# Supporting information

**Nano-Pd catalyzed synthesis of sulfoxides and sulfones from symmetrical and unsymmetrical sulfides obtained *via* the reaction of diazonium tetrafluoroborate with $Na_2S·9H_2O$**

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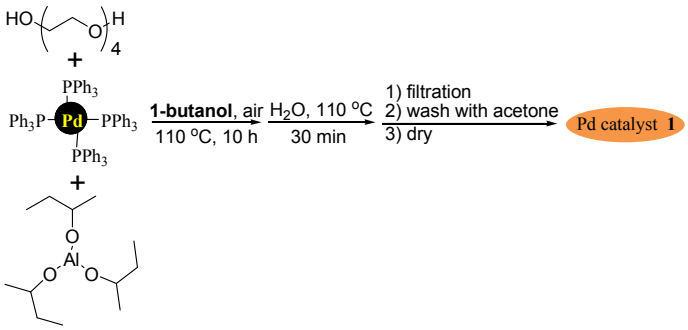
# 1 General

All reagents were purchased from commercial sources and used without further purification, unless otherwise indicated. Deuterated solvents were purchased from Sigma-Aldrich. Column chromatography was performed on silica gel (200-300 mesh) with petroleum ether (solvent A)/ethyl acetate (solvent B) gradients, unless otherwise specified. The microwave reactions were carried out by using MC8S-3 microwave instrument. All yields were referred to isolated yields (average of two runs) of compounds. The known compounds were partly characterized by melting points (for solid samples), $^1$H NMR, and compared to authentic samples or the literature data. Melting points were measured with a RD-II digital melting point apparatus and are uncorrected. $^1$H NMR data were acquired at 300 K on a Bruker Advance 600 III MHz spectrometer or Avarian Inova 500 MHz spectrometer using $CDCl_3$ as a solvent. Chemical shifts are reported in ppm from tetramethylsilane with the solvent resonance as the internal standard ($^1$H NMR TMS at 0.00 ppm, $CHCl_3$ at 7.26 ppm; $^{13}C\{^1H\}$ NMR $CDCl_3$ at 77.16 ppm). Spectra are reported as follows: chemical shift (δ = ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constants (Hz), integration, and assignment. New compounds were further characterized by HRMS. High-resolution mass spectra were recorded on an ESI-Q-TOF mass spectrometer.

# 2 General procedures

## 2.1 General procedure for the preparation of the nano-Pd catalyst

A mixture of $Pd(PPh_3)_4$ (260 mg, 0.225 mmol), tetra(ethylene glycol) (418 mg, 2.20 mmol), 1-butanol (3 mL, 32.7 mmol), and aluminum tri-sec-butoxide (9.50 g, 38.5 mmol) was stirred at 110 $^o$C for 10 h. Then water was dropwise added and the system was stirred at 110 $^o$C for another 0.5 h to form a black gel. Subsequently, filtering, washing with acetone, and drying the gel gave the nano-Pd catalyst **1** at room temperature as dark greyish-green powder (See Scheme 1).




**Scheme 1.** Preparation of the palladium nanoparticles catalyst **1**.

### 2.2 General procedure for the synthesis of symmetrical sulfides under microwave

The mixture of phenyl diazonium tetreafluoroborate (38.5 mg, 0.2 mmol), and $Na_2S·9H_2O$ (53.2 mg, 1.1 equiv.) in water (1.0 mL) was heated under microwave irradiation (300 W, 100 °C) until the starting material was consumed which was determined by TLC. The reaction system was then extracted with ethyl acetate (3 × 10 mL), and the combined organic phase was dried over anhydrous $Na_2SO_4$. At last, the organic extracts were concentrated in vacuum and the resulting mixture was purified by column chromatography on silica gel with petroleum ether as an eluent to afford the pure product **3a**.

### 2.3 General procedure for the synthesis of symmetrical disulfides promoted by $FeCl_3$

To the mixture system of phenyl diazonium tetrafluoroborate (38.5 mg, 0.2 mmol) and $FeCl_3$ (39.1 mg, 0.24 mmol, 1.2 equiv) in $CH_3OH$ (1.0 mL) was added $Na_2S·9H_2O$ (53.2 mg, 1.1 equiv.) slowly at 0 °C. The reaction mixture was then stirred, and the temperature rose to room temperature naturally. The stirring continued until no substrate could be detected by TLC. After the solvent $CH_3OH$ was removed under reduced pressure, the residue was purified by column chromatography on silica gel with petroleum ether as an eluent to afford the direct cross-coupling product diphenyl disulfide **4a**.

### 2.4 General procedure for the synthesis of asymmetrical sulfides *via* the cross-coupling of disulfides with aryl diazonium tetrafluoroborate

To the mixture system of *p*-MeO-phenyl diazonium tetrafluoroborate (44.5 mg, 0.2 mmol) and $K_2CO_3$ (27.7 mg 0.2 mmol) in $CH_3CN$ (1.0 mL) was added diphenyl disulfide (39.3 mg, 0.18 mmol) under $N_2$ atmosphere at 25 °C. The reaction mixture was then stirred until no substrate could be detected by TLC. The resulting mixture was purified by column chromatography on

silica gel with petroleum ether as an eluent to afford the direct cross-coupling product (4-methoxyphenyl)(phenyl)sulfide **5a**.

### 2.5 General procedure for oxidation of symmetric sulfides to sulfoxides with $H_2O_2$

The mixture of nano Pd catalyst (4.1 mg, 0.12 mol% Pd), symmetric diphenyl sulfide (0.2 mmol) and 30% $H_2O_2$ (0.2 mL, 10 equiv.) in methanol (1.0 mL) was stirred at 60 $^oC$ until the starting material was consumed which was determined by TLC. After the solvent $CH_3OH$ was removed under reduced pressure, the resulting product was purified by column chromatography on silica gel with ethyl acetate and petroleum ether as eluents to afford the pure product **6a**.

### 2.6 General procedure for oxidation of asymmetric sulfides to sulfoxides with $H_2O_2$

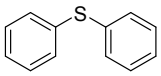
The mixture of nano Pd catalyst (4.1 mg, 0.12 mol% Pd), asymmetric sulfide (0.2 mmol), 30% $H_2O_2$ (0.2 mL, 10 equiv.) in methanol (1.0 mL) was stirred at 60 $^oC$ until the starting material was consumed which was determined by TLC. After the solvent $CH_3OH$ was removed under reduced pressure, the resulting mixture was purified by column chromatography on silica gel with ethyl acetate and petroleum ether as eluents to afford the pure product **7**.

### 2.7 General procedure for the symmetrical and asymmetric sulfides to sulfones

The mixture of nano Pd catalyst (4.1 mg, 0.12 mol% Pd), diphenyl disulfide (10 mol%) symmetric or asymmetric sulfide (0.2 mmol), 30% $H_2O_2$ (0.2 mL, 10 equiv.) in methanol (1.0 mL) was stirred at 100 $^oC$ until the starting material was consumed which was determined by TLC. After the solvent $CH_3OH$ was removed under reduced pressure, the resulting mixture was purified by column chromatography on silica gel with ethyl acetate and petroleum ether as eluents to afford the pure product **8**.

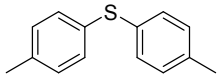
## 3 Characterization data for the corresponding products

### Part 1: symmetric sulfides



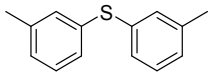
**Diphenyl sulfide**[1, 2, 3] (**3a**, **5a**)

Colorless liquid; $^1H$ NMR (600 MHz, $CDCl_3$): $\delta$ = 7.35-7.33 (m, 4H, Ar-H), 7.31 (t, $J$ = 7.4 Hz, 4H, Ar-H), 7.25 (tt, $J$ = 7.1, 2.1 Hz, 2H, Ar-H) ppm.



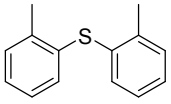
**Di-*p*-tolylsulfide**[1, 2, 3] (**3b**)

White solid; M.p.: 57 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.23 (d, $J$ = 8.2 Hz, 4H, Ar-H), 7.15 (d, $J$ = 8.0 Hz, 4H, Ar-H), 2.32 (s, 6H, Me-H) ppm.



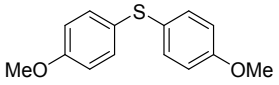
**Di-*m*-tolylsulfide**[3] (**3c**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.20-7.17 (m, 4H, Ar-H), 7.13 (d, $J$ = 7.8 Hz, 2H, Ar-H), 7.05 (d, $J$ = 7.6 Hz, 2H, Ar-H), 2.31 (d, $J$ = 6.4 Hz, 6H, Me-H) ppm.



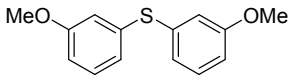
**Di-*o*-tolylsulfide**[1, 2] (**3d**)

White solid; M.p.: 64 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.24 (d, $J$ = 7.3 Hz, 2H, Ar-H), 7.18 (td, $J$ = 7.3, 1.4 Hz, 2H, Ar-H), 7.11 (td, $J$ = 8.1, 1.2 Hz, 2H, Ar-H), 7.06 (dd, $J$ = 7.7, 2.0 Hz, 2H, Ar-H), 2.38 (s, 6H, Me-H) ppm.



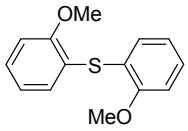

**Bis(4-methoxyphenyl)sulfide**[1, 2, 3] (**3e**)

White solid; M.p.: 44 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.28-7.26 (m, 4H, Ar-H), 6.85 (d, $J$ = 8.8 Hz, 4H, Ar-H), 3.79 (s, 6H, OMe-H) ppm.




**Bis(3-methoxyphenyl)sulfide**[1, 3] (**3f**)

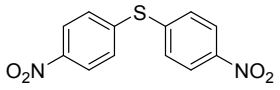
White solid; M.p.: 45-47 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.22-7.19 (m, 2H, Ar-H), 6.94-7.92 (m, 2H, Ar-H), 6.90-6.89 (m, 2H, Ar-H), 6.80-6.78 (m, 2H, Ar-H), 3.76 (s, 6H, OMe-H) ppm.




**Bis(2-methoxyphenyl)sulfide**[1, 3] (**3g**)

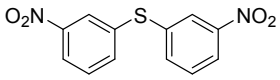
White solid; M.p.: 73-74 °C; $^1$H NMR (400 MHz, $CDCl_3$): $\delta$ = 7.27-7.22 (m, 2H, Ar-H), 7.07 (dd,

*J* = 7.7, 1.7 Hz, 2H, Ar-H), 6.93-6.90 (m, 2H, Ar-H), 6.89 (td, *J* = 7.5, 1.2 Hz, 2H, Ar-H), 3.87 (s, 6H, OMe-H) ppm.



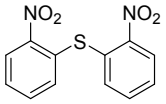
**Bis(4-nitrophenyl)sulfide**[1, 2] (**3h**)

White solid; M.p.: 156 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 8.07 (d, *J* = 8.9 Hz, 2H, Ar-H), 7.55-7.53 (m, 2H, Ar-H), 7.46-7.45 (m, 2H, Ar-H), 7.18 (d, *J* = 9.0 Hz, 2H, Ar-H) ppm.



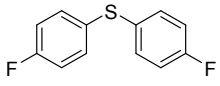
**Bis(3-nitrophenyl)sulfide**[7] (**3i**)

White solid; M.p.: 42 °C; $^1$H NMR (400 MHz, $CDCl_3$): $\delta$ = 8.37 (t, *J* = 4.0 Hz, 2H, Ar-H), 8.12-8.10 (m, *J* = 8.4 Hz, 2H, Ar-H), 7.83-7.80 (m, *J* = 8.0 Hz, 2H, Ar-H), 7.53 (t, *J* = 16.0 Hz, 2H, Ar-H) ppm.



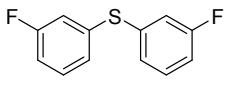
**Bis(2-nitrophenyl)sulfide**[1, 8] (**3j**)

Yellow solid; M.p.: 123-124 °C; $^1$H NMR (400 MHz, $CDCl_3$); $\delta$ = 8.06-8.09 (m, 2H, Ar-H), 7.79-7.84 (m, 2H, Ar-H), 7.63-7.76 (m, 2H, Ar-H), 7.56-7.60 (m, 2H, Ar-H) ppm.



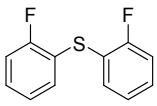
**Bis(4-fluorophenyl)sulfide**[1, 3] (**3k**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.32-7.29 (m, 4H, Ar-H), 7.02-6.99 (m, 4H, Ar-H) ppm.



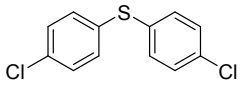
**Bis(3-fluorophenyl)sulfide**[3] (**3l**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.31-7.27 (m, 2 H, Ar-H), 7.14-7.12 (m, 2H, Ar-H), 7.05 (dt, *J* = 9.1, 2.2 Hz, 2H, Ar-H), 6.99-6.95 (m, 2H, Ar-H) ppm.



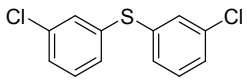
**Bis(2-fluorophenyl)sulfide**[12] (**3m**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.30-7.24 (m, 4 H, Ar-H), 7.12-7.08 (m, 4H, Ar-H) ppm.



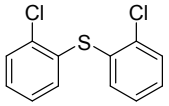
**Bis(4-clorophenyl)sulfide**[1, 8] (**3n**)

White solid; M.p.: 88-89 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.29-7.23 (m, 8H, Ar-H) ppm.



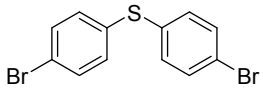
**Bis(3-fluorophenyl)sulfide**[8] (**3o**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.32-7.31 (m, 2H, Ar-H), 7.25-7.24 (m, 4H, Ar-H) , 7.22-7.21 (m, 2H, Ar-H) ppm.



**Bis(2-clorophenyl)sulfide**[3] (**3p**)

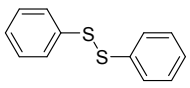
White solid; M.p.: 68-70 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.47 (dd, $J$ = 7.9, 1.3 Hz, 2H, Ar-H), 7.25 (td, $J$ = 7.8, 1.7 Hz, 2H, Ar-H). 7.21 (td, $J$ = 7.8, 1.3 Hz, 2H, Ar-H), 7.15 (dd, $J$ = 7.8, 1.7 Hz, 2H, Ar-H) ppm.



**Bis(4-bromophenyl)sulfide**[1, 2] (**3q**)

White solid; M.p.: 110-111 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.44-7.42 (m, 4H, Ar-H), 7.20-7.17 (m, 4H, Ar-H) ppm.

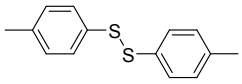
**Part 2: symmetric disulfides**



**Diphenyldisulfide**[4, 5] (**4a**)

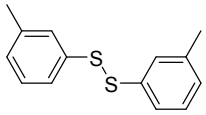
White solid; M.p.: 58-60 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.51-7.49 (m, 4H, Ar-H), 7.31-7.29

(m, 4H, Ar-H), 7.24 (tt, $J$ = 7.3, 1.8 Hz, 2H, Ar-H) ppm.



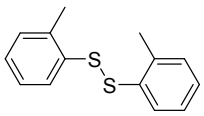
**Di(*p*-methylphenyl)disulfide**[4, 5] (**4b**)

White solid; M.p.: 48-50 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.43 (d, $J$ = 8.1 Hz, 4 H, Ar-H), 7.16 (q, $J$ = 7.7 Hz, 4 H, Ar-H), 2.34 (s, 6H, Me-H) ppm.



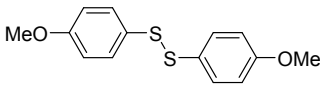
**Di(*m*-methylphenyl)disulfide**[4] (**4c**)

White solid; M.p.: 112-113 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.38 (t, $J$ = 6.8 Hz, 4 H, Ar-H), 7.19 (t, $J$ = 7.7 Hz, 4 H, Ar-H), 7.08 (d, $J$ = 7.6 Hz, 2 H, Ar-H), 2.32 (s, $J$ = 6.4 Hz**,** 6H, Me-H) ppm.



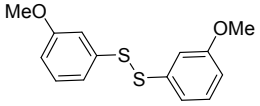
**Di(*o*-methylphenyl)disulfide**[4, 5] (**4d**)

White solid; M.p.: 40 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.16-7.18 (m, Ar-H), 7.13-7.15 (m, Ar-H), 7.08 (td, $J$ = 6.0, 1.2 Hz, 2H, Ar-H), 7.04 (dd, $J$ = 6.0, 1.8 Hz, 2H, Ar-H), 2.37 (s, 6H, Me-H) ppm.



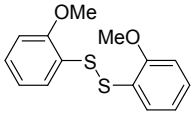
**Di(4-methoxyphenyl)disulfide**[5, 6] (**4e**)

White solid; M.p.: 45-47 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.28-7.26 (m, 4 H, Ar-H), 6.84-6.82 (m, 4 H, Ar-H), 3.78 (s, 6 H, OMe-H) ppm.



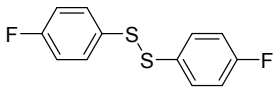
**Di(3-methoxyphenyl)disulfide**[5, 6] (**4f**)

White solid; M.p.: 106-107 °C; $^1$H NMR (400 MHz, $CDCl_3$); $\delta$ = 7.12-7.16 (m, 2H, Ar-H), 6.99-7.03 (m, 2H, Ar-H), 6.82-6.88 (m, 2H, Ar-H), 6.67-6.73 (m, 2H, Ar-H), 3.69 (s, 6H, OMe-H) ppm.



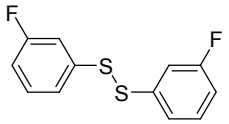

**Di(2-methoxyphenyl)disulfide**[13, 14] (**4g**)

White solid; M.p.: 120-121 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.53 (d, 2 H, $J$ = 1.6 Hz, Ar-H), 7.19-7.17 (m, 2 H, Ar-H), 6.92-6.89 (m, 2 H, Ar-H), 6.86-6.83 (m, 2 H, Ar-H), 3.89 (s, 6 H, OMe-H) ppm.



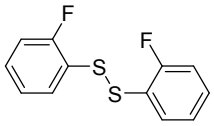

**Bis(4-fluorophenyl)disulfide**[4, 5] (**4h**)

White solid; M.p.: 50-52 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.32-7.29 (m, 4 H, Ar-H), 7.02-6.99 (m, 4 H, Ar-H) ppm.



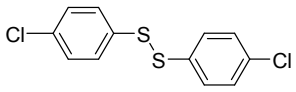

**Bis(3-fluorophenyl)disulfide**[6] (**4i**)

Slight yellow oil; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.31-7.27 (m, 2 H, Ar-H), 7.14-7.12 (m, 2 H, Ar-H), 7.05 (dt, $J$ = 9.1, 2.2 Hz, 2H, Ar-H), 6.99-6.95 (m, 2H, Ar-H) ppm.



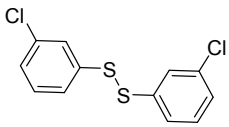

**Bis(2-fluorophenyl)disulfide**[14] (**4j**)

Slight yellow oil; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.60 (td, 2 H, $J$ = 7.7, 1.7 Hz, Ar-H), 7.28-7.25 (m, 2H, Ar-H), 7.13 (td, 2 H, $J$ = 7.7, 1.2 Hz, Ar-H), 7.08-7.04 (m, 2H, Ar-H) ppm.



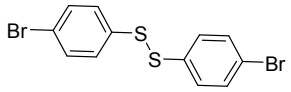

**Bis(4-clorophenyl)disulfide**[4, 5, 6] (**4k**)

White solid; M.p.: 68-70 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.41-7.39 (m, 4 H, Ar-H), 7.29-7.27 (m, 4 H, Ar-H) ppm.



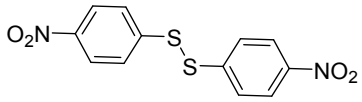

**Bis(3-clorophenyl)disulfide**[8] (**4l**)

White solid; M.p.: 80-82 °C; $^1$H NMR (400 MHz, $CDCl_3$): $\delta$ = 7.31 (s, 2 H, Ar-H), 7.24-7.22 (m, 6H, Ar-H) ppm.



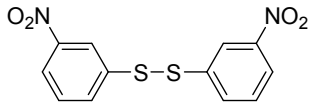
**Bis(4-bromophenyl)disulfide**[6, 8] (**4n**)

White solid; M.p.: 110-111 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.43-7.41 (m, 4 H, Ar-H), 7.34-7.32 (m, 4 H, Ar-H) ppm.



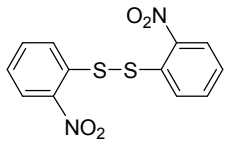
**Bis(4-nitrophenyl)disulfide**[5, 13] (**4o**)

Slight yellow solid; M.p.: 185-186 °C; $^1$H NMR (400 MHz, $CDCl_3$): $\delta$ = 8.19 (d, $J$ = 8.8 Hz, 4 H, Ar-H), 7.61 (d, $J$ = 9.2 Hz, 4 H, Ar-H) ppm.



**Bis(3-nitrophenyl)disulfide**[8] (**4p**)

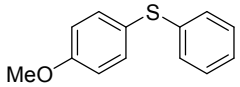
Yellow solid; M.p.: 78-80 °C; $^1$H NMR (600 MHz, $CDCl_3$); $\delta$ = 8.36 (t, $J$ = 1.8 Hz, 2H, Ar-H), 8.09 (dt, $J$ = 6.0, 1.2 Hz, 2H, Ar-H), 7.79 (dq, $J$ = 5.4, 0.6 Hz, 2H, Ar-H), 7.51 (t, $J$ = 7.8 Hz, 2H, Ar-H) ppm.



**Bis(2-nitrophenyl)disulfide**[5] (**4q**)

Yellow solid; M.p.: 193-194 °C; $^1$H NMR (400 MHz, $CDCl_3$); $\delta$ = 8.33 (d, $J$ = 8,0 Hz, 2H, Ar-H), 7.86 (dd, $J$ = 7.2, 1.2 Hz, 2H, Ar-H), 7.60 (td, $J$ = 6.0, 1.2 Hz, 2H, Ar-H), 7.42 (td, $J$ = 7.2, 1.2 Hz, 2H, Ar-H) ppm.

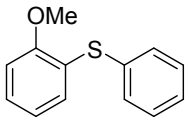
**Part 3: asymmetric sulfides**



**(4-Methoxyphenyl)(phenyl)sulfide**[1, 2] (**5b**, **5n**)

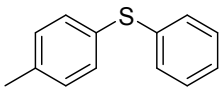
Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.42 (d, $J$ = 8.7 Hz, 2H, Ar-H), 7.25-7.21 (m,

2H, Ar-H), 7.18-7.16 (m, 2H, Ar-H), 7.14-7.11 (m, 1H, Ar-H), 6.90 (d, $J$ = 8.8 Hz, 2H, Ar-H), 3.81 (s, 3H, OMe-H) ppm.



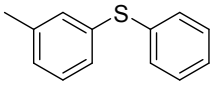

**(2-Methoxyphenyl)(phenyl)sulfide**[11] (**5c**, **5o**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.36-7.34 (m, 2H, Ar-H), 7.32-7.29 (m, 2 H, Ar-H), 7.26-7.22 (m, 2H, Ar-H), 7.09-7.07 (m, 1H, Ar-H), 6.91 (dd, $J$ = 8.2, 1.1 Hz, 1H, Ar-H ), 6.88 (td, $J$ = 7.6, 1.3 Hz, 1 H, Ar-H ), 3.87 (s, 3H, OMe-H) ppm.



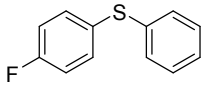

**Phenyl(*p*-tolyl)sulfide**[1, 2] (**5d**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.31 (d, $J$ = 8.2 Hz, 2H, Ar-H), 7.26 (d, $J$ = 4.4 Hz, 4H, Ar-H), 7.20-7.17 (m, 1H, Ar-H), 7.14 (d, $J$ = 8.5 Hz, 2H, Ar-H), 2.34 (s, 3H, Me-H) ppm.



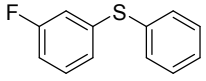

**Phenyl(*m*-tolyl)sulfide**[15] (**5e**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.20-7.17 (m, 4 H, Ar-H), 7.13 (d, $J$ = 7.8 Hz, 2H, Ar-H), 7.05 (d, $J$ = 7.6 Hz, 2H, Ar-H), 2.31 (d, $J$ = 6.4 Hz, 3H, Me-H) ppm.



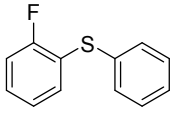

**(4-Fluorophenyl)(phenyl)sulfide**[9] (**5f**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.50-7.49 (m, 2 H, Ar-H), 7.39-7.36 (m, 1 H, Ar-H), 7.32-7.27 (m, 4H, Ar-H), 7.24-7.22 (m, 2H, Ar-H) ppm.



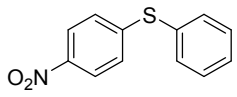

**(3-Fluorophenyl)(phenyl)sulfide**[10] (**5g**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.51-7.49 (m, 1H, Ar-H), 7.43-7.42 (m, 2H, Ar-H), 7.43-7.42 (m, 2H, Ar-H), 7.37-7.34 (m, 2H, Ar-H), 7.24-7.21 (m, 1H, Ar-H), 7.05 (dq, $J$ = 7.9, 1.1 Hz, 1H, Ar-H), 6.94 (dt, $J$ = 9.4, 2.4 Hz, Ar-H), 6.90 (tq, $J$ = 8.5, 1.0 Hz, 2H, Ar-H) ppm.



