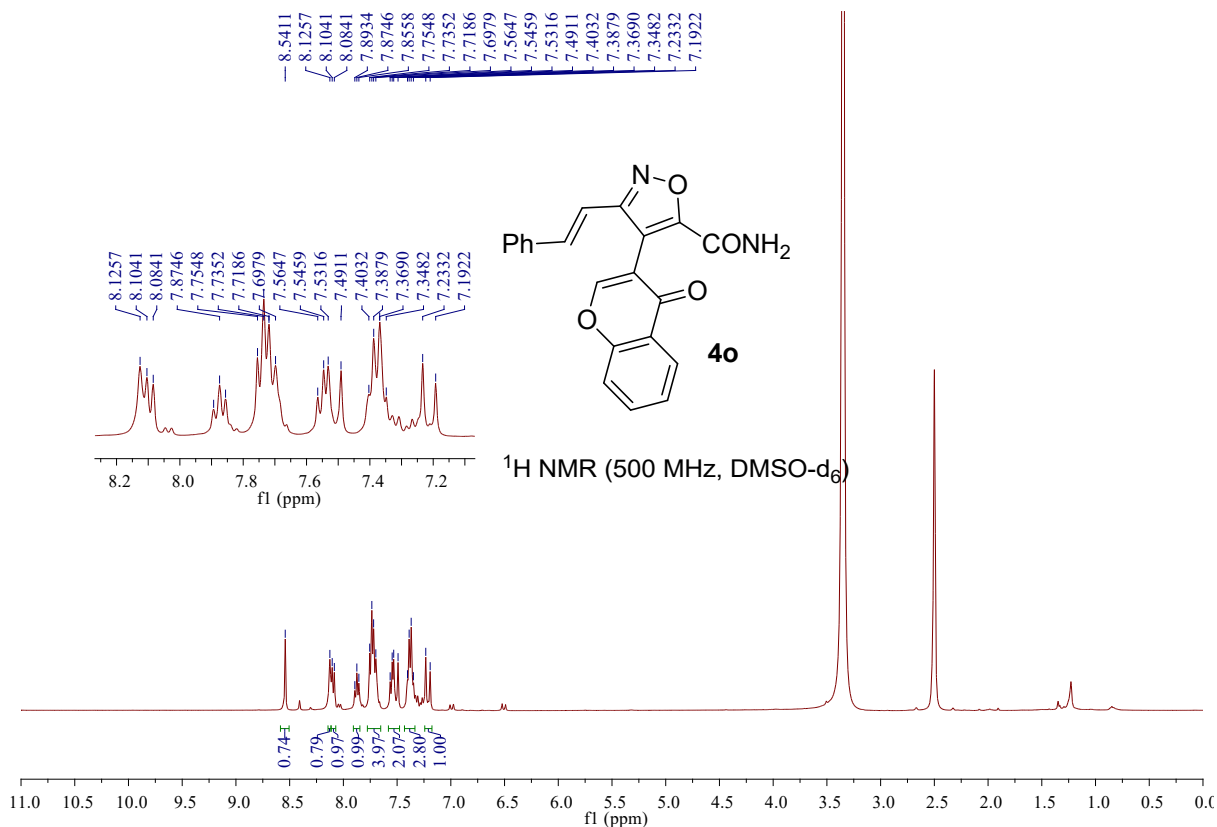


166.8393
160.6895
155.4307
136.4746
135.4812
130.0293
129.7065
129.0773
128.2422
127.5666
127.5373
111.6768
111.0847

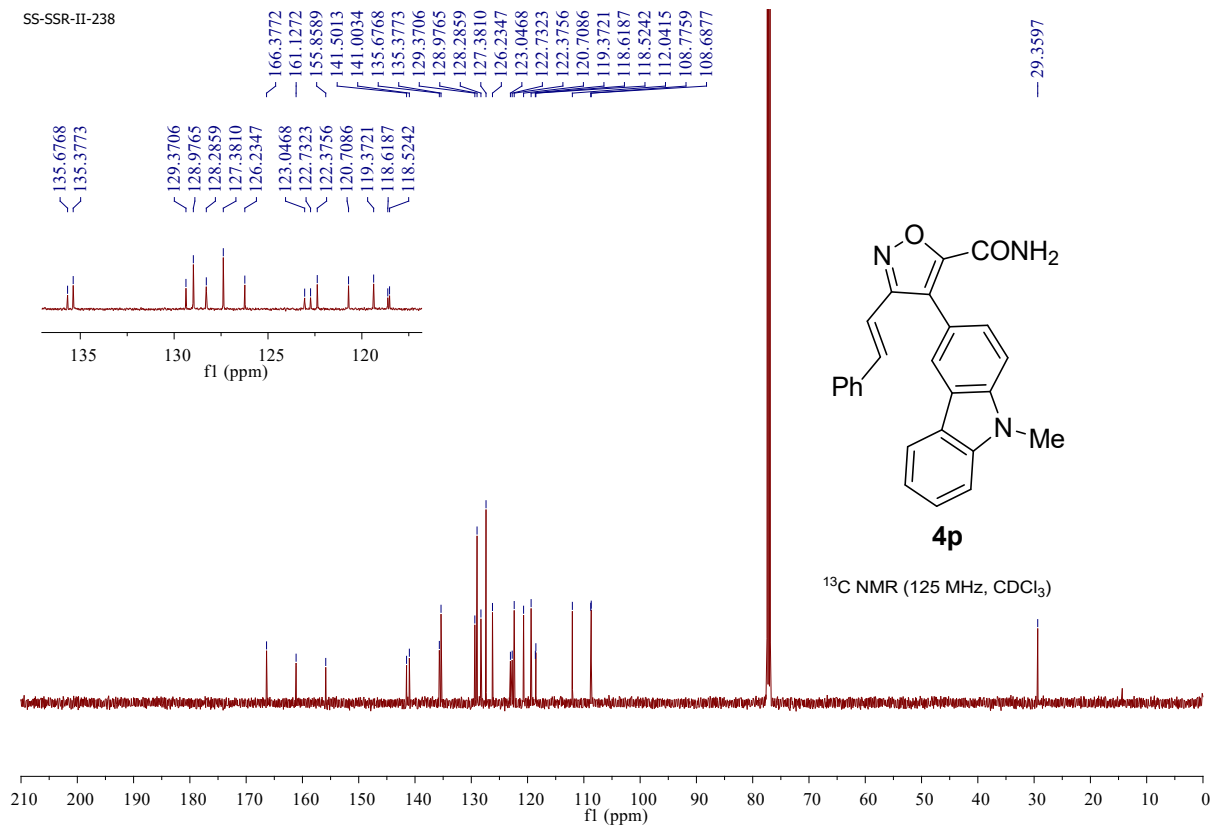
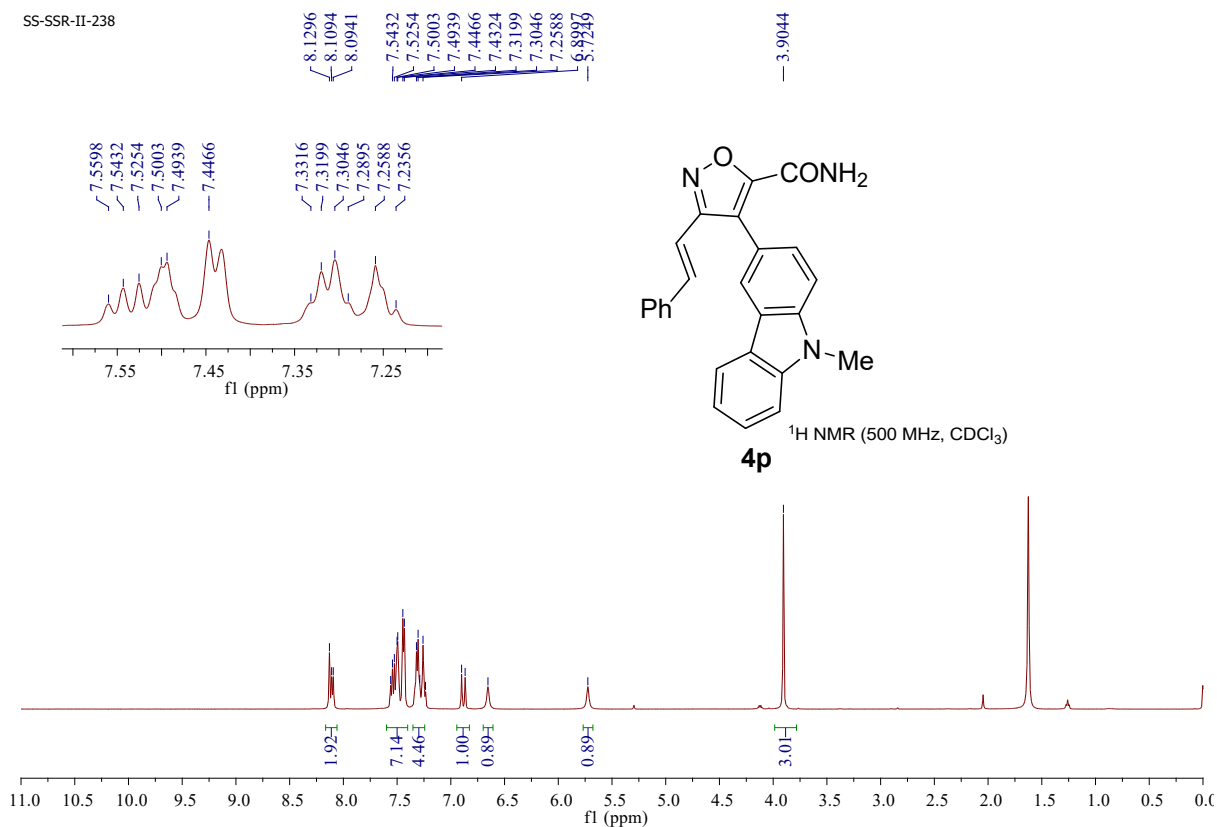


