SUPPORTING INFORMATION

Efficient and mild Swern oxidation using a new sulfoxide and

*trichloromethyl)carbonate

Xiaojing Ye, Hongliang Fu, Jiahao Ma, and Weihui Zhong*

Collaborative Innovation Center of Green Pharmaceutical Engineering, College of Pharmaceutical Sciences, Zhejiang University of Technology, Hangzhou 310014, P.R. China
E-mail: weihuizhong@zjut.edu.cn

Table of Contents:

Typical procedure ———————————————————————————————————— S2-S4
Characterization data ———————————————————————————————————— S2-S9
$^1$H NMR, $^{13}$C NMR, LRMS, HRMS of I, II, III, IV ———————————————————— S10-S17
$^1$H NMR, LRMS of V ———————————————————————————————————— S18
$^1$H NMR, $^{13}$C NMR of aldehydes and ketones ———————————————————— S19-S26
Typical procedure for the preparation of I:

A solution of IV (5.0 g, 18.5 mmol) in EtOH (10 mL) was stirred, and a 20% solution of CH₃SNa in water (9.07 g, 25.9 mmol) was added dropwise over 0.5 h at rt. The flask was heated to 60°C and the reaction was monitored by TLC until completed. A 30% solution of H₂O₂ (3.15 g, 27.8 mmol) was added dropwise over 0.5 h at rt. and then the reaction mixture was heated to 30°C in an O₂ atmosphere. After stirring for 1h, the reaction was completed. EtOH was was recovered by vacuum distillation, the mixture was extracted with EtOAc (15 mL x 2), decanted, and washed with brine. After drying over Na₂SO₄ and concentration, the crude was purified by flash chromatography (SiO₂; CH₂Cl₂). 4-(2-(2-(methylsulfinyl)ethyl)-4-nitrophenyl)-morpholine I was acquired, an orange red liquid(4.20 g, 76%).

I: ¹H NMR (400 MHz, CDCl₃): δ 7.99 (dd, J₁ 8.8 Hz, J₂ 2.0 Hz, 1H), 7.84 (m, 1H), 6.27 (d, J 8.8 Hz, 1H), 3.94 – 3.84 (m, 2H), 3.79 – 3.66 (m, 4H), 3.51 – 3.38 (m, 2H), 3.07 (t, J 8.4 Hz,2H), 2.97 – 2.80 (m, 2H), 2.58 (s, 3H ). ¹³C NMR (100 MHz, CDCl₃): δ 156.8, 137.7, 129.5, 126.3, 120.5, 103.3, 68.8, 63.6, 54.8, 53.0, 46.9, 39.3, 27.2.

LRMS (ESI⁺): m/z 299.3 [M+H]⁺, 321.3 [M+Na]⁺. HRMS (ESI): calcd. for C₁₃H₁₈N₂O₄S[M+Na]⁺ 321.0893; found 321.0879.

Typical Procedure for the oxidation of alcohols:

A solution of BTC (0.41 g, 1.39 mmol) in dry CH₂Cl₂( 5 mL) was cooled in ice salt bath under an atmosphere of N₂. A solution of I (1.24 g, 4.17 mmol) in dry CH₂Cl₂( 5 mL) was added dropwise over 0.5 h at -15°C. Stirring was continued for 0.5h, a
solution of benzyl alcohol (0.3 g, 2.78 mmol) in dry CH$_2$Cl$_2$(5 mL) was added dropwise over 0.5h at -15°C. After stirring for 0.5 h, Et$_3$N (0.84 g, 8.34 mmol) was added slowly while the temperature should be controlled below -15°C. When the reaction was completed, 10% HCl solution in water was added dropwise until the pH of the reaction solution reached 2 under ice bath. The mixture was extracted with n-hexane or petroleum ether (10 mL x 2), decanted. The product was acquired after organic layer was concentrate and purified by flash chromatography (SiO$_2$; n-hexane). (0.27 g, 92%) The water layer was used for the recovery of V and the excess I.