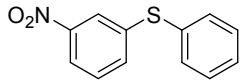

**(2-Fluorophenyl)(phenyl)sulfide**[10] (**5h**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.35-7.30 (m, 4H, Ar-H), 7.27-7.24 (m, 3H, Ar-H), 7.12-7.06 (m, 2H, Ar-H) ppm.



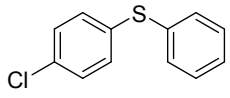

**(4-Nitrophenyl)(phenyl)sulfide**[2, 9] (**5i**, **5p**)

Slight yellow solid; M.p.: 56-57 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 8.07 (d, $J$ = 2.0 Hz, 1H, Ar-H), 8.00 (ddd, $J$ = 8.2, 2.2, 1.0 Hz, 1H, Ar-H), 7.50-7.46 (m, 3H, Ar-H), 7.42-7.39 (m, 4H, Ar-H) ppm.



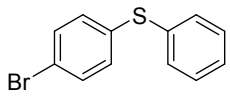

**(3-Nitrophenyl)(phenyl)sulfide**[16] (**5j**, **5q**)

Slight yellow solid; M.p.: 42-44 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 8.03 (t, $J$ = 8.9 Hz, 2H, Ar-H), 7.55-7.54 (m, 2H, Ar-H), 7.46-7.45 (m, 3H, Ar-H), 7.18-7.17 (m, 2H, Ar-H) ppm.



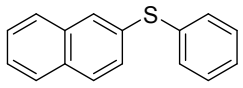

**(4-Clorophenyl)(phenyl)sulfide**[1, 2] (**5k**)

White solid; M.p.: 64-66 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.35-7.30 (m, 4H, Ar-H), 7.28-7.24 (m, 5H, Ar-H) ppm.




**(4-Bromophenyl)(phenyl)sulfide**[2] (**5l**)

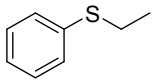
Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.42-7.39 (m, 2H, Ar-H), 7.36-7.32 (m, 4H, Ar-H), 7.29-7.27 (m, 1H, Ar-H), 7.18-7.16 (m, 2H, Ar-H) ppm.




**(2-Naphyl)(phenyl)sulfide**[9] (**5m**)

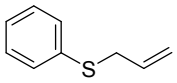
White solid; M.p.: 41-42 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 8.38-8.37 (m, 1H, Ar-H), 7.88-7.85

(m, 2H, Ar-H), 7.67 (dd, $J$ = 7.1, 1.1 Hz, 1 H, Ar-H), 7.52 (q, $J$ = 3.2 Hz, 2H, Ar-H), 7.44 (t, $J$ = 7.7 Hz, 1H, Ar-H), 7.23-7.20 (m, 2H, Ar-H), 7.19-7.17 (m, 2H, Ar-H), 7.16-7.13 (m, 1H, Ar-H) ppm.



**Ethyl(phenyl)sulfane**[18, 26] (**5r**)

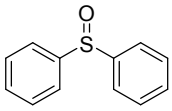
Slight yellow liquid; $^1$H NMR (400 MHz, $CDCl_3$); $\delta$ = 7.32 (d, $J$ = 8.0 Hz, 2H, Ar-H), 7.28 (d, $J$ = 8.0 Hz, 2H, Ar-H), 7.18-7.15 (t, $J$ = 7.2 Hz, 1H, Ar-H), 2.97 (q, $J$ = 7.6 Hz, 2 H, $CH_2$), 1.33 (t, $J$ = 7.6 Hz, 3H, $CH_3$) ppm.



**(3-Methylbut-2-en-1-yl)(phenyl)sulfane**[19, 26] (**5s**)

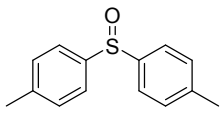
Slight yellow liquid; $^1$H NMR (400 MHz, $CDCl_3$); $\delta$ = 7.87 (d, $J$ = 9.2 Hz, 2H, Ar-H), 7.68-7.63 (m, 1H, Ar-H), 7.58-7.54 (m, 2H, Ar-H), 5.85-5.74 (m, 1H), 5.35 (dd, $J$ = 9.2, 1.2 Hz, 1H), 5.18 (dd, $J$ = 16, 1.2 Hz, 1H, $CH_2$-H), 3.82 (d, $J$ = 7.6 Hz, 2 H, $CH_2$) ppm.

**Part 4: symmetric sulfoxides**



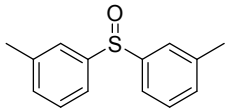
**Diphenyl-sulfoxide**[20, 22] (**6a**)

White solid; M.p.: 72-74 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.66-7.64 (m, 4H, Ar-H), 7.47-7.43 (m, 6H, Ar-H) ppm.



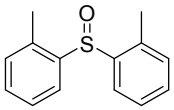
**Di-*p*-tolylsulfoxide**[20] (**6b**)

White solid; M.p.: 93-94 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.52 (d, $J$ = 8.2 Hz, 4H, Ar-H), 7.26 (t, $J$ = 8.0 Hz, 4H, Ar-H), 2.36 (s, 6H, Me-H) ppm.



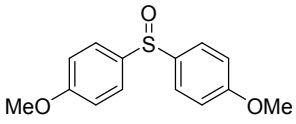
**Di-*m*-tolylsulfoxide**[12] (**6c**)

Slight yellow oil; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.48 (s, 2 H, Ar-H), 7.42 (d, $J$ = 7.9 Hz, 2H, Ar-H), 7.34 (t, $J$ = 7.7 Hz, 2H, Ar-H), 7.23 (d, $J$ = 7.6 Hz, 2H, Ar-H), 2.37 (s, 6H, Me-H) ppm.



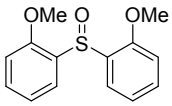
**Di-*o*-tolylsulfoxide**[12] (**6d**)

Slight yellow oil; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.70 (dd, $J$ = 7.0, 2.2 Hz, 2H Ar-H), 7.38-7.33 (m, 4H, Ar-H), 7.20 (dd, $J$ = 6.9, 1.6 Hz, 2H, Ar-H), 2.41 (s, 6H, Me-H) ppm.



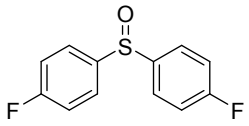

**Bis(4-methoxyphenyl)sulfoxide**[20] (**6e**)

White solid; M.p.: 200-202 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.54-7.52 (m, 4H, Ar-H), 6.97–6.94 (m, 4H, Ar-H), 3.82 (s, 6H, OMe-H) ppm.



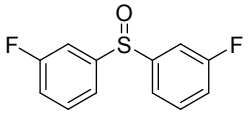

**Bis(2-methoxyphenyl)sulfoxide**[12] (**6f**)

White solid; M.p.: 96-97 $^o$C; $^1$H NMR (400 MHz, $CDCl_3$): $\delta$ = 7.66 (d, $J$ = 7.6 Hz, 2H, Ar-H), 7.39 (t, $J$ = 7.6 Hz, 2H, Ar-H), 7.05 (t, $J$ = 7.5 Hz, 2H, Ar-H), 6.88 (d, $J$ = 8.0 Hz, 2H, Ar-H), 3.81 (s, 6H, OMe-H) ppm.



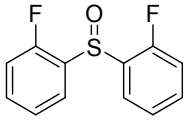

**Bis(4-fluorophenyl)sulfoxide**[20] (**6g**)

Slight yellow oil; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.64-7.61 (m, 4H, Ar-H), 7.18 (t, $J$ = 8.6 Hz, 4H, Ar-H) ppm.



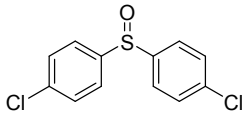

**Bis(3-fluorophenyl)sulfoxide**[12] (**6h**)

White solid; M.p.: 136-138 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.48-7.42 (m, 4H, Ar-H), 7.40 (dt, $J$ = 7.9, 2.0 Hz, 2H, Ar-H), 7.16 (tq, $J$ = 8.2, 1.0 Hz, 2H, Ar-H) ppm.



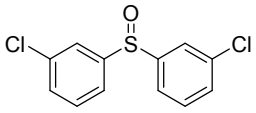
**Bis(2-fluorophenyl)sulfoxide**[12] (**6i**)

White solid; M.p.: 127-129 $^{o}$C; $^{1}$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.85-7.82 (m, 2H, Ar-H), 7.48-7.45 (m, 2H, Ar-H) 7.34 (t, $J$ = 7.6 Hz, 2 H, Ar-H) ppm.



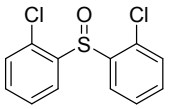
**Bis(4-clorophenyl)sulfoxide**[20] (**6j**)

White solid; M.p.: 143-145 $^{o}$C; $^{1}$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.58-7.55 (m, 4H, Ar-H), 7.46-7.44 (m, 4H, Ar-H) ppm.



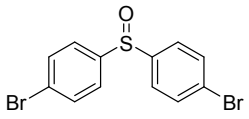
**Bis(3-clorophenyl)sulfoxide**[21] (**6k**)

Colorless liquid; $^{1}$H NMR (400 MHz, $CDCl_3$); $\delta$ = 7.64-7.66 (m, 2H, Ar-H), 7.51-7.53 (m, 3H, Ar-H), 7.41-7.44 (m, 3H, Ar-H) ppm.



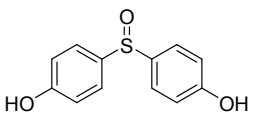
**Bis(2-chlorophenyl)sulfoxide**[12] (**6l**)

Colorless liquid; $^{1}$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.46 (dd, $J$ = 7.9, 1.4 Hz, 2H, Ar-H), 7.24 (td, $J$ = 7.8, 1.2 Hz, 2 H, Ar-H), 7.20 (td, $J$ = 7.5, 1.4 Hz, 2H, Ar-H), 7.15 (dd, $J$ = 7.7, 1.7 Hz, 2H, Ar-H) ppm.



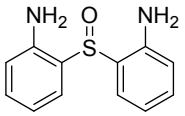
**Bis(4-bromophenyl)sulfoxide**[20] (**6m**)

White solid; M.p.: 150 $^{o}$C; $^{1}$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.62-7.59 (m, 4H, Ar-H), 7.50-7.48 (m, 4H, Ar-H) ppm.



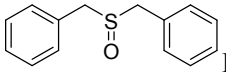
**4,4'-Thiodiphenol**[22] (**6n**)

White solid; M.p.: 201 °C; $^1$H NMR (600 MHz, $CD_3OD$): $\delta$ = 7.45-7.42 (m, 4H, Ar-H), 6.91-6.88 (m, 4H, Ar-H) , 4.83 (s, 2H, OH-H) ppm.



**2,2'-Sulfinyldianiline**[33] (**6o**)

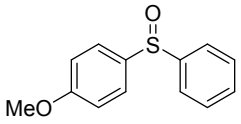
Colorless liquid; $^1$H NMR (400 MHz, $CDCl_3$); $\delta$ = 7.26 (d, $J$ = 2.4 Hz, 2H, Ar-H), 7.24 (t, $J$ = 2.4 Hz, 2H, Ar-H), 6.75 (t, $J$ = 7.6 Hz, 2H, Ar-H), 6. 68 (d, $J$ = 8.0 Hz, 2H, Ar-H), 4.81 (s, 4H) ppm.



**Dibenzylsulfoxide**[23] (**6p**)

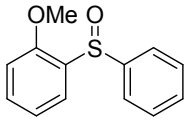
White solid; M.p.: 130-132 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.39-7.34 (m, 6H, Ar-H), 7.30-7.28 (m, 4H, Ar-H), 3.93 (q, $J$ = 8.8 Hz, 4H, $CH_2$-H) ppm.

**Part 5: asymmetric sulfoxides**



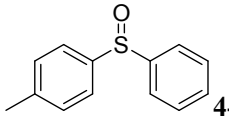
**(4-Methoxyphenyl)(phenyl)sulfoxide**[24] (**7a**)

White solid; M.p.: 63-64 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.92 (dt, $J$ = 3.6, 1.2 Hz, 2H, Ar-H), 7.88 (dd, $J$ = 4.8, 2.0 Hz, 2H, Ar-H), 7.55-7.50 (m, 1H, Ar-H), 7.49-7.45 (m, 2H, Ar-H), 6.98 (dt, $J$ = 4.8, 2.4 Hz, 2H), 3.81 (s, 3H, OMe-H) ppm.



**2-Methoxy-diphenyl sulfoxide**[25] (**7b**)

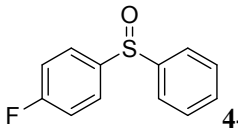
Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.91 (d, $J$ = 1.7 Hz, 1 H, Ar-H), 7.72-7.71 (m, 2 H, Ar-H), 7.42-7.40 (m, 4 H, Ar-H), 7.17 (td, $J$ = 7.6, 0.7 Hz, 1 H, Ar-H ), 6.86 (d, $J$ = 8.2 Hz, 1 H, Ar-H), 3.81 (s, 3H, OMe-H) ppm.



**4-Methyldiphenyl sulfoxide**[25] (**7c**)

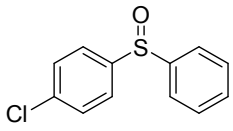
White solid; M.p.: 63-65 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.64-7.62 (m, 2 H, Ar-H), 7.45-

7.44 (m, 3 H, Ar-H), 7.27 (s, 1 H, Ar-H), 7.26 (s, 1H, Ar-H), 2.37 (s, 3 H, Me-H) ppm.



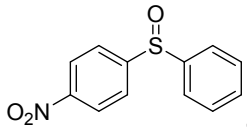
**4-Florodiphenyl sulfoxide**[24] (**7d**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.66-7.63 (m, 4 H, Ar-H), 7.49-7.46 (m, 3 H, Ar-H), 7.17 (t, $J$ = 8.7 Hz, 2 H, Ar-H) ppm.



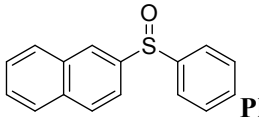
**4-Clorodiphenyl sulfoxide**[24] (**7e**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.65-7.63 (m, 2 H, Ar-H), 7.60 (d, $J$ = 8.6 Hz, 2 H, Ar-H), 7.47-7.46 (m, 3 H, Ar-H), 7.44 (d, $J$ = 8.7 Hz, 2 H, Ar-H) ppm.



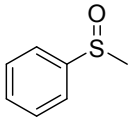
**4-Nitrodiphenyl sulfoxide**[26] (**7f**)

Light yellow solid; M.p.: 84-86 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 8.33 (d, $J$ = 8.9 Hz, 2 H, Ar-H), 7.85 (d, $J$ = 8.9 Hz, 2 H, Ar-H), 7.69-7.67 (m, 2 H, Ar-H), 7.51-7.50 (m, 3H, Ar-H) ppm.



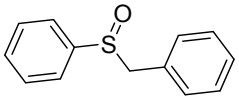
**Phenyl naphyl sulfides**[24] (**7g**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 8.23-8.21 (m, 2 H, Ar-H), 7.98 (d, $J$ = 8.2 Hz, 1 H, Ar-H), 7.69-7.67 (m, 2 H, Ar-H), 7.67 (t, $J$ = 7.3 Hz, 1 H, Ar-H), 7.55-7.52 (m, 2 H, Ar-H), 7.40-7.38 (m, 3 H, Ar-H) ppm.



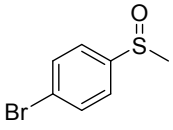
**Methyl(phenyl)sulfoxide**[27] (**7h**)

White solid; M.p.: 35-37 $^o$C; $^1$H NMR (400 MHz, $CDCl_3$): $\delta$ = 7.57 (d, $J$ = 8.0 Hz, 2H, Ar-H), 7.46 (d, $J$ = 2.4 Hz, 1H, Ar-H), 7.44 (d, $J$ = 2.4 Hz, 2H, Ar-H), 2.65 (s, 3H) ppm.



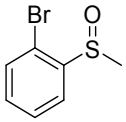
**Benzyl(phenyl)sulfoxide**[27] (**7i**)

White solid; M.p.: 126-128 $^{o}$C; $^{1}$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.47-7.45 (m, 1H, Ar-H), 7.44-7.41 (m, 2 H, Ar-H), 7. 38-7.36 (m, 2H, Ar-H), 7.29-7.28 (m, 1H, Ar-H), 7.26-7.24 (m, 2H, Ar-H), 6.98 (t, $J$ = 7.1 Hz, 2H, Ar-H ), 4.11 (q, $J$ = 12.6 Hz, 2H, $CH_2$-H) ppm.



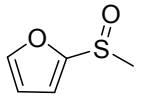
**(4-Bromophenyl)(methyl)sulfoxide**[28] (**7j**)

White solid; M.p.: 88-89 $^{o}$C; $^{1}$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.68-7.66 (m, 2H, Ar-H), 7.54-7.51 (m, 2H, Ar-H), 2.72 (s, Me-H) ppm.



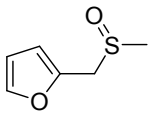
**(2-Bromophenyl)(methyl)sulfoxide**[29] (**7k**)

Slight yellow oil; $^{1}$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.96 (dd, $J$ =7.8, 1.6 Hz, 1H, Ar-H), 7.60-7.56 (m, 2H, Ar-H), 7.39 (td, $J$ =7.6, 1.6 Hz, 1H, Ar-H), 2.82 (s, Me-H) ppm.



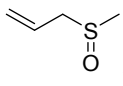
**2-((Methylsulfinyl)methyl)furan**[30] (**7l**)

Slight yellow oil; $^{1}$H NMR (600 MHz, $CD_3Cl$): $\delta$ = 7.43 (dd, $J$ = 1.2, 0.8 Hz, 1H, Ar-H), 6.41-6.39 (m, 2 H, Ar-H), 2.52 (s, 3 H, Me-H) ppm.



**2-((methylsulfinyl)methyl)furan**[31] (**7m**)

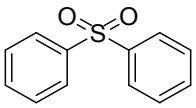
Slight yellow liquid; $^{1}$H NMR (400 MHz, $CDCl_3$); $\delta$ = 7.44 (s, 1H), 6.41 (d, $J$ = 3.2 Hz, 1H), 6.39 (t, $J$ = 2 Hz, 1H), 4.01 (q, $J$ = 14 Hz, 2H), 2.53 (s, 3H) ppm.



**3-(methylsulfinyl)prop-1-ene**[32] (**7n**)

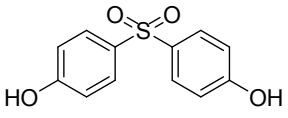
Slight yellow oil; $^1$H NMR (400 MHz, $CDCl_3$): $\delta$ = 5.96 (td, J = 10.0, 7.6 Hz, 1H), 5.48-5.38 (m, 2H), 3.54-3.41 (m, 2H), 2.56 (s, 3H) ppm.

**Part 6: sulfones**



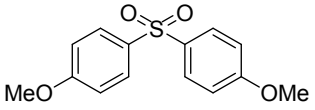
**Diphenyl sulfone**[34, 37] (**8a**)

White solid; M.p.: 122-124 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.96 (dt, $J$ = 10.6, 1.7 Hz, 4 H, Ar-H), 7.59 (tt, $J$ = 11.0, 4.2 Hz, 2 H, Ar-H), 7.53-7.48 (m, 4 H, Ar-H) ppm.



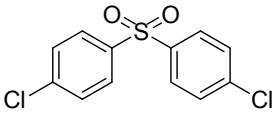
**4, 4'-sulfonyldiphenol**[34] (**8b**)

White solid; M.p.: 240-242 $^o$C; $^1$H NMR (600 MHz, $CD_3OD$): $\delta$ = 7.73 (d, $J$ = 8.8 Hz, 4 H, Ar-H), 6.89 (d, $J$ = 8.8, 4 H, Ar-H) ppm.



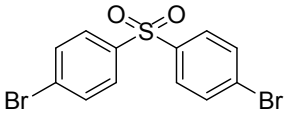
**Bis(methoxy)dipheney sulfone**[34, 35] (**8c**)

White solid; M.p.: 129-130 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.86 (d, $J$ = 13.4 Hz, 4 H, Ar-H), 6.97 (d, $J$ = 22.3, 4 H, Ar-H) 3.83 (s, 6 H, OMe-H) ppm.



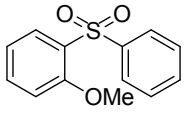
**Bis(cloro)diphenyl sulfone**[35, 36] (**8d**)

White solid; M.p.: 148-150 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.87 (d, $J$ = 13.0 Hz, 4 H, Ar-H), 7.50 (d, $J$ = 13.0, 4 H, Ar-H) ppm.



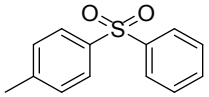
**Bis(bromo)diphenyl sulfone**[35] (**8e**)

White solid; M.p.: 158-160 $^o$C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.80 (d, $J$ = 20.0 Hz, 4 H, Ar-H), 7.67 (d, $J$ = 13.1, 4 H, Ar-H) 3.83 (s, 6 H, OMe-H) ppm.



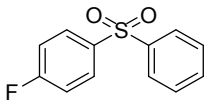
**2-Methoxyphenyl phenyl sulfone**[37] (**8g**)

White solid; M.p.: 120-122 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 8.17 (dd, $J$ = 11.8, 2.6 Hz, 1 H, Ar-H), 7.99-7.96 (m, 2 H, Ar-H), 7.59-7.52 (m, 2 H, Ar-H), 7.50-7.46 (m, 2 H, Ar-H), 7.13 (td, $J$ = 11.8, 1.3 Hz, 1 H, Ar-H), 6.91 (d, $J$ = 12.4 Hz, 1 H, Ar-H), 3.75 (s, 3 H, OMe-H) ppm.



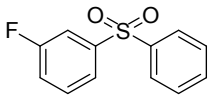
**4-Methyl diphenyl sulfone**[36, 37] (**8h**)

White solid; M.p.: 120-122 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.94-7.92 (m, 2 H, Ar-H), 7.84 (d, $J$ = 12.4 Hz, 2 H, Ar-H), 7.56-7.52 (m, 1 H, Ar-H), 7.30 (d, $J$ = 12.2 Hz, 2 H, Ar-H), 2.39 (s, 3 H, Me-H) ppm.



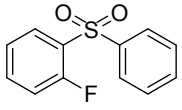
**4-Florophenyl phenyl sulfone**[37, 38] (**8i**)

White solid; M.p.: 110-112 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.98-7.92 (m, 4 H, Ar-H), 7.60 (tt, $J$ = 11.0, 4.0 Hz, 1 H, Ar-H), 7.54-7.49 (m, 2 H, Ar-H), 7.20 (t, $J$ = 12.7 Hz, 2 H, Ar-H) ppm.



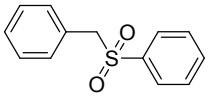
**3-florophenyl phenyl sulfone**[38] (**8j**)

Colorless liquid; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.97-7.94 (m, 2 H, Ar-H), 7.76 (dq, $J$ = 11.8, 1.5 Hz, 1 H, Ar-H), 7.66 (dt, $J$ = 11.5, 3.6 Hz, 1 H, Ar-H), 7.62 (tt, $J$ = 11.0, 3.8 Hz, 1 H, Ar-H), 7.55-7.52 (m, 2 H, Ar-H), 7.51-7.47 (m, 1 H, Ar-H), 7.28-7.23 (m, 1 H, Ar-H) ppm.



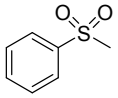
**2-florophenyl phenyl sulfone**[39] (**8k**)

White solid; M.p.: 95-97 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 8.14 (td, $J$ = 11.7, 2.7 Hz, 1 H, Ar-H), 8.03-8.00 (m, 2 H, Ar-H), 7.64-7.60 (m, 1 H, Ar-H), 7.59-7.56 (m, 1 H, Ar-H), 7.55 (t, $J$ = 11.9 Hz, 2 H, Ar-H), 7.34 (td, $J$ = 11.6, 1.5 Hz, 1 H, Ar-H), 7.13-7.08 (m, 1 H, Ar-H) ppm.



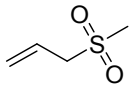
**Benzyl phenyl sulfone**[36] (**8l**)

White solid; M.p.: 146-148 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.64 (dd, $J$ = 12.4, 1.6 Hz, 2 H, Ar-H), 7.60 (d, $J$ = 11.2 Hz, 1 H, Ar-H), 7.46 (t, $J$ = 11.8 Hz, 2 H, Ar-H), 7.34 (tt, $J$ = 11.0, 7.7 Hz, 1 H, Ar-H), 7.27-7.23 (m, 2 H, Ar-H), 7.09-7.07 (m, 2 H, Ar-H), 4.31 (s, 2 H, $CH_2$-H) ppm.



**Phenyl methyl sulfone**[36] (**8m**)

White solid; M.p.: 85-87 °C; $^1$H NMR (600 MHz, $CDCl_3$): $\delta$ = 7.97-7.95 (m, 2 H, Ar-H), 7.69 (tt, $J$ = 11.1, 3.3 Hz, 1 H, Ar-H), 7.60-7.57 (t, $J$ = 11.8 Hz, 2 H, Ar-H), 3.06 (s, 3 H, $CH_3$-H) ppm.



**3-(methylsulfonyl)prop-1-ene**[40] (**8n**)

Yellow liquid; $^1$H NMR (400 MHz, $CDCl_3$); $\delta$ = 6.03-5.92 (m, 1H), 5.51 (d, $J$ = 12.0 Hz, 1H), 5.46 (d, $J$ = 16.0 Hz, 1H), 3.73 (d, $J$ = 7.6 Hz, 2H), 2.88 (s, 3H) ppm.