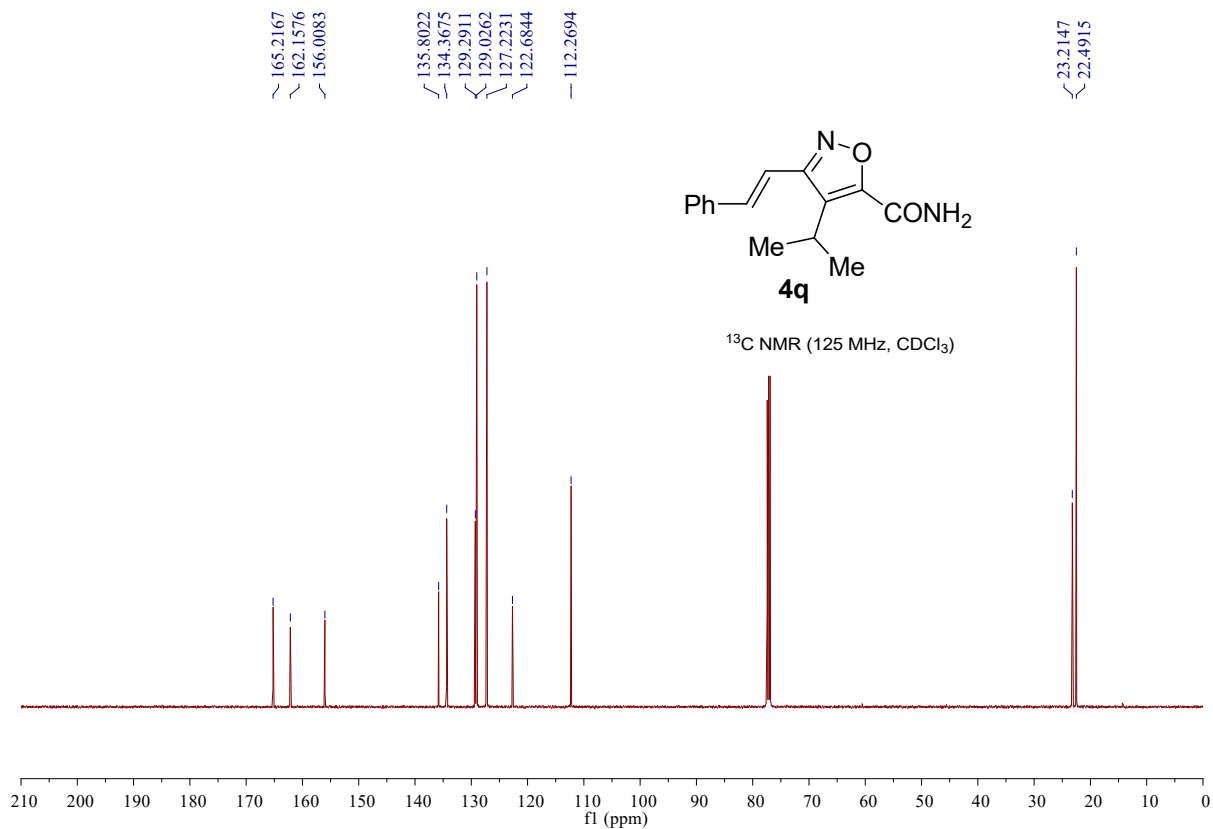
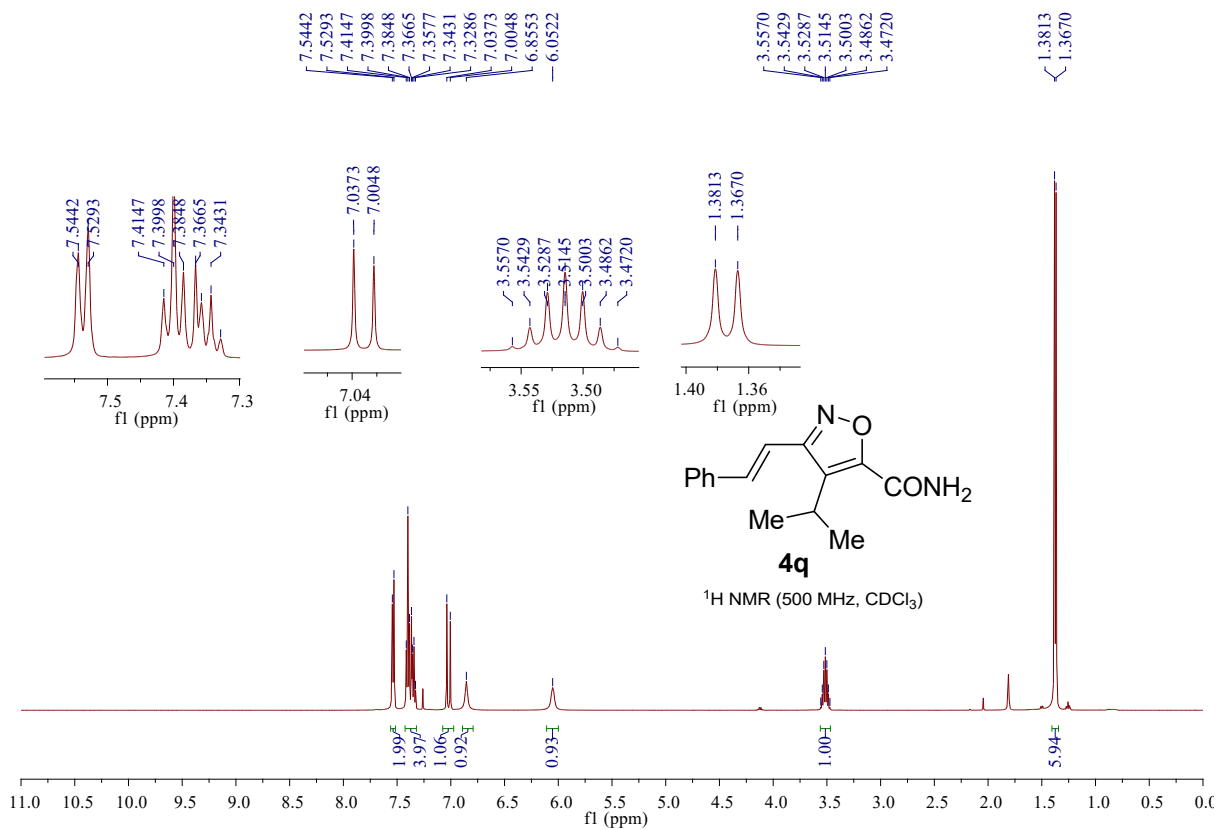
¹³C NMR (125 MHz, CDCl₃)

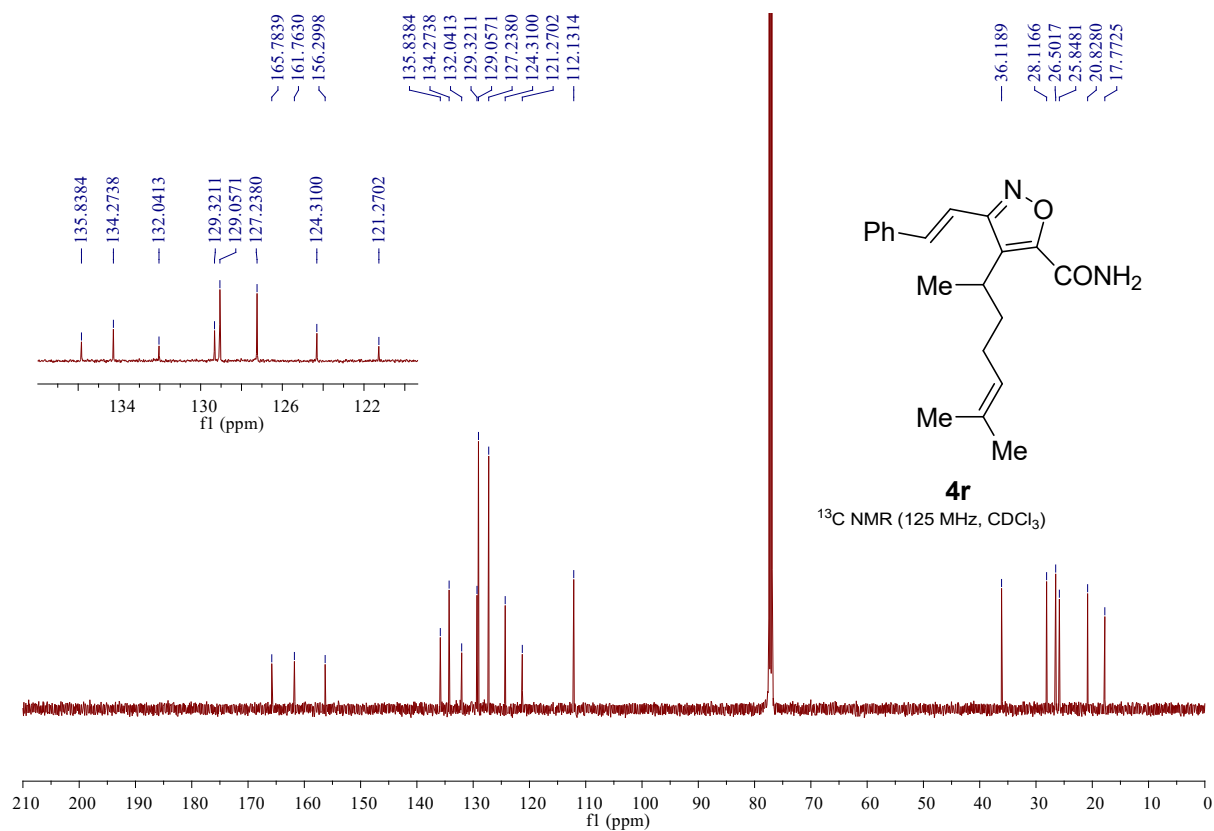
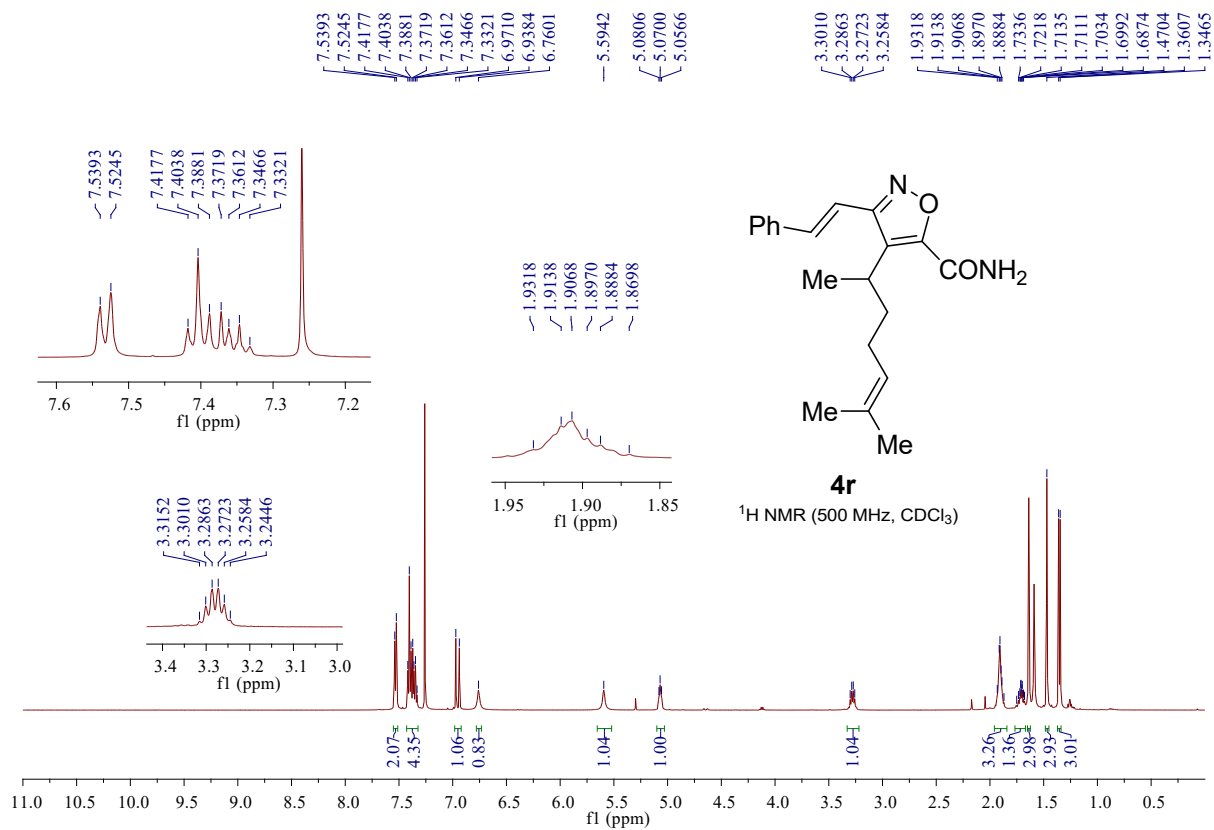