**Typical Procedure for the recovery and re-oxidized of co-product 4-(2-(2-(methylthio)ethyl)-4-nitrophenyl)morpholine V:**

A solution of 25% NaOH in water was added dropwise in the water layer from the oxidation procedure until the pH reached 12. The mixture was extracted with CH$_2$Cl$_2$ (15 mL x 2), decanted, and washed with brine. The co-product 4-(2-(2-(methylthio)-ethyl)-4-nitrophenyl)morpholine V was recovered after concentration (90%). Treated V with a 30% solution of H$_2$O$_2$ in water at r.t. and then the reaction mixture was heated to 30°C in an O$_2$ atmosphere. After stirring for 1h, the reaction was completed. EtOH was was recovered by vacuum distillation, the mixture was extracted with EtOAc (15 mL x 2), decanted, and washed with brine. After drying over Na$_2$SO$_4$ and concentration, the crude was purified by flash chromatography (SiO$_2$; CH$_2$Cl$_2$), (94%).

**V:** $^1$H NMR (400 MHz, CDCl$_3$): δ 7.98 (dd, $J_1$ 8.8 Hz, $J_2$ 2.4 Hz, 1H), 7.82 (d, $J$ 2.4
Hz, 1H), 6.26 (d, J 8.8 Hz, 1H), 3.76 (t, J 8.4 Hz, 2H), 3.69 – 3.60 (m, 4H), 3.43 (t, J 5.2 Hz, 2H), 3.06 (t, J 8.4 Hz, 2H), 2.65 (t, J 6.4 Hz, 2H), 2.11 (s, 3H). LRMS (ESI⁺): m/z 283.0 [M+H]+.

**Typical Procedure for the reuse of I:** The procedure was the same as the typical procedure for the oxidation of alcohols. The yield of benzaldehyde was 90%.

**Typical procedure for the preparation of III and IV:**

(1) A mixture of 2-(2-chloro-5-nitrophenyl)ethanol II (5.0 g, 24.8 mmol) and morpholine (10.8 g, 124 mmol) was stirred and heated to 120°C for 5h, the reaction was monitored by TLC. The excess morpholine was recovered by vacuum distillation, and then water (25 mL) was added, then the mixture was filtered and washed with water to afford a yellow solid, 2-(2-morpholino-5-nitrophenyl)ethanol III (6.21 g, 99%), (m.p. 150.8°C-151.5°C).

(2) A mixture of III (5.00 g, 19.8 mmol) and chlorobenzene (20 mL) was heated to 100°C, then a solution of BTC (2.16 g, 7.27 mmol) in chlorobenzene (5 mL) was added dropwise over 0.5 h. The reaction was monitored by TLC until completed. Chlorobenzene was recovered by vacuum distillation and the residue was quenched with water (15 mL), and extracted with CH₂Cl₂ (15 mL x 2), decanted, and washed with brine. The organic phase was concentrated under vacum to afford brownish red liquid 4-(2-(2-chloroethyl)-4-nitrophenyl)morpholine IV (5.30 g, 99%).
(2-(methylsulfinyl)ethyl)benzene: a yellow liquid (2.18 g, 100%). $^1$H NMR (400 MHz, CDCl$_3$): δ 7.33 – 7.23 (m, 5H), 3.17 – 3.04 (m, 2H), 3.03 – 2.90 (m, 2H), 2.59 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ = 138.6, 128.8(2C), 128.5(2C), 126.8, 56.1, 38.7, 29.0. LRMS (ESI$^+$): m/z 169.1[M+H]$^+$. HRMS(ESI): calcd. for C$_9$H$_{12}$OS[M+Na]$^+$ 191.0501; found 191.0496.

2-(2-morpholino-5-nitrophenyl)ethanol III: a yellow solid (6.21 g, 99%); m.p. 149-150°C. $^1$H NMR (400 MHz, DMSO-$d_6$): δ 8.15 (d, $J$ 2.8 Hz, 1H), 8.03 (dd, $J_1$ 8.8 Hz, $J_2$ 2.8 Hz, 1H), 7.19 (d, $J$ 8.8 Hz, 1H), 4.81 (t, $J$ 5.2 Hz, 1H), 3.81 – 3.67 (m, 6H), 3.03 – 2.91 (m, 4H), 2.85 (t, $J$ 6.4 Hz, 2H) ppm. $^{13}$C NMR (100 MHz, DMSO-$d_6$): δ 157.2, 142.0, 134.6, 124.8, 122.3, 119.3, 66.2(2C), 60.3, 51.9(2C), 33.4 ppm. LRMS (ESI$^+$): m/z 253.1[M+H]$^+$. HRMS(ESI): calcd. for C$_{12}$H$_{16}$N$_2$O$_4$ [M+Na]$^+$ 275.1002; found 275.1008.