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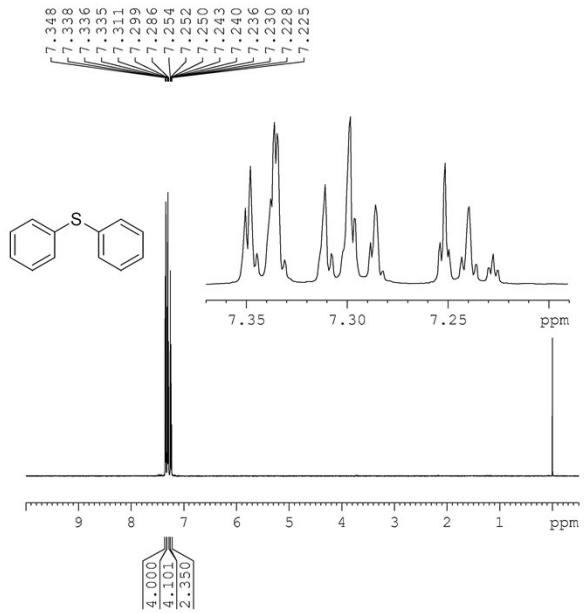
## 4 $^{1}$H and $^{13}$C NMR spectra

### Part 1: symmetric sulfides

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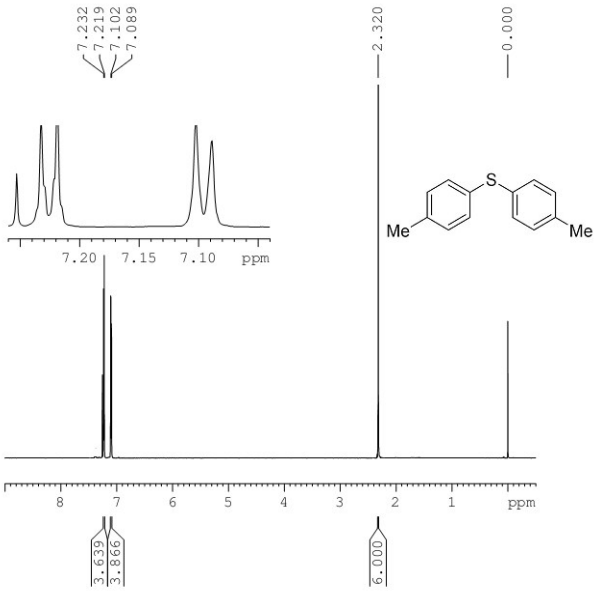


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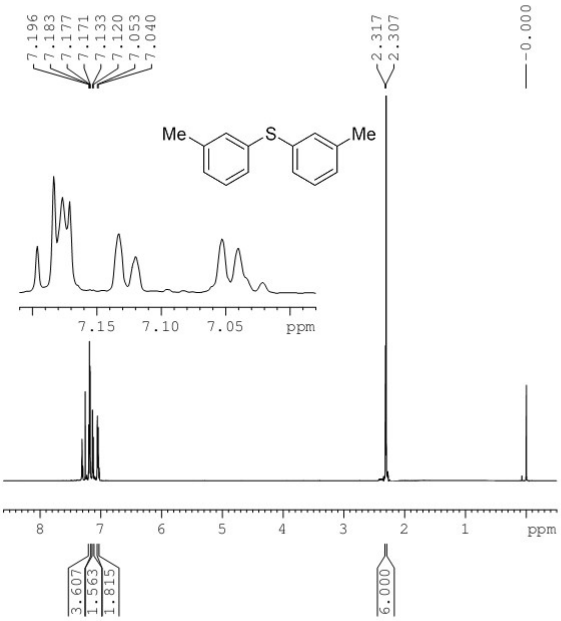


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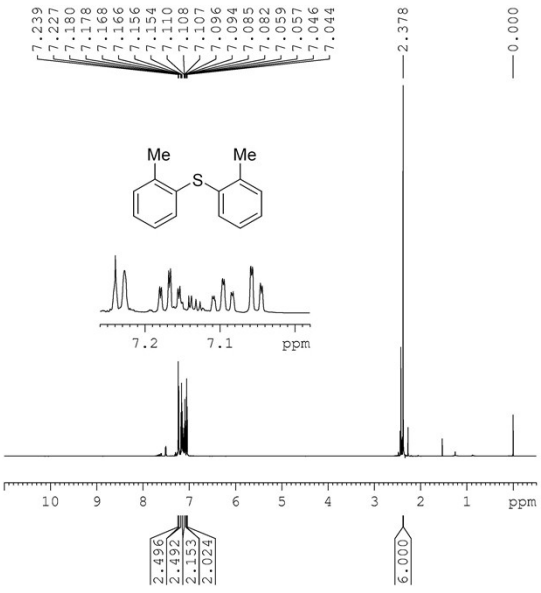


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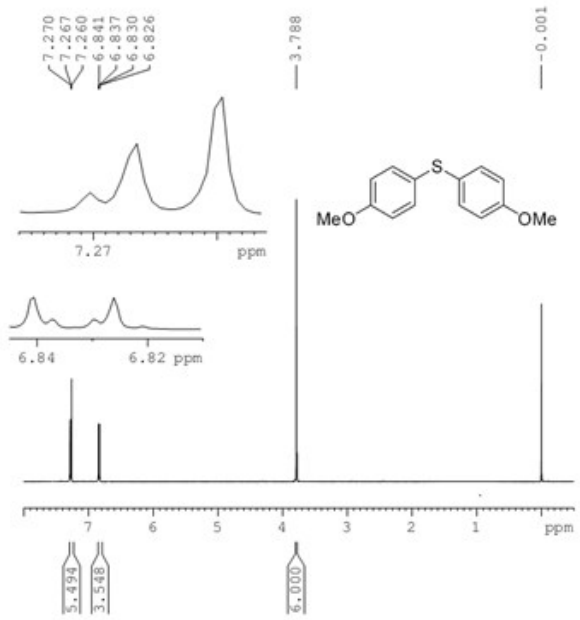


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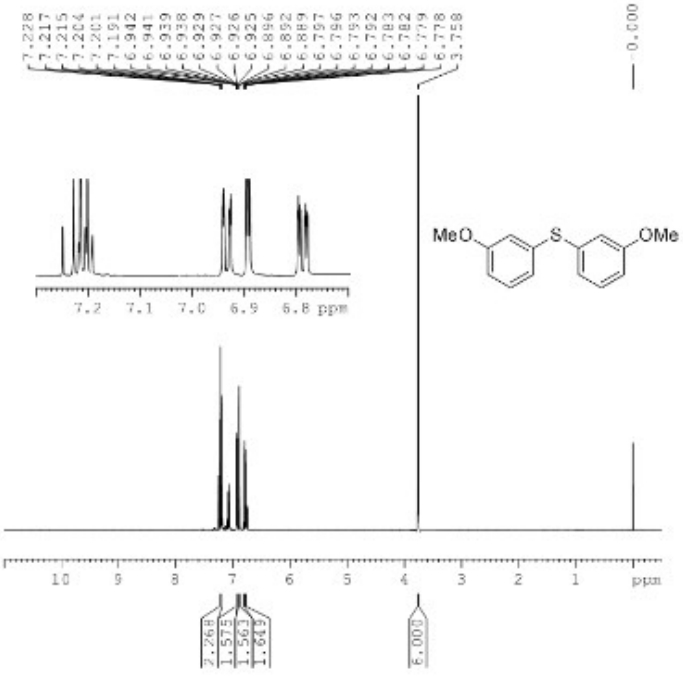


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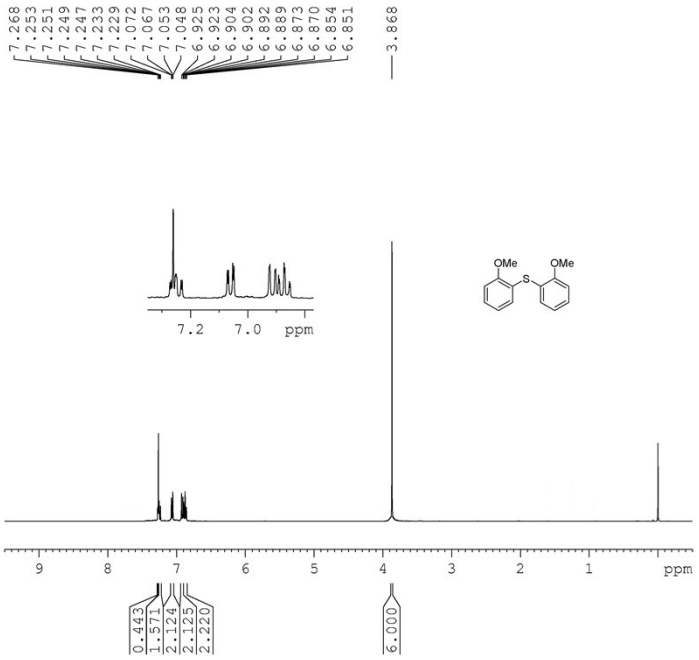


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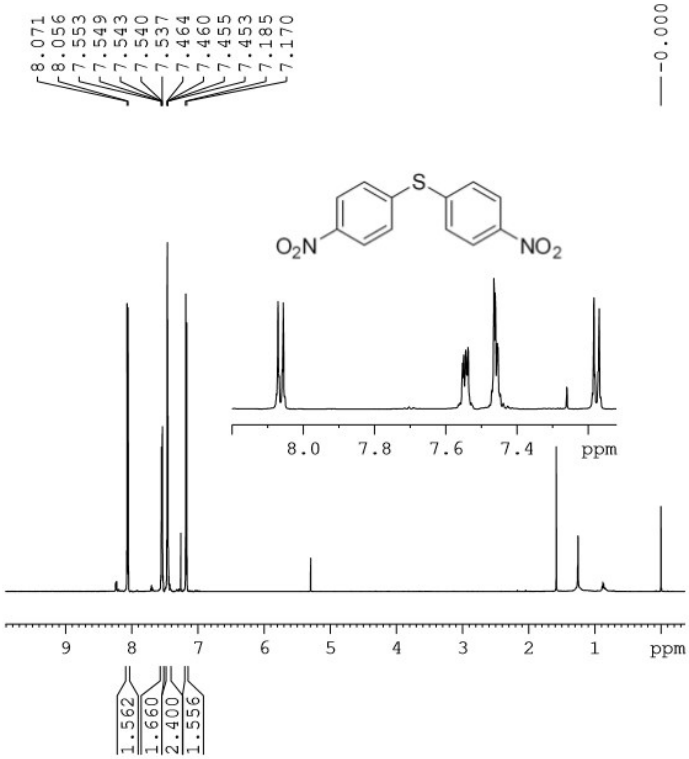


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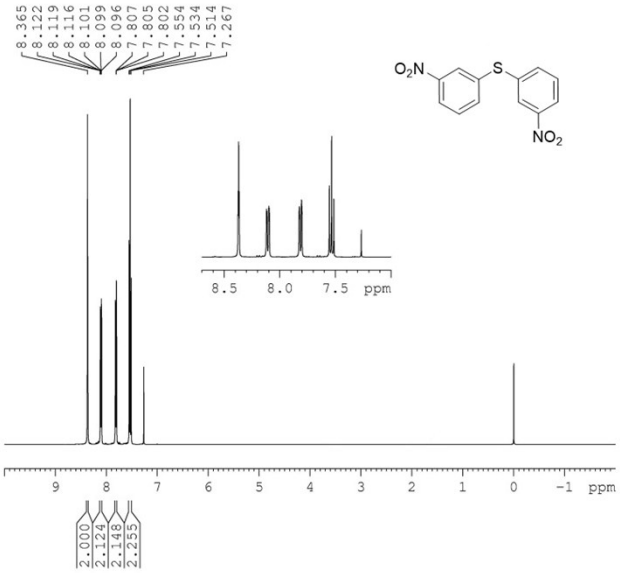
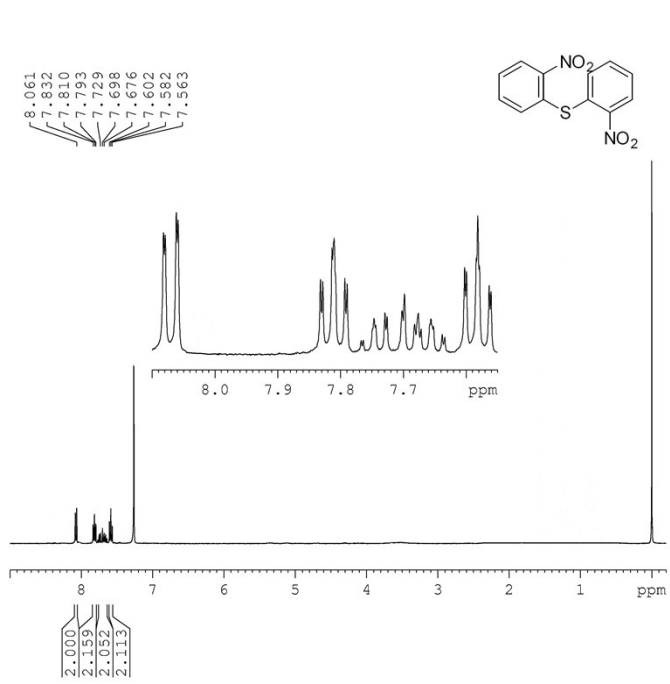
PC                    1.00
```



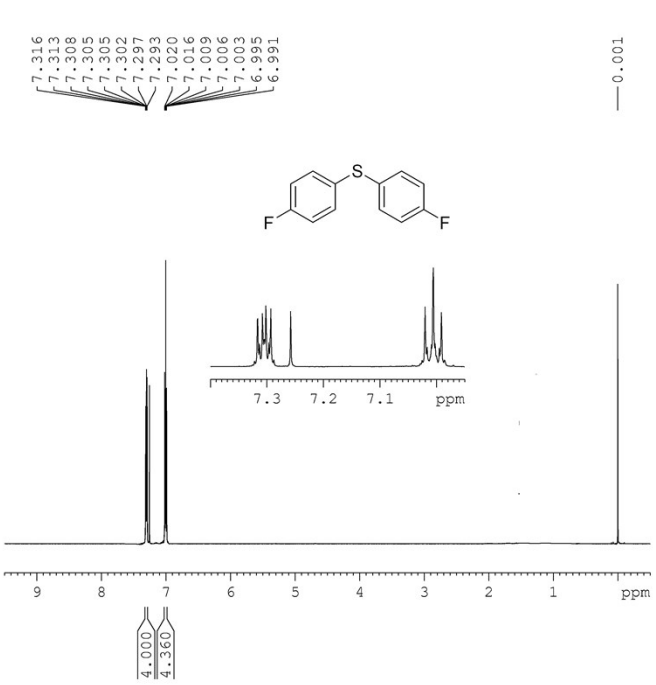

```
NAME      2016-07-06 TYUT-CHH
EXPNO               10
PROCNO               1
Date_         20160706
Time             20.15
INSTRUM          spect
PROBHD   5 mm PABBO BB/
PULPROG           zg30
TD               65536
SOLVENT          CDCl3
NS                  16
DS                   2
SWH           8012.820 Hz
FIDRES        0.122266 Hz
AQ           4.0894966 sec
RG               74.25
DW             62.400 usec
DE              6.50 usec
TE             295.3 K
D1          1.00000000 sec
TD0                  1

======== CHANNEL f1 ========
SFO1       400.1324710 MHz
NUC1               1H
P1               9.70 usec
SI              65536
SF         400.1300072 MHz
WDW                EM
SSB                 0
LB              0.30 Hz
GB                  0
PC               1.00
```



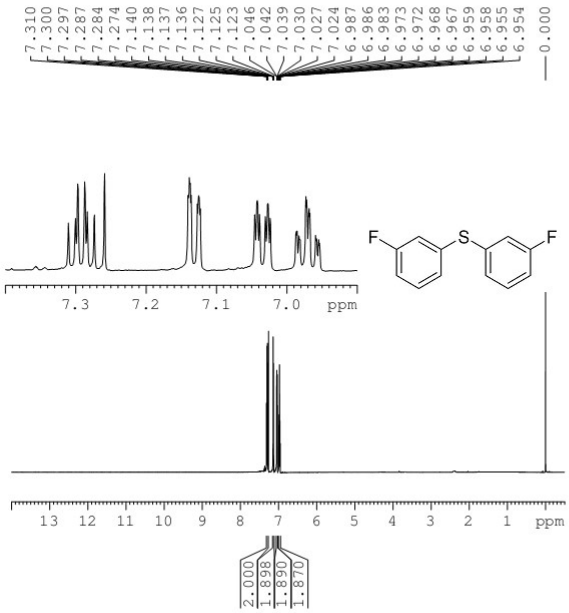

```
NAME      2016-07-06 TYUT-CHH
EXPNO               10
PROCNO               1
Date_         20160706
Time             20.23
INSTRUM          spect
PROBHD   5 mm PABBO BB/
PULPROG           zg30
TD               65536
SOLVENT          CDCl3
NS                  16
DS                   2
SWH           8012.820 Hz
FIDRES        0.122266 Hz
AQ           4.0894966 sec
RG              107.24
DW             62.400 usec
DE              6.50 usec
TE             295.4 K
D1          1.00000000 sec
TD0                  1

======== CHANNEL f1 ========
SFO1       400.1324710 MHz
NUC1               1H
P1               9.70 usec
SI              65536
SF         400.1300091 MHz
WDW                EM
SSB                 0
LB              0.30 Hz
GB                  0
PC               1.00
```



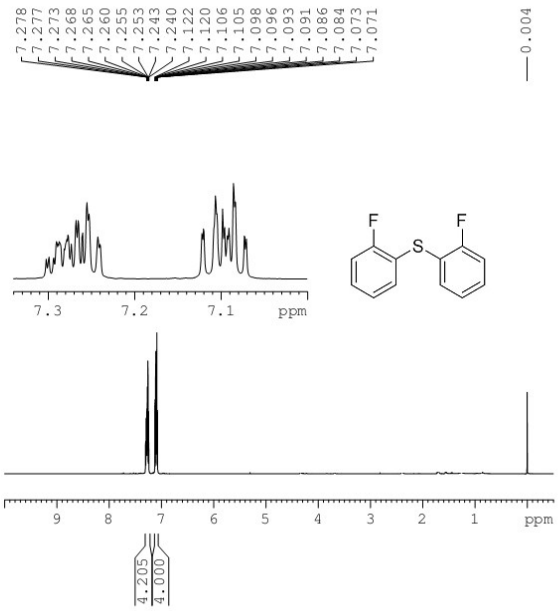

```
NAME      20140827zhangrui
EXPNO                    2
PROCNO                   1
Date_             20140827
Time                 10.05
INSTRUM              spect
PROBHD   5 mm PABBO BB-
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                     181
DW                40.533 usec
DE                 6.50 usec
TE                 299.9 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  12.60 usec
SI                   32768
SF           600.1300178 MHz
WDW                     EM
SSB                      0
LB                  0.10 Hz
GB                       0
PC                    1.00
```



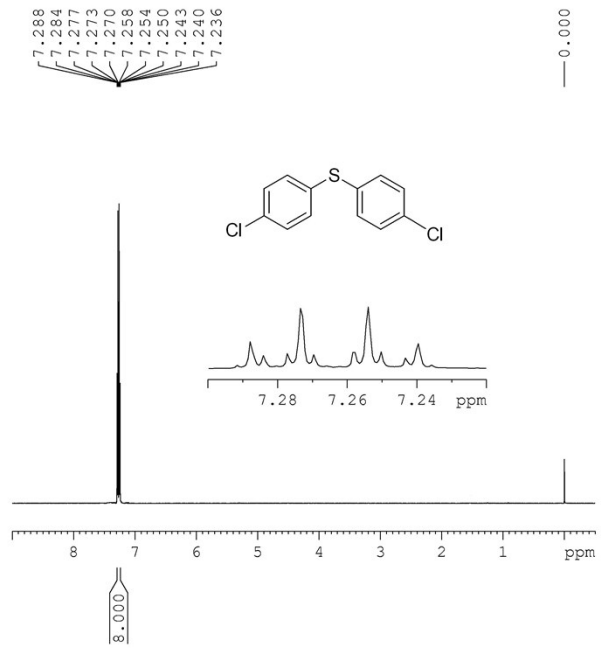

```
NAME      20140912zhangrui
EXPNO                    5
PROCNO                   1
Date_             20140912
Time                 11.24
INSTRUM              spect
PROBHD   5 mm PABBO BB-
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                     181
DW                40.533 usec
DE                 6.50 usec
TE                 296.3 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  12.60 usec
SI                   32768
SF           600.1300172 MHz
WDW                     EM
SSB                      0
LB                  0.10 Hz
GB                       0
PC                    1.00
```



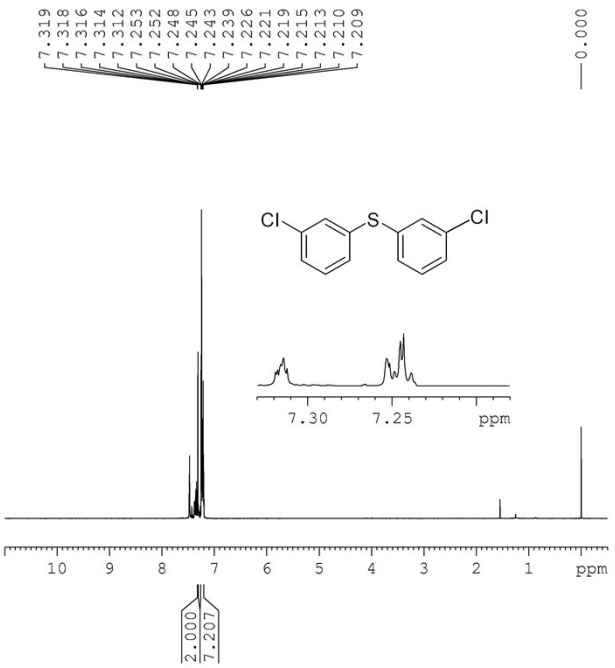

```
NAME      20140912zhangrui
EXPNO                    6
PROCNO                   1
Date_             20140912
Time                 11.28
INSTRUM              spect
PROBHD   5 mm PABBO BB-
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                     128
DW                40.533 usec
DE                 6.50 usec
TE                 296.2 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  12.60 usec
SI                   32768
SF            600.1300164 MHz
WDW                     EM
SSB                      0
LB                  0.10 Hz
GB                       0
PC                    1.00
```



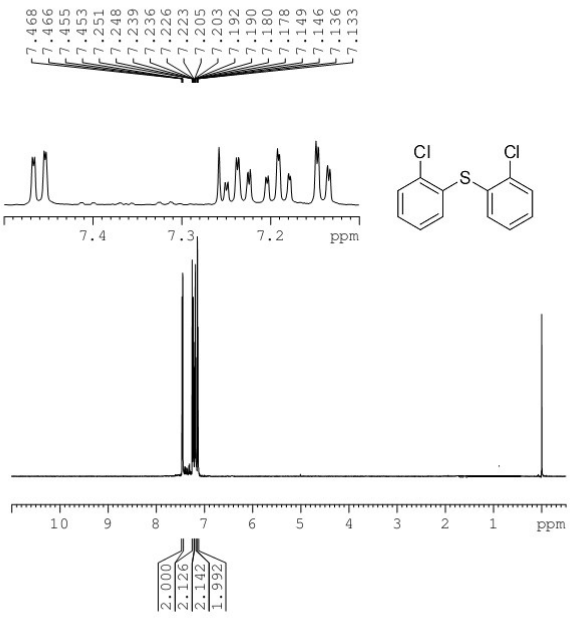

```
NAME      20141219baiyana
EXPNO                  10
PROCNO                  1
Date_           20141219
Time                10.44
INSTRUM             spect
PROBHD   5 mm PADUL 13C
PULPROG              zg30
TD                  65536
SOLVENT             CDCl3
NS                      4
DS                      2
SWH             12335.526 Hz
FIDRES           0.188225 Hz
AQ              2.6564426 sec
RG                    203
DW               40.533 usec
DE                 6.50 usec
TE                 289.7 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  14.00 usec
SI                   32768
SF            600.1300190 MHz
WDW                     EM
SSB                      0
LB                 -0.10 Hz
GB                       0
PC                    1.00
```



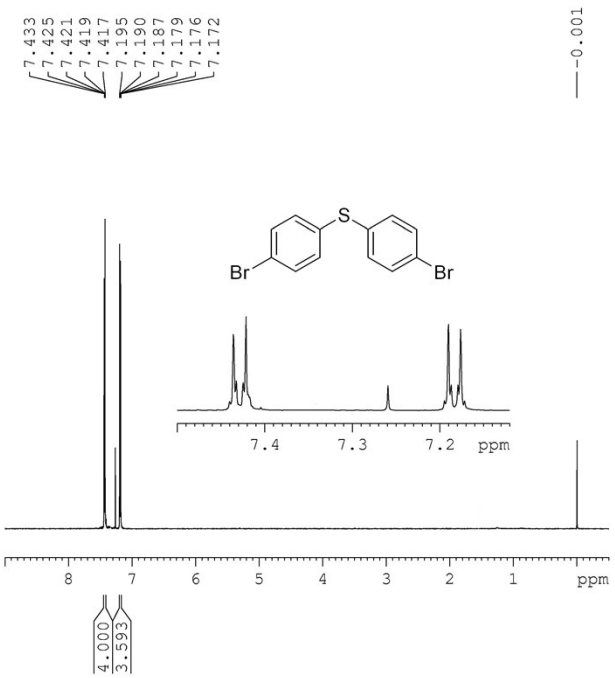