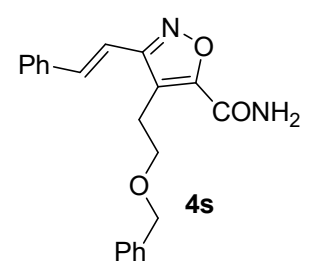
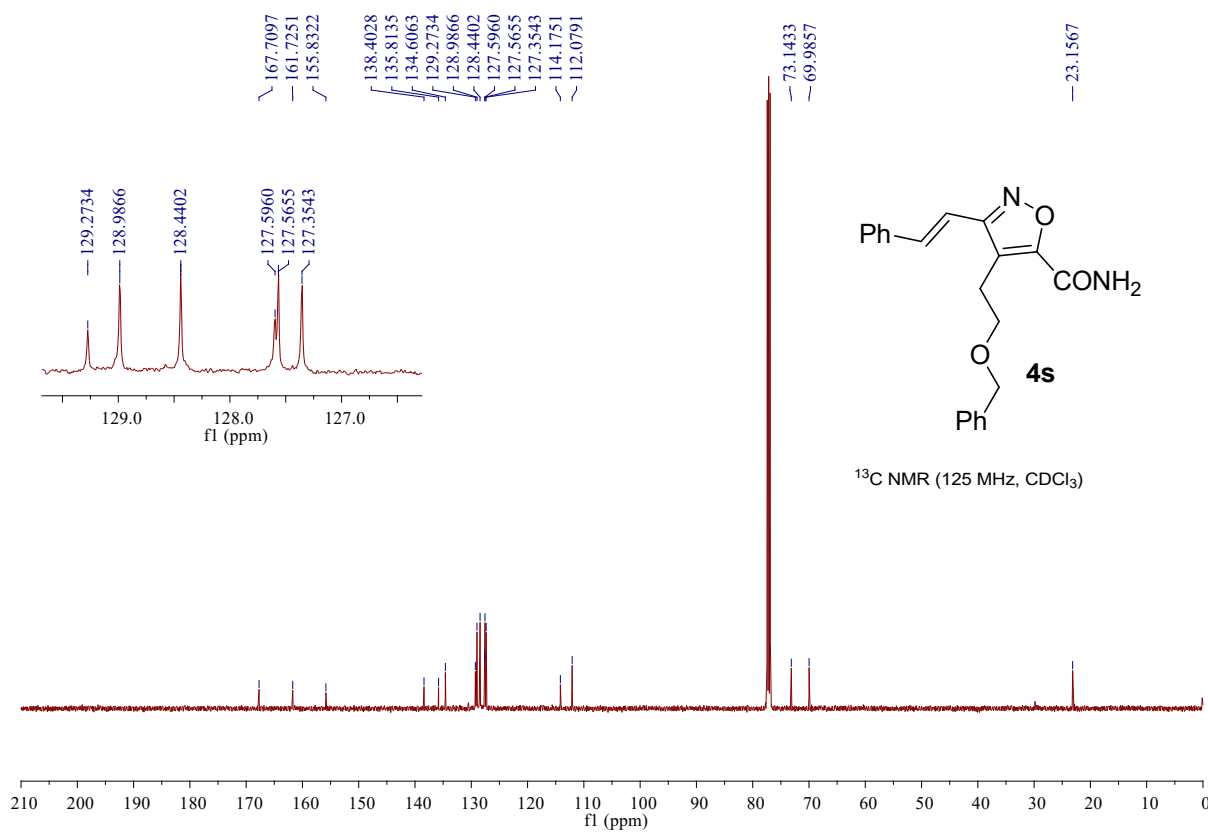
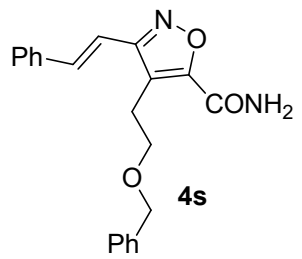
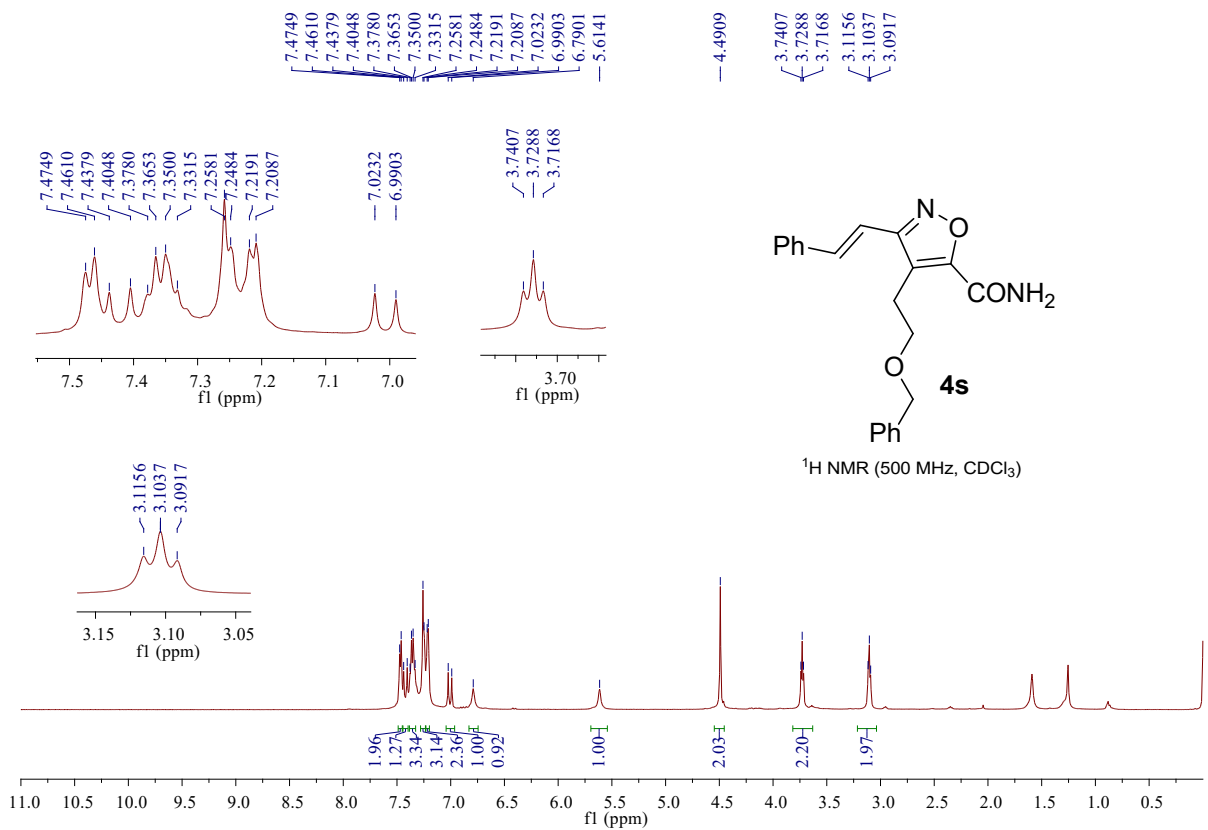


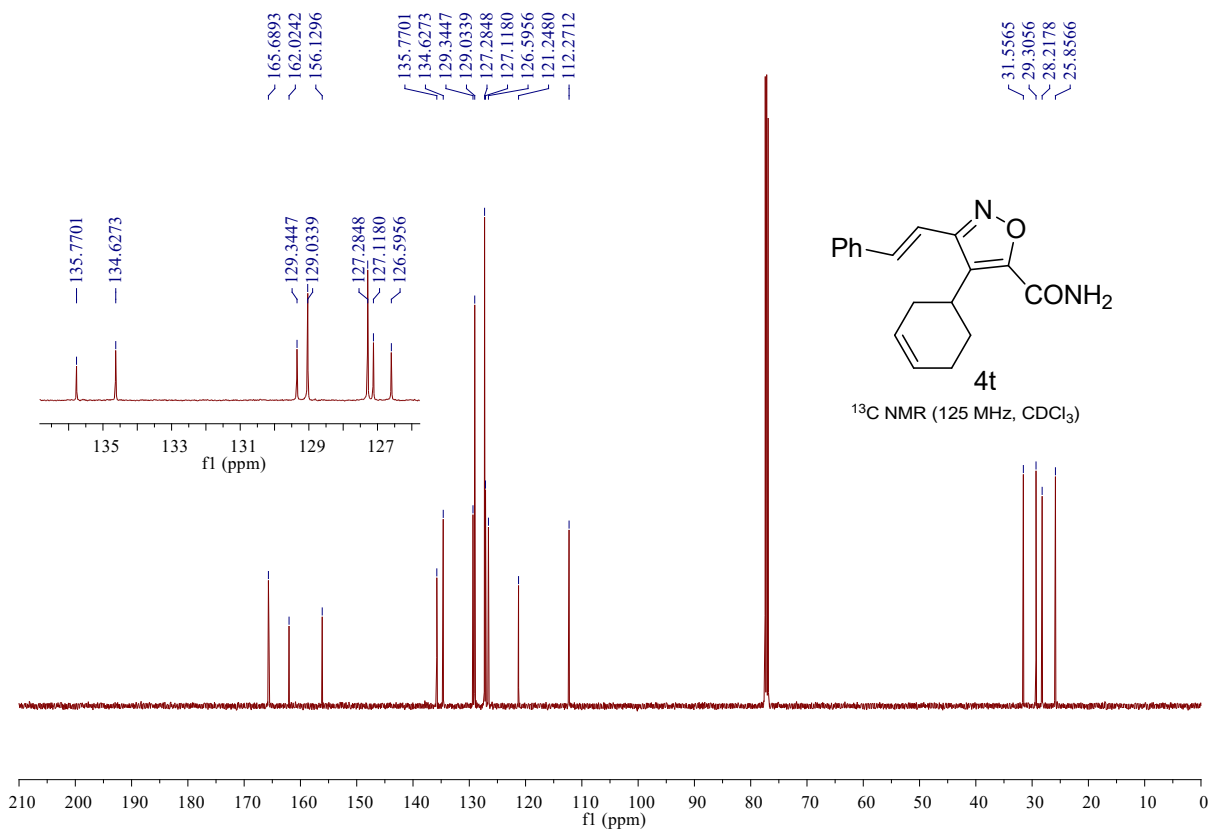
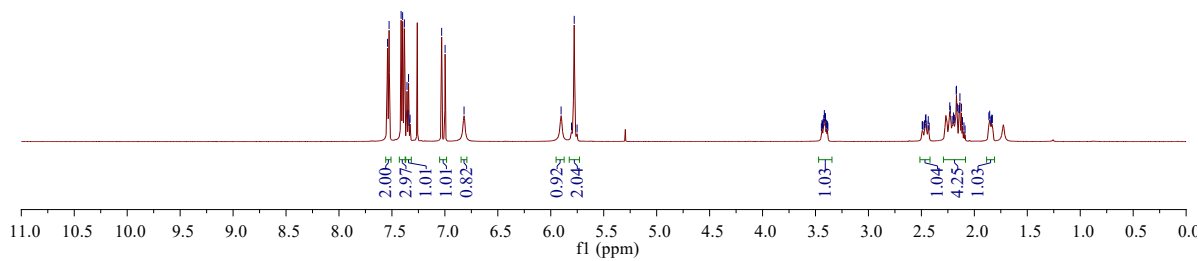
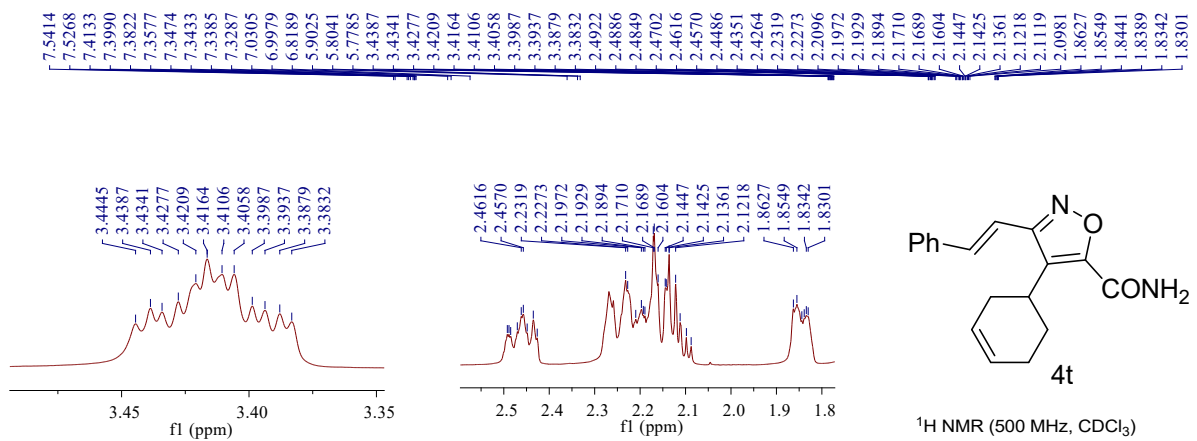
SS-SSR-II-238