4-(2-(2-chloroethyl)-4-nitrophenyl)morpholine IV: a brownish red liquid (5.30 g, 99%). $^1$H NMR (400 MHz, CDCl$_3$): δ 8.02 (dd, $J_1$ 8.8 Hz, $J_2$ 2.4 Hz, 1H), 7.86 (d, $J$ 2.4 Hz, 1H), 6.29 (d, $J$ 8.8 Hz, 1H), 3.79 (t, $J$ 8.4Hz, 2H), 3.75-3.71 (m, 4H), 3.61 (t, $J$ 5.6 Hz, 2H), 3.46 (t, $J$ 5.6 Hz, 2H), 3.09 (t, $J$ 8.4 Hz, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ 156.9, 137.8, 129.7, 126.6, 120.7, 103.4, 71.4, 69.0, 53.4, 47.1, 43.1, 27.4. LRMS (ESI$^+$): m/z 271.1 [M+H]$^+$. HRMS(ESI): calcd. for C$_{12}$H$_{15}$ClN$_2$O$_3$[M+Na]$^+$ 293.0663; found 293.0666.

4-(2-(methylsulfinyl)ethyl)-4-nitrophenyl)morpholine I: an orange red liquid (4.20 g, 76.0%). $^1$H NMR (400 MHz, CDCl$_3$): δ 7.99 (dd, $J_1$ 8.8 Hz, $J_2$ 2.0 Hz, 1H), 7.84 (m, 1H), 6.27 (d, $J$ 8.8 Hz, 1H), 3.94 – 3.84 (m, 2H), 3.79 – 3.66 (m, 4H),
3.51 – 3.38 (m, 2H), 3.07 (t, J 8.4 Hz, 2H), 2.97 – 2.80 (m, 2H), 2.58 (s, 3H).

$^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 156.8, 137.7, 129.5, 126.3, 120.5, 103.3, 68.8, 63.6, 54.8, 53.0, 46.9, 39.3, 27.2. LRMS (ESI$^{+}$): $m/z$ 299.3 [M+H]$^+$, 321.3 [M+Na]$^+$. HRMS(ESI): calcd. for C$_{13}$H$_{18}$N$_2$O$_4$S[M+Na]$^+$ 321.0893; found 321.0879.

4-(2-(2-(methylthio)-ethyl)-4-nitrophenyl)morpholine V: an orange liquid. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.98 (dd, $J_1$ 8.8 Hz, $J_2$ 2.4 Hz, 1H), 7.82 (d, J 2.4 Hz, 1H), 6.26 (d, J 8.8 Hz, 1H), 3.76 (t, J 8.4 Hz, 2H), 3.69 – 3.60 (m, 4H), 3.43 (t, J 5.2 Hz, 2H), 3.06 (t, J 8.4 Hz, 2H), 2.65 (t, J 6.4 Hz, 2H), 2.11 (s, 3H). LRMS (ESI$^+$): $m/z$ 283.0 [M+H]$^+$.

Benzaldehyde: (242 mg, 91.4 % yield); liquid (commercially available, liquid). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 10.01 (s, 1H), 7.91-7.85 (m, 2H), 7.66-7.57 (m, 1H), 7.56-7.44 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 192.2, 136.4, 134.4, 129.7(2C), 129.0(2C).

4-Methylbenzaldehyde: (245 mg, 81.6% yield); liquid (commercially available, liquid). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 9.94 (s, 1H), 7.77 (d, J 8.0 Hz, 2H), 7.32 (d, J 8.0 Hz, 2H), 2.45 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 191.7, 145.5, 134.3, 129.8(2C), 129.7(2C), 22.1.