```
NAME      20141219baiyana
EXPNO                  11
PROCNO                  1
Date_           20141219
Time               10.49
INSTRUM            spect
PROBHD   5 mm PADUL 13C
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     2
SWH           12335.526 Hz
FIDRES         0.188225 Hz
AQ            2.6564426 sec
RG                   203
DW              40.533 usec
DE               6.50 usec
TE               289.8 K
D1            1.00000000 sec

======== CHANNEL f1 ========
NUC1                   1H
P1                 14.00 usec
SI                 32768
SF           600.1300225 MHz
WDW                   EM
SSB                    0
LB                 -0.10 Hz
GB                     0
PC                  1.00
```




```
NAME      20140918zhangrui
EXPNO                    2
PROCNO                   1
Date_             20140918
Time                 15.44
INSTRUM              spect
PROBHD   5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH             12335.526 Hz
FIDRES           0.188225 Hz
AQ              2.6564426 sec
RG                     203
DW                40.533 usec
DE                 6.50 usec
TE                 296.5 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                   1H
P1                 14.00 usec
SI                 32768
SF           600.1300188 MHz
WDW                   EM
SSB                    0
LB                  0.10 Hz
GB                     0
PC                  1.00
```

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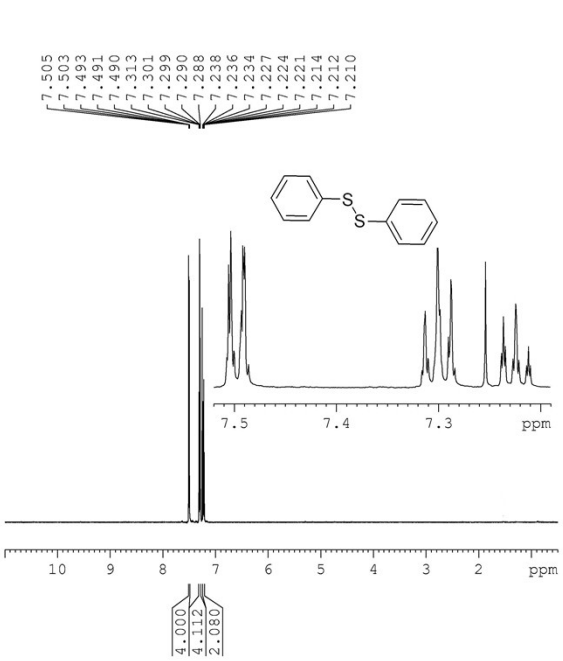
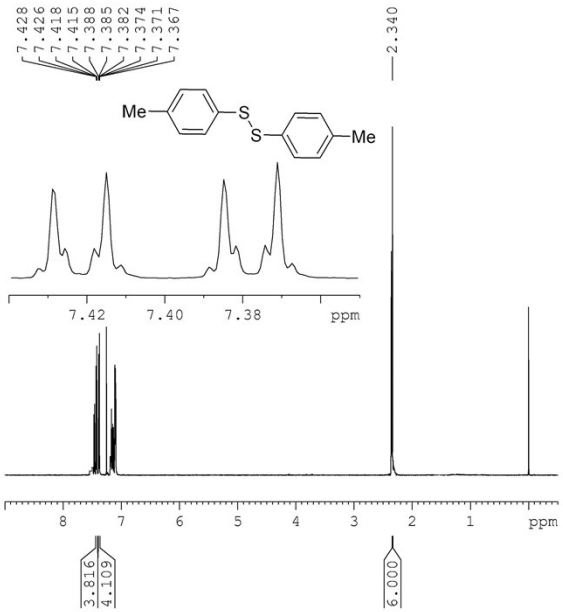
| | |
|---|---|
| NAME | 20141219baiyana |
| EXPNO | 9 |
| PROCNO | 1 |
| Date_ | 20141219 |
| Time | 10.41 |
| INSTRUM | spect |
| PROBHD | 5 mm PADUL 13C |
| PULPROG | zg30 |
| TD | 65536 |
| SOLVENT | CDCl3 |
| NS | 4 |
| DS | 2 |
| SWH | 12335.526 Hz |
| FIDRES | 0.188225 Hz |
| AQ | 2.6564426 sec |
| RG | 203 |
| DW | 40.533 usec |
| DE | 6.50 usec |
| TE | 289.7 K |
| D1 | 1.00000000 sec |
| ======== CHANNEL f1 ======== | |
| NUC1 | 1H |
| P1 | 14.00 usec |
| SI | 32768 |
| SF | 600.1300182 MHz |
| WDW | EM |
| SSB | 0 |
| LB | -0.10 Hz |
| GB | 0 |
| PC | 1.00 |

**Part 2: symmetric disulfides**



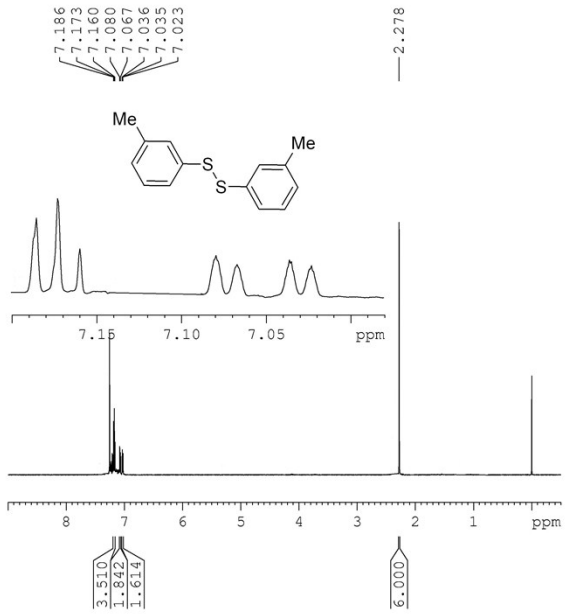

```
NAME        20150113zhaojinjin
EXPNO                        1
PROCNO                       1
Date_             20150113
Time                    14.57
INSTRUM                 spect
PROBHD     5 mm PADUL 13C
PULPROG                  zg30
TD                      65536
SOLVENT                 CDCl3
NS                           4
DS                           2
SWH                12335.526 Hz
FIDRES              0.188225 Hz
AQ                 2.6564426 sec
RG                         203
DW                    40.533 usec
DE                     6.50 usec
TE                     294.8 K
D1                1.00000000 sec

======== CHANNEL f1 ========
NUC1                        1H
P1                     14.00 usec
SI                         32768
SF               600.1300213 MHz
WDW                        EM
SSB                         0
LB                     -0.10 Hz
GB                          0
PC                      1.00
```



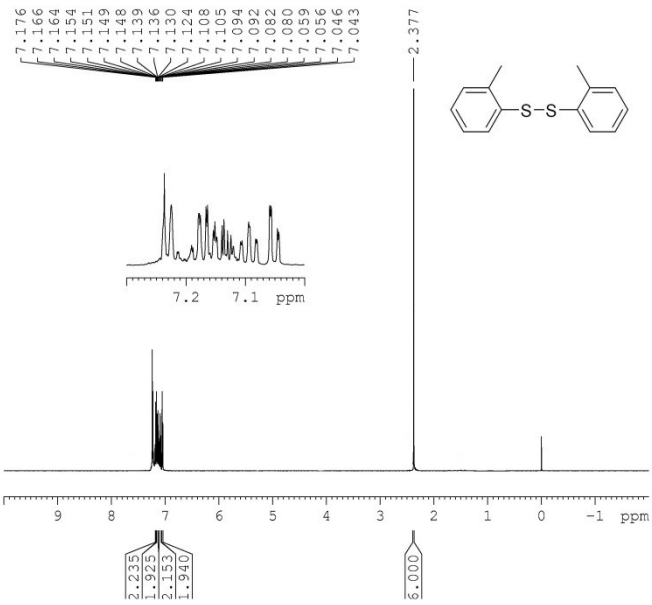

```
NAME        20150121wangmengge
EXPNO                        6
PROCNO                       1
Date_             20150121
Time                    10.41
INSTRUM                 spect
PROBHD     5 mm PADUL 13C
PULPROG                  zg30
TD                      65536
SOLVENT                 CDCl3
NS                           4
DS                           2
SWH                12335.526 Hz
FIDRES              0.188225 Hz
AQ                 2.6564426 sec
RG                         181
DW                    40.533 usec
DE                     6.50 usec
TE                     291.1 K
D1                1.00000000 sec

======== CHANNEL f1 ========
NUC1                        1H
P1                     14.00 usec
SI                         32768
SF               600.1300236 MHz
WDW                        EM
SSB                         0
LB                     -0.10 Hz
GB                          0
PC                      1.00
```



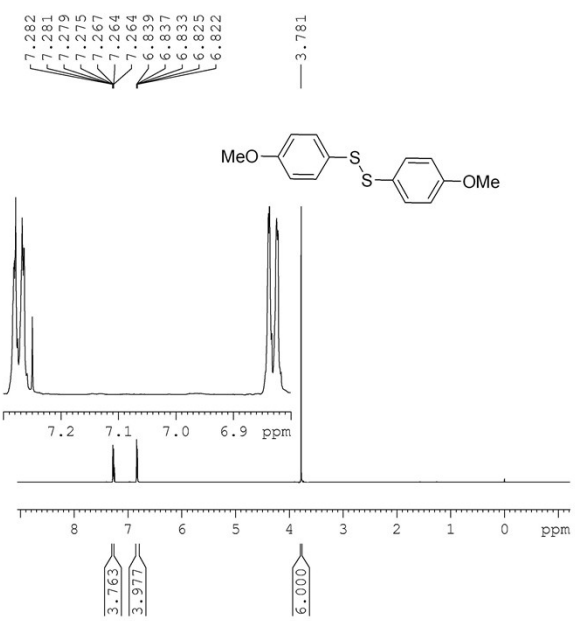

```
NAME      20150121wangmengge
EXPNO                  7
PROCNO                 1
Date_           20150121
Time              10.45
INSTRUM           spect
PROBHD   5 mm PADUL 13C
PULPROG             zg30
TD                65536
SOLVENT           CDCl3
NS                    4
DS                    2
SWH           12335.526 Hz
FIDRES         0.188225 Hz
AQ            2.6564426 sec
RG                  203
DW               40.533 usec
DE                6.50 usec
TE                291.1 K
D1           1.00000000 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                14.00 usec
SI                32768
SF          600.1300212 MHz
WDW                  EM
SSB                   0
LB                -0.10 Hz
GB                    0
PC                 1.00
```



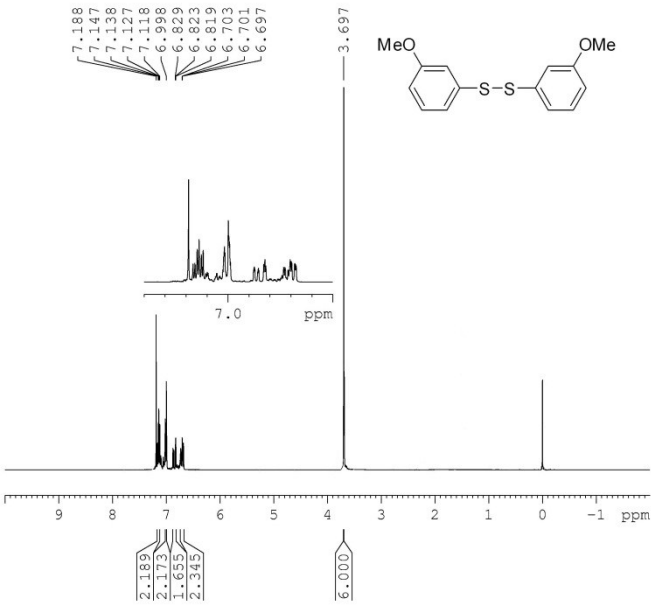

```
NAME      20150121wangmengge
EXPNO                  8
PROCNO                 1
Date_           20150121
Time              10.49
INSTRUM           spect
PROBHD   5 mm PADUL 13C
PULPROG             zg30
TD                65536
SOLVENT           CDCl3
NS                    4
DS                    2
SWH           12335.526 Hz
FIDRES         0.188225 Hz
AQ            2.6564426 sec
RG                 80.6
DW               40.533 usec
DE                6.50 usec
TE                291.1 K
D1           1.00000000 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                14.00 usec
SI                32768
SF          600.1300317 MHz
WDW                  EM
SSB                   0
LB                -0.10 Hz
GB                    0
PC                 1.00
```



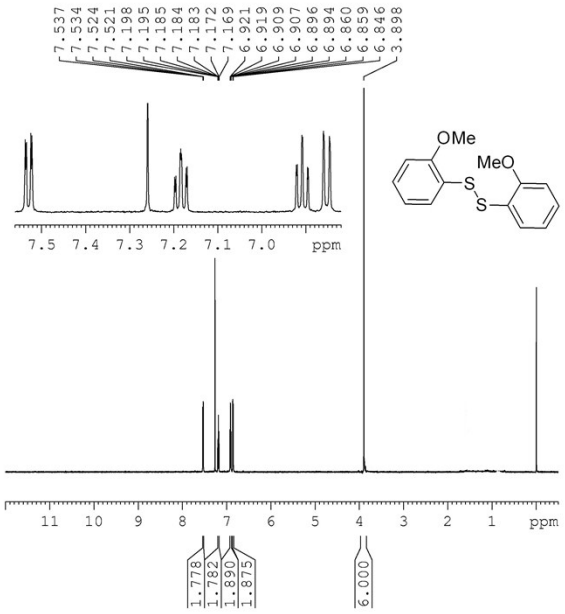

```
NAME        20150121wangmengge
EXPNO                        9
PROCNO                       1
Date_                 20150121
Time                     10.52
INSTRUM                  spect
PROBHD    5 mm PADUL 13C
PULPROG                  zg30
TD                      65536
SOLVENT                 CDCl3
NS                           4
DS                           2
SWH                 12335.526 Hz
FIDRES                0.188225 Hz
AQ                    2.6564426 sec
RG                         80.6
DW                       40.533 usec
DE                        6.50 usec
TE                       291.1 K
D1                  1.00000000 sec

======== CHANNEL f1 ========
NUC1                        1H
P1                       14.00 usec
SI                       32768
SF                600.1300238 MHz
WDW                         EM
SSB                          0
LB                       -0.10 Hz
GB                           0
PC                        1.00
```




```
NAME        2016-07-13 tyut-chh
EXPNO                       10
PROCNO                       1
Date_                 20160714
Time                     2.25
INSTRUM                  spect
PROBHD    5 mm PABBO BB/
PULPROG                  zg30
TD                      65536
SOLVENT                 CDCl3
NS                          16
DS                           2
SWH                  8012.820 Hz
FIDRES                0.122266 Hz
AQ                    4.0894966 sec
RG                         87.46
DW                       62.400 usec
DE                        6.50 usec
TE                       295.6 K
D1                  1.00000000 sec
TD0                          1

======== CHANNEL f1 ========
SFO1                400.1324710 MHz
NUC1                        1H
P1                        9.70 usec
SI                       65536
SF                400.1300389 MHz
WDW                         EM
SSB                          0
LB                        0.30 Hz
GB                           0
PC                        1.00
```

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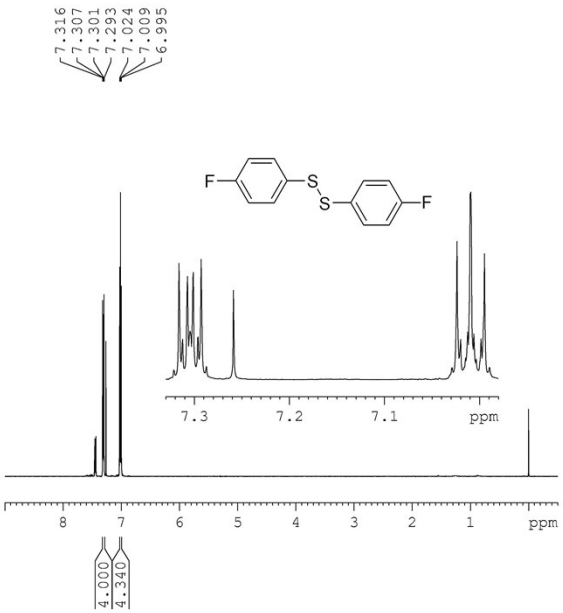
```
NAME        20140926wangqingyu
EXPNO                        7
PROCNO                       1
Date_             20140926
Time                    17.04
INSTRUM                 spect
PROBHD    5 mm PADUL 13C
PULPROG                  zg30
TD                      65536
SOLVENT                 CDCl3
NS                           4
DS                           2
SWH                12335.526 Hz
FIDRES              0.188225 Hz
AQ                 2.6564426 sec
RG                         203
DW                    40.533 usec
DE                     6.50 usec
TE                     298.3 K
D1                1.00000000 sec

======== CHANNEL f1 ========
NUC1                        1H
P1                     14.00 usec
SI                         32768
SF               600.1300184 MHz
WDW                        EM
SSB                         0
LB                     -0.10 Hz
GB                          0
PC                       1.00
```

同

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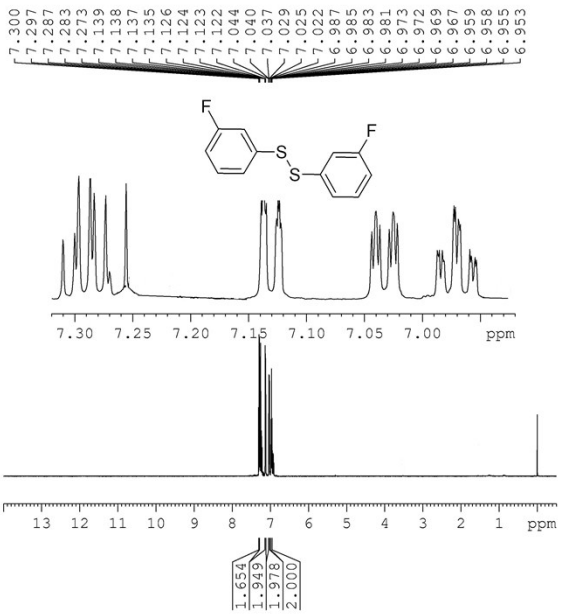
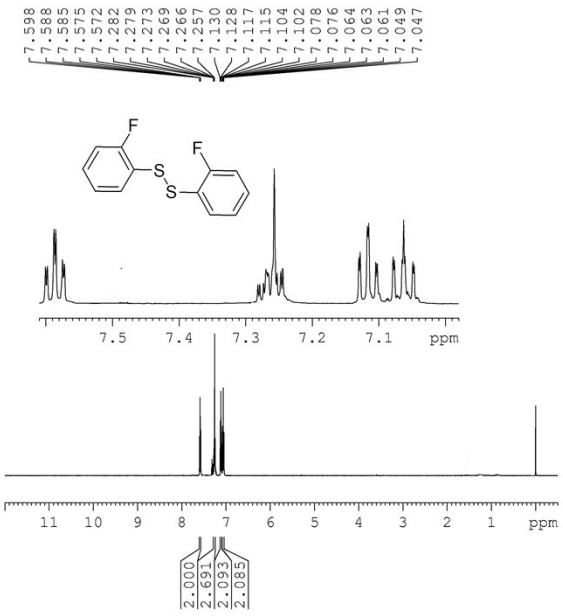
```
NAME        20150309hufei
EXPNO                        4
PROCNO                       1
Date_             20150309
Time                    11.12
INSTRUM                 spect
PROBHD    5 mm PADUL 13C
PULPROG                  zg30
TD                      65536
SOLVENT                 CDCl3
NS                           4
DS                           2
SWH                12335.526 Hz
FIDRES              0.188225 Hz
AQ                 2.6564426 sec
RG                         181
DW                    40.533 usec
DE                     6.50 usec
TE                     290.4 K
D1                1.00000000 sec

======== CHANNEL f1 ========
NUC1                        1H
P1                     14.00 usec
SI                         32768
SF               600.1300187 MHz
WDW                        EM
SSB                         0
LB                     -0.10 Hz
GB                          0
PC                       1.00
```



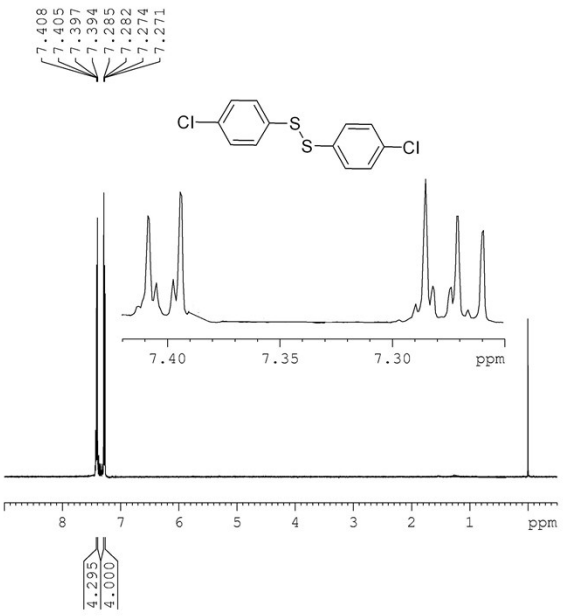

```
NAME          20150309hufei
EXPNO                    5
PROCNO                   1
Date_             20150309
Time                 11.16
INSTRUM              spect
PROBHD    5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                     181
DW                  40.533 usec
DE                   6.50 usec
TE                  290.5 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                   14.00 usec
SI                   32768
SF           600.1300206 MHz
WDW                     EM
SSB                      0
LB                   -0.10 Hz
GB                       0
PC                    1.00
```



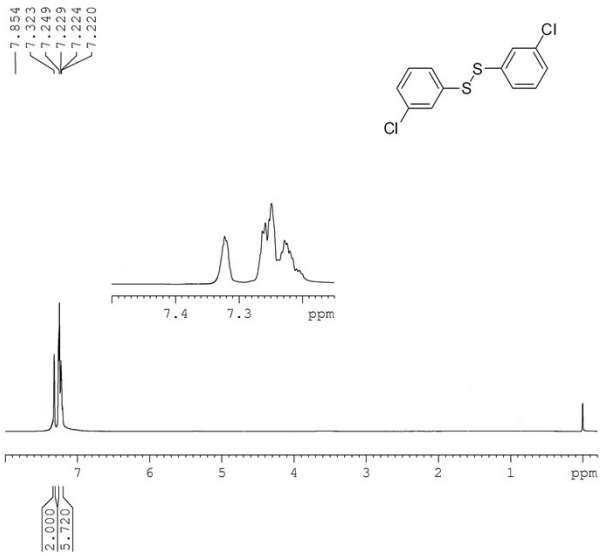

```
NAME          20150309hufei
EXPNO                    6
PROCNO                   1
Date_             20150309
Time                 11.19
INSTRUM              spect
PROBHD    5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                     181
DW                  40.533 usec
DE                   6.50 usec
TE                  290.6 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                   14.00 usec
SI                   32768
SF           600.1300198 MHz
WDW                     EM
SSB                      0
LB                   -0.10 Hz
GB                       0
PC                    1.00
```



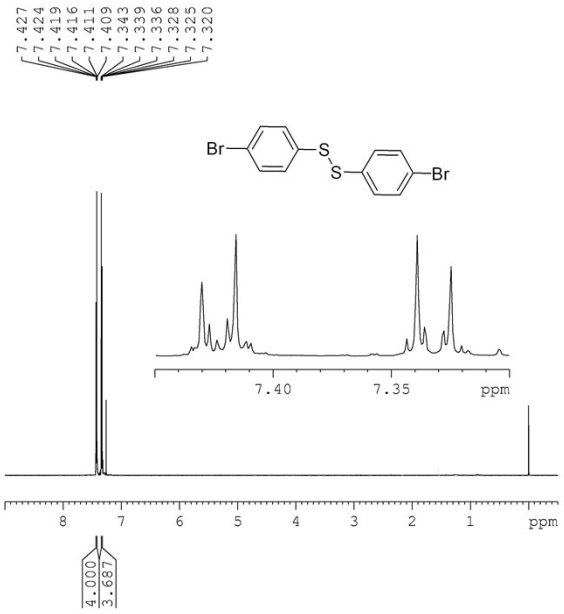

```
NAME          20150113zhaojinjin
EXPNO                          3
PROCNO                         1
Date_                   20150113
Time                       15.17
INSTRUM                    spect
PROBHD    5 mm PADUL 13C
PULPROG                     zg30
TD                         65536
SOLVENT                    CDCl3
NS                             4
DS                             2
SWH                    12335.526 Hz
FIDRES                  0.188225 Hz
AQ                     2.6564426 sec
RG                           203
DW                        40.533 usec
DE                         6.50 usec
TE                        293.6 K
D1                   1.00000000 sec

======== CHANNEL f1 ========
NUC1                          1H
P1                         14.00 usec
SI                         32768
SF                600.1300176 MHz
WDW                           EM
SSB                            0
LB                         -0.10 Hz
GB                             0
PC                          1.00
```



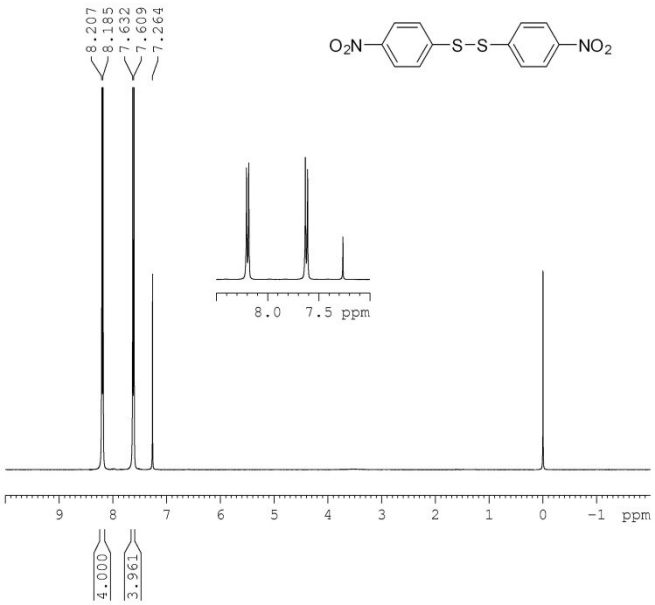