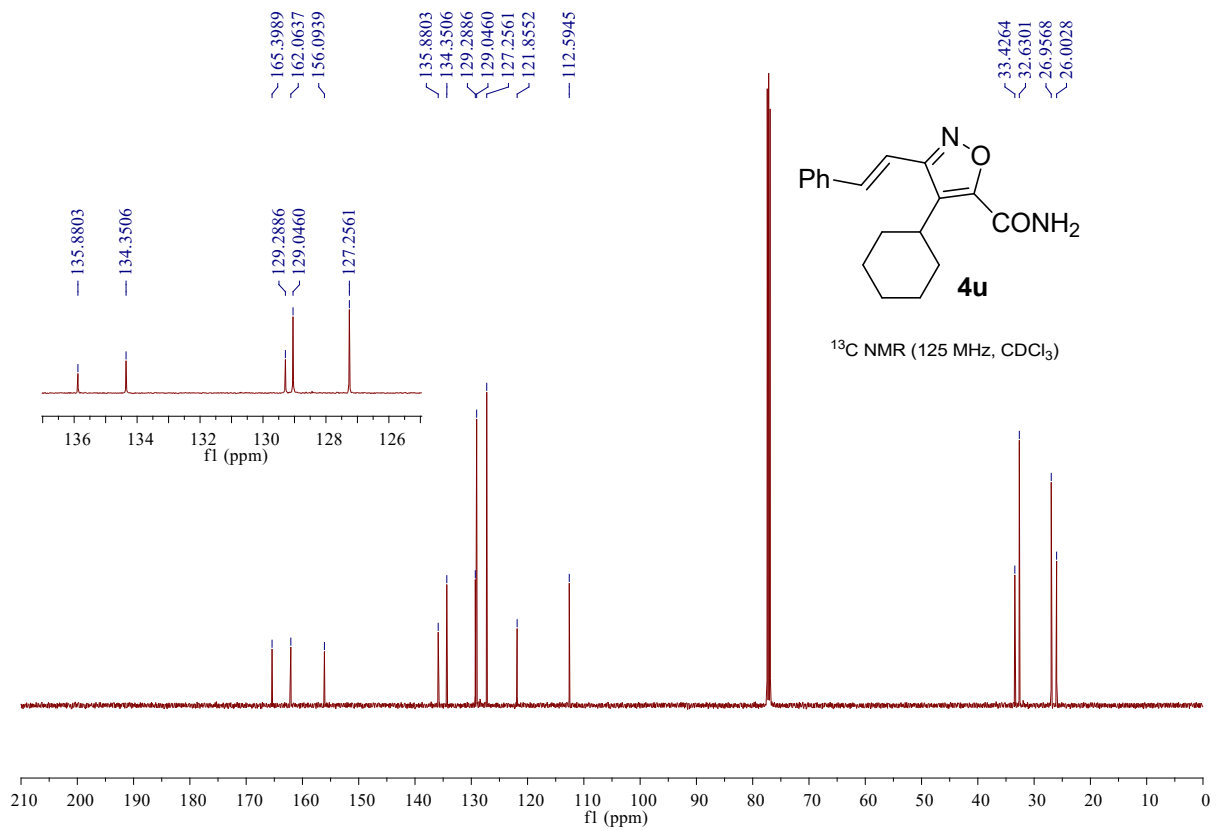
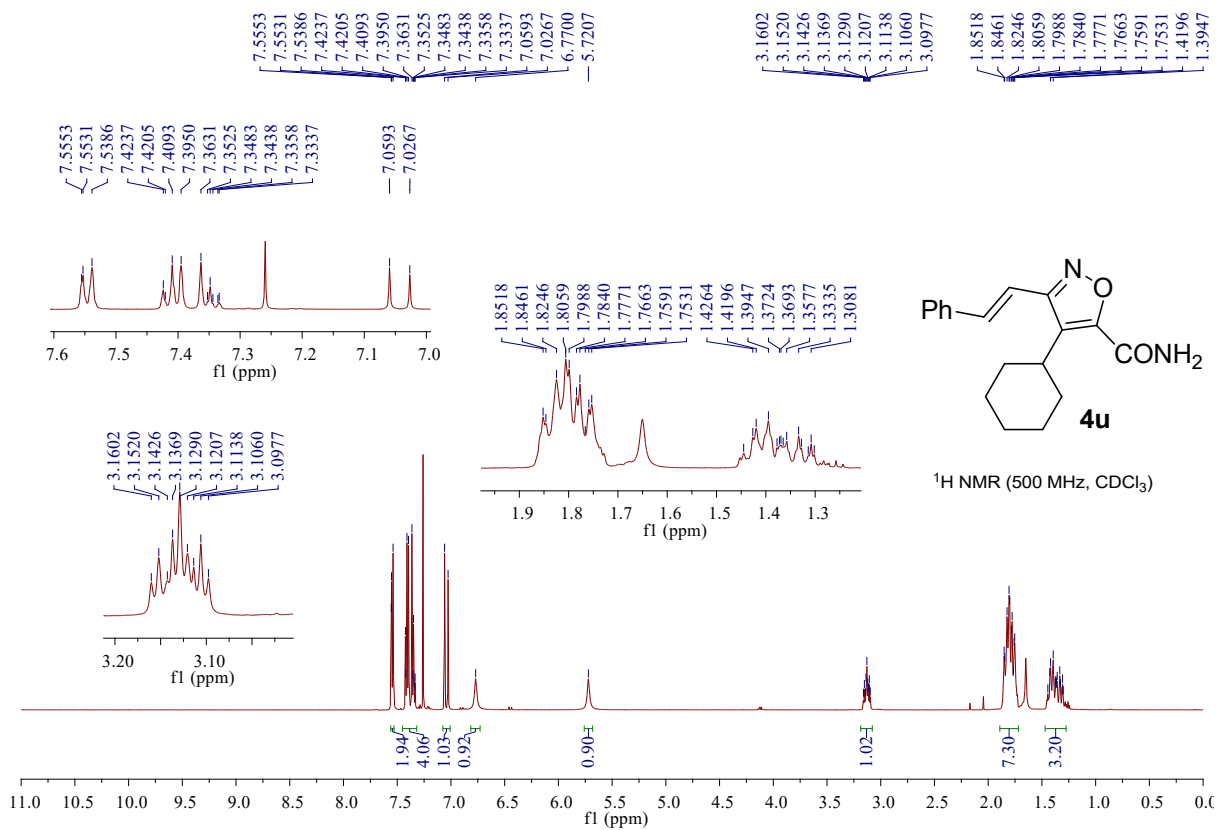