4-Methoxybenzaldehyde: (274 mg, 80.5% yield); liquid (commercially available, liquid). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 9.88 (s, 1H), 7.84 (d, J 8.8 Hz, 2H), 7.01 (d, J 8.8 Hz, 2H), 3.90 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 190.5, 164.5, 131.9(2C), 129.4, 114.4(2C), 55.8.
2-Cholorbenzaldehyde: (326 mg, 92.7% yield); liquid (commercially available, liquid). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 10.48 (s, 1H), 7.92 (dd, $J_1$ 7.6 Hz, $J_2$ 1.6 Hz, 1H), 7.56-7.50 (m, 1H), 7.46 (dd, $J_1$ 8.0 Hz, $J_2$ 1.2 Hz, 1H), 7.42-7.37 (m, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 189.6, 137.9, 135.1, 133.3, 130.6, 129.4, 127.3.

2-Nitrobenzaldehyde: (289 mg, 76.6% yield); m.p. 42-43°C (commercially available, m.p. 43-44°C). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 10.42 (s, 1H), 8.12 (dd, $J_1$ 7.6 Hz, $J_2$ 1.2 Hz, 1H), 7.96 (dd, $J_1$ 7.6 Hz, $J_2$ 1.6 Hz, 1H), 7.83 – 7.73 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 187.9, 149.6, 134.0, 133.7, 131.3, 129.6, 124.5.

Methyl 4-formylbenzoate: (314 mg, 76.5% yield); m.p. 55-57°C (commercially available, m.p. 59-63°C). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 10.09 (s, 1H), 8.22-8.13 (m, 2H), 8.08-7.91 (m, 2H), 3.97 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 191.4, 166.0, 139.1, 135.0, 130.2(2C), 129.5(2C), 52.7.

Terephthalaldehyde: (236 mg, 70.4% yield); m.p. 112-113°C (commercially available, m.p. 114-116°C). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 10.13 (s, 2H), 8.06 (s, 4H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 191.3(2C), 140.0(2C), 130.2(4C).

1-Naphthaldehyde: (267 mg, 68.5% yield); liquid (commercially available, liquid). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 10.40 (s, 1H), 9.26 (d, $J$ 8.8 Hz, 1H), 8.11 (d, $J$ 8.4 Hz, 1H), 8.00 (dd, $J_1$ 7.2, $J_2$ 1.6 Hz, 1H), 7.93 (d, $J$ 8.0 Hz, 1H), 7.73-7.68 (m, 1H), 7.66-7.58 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 193.3, 136.5, 135.2, 133.8, 131.5, 130.6, 129.0, 128.5, 127.0, 125.8, 124.9.

Acetophenone: (276 mg, 92.1% yield); liquid (commercially available, liquid). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.99-7.94 (m, 2H), 7.59-7.54 (m, 1H), 7.49-7.44 (m, 2H),
7.38-7.29 (m, 1H), 2.62 (s, 3H). 13C NMR (100 MHz, CDCl3): δ 198.0, 137.0, 132.9, 128.3(2C), 128.2(2C), 26.9.

1-(P-tolyl)ethanone: (270 mg, 80.5% yield); liquid (commercially available, liquid).

1H NMR (400 MHz, CDCl3): δ 7.86 (d, J 8.4 Hz, 2H), 7.25 (d, J 7.6 Hz, 2H), 2.59 (s, 3H), 2.42 (s, 3H). 13C NMR (100 MHz, CDCl3): δ 197.5, 143.7, 134.7, 129.2(2C), 128.4(2C), 26.7, 21.8.

Benzophenone: (367 mg, 79.7% yield); m.p. 47-48 °C (commercially available, m.p. 47-49 °C). 1H NMR (400 MHz, CDCl3): δ 7.86-7.75 (m, 4H), 7.62-7.56 (m, 2H), 7.54-7.45 (m, 4H). 13C NMR (100 MHz, CDCl3): δ 196.5, 137.6(2C), 132.3(2C), 130.0(4C), 128.2(4C).

1-(4-Fluorophenyl)ethanone: (253 mg, 73.4% yield); liquid (commercially available, liquid).

1H NMR (400 MHz, CDCl3): δ 8.03-7.93 (m, 2H), 7.13 (t, J 8.8 Hz, 2H), 2.60 (s, 3H). 13C NMR (100 MHz, CDCl3): δ 196.2, 166.9, 133.6, 131.0, 130.9, 115.8, 115.5, 26.7.