```
NAME          2016-07-13 tyut-chh
EXPNO                         10
PROCNO                         1
Date_                   20160714
Time                       2.12
INSTRUM                    spect
PROBHD    5 mm PABBO BB/
PULPROG                     zg30
TD                         65536
SOLVENT                    CDCl3
NS                            16
DS                             2
SWH                     8012.820 Hz
FIDRES                  0.122266 Hz
AQ                     4.0894966 sec
RG                          87.46
DW                        62.400 usec
DE                         6.50 usec
TE                        295.7 K
D1                   1.00000000 sec
TD0                            1

======== CHANNEL f1 ========
SFO1          400.1324710 MHz
NUC1                          1H
P1                          9.70 usec
SI                         65536
SF                400.1300100 MHz
WDW                           EM
SSB                            0
LB                          0.30 Hz
GB                             0
PC                          1.00
```



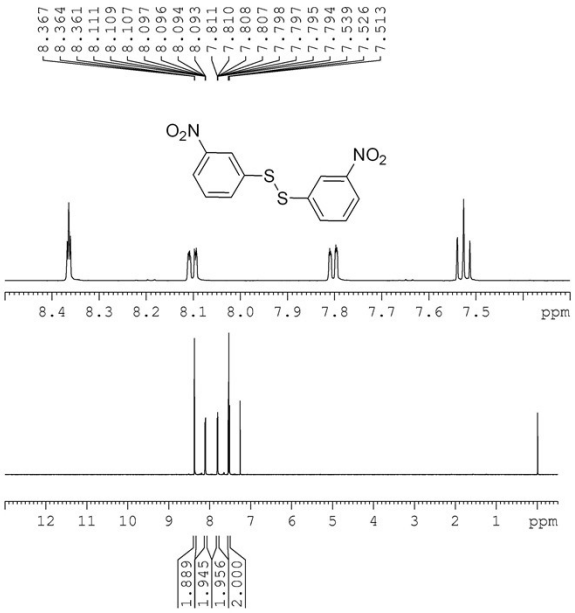

```
NAME          20150113zhaojinjin
EXPNO                          2
PROCNO                         1
Date_                   20150113
Time                       15.13
INSTRUM                    spect
PROBHD     5 mm PADUL 13C
PULPROG                     zg30
TD                         65536
SOLVENT                    CDCl3
NS                             4
DS                             2
SWH                    12335.526 Hz
FIDRES                  0.188225 Hz
AQ                      2.6564426 sec
RG                           181
DW                        40.533 usec
DE                         6.50 usec
TE                        293.8 K
D1                   1.00000000 sec

======== CHANNEL f1 ========
NUC1                         1H
P1                        14.00 usec
SI                         32768
SF                600.1300202 MHz
WDW                          EM
SSB                           0
LB                        -0.10 Hz
GB                            0
PC                         1.00
```




```
NAME          2016-07-06 TYUT-CHH
EXPNO                         10
PROCNO                         1
Date_                   20160706
Time                       20.19
INSTRUM                    spect
PROBHD     5 mm PABBO BB/
PULPROG                     zg30
TD                         65536
SOLVENT                    CDCl3
NS                            16
DS                             2
SWH                    8012.820 Hz
FIDRES                  0.122266 Hz
AQ                      4.0894966 sec
RG                         107.24
DW                        62.400 usec
DE                         6.50 usec
TE                        295.3 K
D1                   1.00000000 sec
TD0                            1

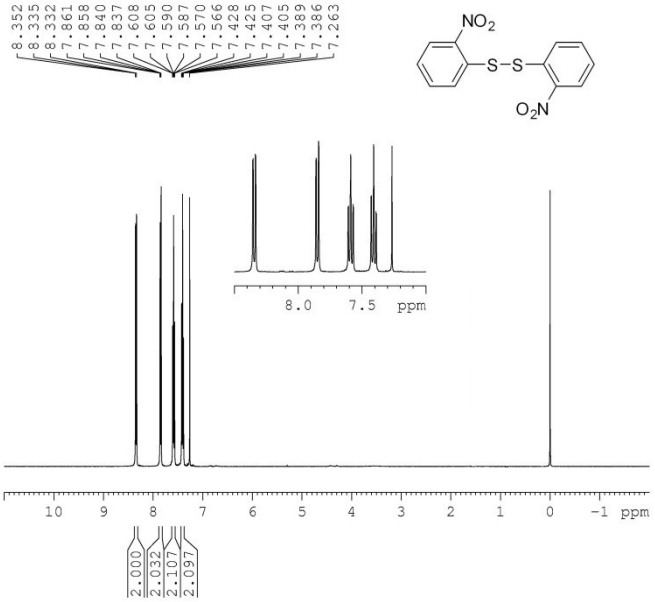
======== CHANNEL f1 ========
SFO1          400.1324710 MHz
NUC1                         1H
P1                         9.70 usec
SI                         65536
SF                400.1300084 MHz
WDW                          EM
SSB                           0
LB                         0.30 Hz
GB                            0
PC                         1.00
```





```
NAME          20150309hufei
EXPNO                     2
PROCNO                    1
Date_              20150309
Time                  11.04
INSTRUM               spect
PROBHD    5 mm PADUL 13C
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                        4
DS                        2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                      181
DW                 40.533 usec
DE                  6.50 usec
TE                  290.1 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  14.00 usec
SI                     32768
SF            600.1300203 MHz
WDW                    EM
SSB                     0
LB                  -0.10 Hz
GB                      0
PC                   1.00
```

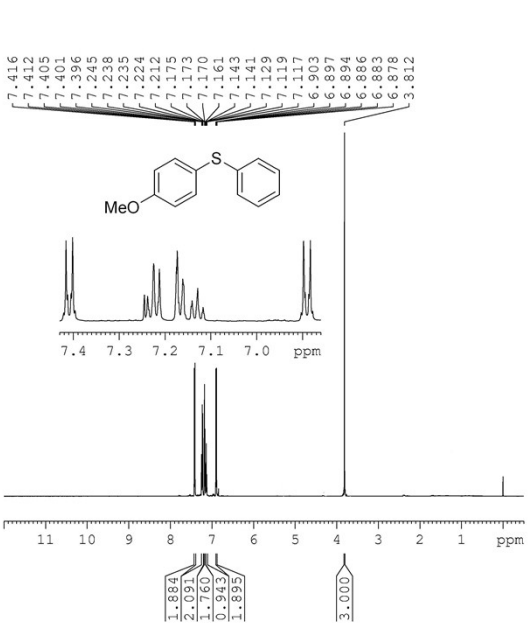




```
NAME       2016-07-06 TYUT-CHH
EXPNO                      10
PROCNO                      1
Date_               20160706
Time                   20.11
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG                 zg30
TD                     65536
SOLVENT                CDCl3
NS                        16
DS                         2
SWH               8012.820 Hz
FIDRES            0.122266 Hz
AQ               4.0894966 sec
RG                    107.24
DW                 62.400 usec
DE                  6.50 usec
TE                  295.4 K
D1              1.00000000 sec
TD0                        1

======== CHANNEL f1 ========
SFO1          400.1324710 MHz
NUC1                    1H
P1                   9.70 usec
SI                     65536
SF            400.1300086 MHz
WDW                    EM
SSB                     0
LB                   0.30 Hz
GB                      0
PC                   1.00
```

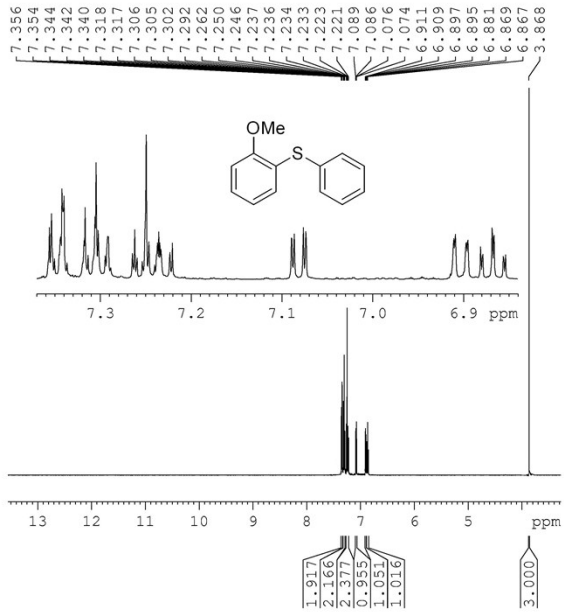
**Part 3: asymmetric sulfides**




BRUKER

```
NAME      20140522songjianyin
EXPNO                       3
PROCNO                      1
Date_              20140522
Time                   15.13
INSTRUM                spect
PROBHD    5 mm PADUL 13C
PULPROG                 zg30
TD                     65536
SOLVENT                CDCl3
NS                        16
DS                         2
SWH                12335.526 Hz
FIDRES              0.188225 Hz
AQ                 2.6564426 sec
RG                       203
DW                    40.533 usec
DE                     6.50 usec
TE                    301.1 K
D1                 1.00000000 sec

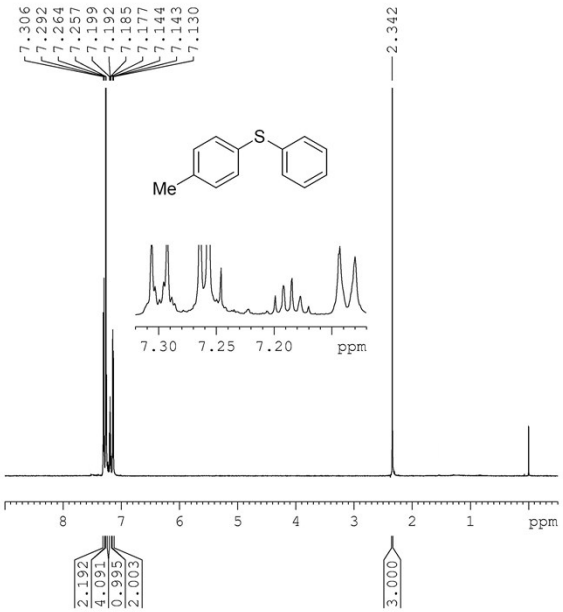
======== CHANNEL f1 ========
NUC1                       1H
P1                     14.00 usec
SI                      32768
SF               600.1300261 MHz
WDW                        GM
SSB                         0
LB                     -0.10 Hz
GB                        0.1
PC                       1.00
```




BRUKER

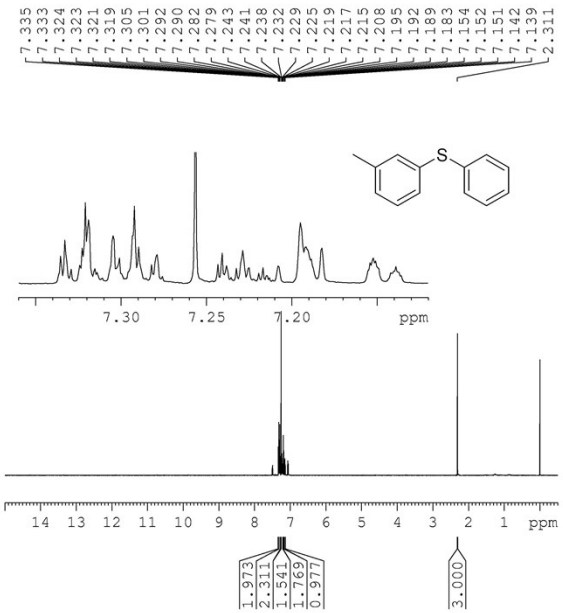
```
NAME      20150309hufei
EXPNO                 15
PROCNO                 1
Date_           20150309
Time               14.46
INSTRUM            spect
PROBHD   5 mm PADUL 13C
PULPROG            zg30
TD                65536
SOLVENT           CDCl3
NS                    4
DS                    2
SWH           12335.526 Hz
FIDRES         0.188225 Hz
AQ            2.6564426 sec
RG                  181
DW               40.533 usec
DE                6.50 usec
TE               295.2 K
D1            1.00000000 sec

======== CHANNEL f1 ========
NUC1                  1H
P1               14.00 usec
SI                32768
SF          600.1300239 MHz
WDW                  EM
SSB                   0
LB               -0.10 Hz
GB                    0
PC                 1.00
```



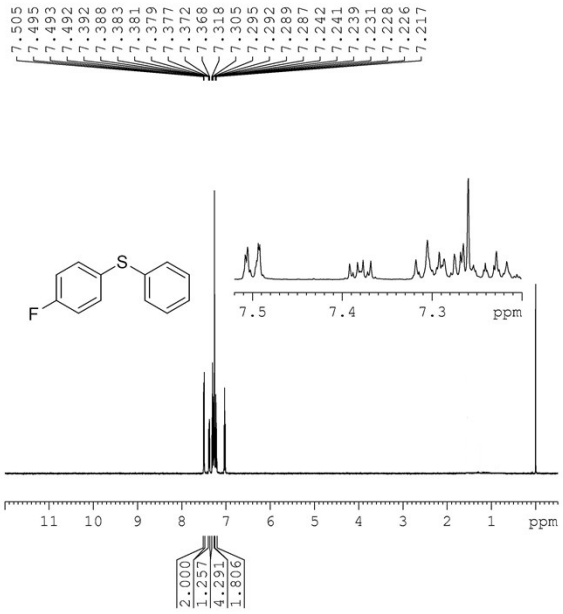

```
NAME        20150128hufei
EXPNO                  3
PROCNO                 1
Date_           20150128
Time               15.35
INSTRUM            spect
PROBHD   5 mm PADUL 13C
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     2
SWH            12335.526 Hz
FIDRES          0.188225 Hz
AQ             2.6564426 sec
RG                   181
DW                40.533 usec
DE                 6.50 usec
TE                290.9 K
D1           1.00000000 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                 14.00 usec
SI                 32768
SF          600.1300261 MHz
WDW                   EM
SSB                    0
LB                 -0.10 Hz
GB                     0
PC                  1.00
```




```
NAME        20150309hufei
EXPNO                 13
PROCNO                 1
Date_           20150309
Time               14.38
INSTRUM            spect
PROBHD   5 mm PADUL 13C
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     2
SWH            12335.526 Hz
FIDRES          0.188225 Hz
AQ             2.6564426 sec
RG                   203
DW                40.533 usec
DE                 6.50 usec
TE                295.2 K
D1           1.00000000 sec

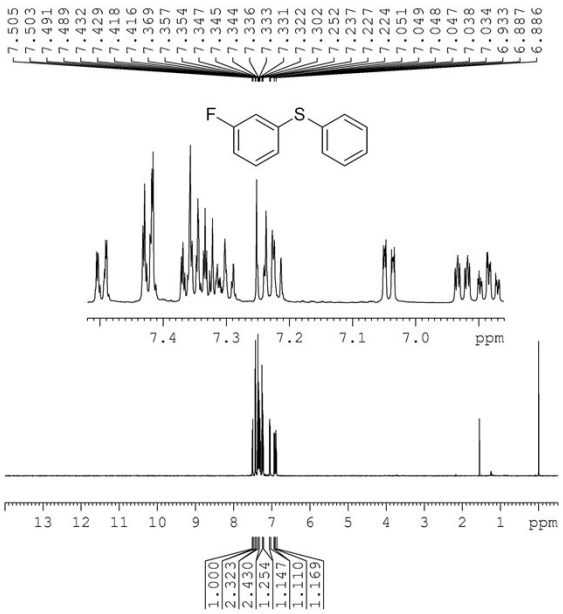
======== CHANNEL f1 ========
NUC1                  1H
P1                 14.00 usec
SI                 32768
SF          600.1300198 MHz
WDW                   EM
SSB                    0
LB                 -0.10 Hz
GB                     0
PC                  1.00
```




BRUKER

```
NAME          20150309hufei
EXPNO                   11
PROCNO                   1
Date_             20150309
Time                 11.37
INSTRUM              spect
PROBHD    5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                     203
DW                  40.533 usec
DE                   6.50 usec
TE                  291.2 K
D1             1.00000000 sec

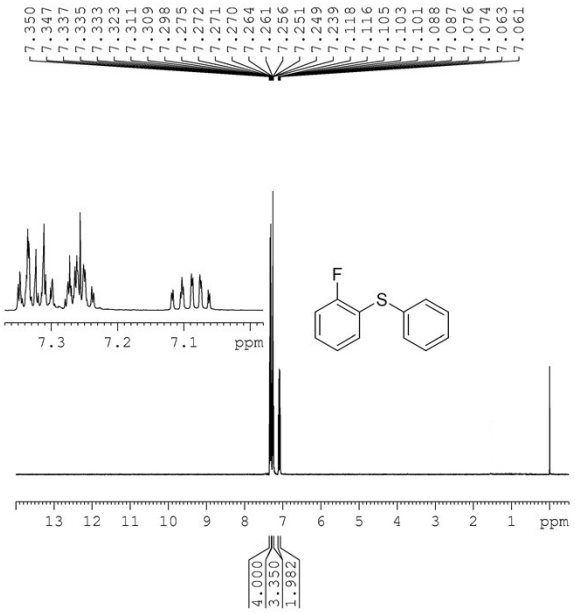
======== CHANNEL f1 ========
NUC1                    1H
P1                   14.00 usec
SI                   32768
SF            600.1300179 MHz
WDW                     EM
SSB                      0
LB                   -0.10 Hz
GB                       0
PC                    1.00
```




BRUKER

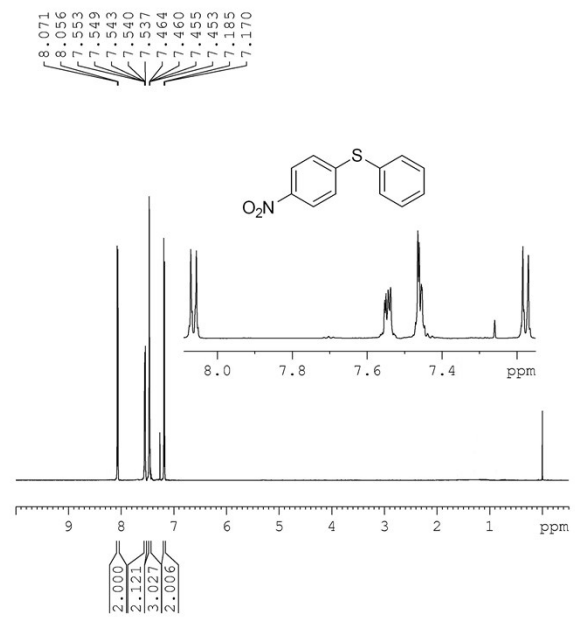
```
NAME          20150408hufei
EXPNO                    1
PROCNO                   1
Date_             20150408
Time                  9.46
INSTRUM              spect
PROBHD    5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                     203
DW                  40.533 usec
DE                   6.50 usec
TE                  288.9 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                   14.00 usec
SI                   32768
SF            600.1300228 MHz
WDW                     EM
SSB                      0
LB                   -0.10 Hz
GB                       0
PC                    1.00
```



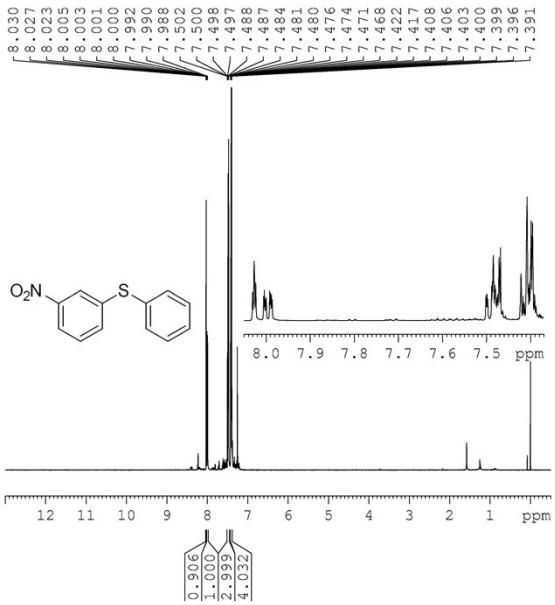

```
NAME        20150309hufei
EXPNO                  9
PROCNO                 1
Date_           20150309
Time               11.30
INSTRUM            spect
PROBHD   5 mm PADUL 13C
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     2
SWH            12335.526 Hz
FIDRES          0.188225 Hz
AQ             2.6564426 sec
RG                   181
DW                40.533 usec
DE                 6.50 usec
TE                291.0 K
D1           1.00000000 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                 14.00 usec
SI                 32768
SF          600.1300201 MHz
WDW                   EM
SSB                    0
LB                 -0.10 Hz
GB                     0
PC                  1.00
```



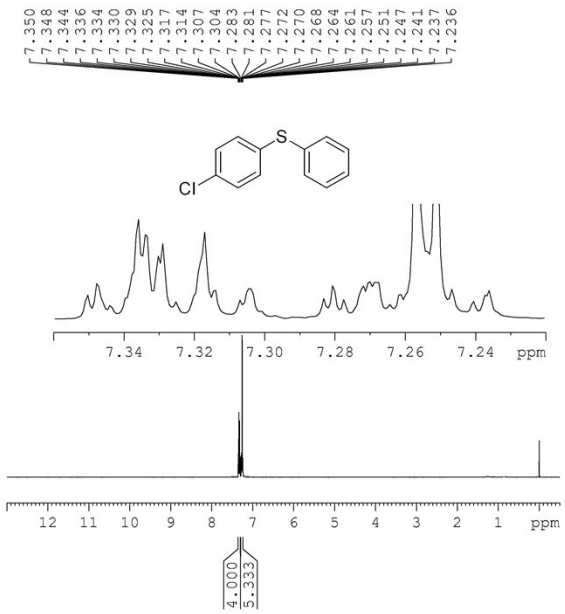

```
NAME      20140912zhangrui
EXPNO                    7
PROCNO                   1
Date_             20140912
Time                 11.33
INSTRUM              spect
PROBHD   5 mm PABBO BB-
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                     90.5
DW                  40.533 usec
DE                   6.50 usec
TE                  296.6 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                   12.60 usec
SI                   32768
SF            600.1300171 MHz
WDW                     EM
SSB                      0
LB                    0.10 Hz
GB                       0
PC                    1.00
```



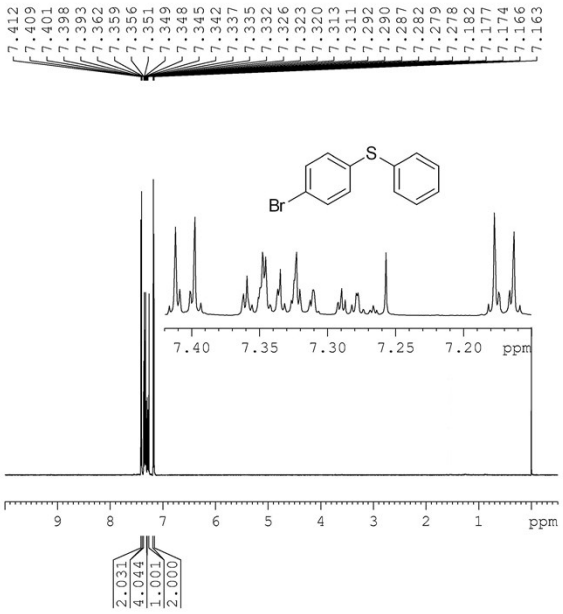

```
NAME          20150401hufei
EXPNO                     3
PROCNO                    1
Date_              20150401
Time                  10.24
INSTRUM               spect
PROBHD   5 mm PADUL 13C
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                        4
DS                        2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                      114
DW                 40.533 usec
DE                  6.50 usec
TE                  295.6 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  14.00 usec
SI                     32768
SF            600.1300206 MHz
WDW                    EM
SSB                     0
LB                  -0.10 Hz
GB                      0
PC                   1.00
```



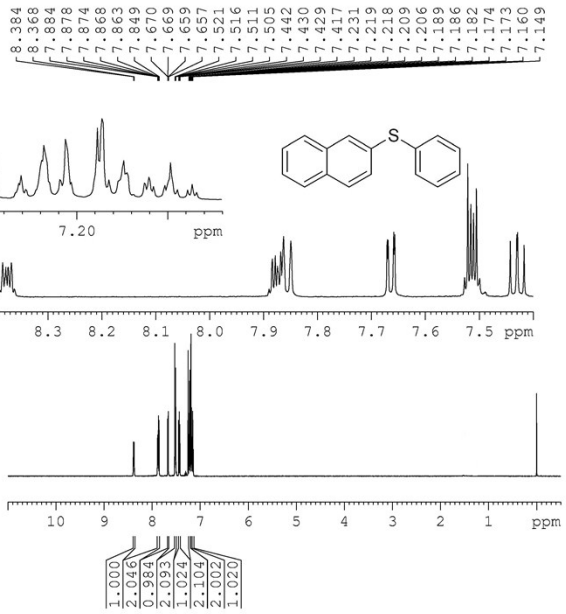