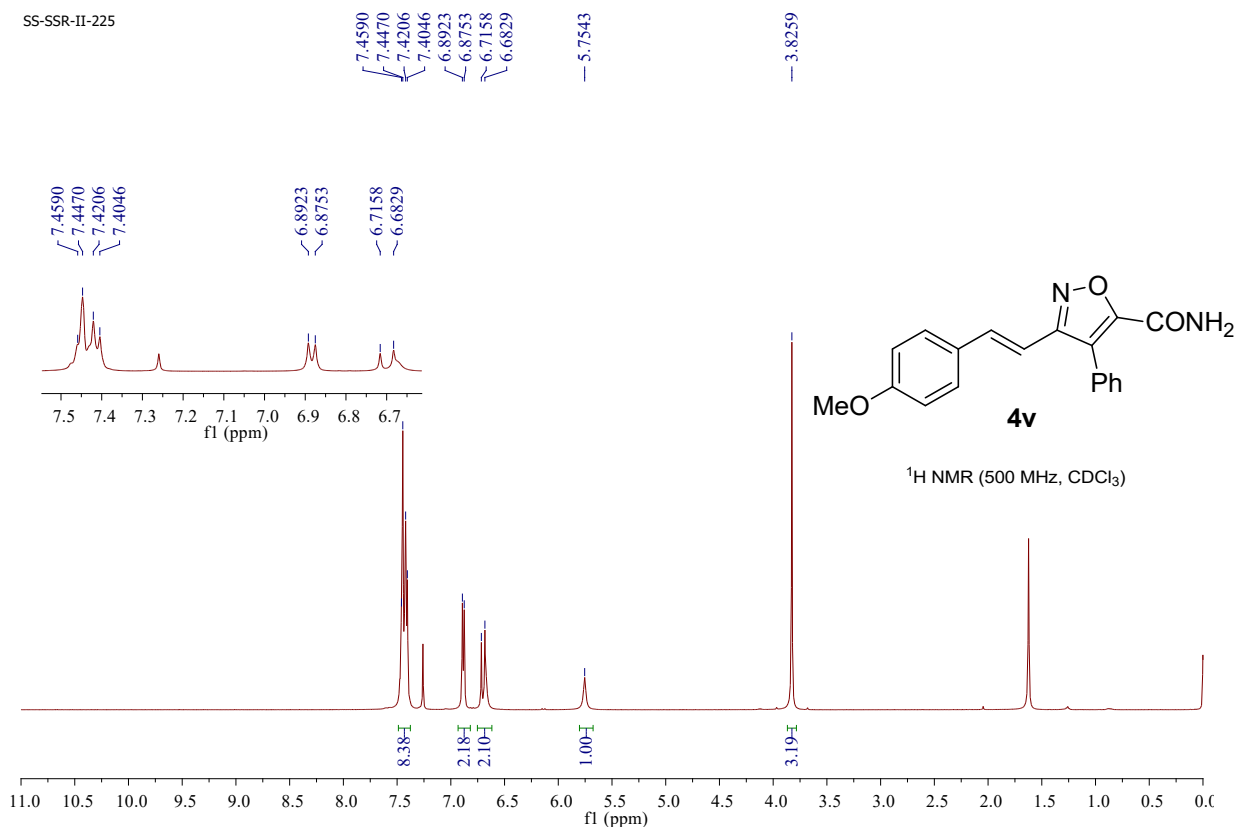




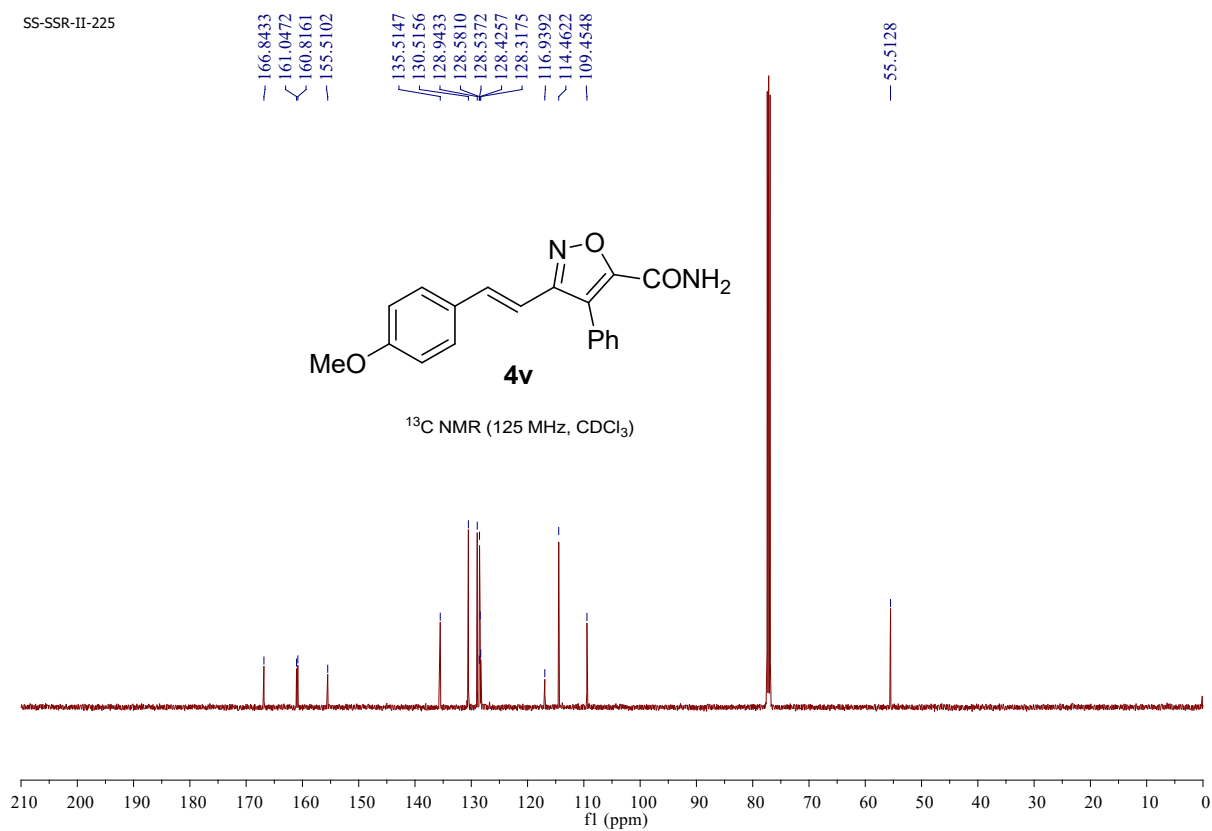




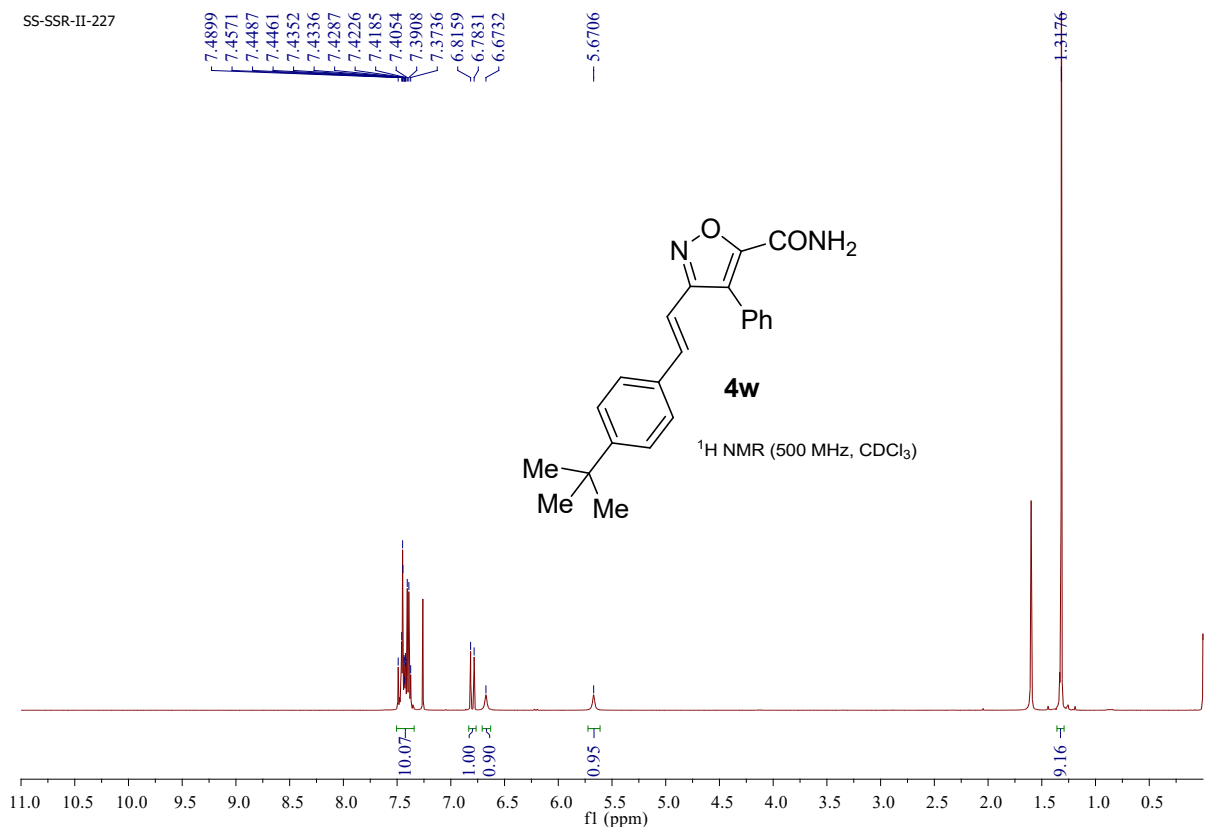
SS-SSR-II-225



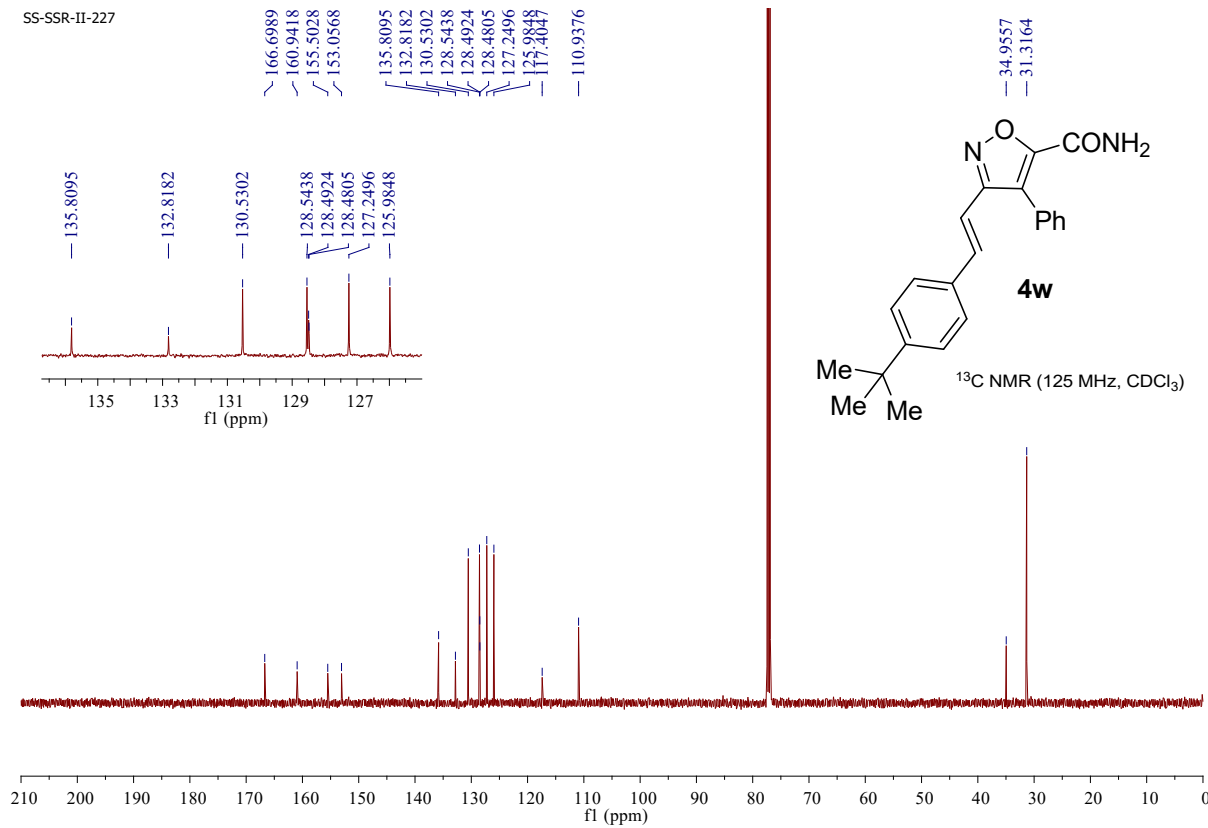
SS-SSR-II-225



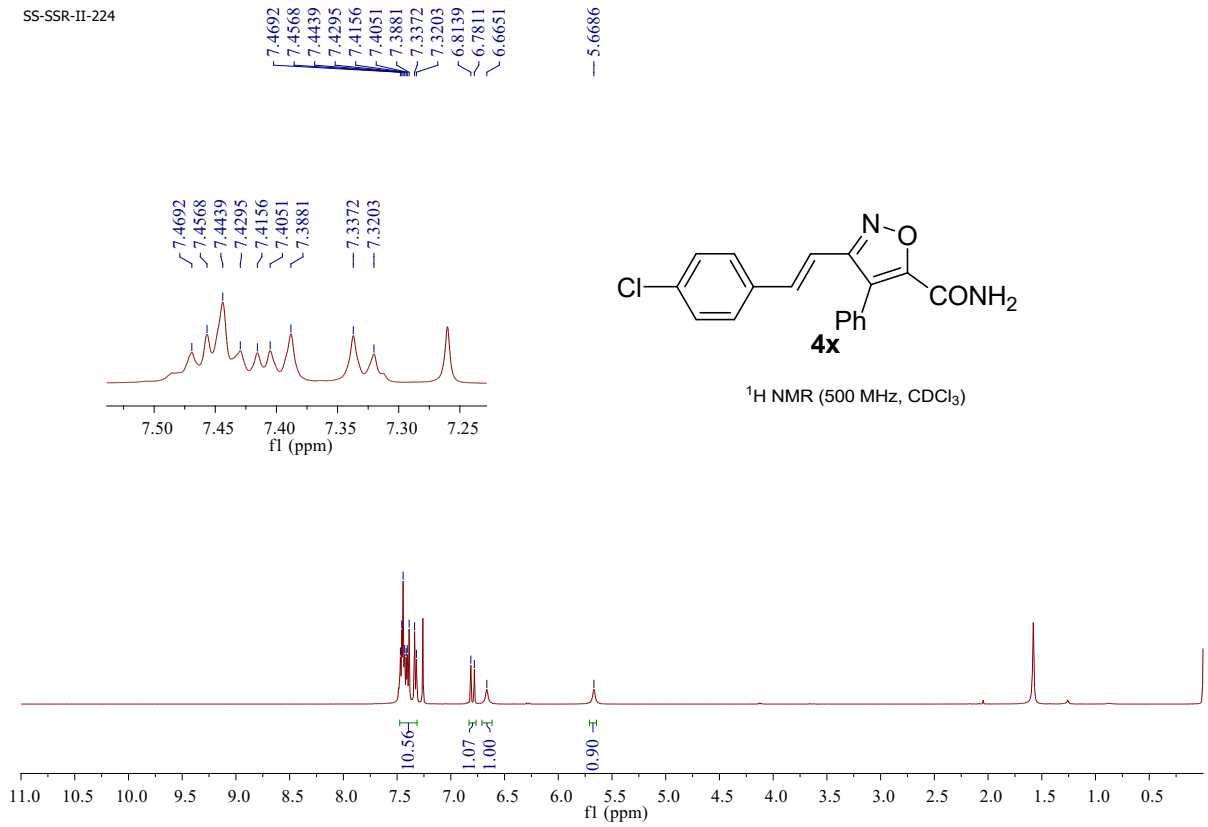
SS-SSR-II-227



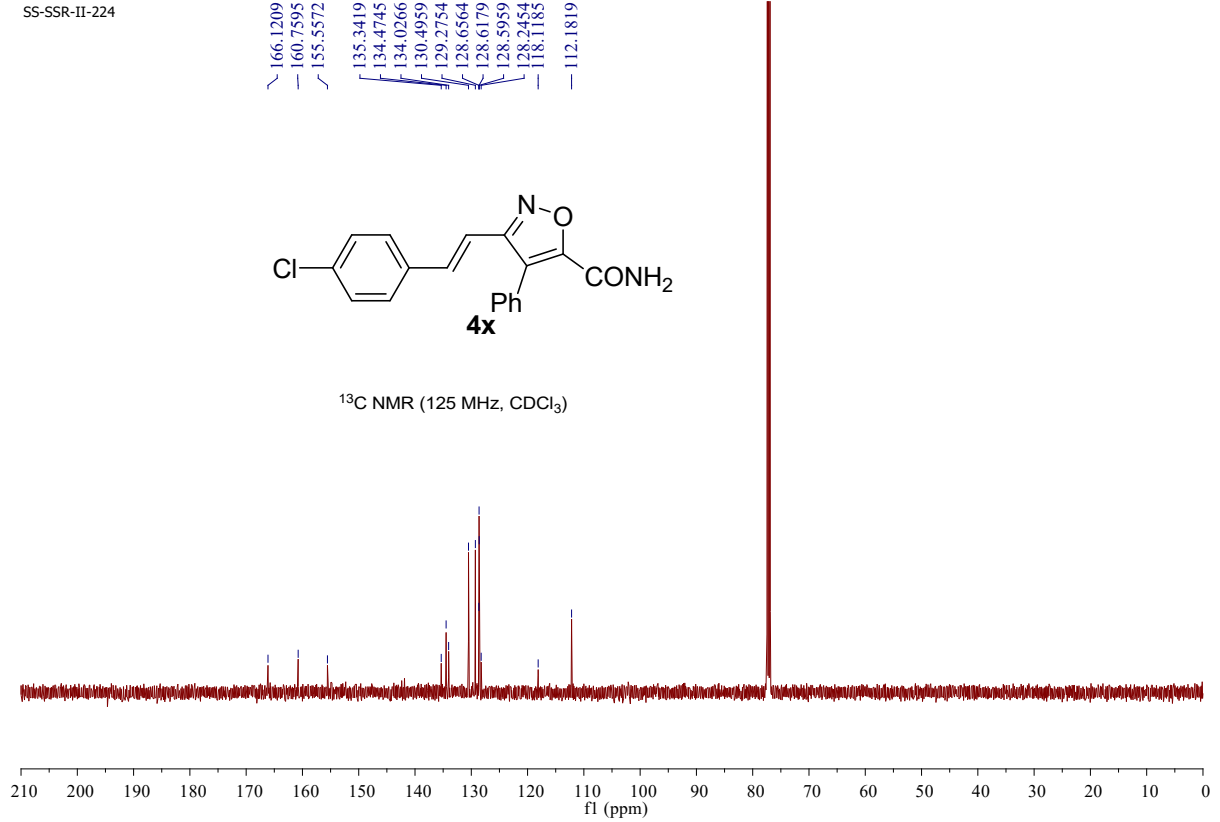
SS-SSR-II-227



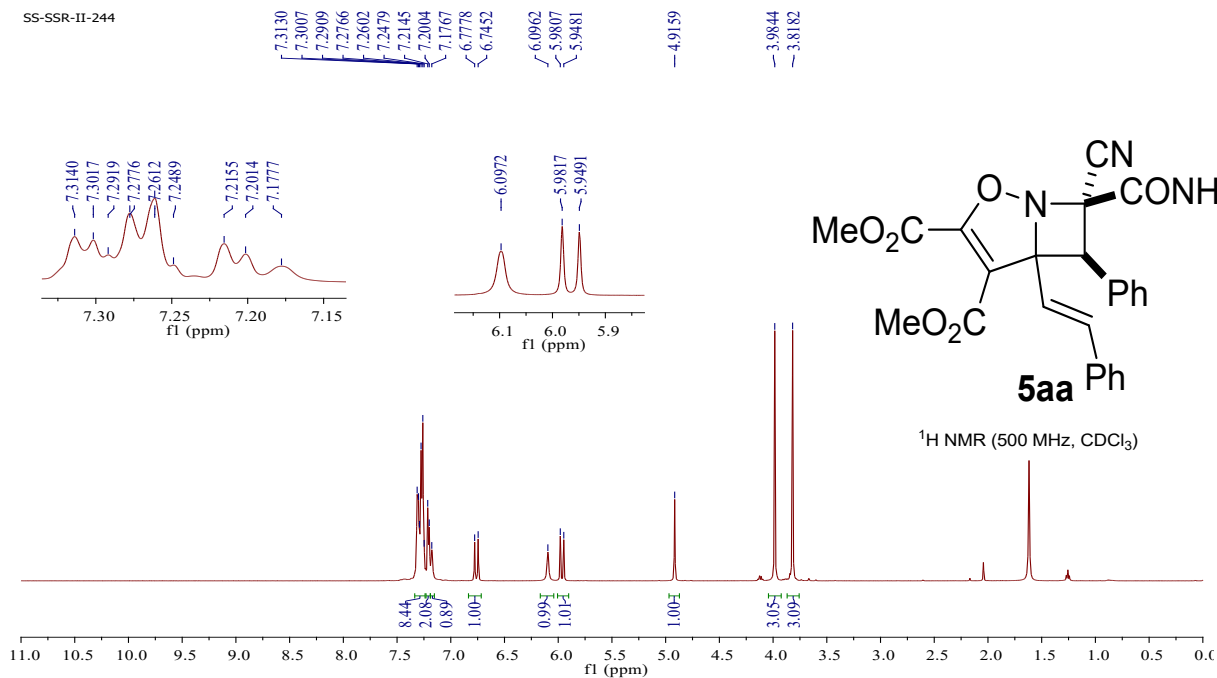
SS-SSR-II-224