1-(3,5-bis(trifluoromethyl)phenyl)ethanone: (421 mg, 65.8% yield); liquid (commercially available, liquid).

1H NMR (400 MHz, CDCl3): δ 8.38 (s, 2H), 8.07 (s, 1H), 2.72 (s, 3H). 13C NMR (100 MHz, CDCl3): δ 194.7, 138.5, 132.6, 132.3, 128.3(2C), 126.3, 124.3, 121.6, 26.8.

1-(4-Nitrophenyl)ethanone: (302 mg, 73.3% yield); m.p. 73-75 °C (commercially available, m.p. 75-78 °C).

1H NMR (400 MHz, CDCl3): δ 8.31 (d, J 9.0 Hz, 2H), 8.11 (d, J 9.0 Hz, 2H), 2.69 (s, 3H). 13C NMR (100 MHz, CDCl3): δ 196.0, 150.3, 141.4, 129.3(2C), 123.9(2C), 27.2.
2,3-Dihydro-1H-inden-1-one: (261 mg, 79.0% yield); m.p. 33-35 °C (commercially available, m.p. 38-40 °C). $^1$H NMR (400 MHz, CDCl$_3$): δ 7.76 (d, $J$ 7.6 Hz, 1H), 7.59 (t, $J$ 7.6 Hz, 1H), 7.48 (d, $J$ 7.6 Hz, 1H), 7.37 (t, $J$ 7.6 Hz, 1H), 3.16 (t, $J$ 6.0Hz, 2H), 2.71 (t, $J$ 6.0Hz, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ 206.8, 155.0, 137.1, 134.5, 127.2, 126.7, 123.7, 36.4, 26.0.

2,7-Dibromo-9H-fluoren-9-one: (644 mg, 76.2% yield); m.p. 195-197 °C (commercially available, m.p. 203-205 °C). $^1$H NMR (400 MHz, CDCl$_3$): δ 7.75 (d, $J$ 1.6 Hz, 1H), 7.62 (dd, $J_1$ 8.0 Hz, $J_2$ 2.0 Hz, 1H), 7.38 (d, $J$ 8.0 Hz, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ 190.7, 142.2(2C), 137.4(2C), 135.3(2C), 127.8(2C), 123.4(2C), 121.8(2C).

(3r,5r,7r)-Adamantane-1-carbaldehyde: (292 mg, 71.2% yield); m.p. 190-194 °C (commercially available, m.p. 189-198 °C). $^1$H NMR (400 MHz, CDCl$_3$): δ 9.31 (s, 1H), 2.12-1.96 (m, 3H), 1.83-1.53 (m, 12H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ 205.7, 39.3, 37.2, 36.9, 36.7, 36.2 (3C), 28.3, 28.1, 27.7.
$^1$H NMR spectrum of (2-(methylsulfinyl)ethyl)benzene

$^{13}$C NMR spectrum of (2-(methylsulfinyl)ethyl)benzene
LRMS of (2-(methylsulfinyl)ethyl)benzene

HRMS of (2-(methylsulfinyl)ethyl)benzene
$^1$H NMR spectrum of 2-(2-morpholino-5-nitrophenyl)ethanol III

$^{13}$C NMR spectrum of 2-(2-morpholino-5-nitrophenyl)ethanol III
LRMS of 2-(2-morpholino-5-nitrophenyl)ethanol III

HRMS of 2-(2-morpholino-5-nitrophenyl)ethanol III
$^1$H NMR spectrum of 4-(2-(2-chloroethyl)-4-nitrophenyl)morpholine IV

$^{13}$C NMR spectrum of 4-(2-(2-chloroethyl)-4-nitrophenyl)morpholine IV
LRMS of 4-(2-(2-chloroethyl)-4-nitrophenyl)morpholine IV

HRMS of 4-(2-(2-chloroethyl)-4-nitrophenyl)morpholine IV
$^1$H NMR spectrum of 4-(2-(2-(methylsulfinyl) ethyl)-4-nitrophenyl)morpholine (I)