```
NAME          20150128hufei
EXPNO                     1
PROCNO                    1
Date_              20150128
Time                  15.27
INSTRUM               spect
PROBHD   5 mm PADUL 13C
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                        4
DS                        2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                      181
DW                 40.533 usec
DE                  6.50 usec
TE                  290.9 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  14.00 usec
SI                     32768
SF            600.1300203 MHz
WDW                    EM
SSB                     0
LB                  -0.10 Hz
GB                      0
PC                   1.00
```



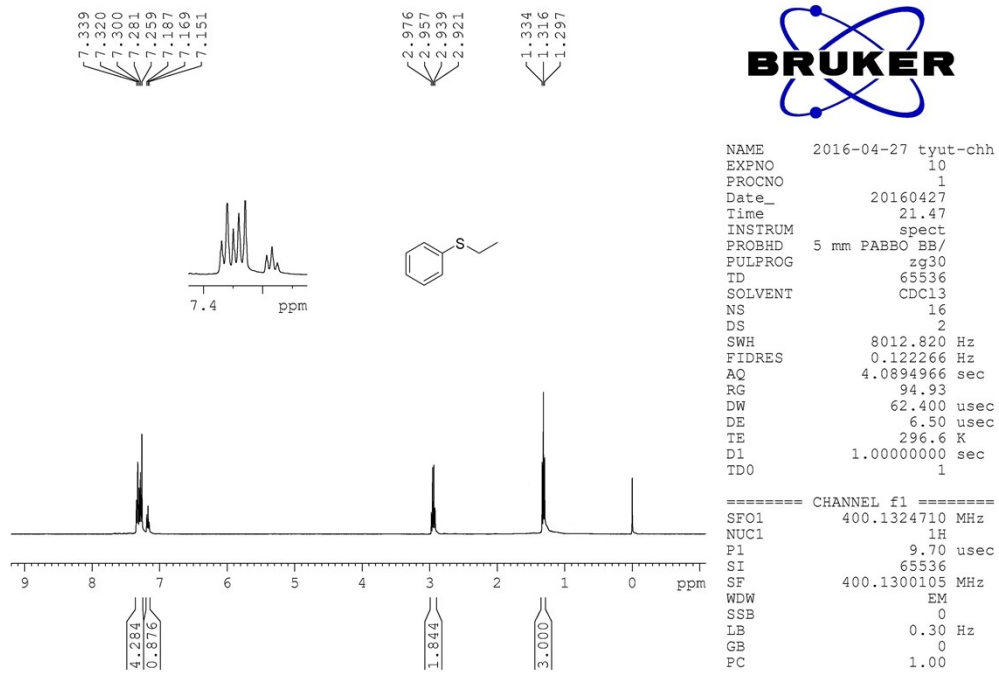

```
NAME          20150128hufei
EXPNO                    2
PROCNO                   1
Date_             20150128
Time                 15.31
INSTRUM              spect
PROBHD    5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ                2.6564426 sec
RG                     181
DW                  40.533 usec
DE                   6.50 usec
TE                  291.0 K
D1               1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                   14.00 usec
SI                   32768
SF            600.1300194 MHz
WDW                     EM
SSB                      0
LB                   -0.10 Hz
GB                       0
PC                    1.00
```



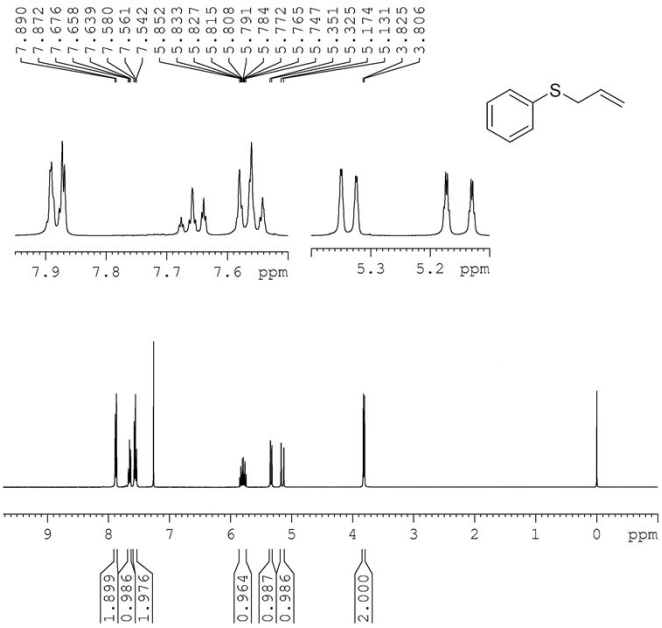

```
NAME          20150309hufei
EXPNO                   14
PROCNO                   1
Date_             20150309
Time                 14.42
INSTRUM              spect
PROBHD    5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ                2.6564426 sec
RG                     181
DW                  40.533 usec
DE                   6.50 usec
TE                  295.2 K
D1               1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                   14.00 usec
SI                   32768
SF            600.1300262 MHz
WDW                     EM
SSB                      0
LB                   -0.10 Hz
GB                       0
PC                    1.00
```




```
NAME      2016-04-27 tyut-chh
EXPNO                 10
PROCNO                 1
Date_           20160427
Time               21.47
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                    16
DS                     2
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894966 sec
RG                 94.93
DW                62.400 usec
DE                 6.50 usec
TE                296.6 K
D1             1.00000000 sec
TD0                    1

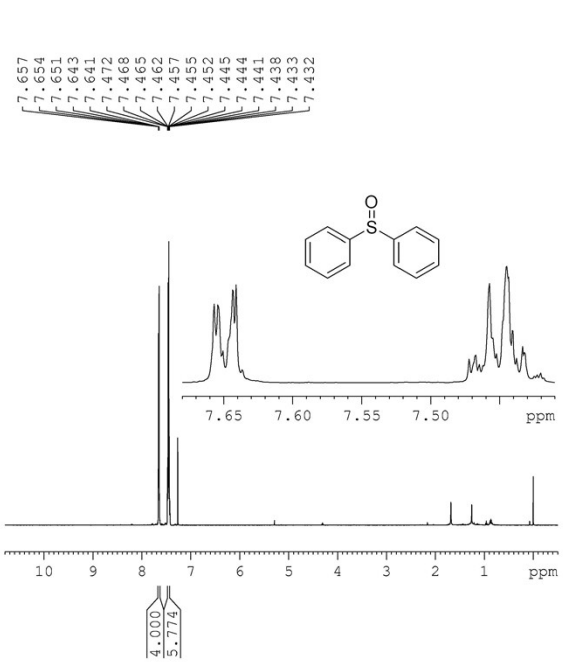
======== CHANNEL f1 ========
SFO1          400.1324710 MHz
NUC1                  1H
P1                 9.70 usec
SI                65536
SF            400.1300105 MHz
WDW                   EM
SSB                    0
LB                  0.30 Hz
GB                     0
PC                  1.00
```




```
NAME      2016-04-27 tyut-chh
EXPNO                 10
PROCNO                 1
Date_           20160427
Time               21.51
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                    16
DS                     2
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894966 sec
RG                 94.93
DW                62.400 usec
DE                 6.50 usec
TE                296.6 K
D1             1.00000000 sec
TD0                    1

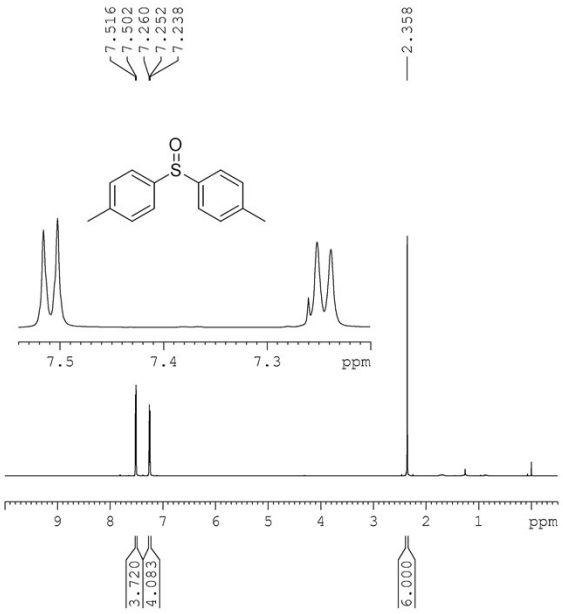
======== CHANNEL f1 ========
SFO1          400.1324710 MHz
NUC1                  1H
P1                 9.70 usec
SI                65536
SF            400.1300084 MHz
WDW                   EM
SSB                    0
LB                  0.30 Hz
GB                     0
PC                  1.00
```

**Part 4: symmetric sulfoxides**



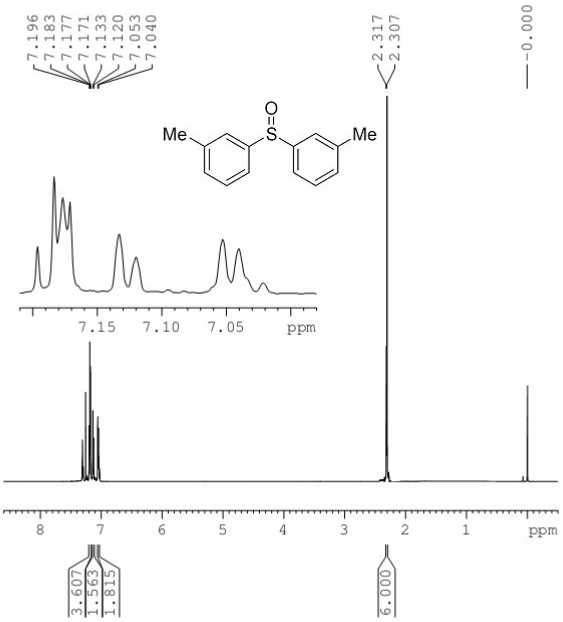

```
NAME        20140522songjianyin
EXPNO                         4
PROCNO                        1
Date_                  20140522
Time                      15.17
INSTRUM                   spect
PROBHD    5 mm PADUL 13C
PULPROG                    zg30
TD                        65536
SOLVENT                   CDCl3
NS                           16
DS                            2
SWH                   12335.526 Hz
FIDRES                 0.188225 Hz
AQ                    2.6564426 sec
RG                          203
DW                       40.533 usec
DE                        6.50 usec
TE                       301.1 K
D1                  1.00000000 sec

======== CHANNEL f1 ========
NUC1                         1H
P1                       14.00 usec
SI                        32768
SF                  600.1300171 MHz
WDW                          EM
SSB                           0
LB                       -0.10 Hz
GB                            0
PC                         1.00
```



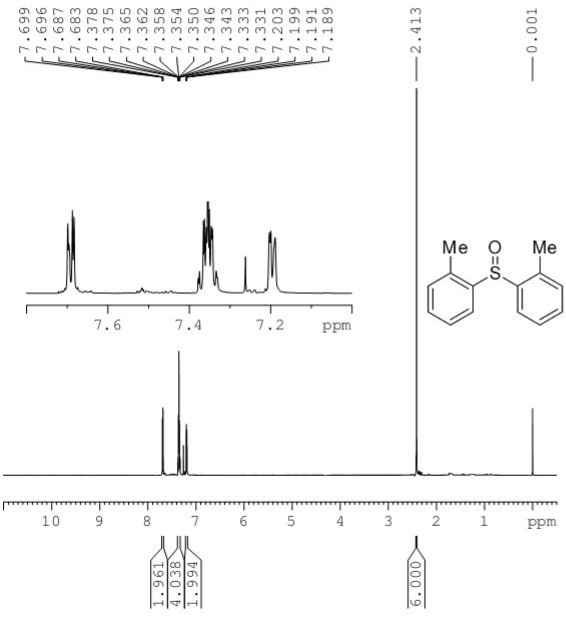

```
NAME        20140522songjianyin
EXPNO                         2
PROCNO                        1
Date_                  20140522
Time                      15.08
INSTRUM                   spect
PROBHD    5 mm PADUL 13C
PULPROG                    zg30
TD                        65536
SOLVENT                   CDCl3
NS                           16
DS                            2
SWH                   12335.526 Hz
FIDRES                 0.188225 Hz
AQ                    2.6564426 sec
RG                          203
DW                       40.533 usec
DE                        6.50 usec
TE                       301.2 K
D1                  1.00000000 sec

======== CHANNEL f1 ========
NUC1                         1H
P1                       14.00 usec
SI                        32768
SF                  600.1300168 MHz
WDW                          GM
SSB                           0
LB                       -0.10 Hz
GB                            0.1
PC                         1.00
```



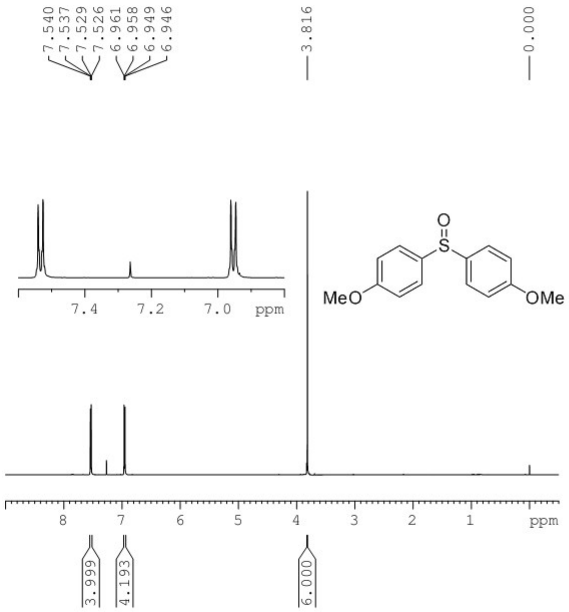

```
NAME        20140912zhangrui
EXPNO                  1
PROCNO                 1
Date_           20140912
Time               11.08
INSTRUM            spect
PROBHD    5 mm PABBO BB-
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     2
SWH            12335.526 Hz
FIDRES          0.188225 Hz
AQ             2.6564426 sec
RG                   128
DW                40.533 usec
DE                 6.50 usec
TE                296.5 K
D1           1.00000000 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                 12.60 usec
SI                 32768
SF           600.1300210 MHz
WDW                   EM
SSB                    0
LB                  0.10 Hz
GB                     0
PC                  1.00
```



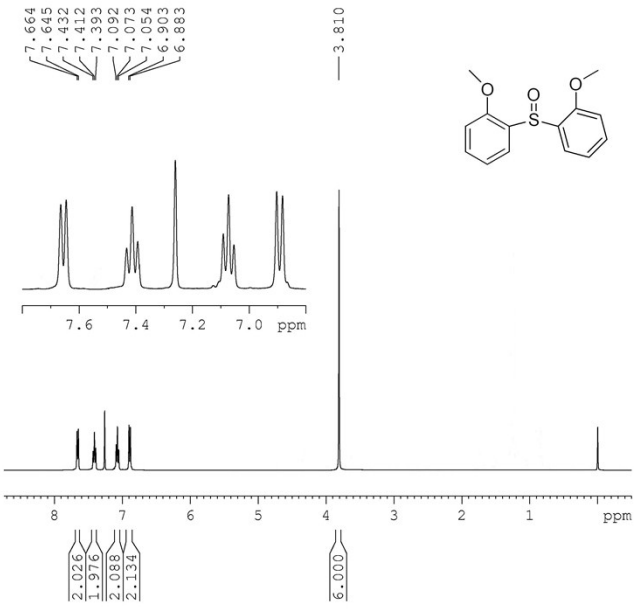

```
NAME        20140708zhangrui
EXPNO                 21
PROCNO                 1
Date_           20140708
Time               17.33
INSTRUM            spect
PROBHD    5 mm PADUL 13C
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     8
DS                     2
SWH            12335.526 Hz
FIDRES          0.188225 Hz
AQ             2.6564426 sec
RG                   203
DW                40.533 usec
DE                 6.50 usec
TE                302.0 K
D1           1.00000000 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                 14.00 usec
SI                 32768
SF           600.1300166 MHz
WDW                   EM
SSB                    0
LB                  0.10 Hz
GB                     0
PC                  1.00
```



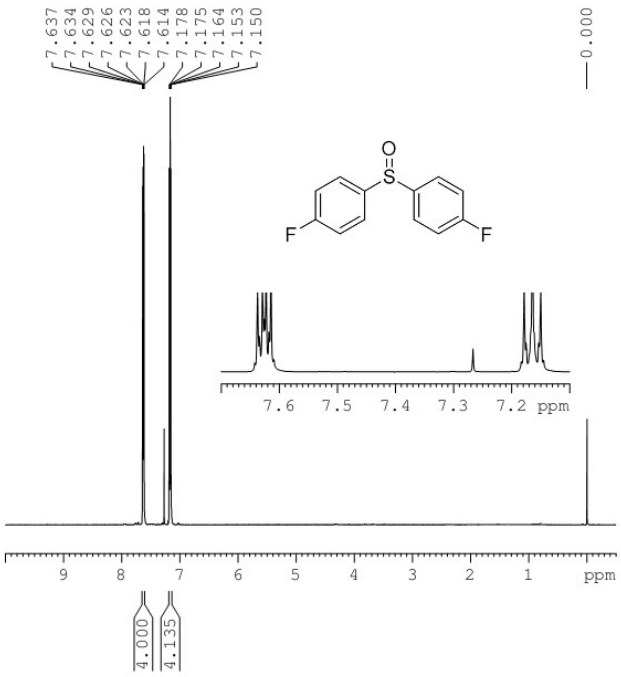

```
NAME        20140708zhangrui
EXPNO                      7
PROCNO                     1
Date_               20140708
Time                   16.29
INSTRUM                spect
PROBHD    5 mm PADUL 13C
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        2
SWH               12335.526 Hz
FIDRES             0.188225 Hz
AQ                2.6564426 sec
RG                      203
DW                   40.533 usec
DE                    6.50 usec
TE                   302.1 K
D1                1.00000000 sec

======== CHANNEL f1 ========
NUC1                      1H
P1                     14.00 usec
SI                     32768
SF              600.1300158 MHz
WDW                       EM
SSB                        0
LB                     0.10 Hz
GB                         0
PC                      1.00
```



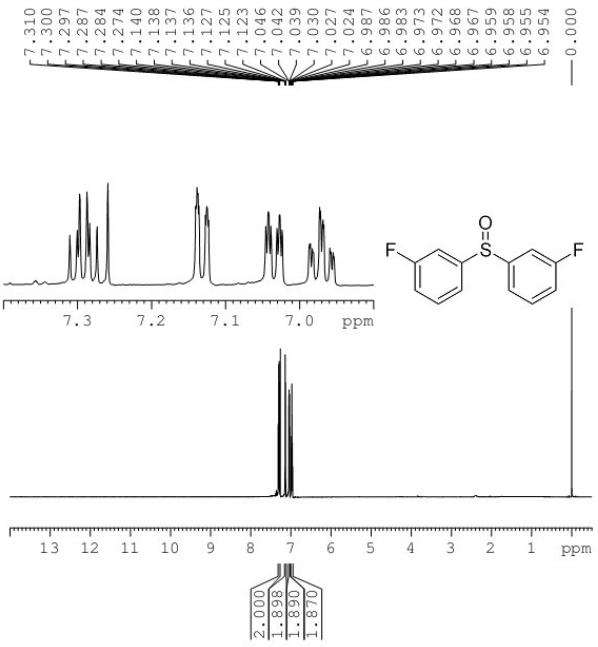

```
NAME        2016-06-01 tyut-chh
EXPNO                      10
PROCNO                      1
Date_               20160601
Time                   19.12
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        2
SWH                8012.820 Hz
FIDRES             0.122266 Hz
AQ                4.0894966 sec
RG                     87.46
DW                   62.400 usec
DE                    6.50 usec
TE                   299.6 K
D1                1.00000000 sec
TD0                        1

======== CHANNEL f1 ========
SFO1            400.1324710 MHz
NUC1                      1H
P1                     9.70 usec
SI                     65536
SF              400.1300098 MHz
WDW                       EM
SSB                        0
LB                     0.30 Hz
GB                         0
PC                      1.00
```



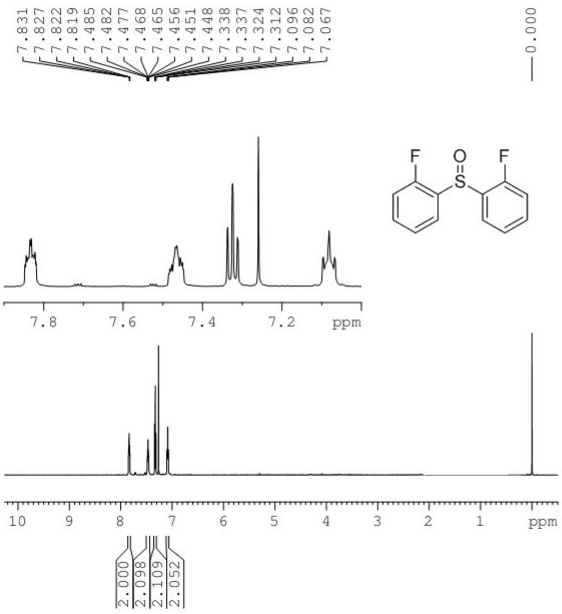

```
NAME      20140708zhangrui
EXPNO                    6
PROCNO                   1
Date_             20140708
Time                 16.25
INSTRUM              spect
PROBHD   5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                      16
DS                       2
SWH             12335.526 Hz
FIDRES           0.188225 Hz
AQ              2.6564426 sec
RG                     203
DW                40.533 usec
DE                 6.50 usec
TE                302.2 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  14.00 usec
SI                   32768
SF           600.1300137 MHz
WDW                     EM
SSB                      0
LB                    0.10 Hz
GB                       0
PC                    1.00
```



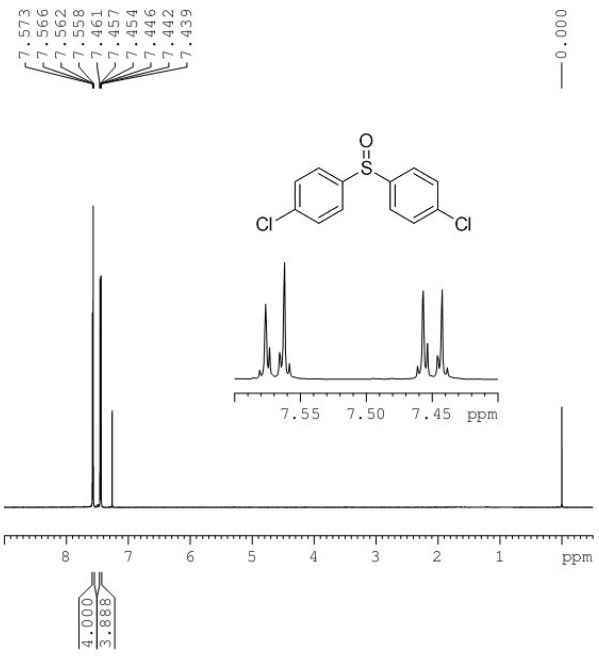

```
NAME      20140912zhangrui
EXPNO                    5
PROCNO                   1
Date_             20140912
Time                 11.24
INSTRUM              spect
PROBHD   5 mm PABBO BB-
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH             12335.526 Hz
FIDRES           0.188225 Hz
AQ              2.6564426 sec
RG                     181
DW                40.533 usec
DE                 6.50 usec
TE                296.3 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  12.60 usec
SI                   32768
SF           600.1300172 MHz
WDW                     EM
SSB                      0
LB                    0.10 Hz
GB                       0
PC                    1.00
```



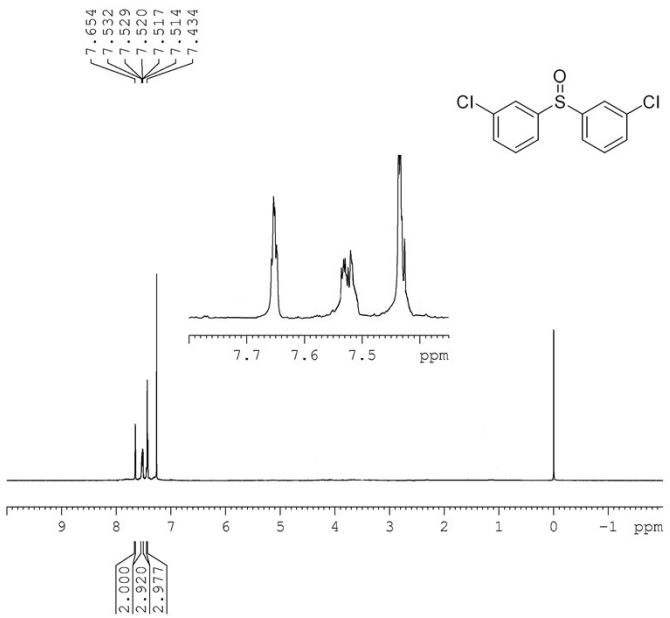

```
NAME      20140708zhangrui
EXPNO                4
PROCNO               1
Date_         20140708
Time             16.16
INSTRUM          spect
PROBHD   5 mm PADUL 13C
PULPROG           zg30
TD               65536
SOLVENT          CDCl3
NS                  16
DS                   2
SWH          12335.526 Hz
FIDRES        0.188225 Hz
AQ           2.6564426 sec
RG                 203
DW              40.533 usec
DE               6.50 usec
TE              302.2 K
D1           1.00000000 sec