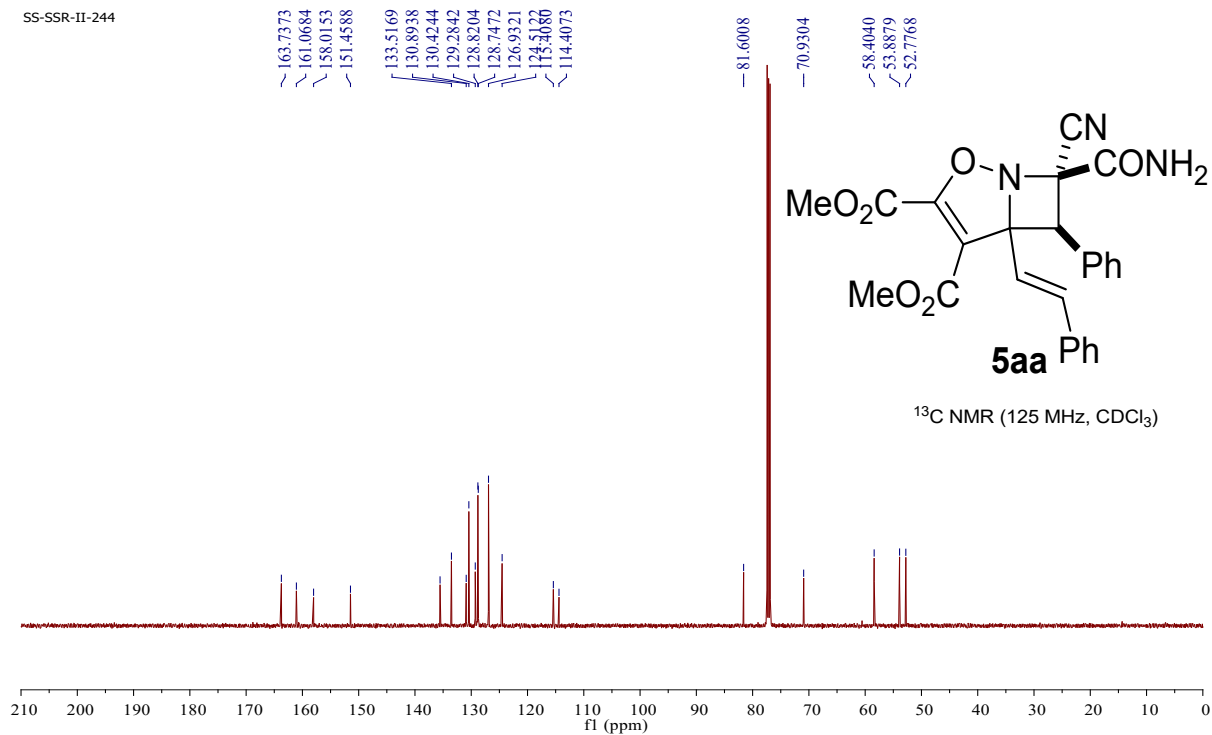
SS-SSR-II-224



SS-SSR-II-244



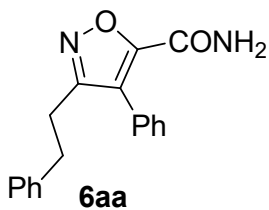
SS-SSR-II-244



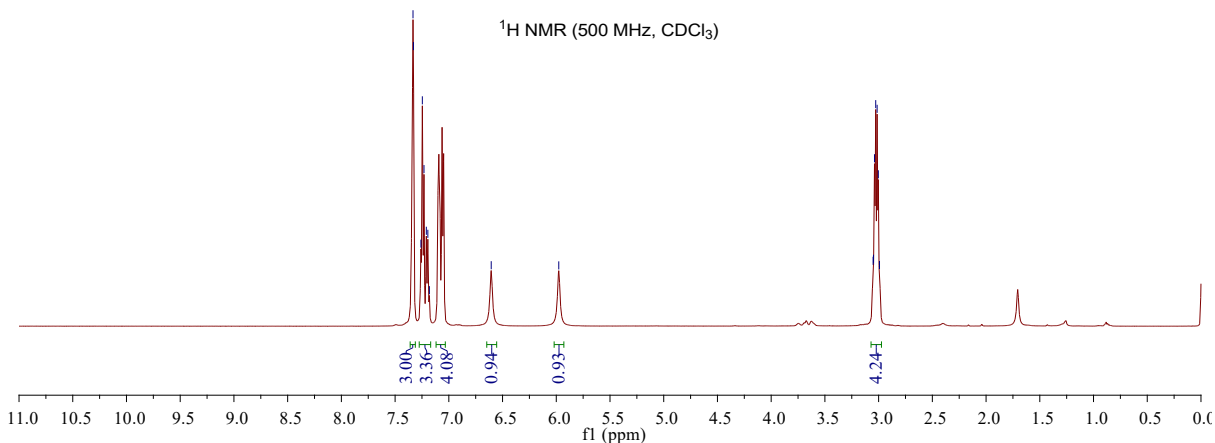
SS-SSR-II-HYD

7.3334
7.3291
7.2597
7.2465
7.2311
7.2094
7.1953
7.1808
6.6054
5.9768

3.0513
3.0478
3.0385
3.0270
3.0140
3.0026
2.9918



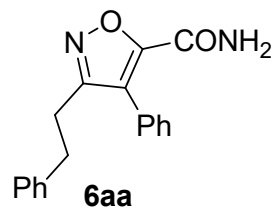
¹H NMR (500 MHz, CDCl₃)