$^{13}$C NMR spectrum of 4-(2-(2-(methylsulfinyl)ethyl)-4-nitrophenyl)morpholine (I)
LRMS of 4-(2-(2-(methylsulfinyl) ethyl)-4-nitrophenyl)morpholine (I)

HRMS of 4-(2-(2-(methylsulfinyl) ethyl)-4-nitrophenyl)morpholine (I)
$^1$H NMR spectrum of 4-(2-(2-(methylthio)ethyl)nitrophenyl)morpholine (V)

LRMS of 4-(2-(2-(methylthio)ethyl)nitrophenyl)morpholine (V)
$^1$H NMR spectrum of **benzaldehyde** in CDCl$_3$:

$^{13}$C NMR spectrum of **benzaldehyde** in CDCl$_3$. 
$^1$H NMR spectrum of 4-methylbenzaldehyde in CDCl$_3$:

$^{13}$C NMR spectrum of 4-methylbenzaldehyde in CDCl$_3$:
$^1$H NMR spectrum of 4-methoxybenzaldehyde in CDCl$_3$: 

$^{13}$C NMR spectrum of 4-methoxybenzaldehyde in CDCl$_3$: 
$^1$H NMR spectrum of 2-chlorobenzaldehyde in CDCl$_3$:

$^{13}$C NMR spectrum of 2-chlorobenzaldehyde in CDCl$_3$:

YXJ20140205-C13
YXJ20140205 CDCl$_3$ C13

77.20
70.10
56.20
$^1$H NMR spectrum of 2-nitrobenzaldehyde in CDCl$_3$:

$^{13}$C NMR spectrum of 2-nitrobenzaldehyde in CDCl$_3$:
$^1$H NMR spectrum of methyl 4-formylbenzoate in CDCl$_3$:

$^{13}$C NMR spectrum of methyl 4-formylbenzoate in CDCl$_3$:
$^1$ HNMR spectrum of terephthalaldehyde in CDCl$_3$:

$^{13}$C NMR spectrum of terephthalaldehyde in CDCl$_3$:
$^1$H NMR spectrum of 1-naphthaldehyde in CDCl$_3$:

$^{13}$C NMR spectrum of 1-naphthaldehyde in CDCl$_3$:
$^1$H NMR spectrum of acetophenone in CDCl$_3$:

$^{13}$C NMR spectrum of acetophenone in CDCl$_3$:
$^1$H NMR spectrum of 1-(p-tolyl)ethanone in CDCl$_3$:

$^{13}$C NMR spectrum of 1-(p-tolyl)ethanone in CDCl$_3$:
$^1$H NMR spectrum of benzophenone in CDCl$_3$:

$^{13}$C NMR spectrum of benzophenone in CDCl$_3$:
$^1$H NMR spectrum of 1-(4-fluorophenyl)ethanone in CDCl$_3$:

$^{13}$C NMR spectrum of 1-(4-fluorophenyl)ethanone in CDCl$_3$:
$^{1}$H NMR spectrum of 1-(3,5-\textit{bis}(trifluoromethyl)phenyl)ethanone in CDCl$_3$:

\[ \text{13C NMR spectrum of 1-(3,5-\textit{bis}(trifluoromethyl)phenyl)ethanone in CDCl$_3$.} \]
$^1$H NMR spectrum of 1-(4-nitrophenyl)ethanone in CDCl$_3$: 

$^{13}$C NMR spectrum of 1-(4-nitrophenyl)ethanone in CDCl$_3$: 

---

S32
$^1$H NMR spectrum of 2,3-dihydro-1H-inden-1-one in CDCl$_3$:

$^{13}$C NMR spectrum of 2,3-dihydro-1H-inden-1-one in CDCl$_3$:
$^1$H NMR spectrum of 2,7-dibromo-9H-fluoren-9-one in CDCl$_3$:

$^{13}$C NMR spectrum of 2,7-dibromo-9H-fluoren-9-one in CDCl$_3$: 
$^1\text{H}$ NMR spectrum of the oxidation product of 4-phenylbutan-1-ol in CDCl$_3$:
The document contains two NMR spectra. The first is a ¹H NMR spectrum of (3r,5r,7r)-adamantane-1-carbaldehyde in CDCl₃, and the second is a ¹³C NMR spectrum of the same compound in CDCl₃.