======== CHANNEL f1 ========
NUC1                1H
P1              14.00 usec
SI                32768
SF          600.1300180 MHz
WDW                EM
SSB                 0
LB               0.10 Hz
GB                  0
PC               1.00
```



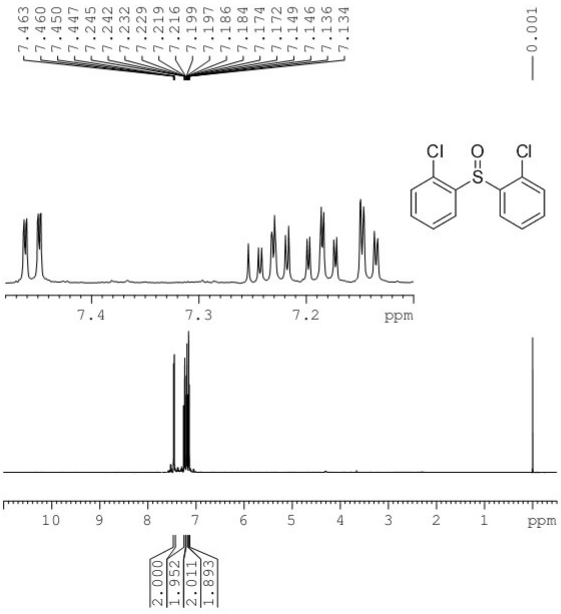

```
NAME      20140926wangqingyu
EXPNO                   3
PROCNO                  1
Date_            20140926
Time                16.47
INSTRUM             spect
PROBHD   5 mm PADUL 13C
PULPROG              zg30
TD                  65536
SOLVENT             CDCl3
NS                      4
DS                      2
SWH             12335.526 Hz
FIDRES           0.188225 Hz
AQ              2.6564426 sec
RG                    203
DW                 40.533 usec
DE                  6.50 usec
TE                 298.3 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                   1H
P1                 14.00 usec
SI                   32768
SF             600.1300163 MHz
WDW                   EM
SSB                    0
LB                  -0.10 Hz
GB                     0
PC                  1.00
```



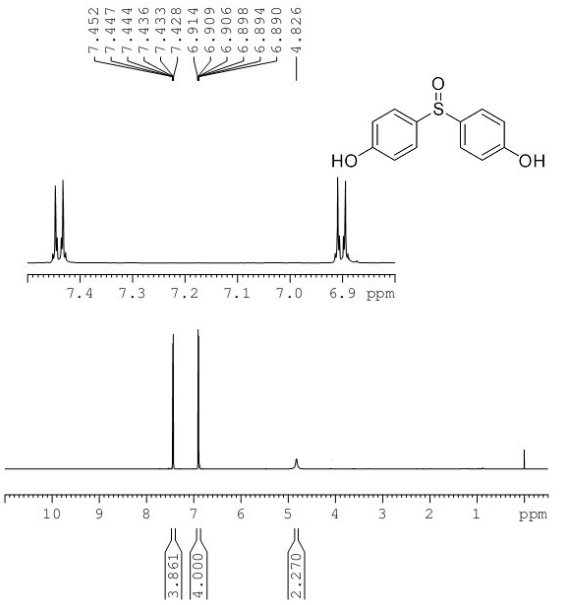

```
NAME        2016-07-13 tyut-chh
EXPNO                       10
PROCNO                       1
Date_                 20160714
Time                      2.20
INSTRUM                  spect
PROBHD    5 mm PABBO BB/
PULPROG                  zg30
TD                      65536
SOLVENT                 CDCl3
NS                         16
DS                          2
SWH                  8012.820 Hz
FIDRES               0.122266 Hz
AQ                   4.0894966 sec
RG                       87.46
DW                     62.400 usec
DE                      6.50 usec
TE                     295.5 K
D1                   1.00000000 sec
TD0                         1

======== CHANNEL f1 ========
SFO1           400.1324710 MHz
NUC1                     1H
P1                     9.70 usec
SI                    65536
SF               400.1300090 MHz
WDW                      EM
SSB                       0
LB                     0.30 Hz
GB                        0
PC                     1.00
```



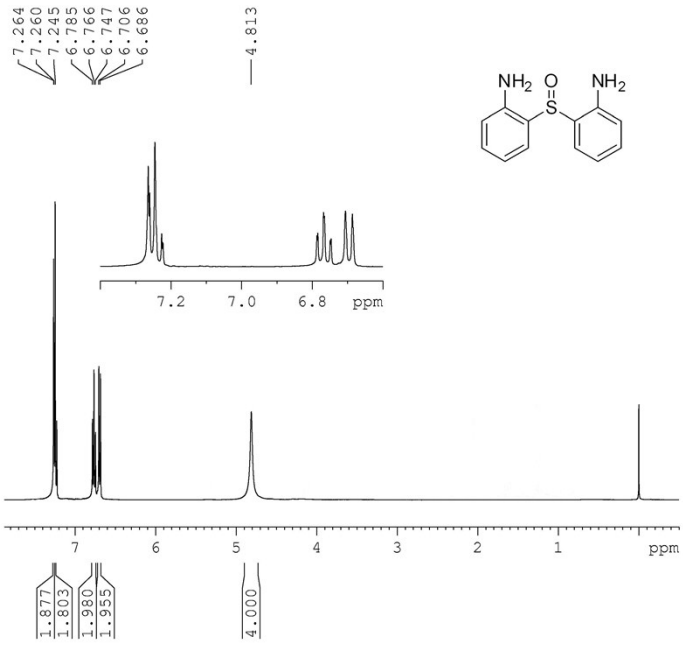

```
NAME        20140708zhangrui
EXPNO                       17
PROCNO                       1
Date_                 20140708
Time                     17.15
INSTRUM                  spect
PROBHD    5 mm PADUL 13C
PULPROG                  zg30
TD                      65536
SOLVENT                 CDCl3
NS                          2
DS                          2
SWH                 12335.526 Hz
FIDRES               0.188225 Hz
AQ                   2.6564426 sec
RG                         203
DW                    40.533 usec
DE                      6.50 usec
TE                     302.0 K
D1                   1.00000000 sec

======== CHANNEL f1 ========
NUC1                     1H
P1                    14.00 usec
SI                    32768
SF               600.1300213 MHz
WDW                      EM
SSB                       0
LB                     0.10 Hz
GB                        0
PC                     1.00
```



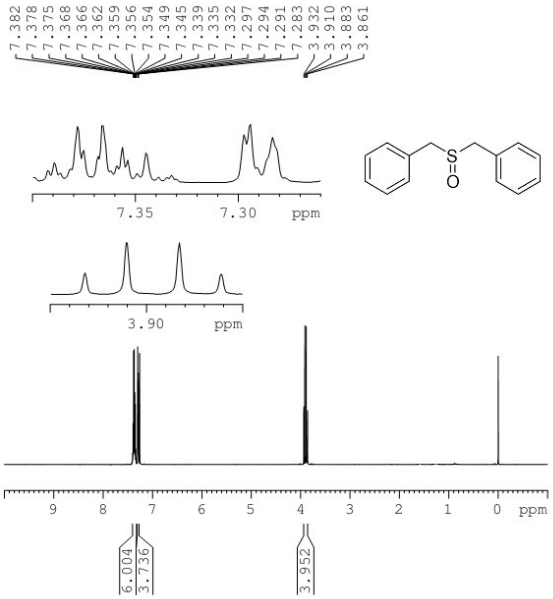

```
NAME      20140708zhangrui
EXPNO                    3
PROCNO                   1
Date_             20140708
Time                 16.11
INSTRUM              spect
PROBHD   5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT               MeOD
NS                      16
DS                       2
SWH             12335.526 Hz
FIDRES           0.188225 Hz
AQ              2.6564426 sec
RG                     203
DW                40.533 usec
DE                 6.50 usec
TE                302.2 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                   1H
P1                  14.00 usec
SI                  32768
SF          600.1300139 MHz
WDW                    EM
SSB                     0
LB                   0.10 Hz
GB                      0
PC                   1.00
```




```
NAME      2016-07-07 tyut-chh
EXPNO                    10
PROCNO                    1
Date_             20160708
Time                 20.20
INSTRUM              spect
PROBHD   5 mm PABBO BB/
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                      16
DS                       2
SWH              8012.820 Hz
FIDRES           0.122266 Hz
AQ              4.0894966 sec
RG                   87.46
DW                62.400 usec
DE                 6.50 usec
TE                299.0 K
D1             1.00000000 sec
TD0                      1

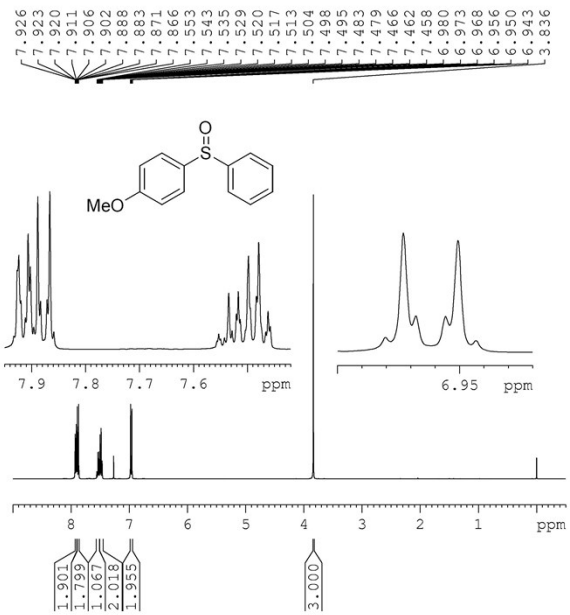
======== CHANNEL f1 ========
SFO1        400.1324710 MHz
NUC1                   1H
P1                   9.70 usec
SI                  65536
SF          400.1300097 MHz
WDW                    EM
SSB                     0
LB                   0.30 Hz
GB                      0
PC                   1.00
```




```
NAME      20140708zhangrui
EXPNO                    1
PROCNO                   1
Date_             20140708
Time                 16.01
INSTRUM              spect
PROBHD   5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       7
DS                       2
SWH              12335.526 Hz
FIDRES           0.188225 Hz
AQ               2.6564426 sec
RG                     203
DW                40.533 usec
DE                 6.50 usec
TE                302.2 K
D1              1.00000000 sec

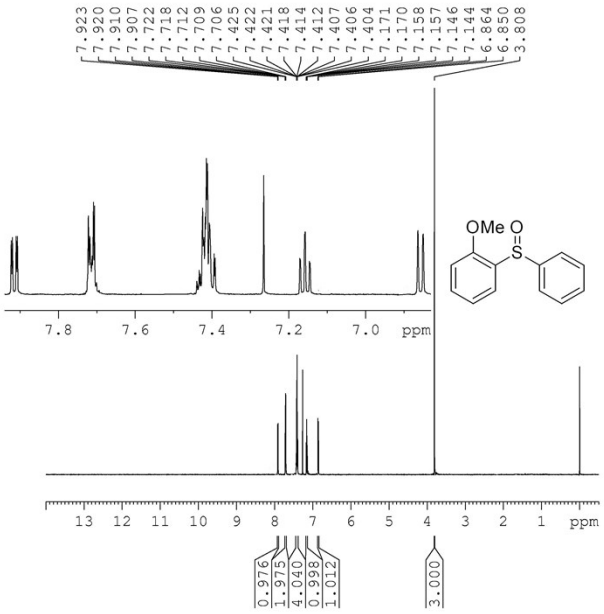
======== CHANNEL f1 ========
NUC1                   1H
P1                  14.00 usec
SI                   32768
SF           600.1300194 MHz
WDW                    EM
SSB                     0
LB                   0.10 Hz
GB                      0
PC                   1.00
```

**Part 5: asymmetric sulfoxides**



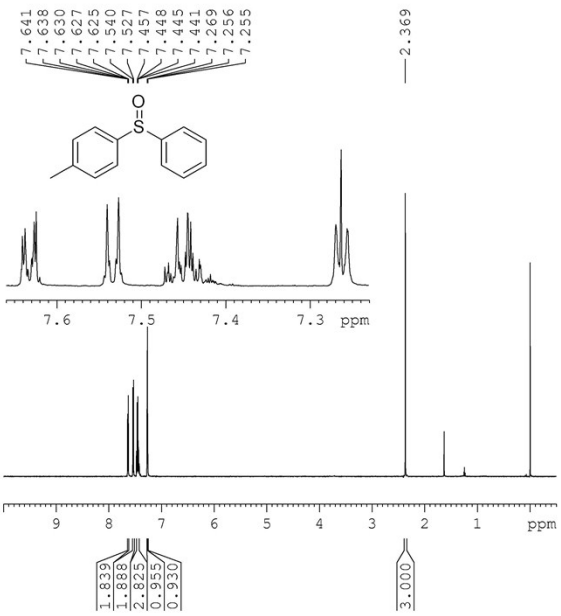

```
NAME      20150520hufei
EXPNO                5
PROCNO               1
Date_         20150520
Time             18.01
INSTRUM          spect
PROBHD   5 mm PABBO BB/
PULPROG           zg30
TD               65536
SOLVENT          CDCl3
NS                  16
DS                   2
SWH           8012.820 Hz
FIDRES        0.122266 Hz
AQ            4.0894966 sec
RG                67.58
DW              62.400 usec
DE                6.50 usec
TE              299.1 K
D1           1.00000000 sec
TD0                  1

======== CHANNEL f1 ========
SFO1       400.1324710 MHz
NUC1                 1H
P1                9.70 usec
SI               65536
SF         400.1300084 MHz
WDW                  EM
SSB                   0
LB                 0.30 Hz
GB                    0
PC                 1.00
```



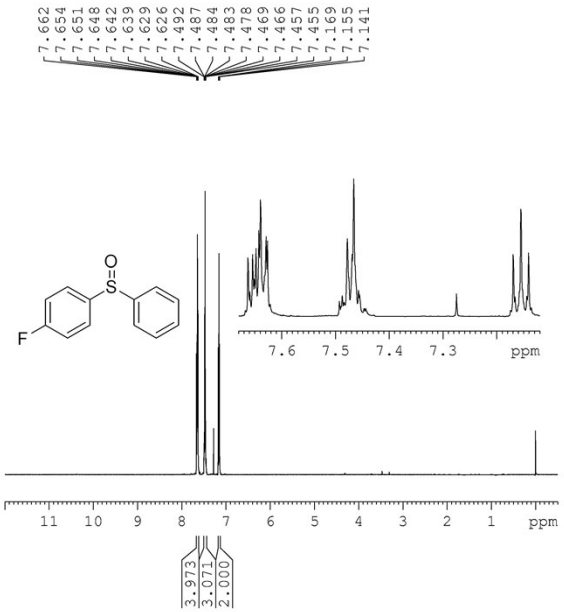

```
NAME          20150408hufei
EXPNO                     3
PROCNO                    1
Date_              20150408
Time                   9.54
INSTRUM               spect
PROBHD    5 mm PADUL 13C
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                        4
DS                        2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                      203
DW                 40.533 usec
DE                  6.50 usec
TE                  289.0 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                      1H
P1                   14.00 usec
SI                        32768
SF            600.1300148 MHz
WDW                       EM
SSB                        0
LB                    -0.10 Hz
GB                         0
PC                      1.00
```



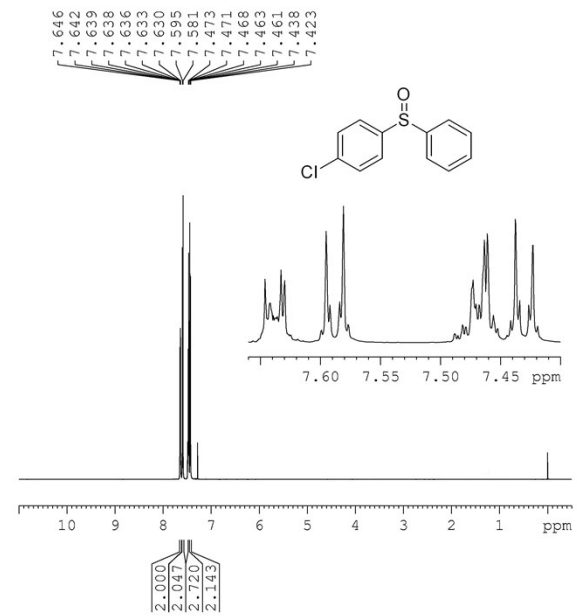

```
NAME          20150408hufei
EXPNO                     2
PROCNO                    1
Date_              20150408
Time                   9.51
INSTRUM               spect
PROBHD    5 mm PADUL 13C
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                        4
DS                        2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ               2.6564426 sec
RG                      203
DW                 40.533 usec
DE                  6.50 usec
TE                  289.0 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                      1H
P1                   14.00 usec
SI                        32768
SF            600.1300157 MHz
WDW                       EM
SSB                        0
LB                    -0.10 Hz
GB                         0
PC                      1.00
```



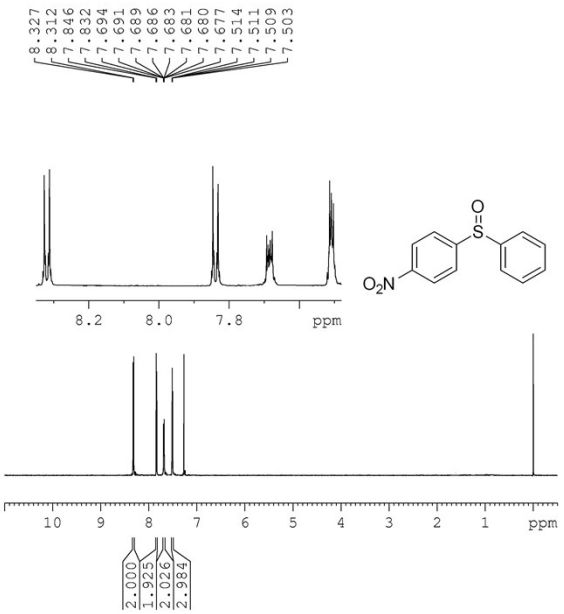

```
NAME          20150408hufei
EXPNO                    5
PROCNO                   1
Date_             20150408
Time                 10.06
INSTRUM              spect
PROBHD    5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ                2.6564426 sec
RG                     114
DW                  40.533 usec
DE                   6.50 usec
TE                  289.2 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                   14.00 usec
SI                   32768
SF           600.1300090 MHz
WDW                     EM
SSB                      0
LB                   -0.10 Hz
GB                       0
PC                    1.00
```




```
NAME          20150408hufei
EXPNO                    6
PROCNO                   1
Date_             20150408
Time                 10.11
INSTRUM              spect
PROBHD    5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       4
DS                       2
SWH              12335.526 Hz
FIDRES            0.188225 Hz
AQ                2.6564426 sec
RG                    90.5
DW                  40.533 usec
DE                   6.50 usec
TE                  289.3 K
D1             1.00000000 sec

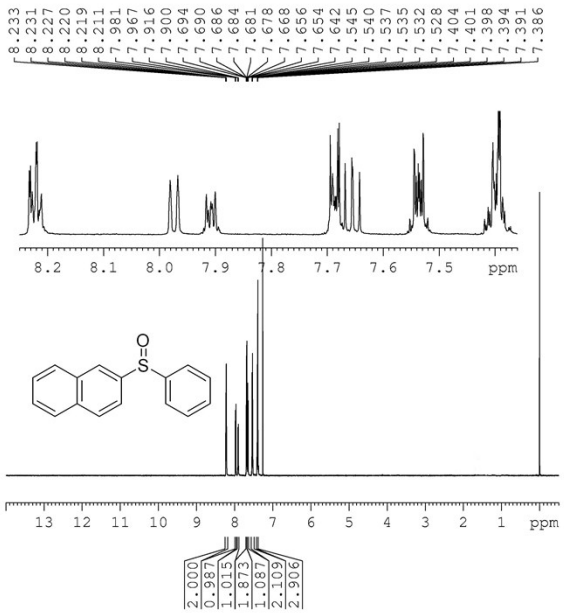
======== CHANNEL f1 ========
NUC1                    1H
P1                   14.00 usec
SI                   32768
SF           600.1300072 MHz
WDW                     EM
SSB                      0
LB                   -0.10 Hz
GB                       0
PC                    1.00
```




BRUKER

```
NAME        20150408hufei
EXPNO                   7
PROCNO                  1
Date_            20150408
Time                10.15
INSTRUM             spect
PROBHD    5 mm PADUL 13C
PULPROG              zg30
TD                  65536
SOLVENT             CDCl3
NS                      4
DS                      2
SWH             12335.526 Hz
FIDRES          0.188225 Hz
AQ              2.6564426 sec
RG                    203
DW                 40.533 usec
DE                  6.50 usec
TE                 289.3 K
D1            1.00000000 sec

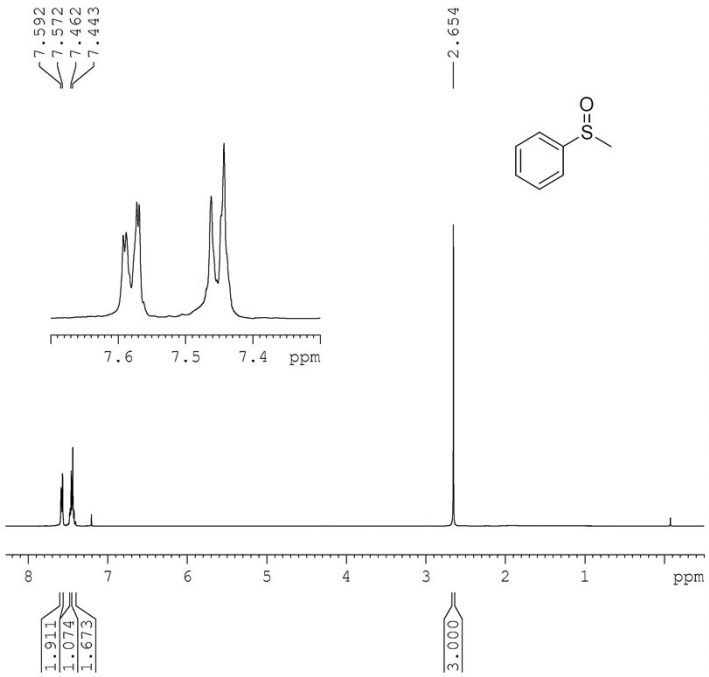
======== CHANNEL f1 ========
NUC1                   1H
P1                  14.00 usec
SI                  32768
SF           600.1300134 MHz
WDW                    EM
SSB                     0
LB                  -0.10 Hz
GB                      0
PC                   1.00
```




BRUKER

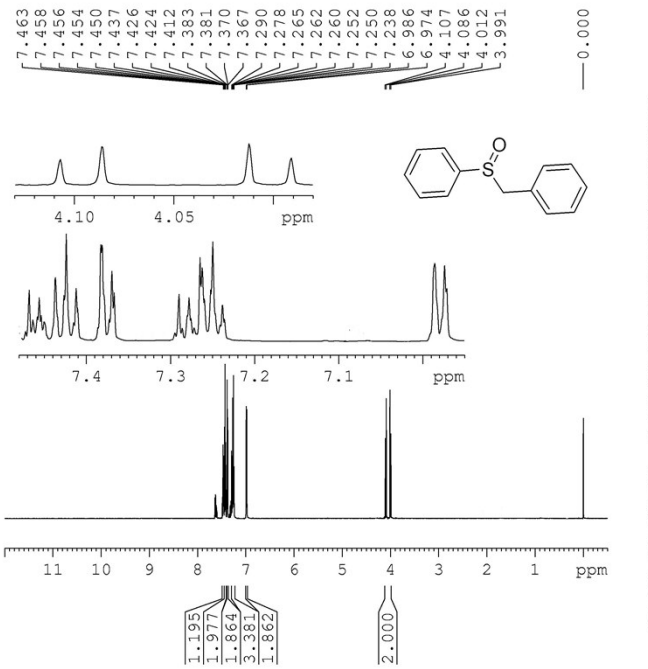
```
NAME        20150408hufei
EXPNO                   4
PROCNO                  1
Date_            20150408
Time                9.59
INSTRUM             spect
PROBHD    5 mm PADUL 13C
PULPROG              zg30
TD                  65536
SOLVENT             CDCl3
NS                      4
DS                      2
SWH             12335.526 Hz
FIDRES          0.188225 Hz
AQ              2.6564426 sec
RG                    203
DW                 40.533 usec
DE                  6.50 usec
TE                 289.1 K
D1            1.00000000 sec

======== CHANNEL f1 ========
NUC1                   1H
P1                  14.00 usec
SI                  32768
SF           600.1300161 MHz
WDW                    EM
SSB                     0
LB                  -0.10 Hz
GB                      0
PC                   1.00
```



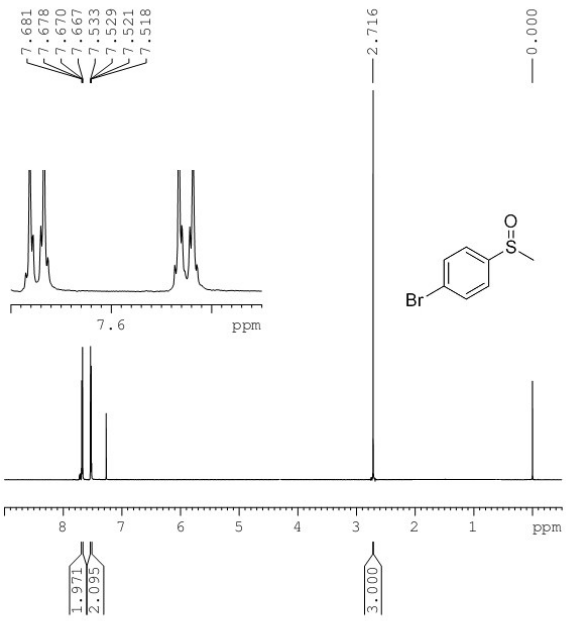