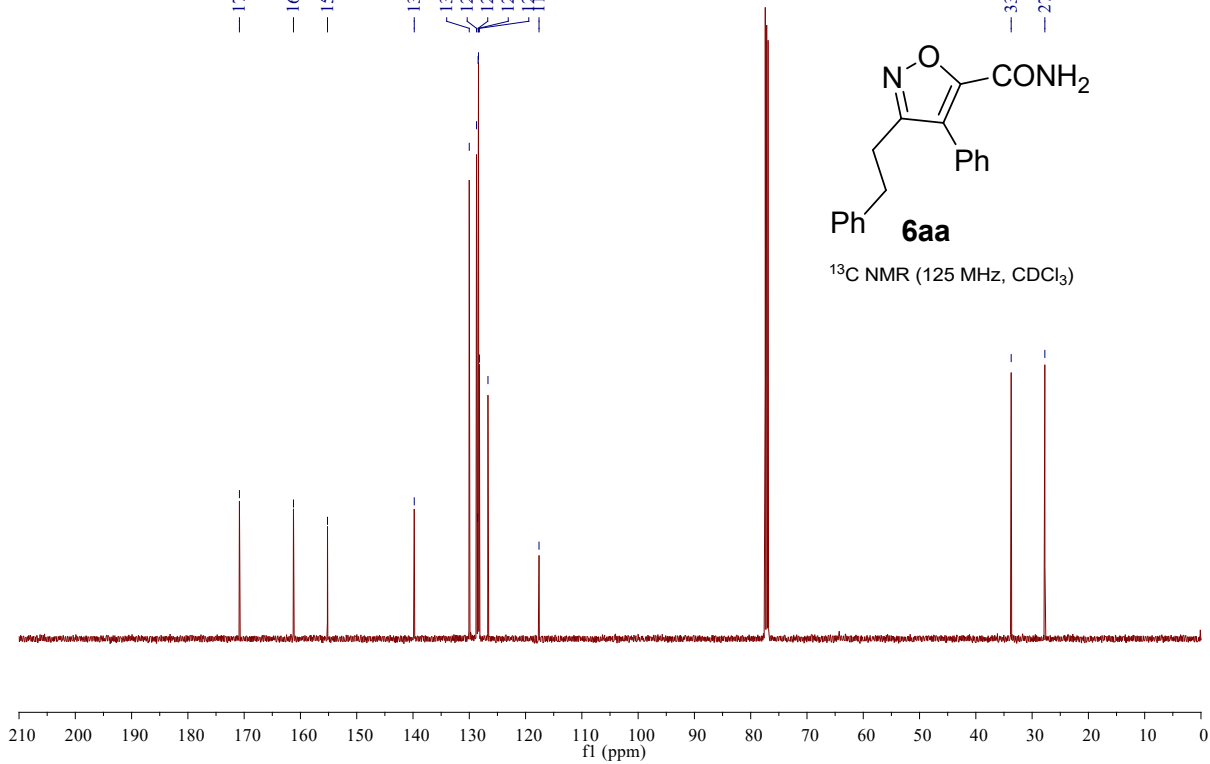
SS-SSR-II-HYD

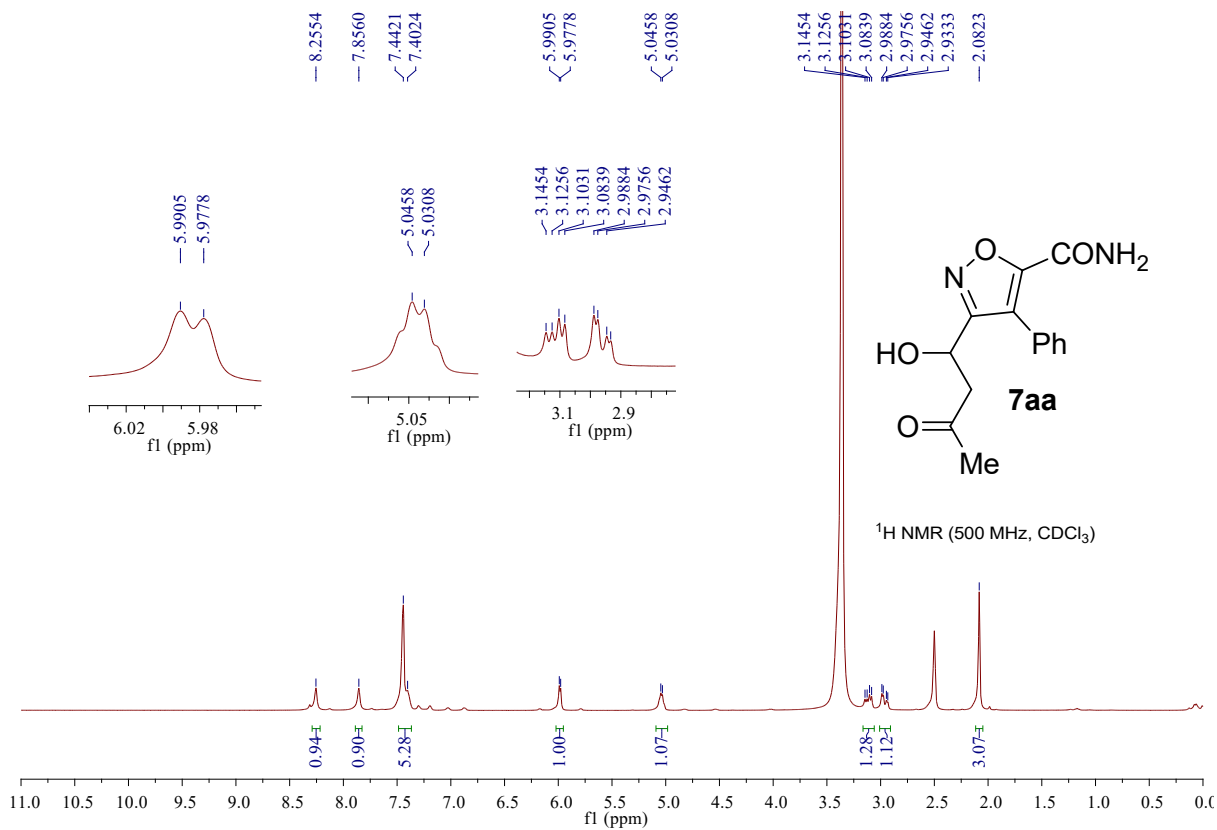
170.8410
161.2371
155.1930
139.7792
130.0066
128.7135
128.4322
128.3653
127.6105

33.7205
27.7387

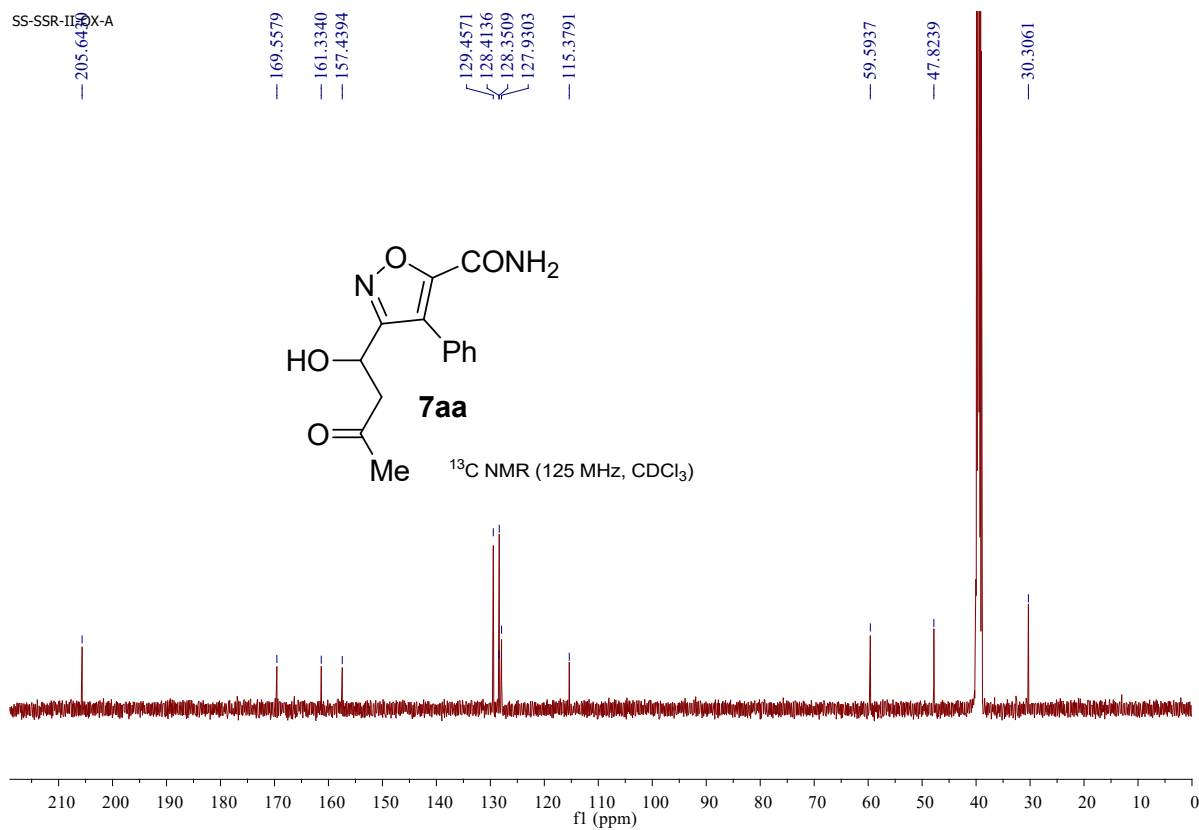


¹³C NMR (125 MHz, CDCl₃)



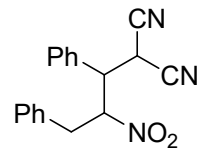
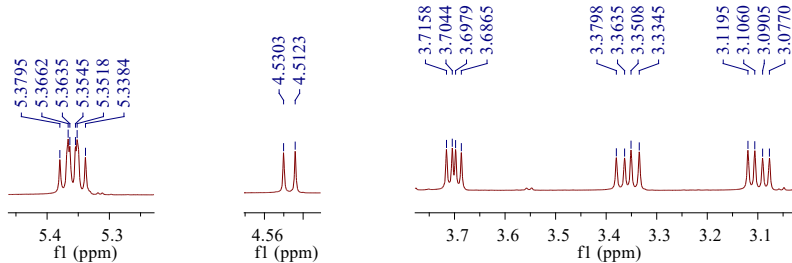


SS-SSR-1120X-A



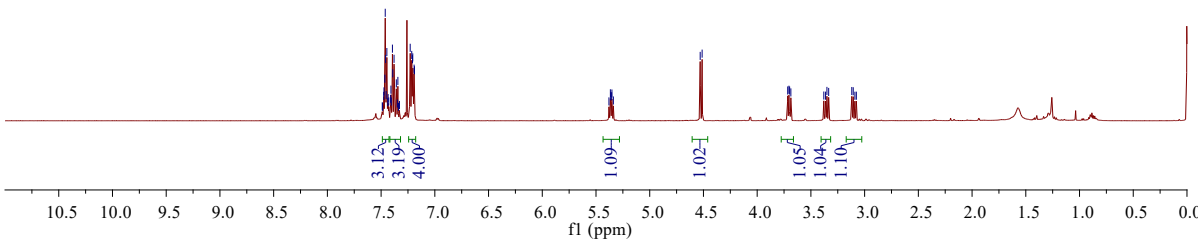
SS-SSR-II-226-LOW

7.4756
7.4756
7.4682
7.4682
7.4545
7.4552
7.4464
7.4384
7.4347
7.4286
7.4111
7.4085
7.3946
7.3918
7.3795
7.3583
7.3484
7.3439
7.3291
7.2292
7.2148
7.2080
7.2052
7.1928
7.1892
5.3662
5.3635
5.3545
5.3518
5.3384
4.5303
4.5123
3.7158
3.7044
3.6979
3.6865
3.3798
3.3635
3.3508
3.3345
3.1195
3.1060
3.0905
3.0770
3.0770
3.0905
3.1060
3.1195
3.3345
3.3508
3.3635
3.3798
3.6865
3.6979
3.7044
3.7158



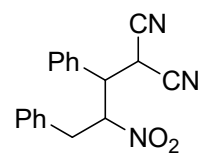
Compound **8** (minor)

¹H NMR (500 MHz, CDCl₃)



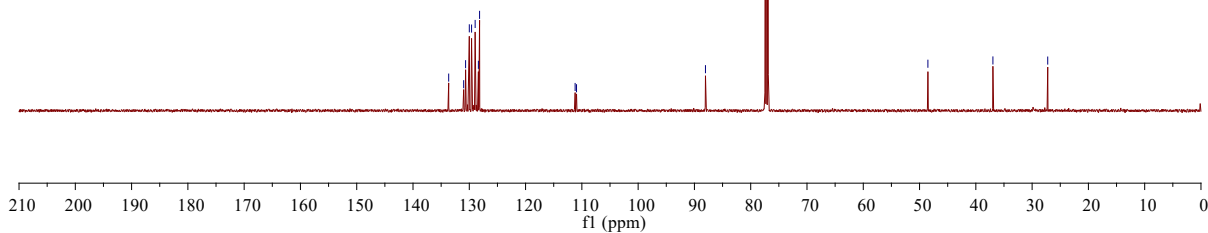
SS-SSR-II-226-LOW

133.6606
131.0002
130.6576
129.9970
129.5942
128.9593
128.3863
128.1723
111.1968
110.9485
88.0384
48.5172
36.9661
27.2273



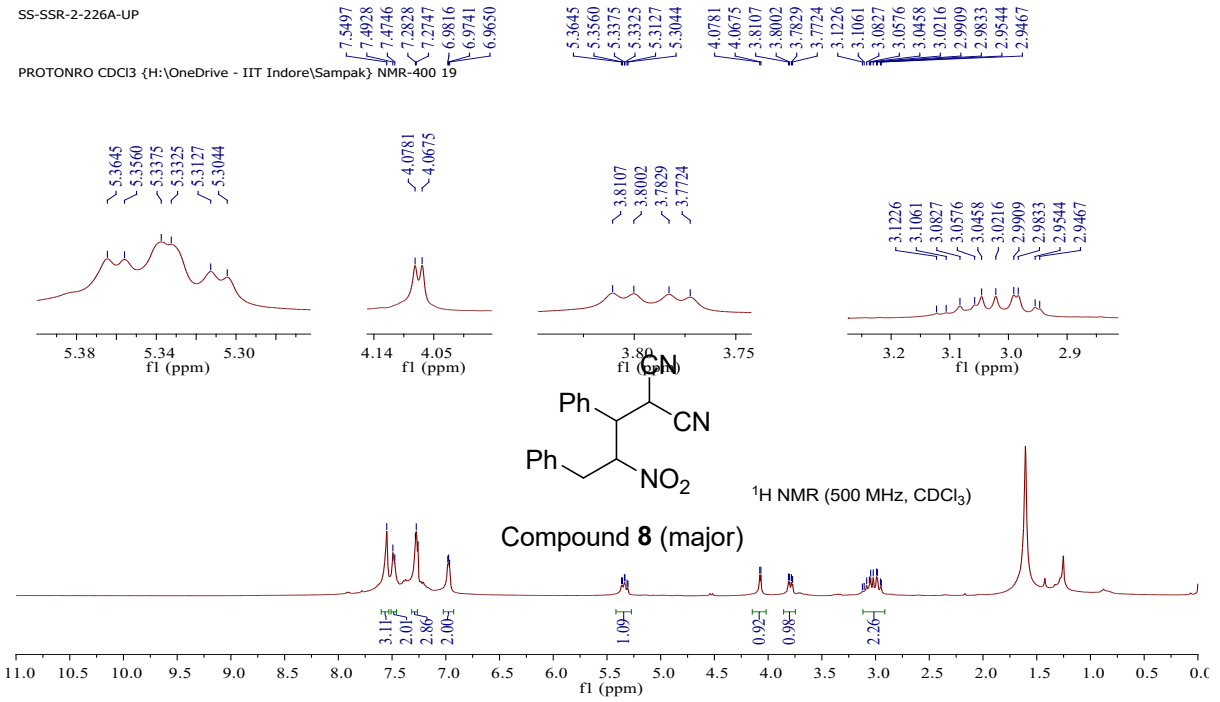
Compound **8** (minor)

¹³C NMR (125 MHz, CDCl₃)



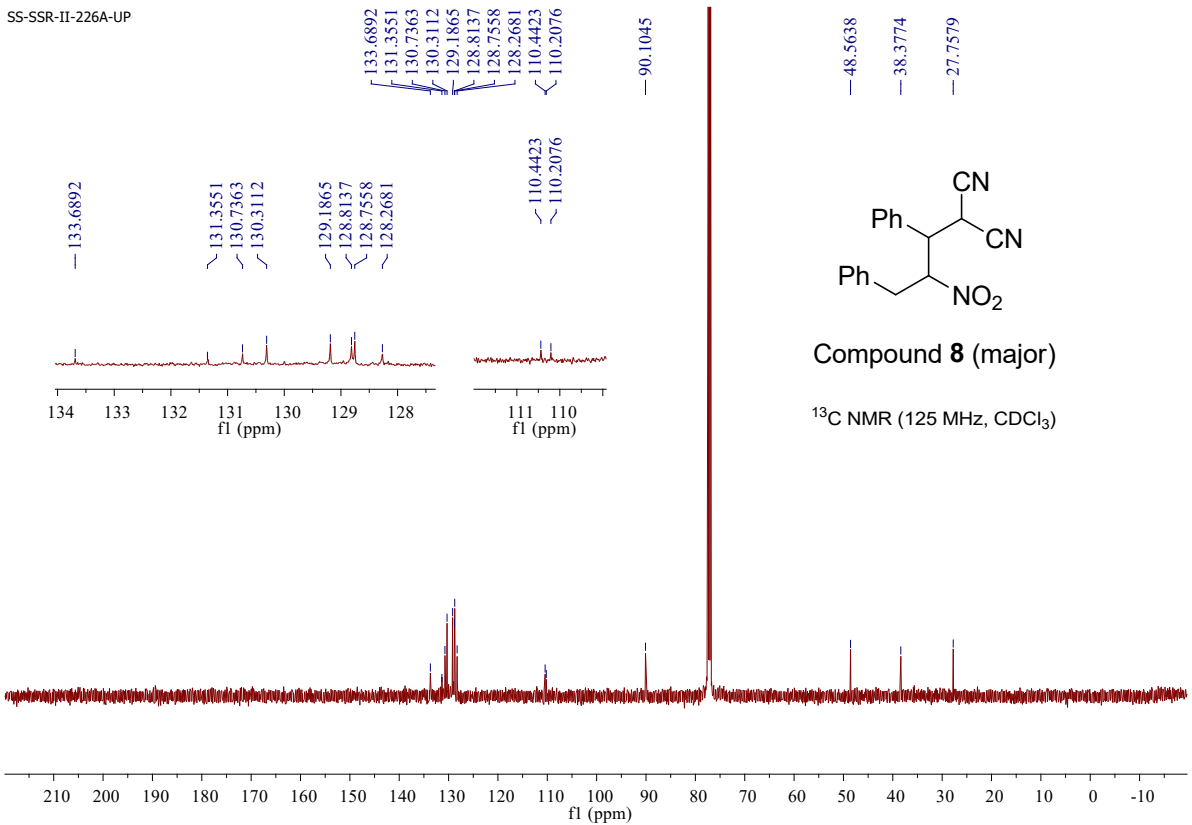
SS-SSR-2-226A-UP

PROTONRO CDCI3 {H:\OneDrive - IIT Indore\Sampak} NMR-400 19



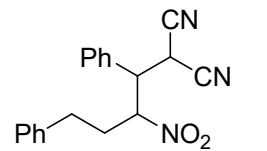
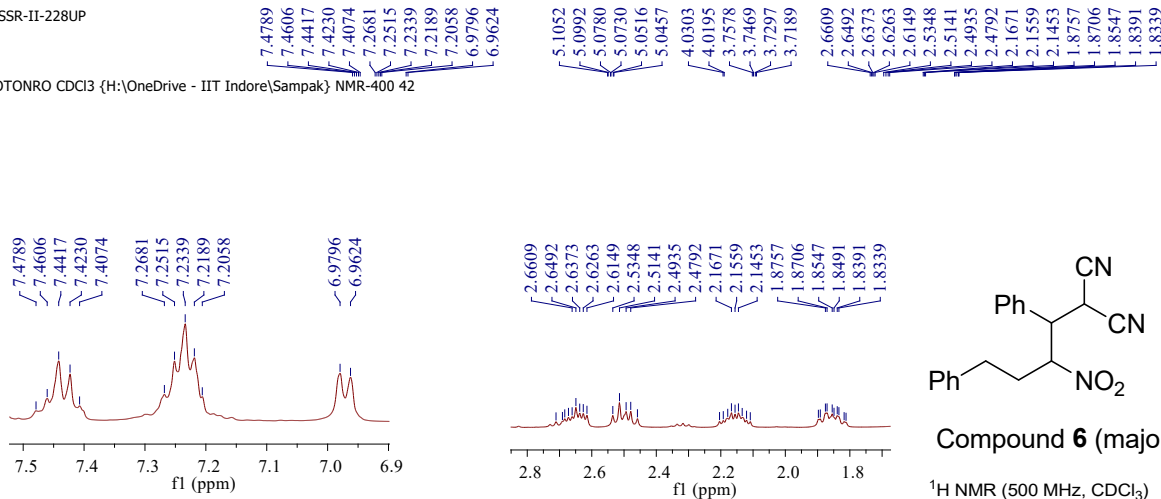
SS-SSR-II-226A-UP

SS-SSR-II-226A-UP



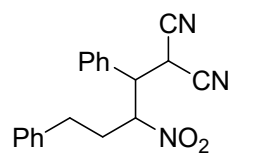
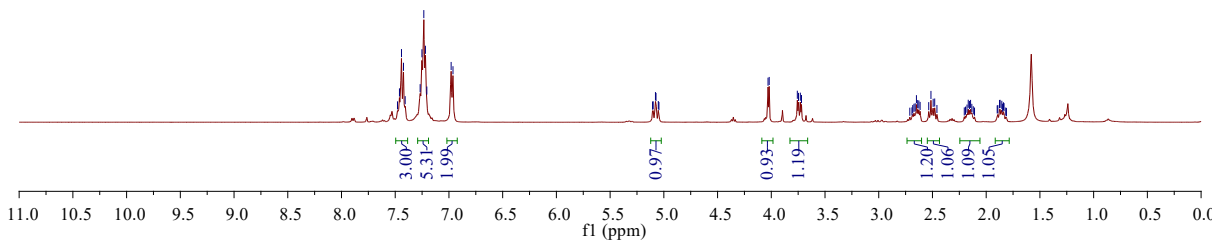
SS-SSR-II-228UP

PROTONRO CDCI3 {H:\OneDrive - IIT Indore\Sampak} NMR-400 42



Compound 6 (major)

¹H NMR (500 MHz, CDCl₃)

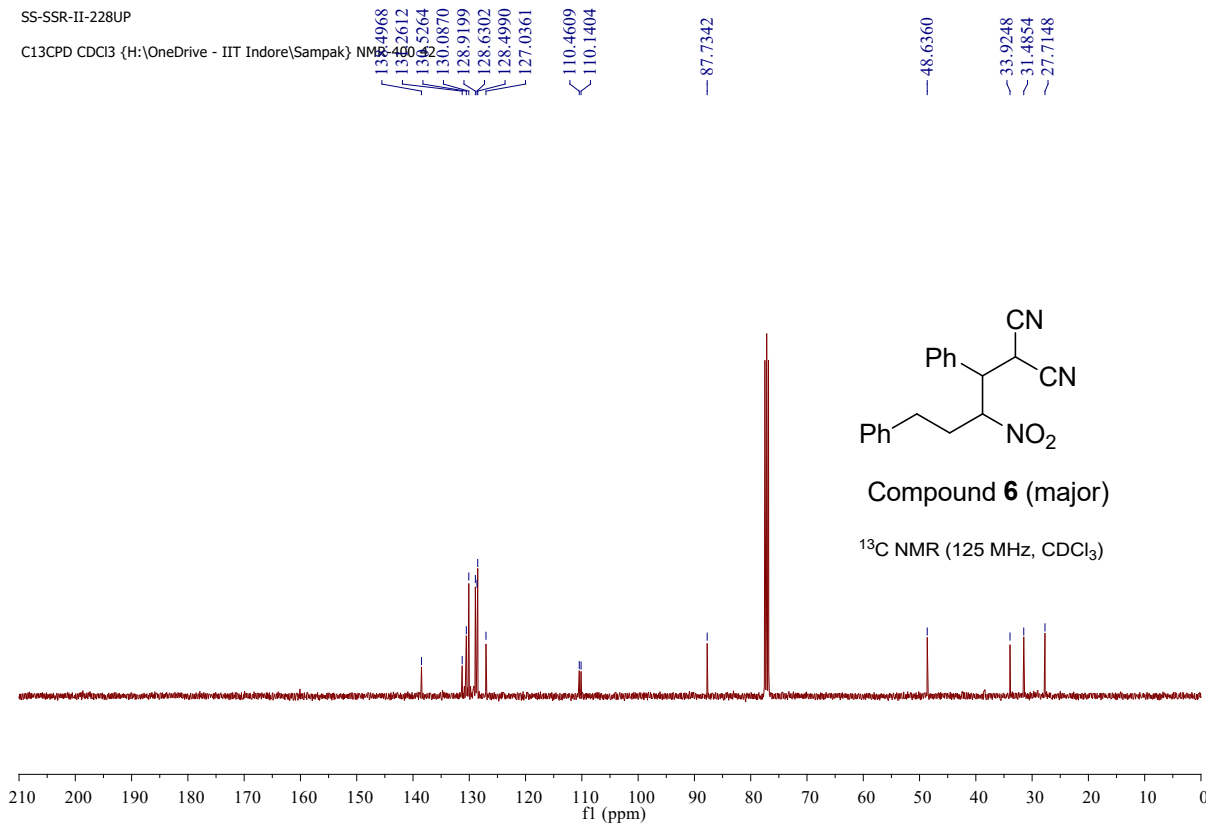


Compound 6 (major)

¹³C NMR (125 MHz, CDCl₃)

SS-SSR-II-228UP

C13CPD CDCI3 {H:\OneDrive - IIT Indore\Sampak} NMR-400 42



SS-SSR-II-228A-LOW