```
NAME      2016-07-07 tyut-chh
EXPNO                  10
PROCNO                  1
Date_           20160708
Time              20.16
INSTRUM           spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                    16
DS                     2
SWH             8012.820 Hz
FIDRES             0.122266 Hz
AQ              4.0894966 sec
RG                 54.19
DW                62.400 usec
DE                 6.50 usec
TE                299.1 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1          400.1324710 MHz
NUC1                  1H
P1                  9.70 usec
SI                 65536
SF            400.1300307 MHz
WDW                   EM
SSB                    0
LB                  0.30 Hz
GB                     0
PC                  1.00
```



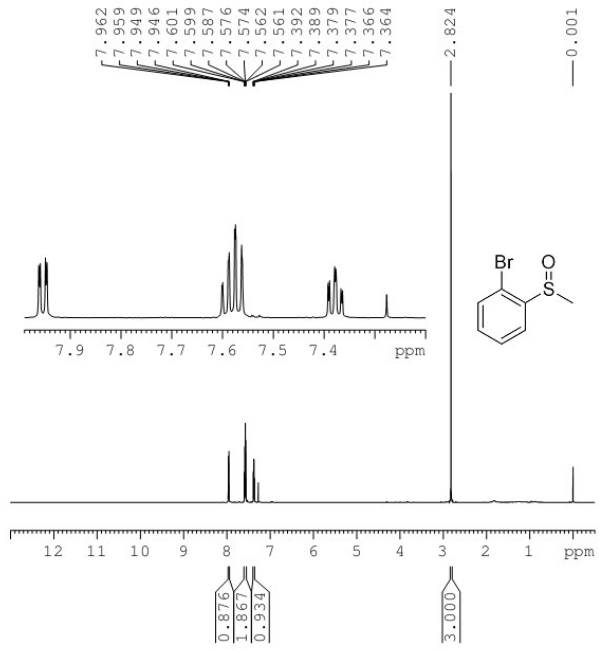

```
NAME      20141219baiyana
EXPNO                  14
PROCNO                  1
Date_           20141219
Time              11.05
INSTRUM           spect
PROBHD   5 mm PADUL 13C
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     2
SWH            12335.526 Hz
FIDRES             0.188225 Hz
AQ              2.6564426 sec
RG                   203
DW                40.533 usec
DE                 6.50 usec
TE                289.8 K
D1             1.00000000 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                 14.00 usec
SI                 32768
SF            600.1300148 MHz
WDW                   GM
SSB                    0
LB                 -0.10 Hz
GB                   0.1
PC                  1.00
```



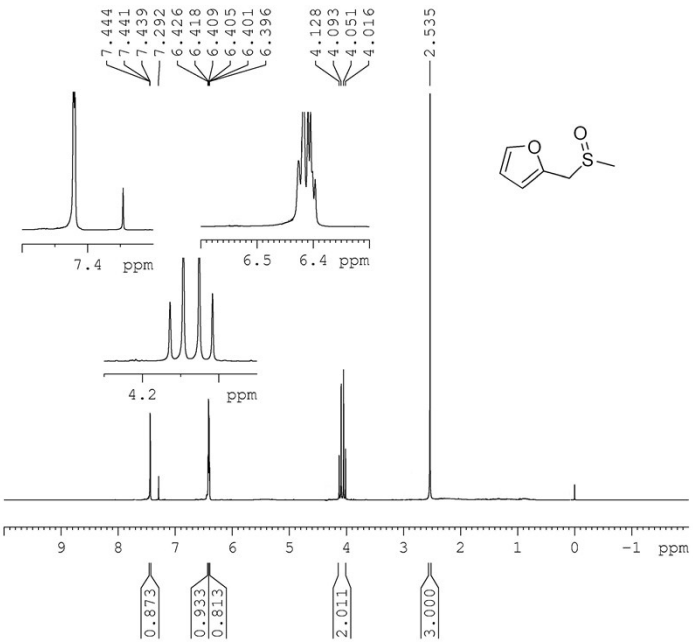

```
NAME      20140708zhangrui
EXPNO                   15
PROCNO                   1
Date_             20140708
Time                 17.07
INSTRUM              spect
PROBHD   5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                       3
DS                       2
SWH              12335.526 Hz
FIDRES               0.188225 Hz
AQ                2.6564426 sec
RG                     203
DW                  40.533 usec
DE                   6.50 usec
TE                   302.0 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  14.00 usec
SI                   32768
SF            600.1300150 MHz
WDW                     EM
SSB                      0
LB                    0.10 Hz
GB                       0
PC                    1.00
```



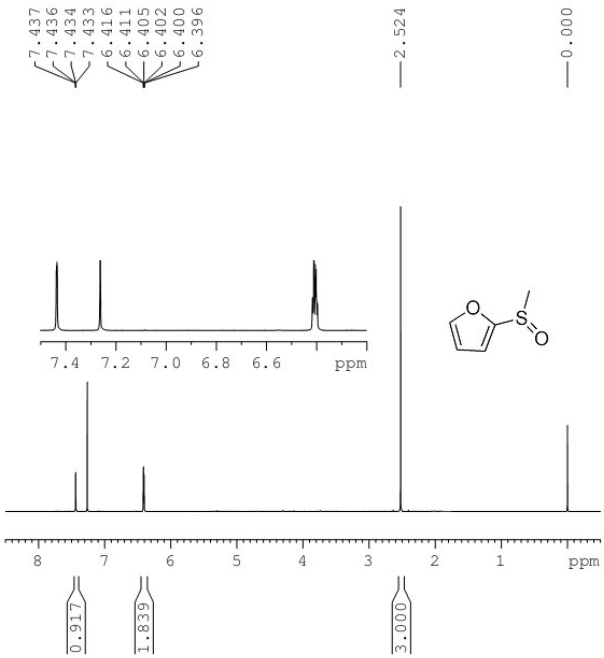

```
NAME      20140708zhangrui
EXPNO                   16
PROCNO                   1
Date_             20140708
Time                 17.10
INSTRUM              spect
PROBHD   5 mm PADUL 13C
PULPROG               zg30
TD                   65536
SOLVENT              CDCl3
NS                      16
DS                       2
SWH              12335.526 Hz
FIDRES               0.188225 Hz
AQ                2.6564426 sec
RG                     203
DW                  40.533 usec
DE                   6.50 usec
TE                   302.0 K
D1              1.00000000 sec

======== CHANNEL f1 ========
NUC1                    1H
P1                  14.00 usec
SI                   32768
SF            600.1300075 MHz
WDW                     EM
SSB                      0
LB                    0.10 Hz
GB                       0
PC                    1.00
```



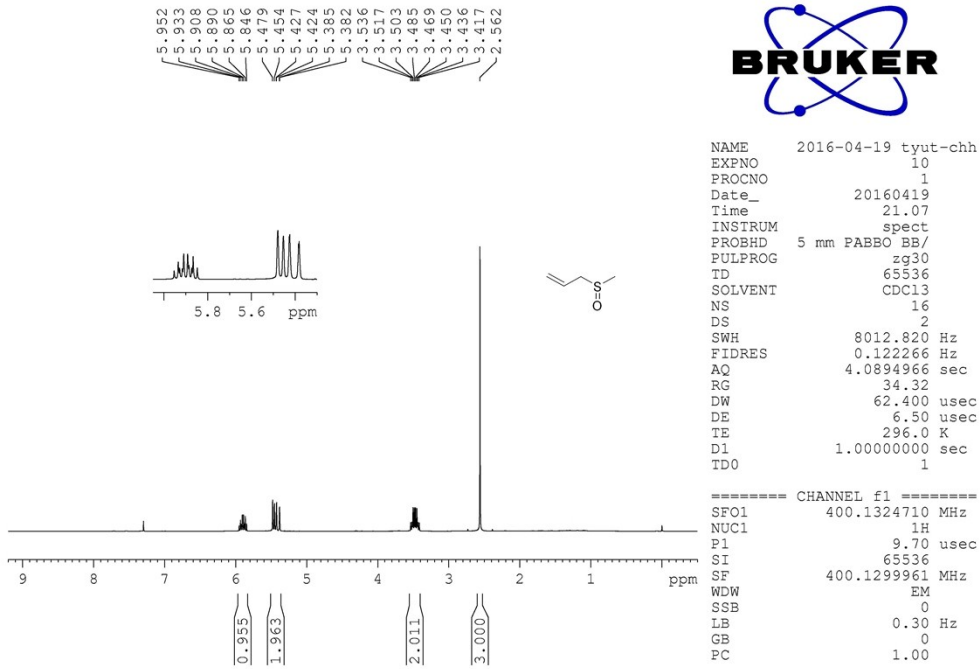

```
NAME      2016-07-21 tyut-chh
EXPNO                  10
PROCNO                  1
Date_           20160722
Time              15.15
INSTRUM           spect
PROBHD   5 mm PABBO BB/
PULPROG            zg30
TD                65536
SOLVENT           CDCl3
NS                   16
DS                    2
SWH            8012.820 Hz
FIDRES         0.122266 Hz
AQ             4.0894966 sec
RG                34.32
DW              62.400 usec
DE               6.50 usec
TE               296.4 K
D1            1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                1H
P1                9.70 usec
SI               65536
SF           400.1299972 MHz
WDW                 EM
SSB                  0
LB                0.30 Hz
GB                   0
PC                1.00
```




```
NAME      20140722zhangrui
EXPNO                  2
PROCNO                 1
Date_           20140722
Time              10.49
INSTRUM           spect
PROBHD   5 mm PADUL 13C
PULPROG            zg30
TD                65536
SOLVENT           CDCl3
NS                   16
DS                    2
SWH           12335.526 Hz
FIDRES         0.188225 Hz
AQ             2.6564426 sec
RG                  203
DW              40.533 usec
DE               6.50 usec
TE               300.5 K
D1            1.00000000 sec

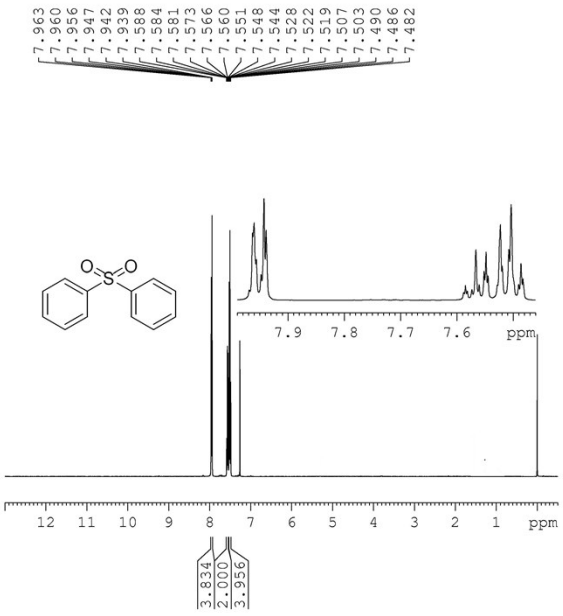
======== CHANNEL f1 ========
NUC1                1H
P1                14.00 usec
SI                32768
SF           600.1300166 MHz
WDW                 EM
SSB                  0
LB                0.10 Hz
GB                   0
PC                1.00
```




```
NAME      2016-04-19 tyut-chh
EXPNO                 10
PROCNO                 1
Date_           20160419
Time              21.07
INSTRUM           spect
PROBHD   5 mm PABBO BB/
PULPROG            zg30
TD                65536
SOLVENT           CDCl3
NS                   16
DS                    2
SWH            8012.820 Hz
FIDRES         0.122266 Hz
AQ             4.0894966 sec
RG                34.32
DW               62.400 usec
DE                6.50 usec
TE                296.0 K
D1           1.00000000 sec
TD0                   1

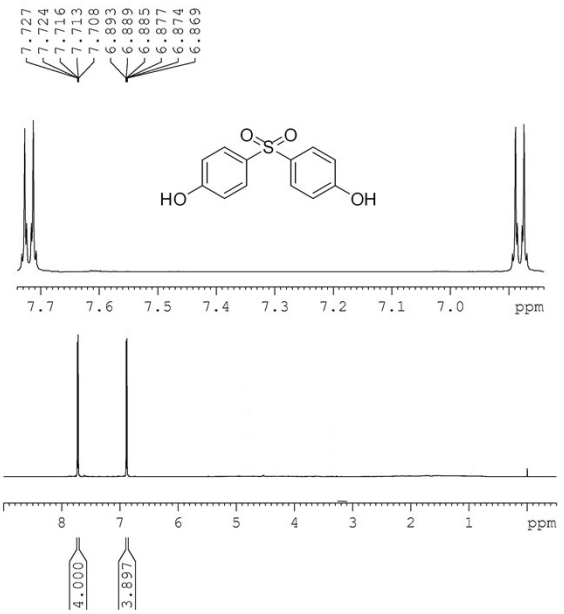
======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1               1H
P1                9.70 usec
SI               65536
SF           400.1299961 MHz
WDW                EM
SSB                 0
LB               0.30 Hz
GB                  0
PC                1.00
```

**Part 6: sulfones**



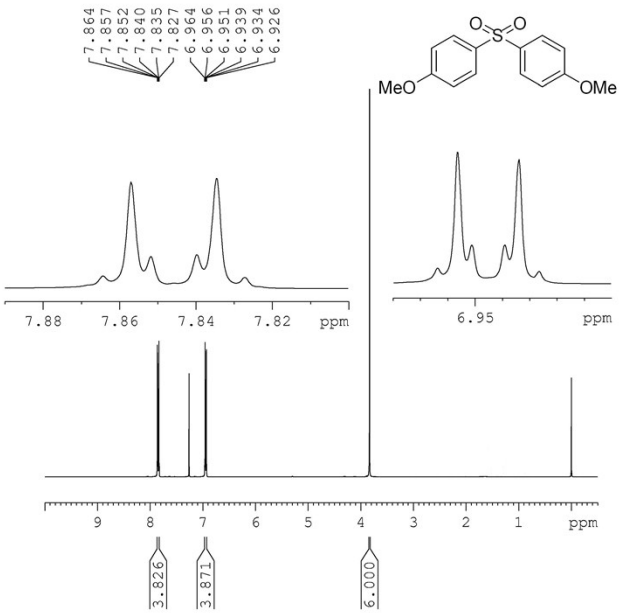

```
NAME       20150520hufei
EXPNO                  1
PROCNO                 1
Date_           20150520
Time              17.44
INSTRUM           spect
PROBHD   5 mm PABBO BB/
PULPROG            zg30
TD                65536
SOLVENT           CDCl3
NS                   16
DS                    2
SWH            8012.820 Hz
FIDRES         0.122266 Hz
AQ             4.0894966 sec
RG               107.24
DW               62.400 usec
DE                6.50 usec
TE                299.0 K
D1           1.00000000 sec
TD0                   1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1               1H
P1                9.70 usec
SI               65536
SF           400.1300096 MHz
WDW                EM
SSB                 0
LB               0.30 Hz
GB                  0
PC                1.00
```



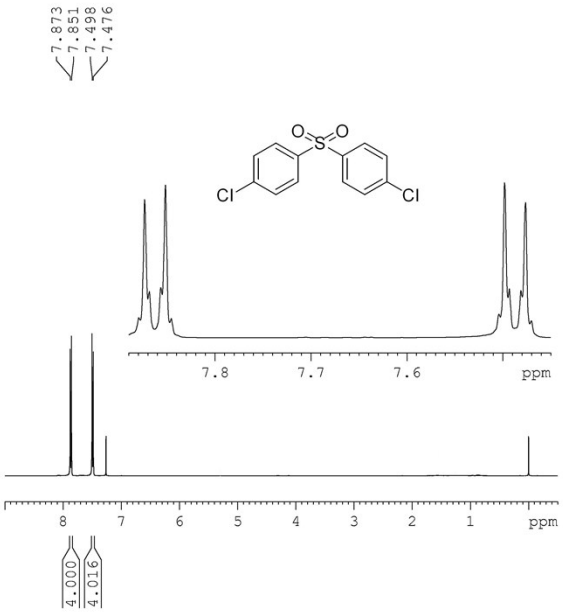

```
NAME        20140708zhangrui
EXPNO                 14
PROCNO                 1
Date_           20140708
Time                17.02
INSTRUM             spect
PROBHD    5 mm PADUL 13C
PULPROG             zg30
TD                 65536
SOLVENT             MeOD
NS                    13
DS                     2
SWH            12335.526 Hz
FIDRES          0.188225 Hz
AQ              2.6564426 sec
RG                   203
DW                40.533 usec
DE                 6.50 usec
TE                302.0 K
D1           1.00000000 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                 14.00 usec
SI                 32768
SF          600.1300140 MHz
WDW                   EM
SSB                    0
LB                  0.10 Hz
GB                     0
PC                  1.00
```



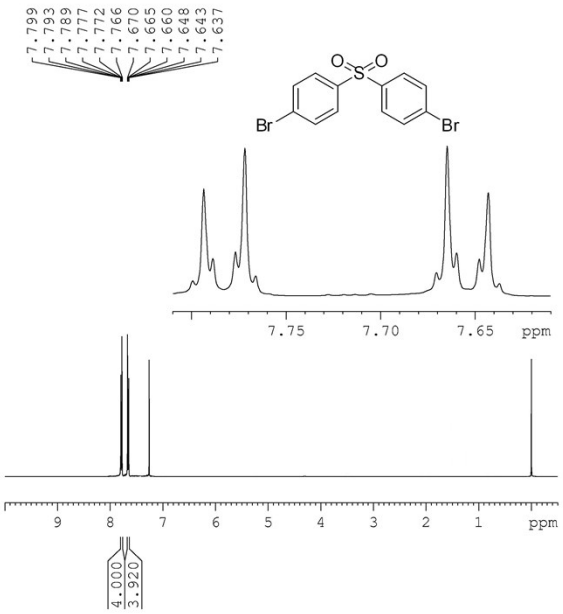

```
NAME        20150520hufei
EXPNO                  4
PROCNO                 1
Date_           20150520
Time                17.57
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT             CDCl3
NS                    16
DS                     2
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894966 sec
RG                 107.24
DW                62.400 usec
DE                 6.50 usec
TE                299.1 K
D1           1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        400.1324710 MHz
NUC1                  1H
P1                 9.70 usec
SI                 65536
SF          400.1300096 MHz
WDW                   EM
SSB                    0
LB                  0.30 Hz
GB                     0
PC                  1.00
```



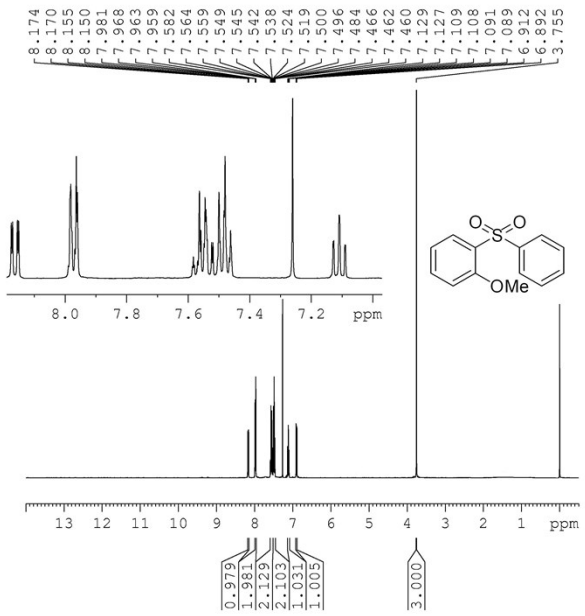

```
NAME          20150520hufei
EXPNO                     2
PROCNO                    1
Date_              20150520
Time                  17.48
INSTRUM               spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        2
SWH                8012.820 Hz
FIDRES             0.122266 Hz
AQ                 4.0894966 sec
RG                     94.93
DW                    62.400 usec
DE                     6.50 usec
TE                    299.1 K
D1              1.00000000 sec
TD0                       1

======== CHANNEL f1 ========
SFO1           400.1324710 MHz
NUC1                     1H
P1                     9.70 usec
SI                    65536
SF             400.1300092 MHz
WDW                      EM
SSB                       0
LB                     0.30 Hz
GB                        0
PC                     1.00
```




```
NAME          20150520hufei
EXPNO                     3
PROCNO                    1
Date_              20150520
Time                  17.53
INSTRUM               spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        2
SWH                8012.820 Hz
FIDRES             0.122266 Hz
AQ                 4.0894966 sec
RG                    123.61
DW                    62.400 usec
DE                     6.50 usec
TE                    299.1 K
D1              1.00000000 sec
TD0                       1

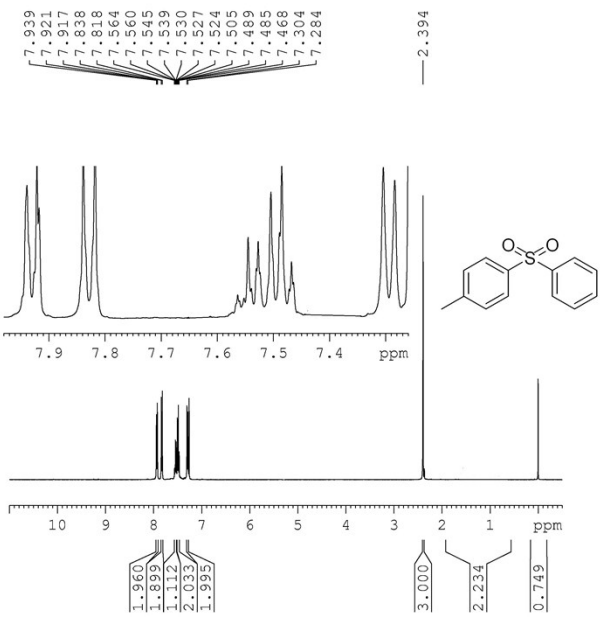
======== CHANNEL f1 ========
SFO1           400.1324710 MHz
NUC1                     1H
P1                     9.70 usec
SI                    65536
SF             400.1300098 MHz
WDW                      EM
SSB                       0
LB                     0.30 Hz
GB                        0
PC                     1.00
```




BRUKER

```
NAME        20150520hufei
EXPNO                   6
PROCNO                  1
Date_            20150520
Time                18.05
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG              zg30
TD                  65536
SOLVENT             CDCl3
NS                     16
DS                      2
SWH              8012.820 Hz
FIDRES           0.122266 Hz
AQ               4.0894966 sec
RG                  107.24
DW                  62.400 usec
DE                    6.50 usec
TE                   299.2 K
D1            1.00000000 sec
TD0                     1

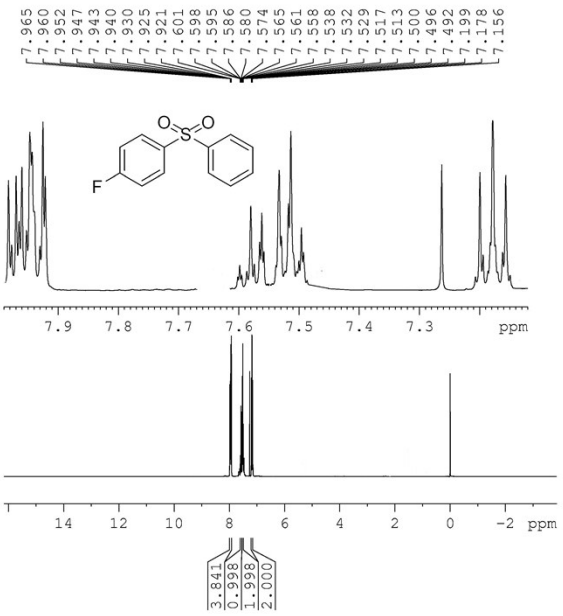
======== CHANNEL f1 ========
SFO1          400.1324710 MHz
NUC1                   1H
P1                   9.70 usec
SI                  65536
SF            400.1300097 MHz
WDW                    EM
SSB                     0
LB                   0.30 Hz
GB                      0
PC                   1.00
```




BRUKER

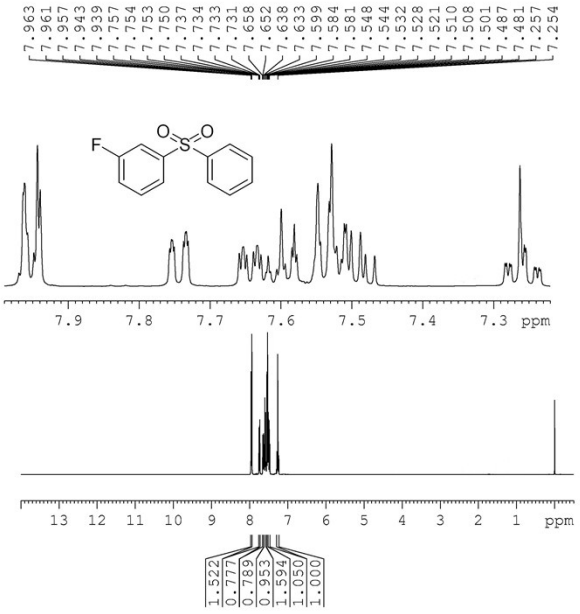
```
NAME      20150526 hufei
EXPNO                   1
PROCNO                  1
Date_            20150526
Time                17.35
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG              zg30
TD                  65536
SOLVENT             CDCl3
NS                     16
DS                      2
SWH              8012.820 Hz
FIDRES           0.122266 Hz
AQ               4.0894966 sec
RG                  94.93
DW                  62.400 usec
DE                    6.50 usec
TE                   299.9 K
D1            1.00000000 sec
TD0                     1

======== CHANNEL f1 ========
SFO1          400.1324710 MHz
NUC1                   1H
P1                   9.70 usec
SI                  65536
SF            400.1300100 MHz
WDW                    EM
SSB                     0
LB                   0.30 Hz
GB                      0
PC                   1.00
```



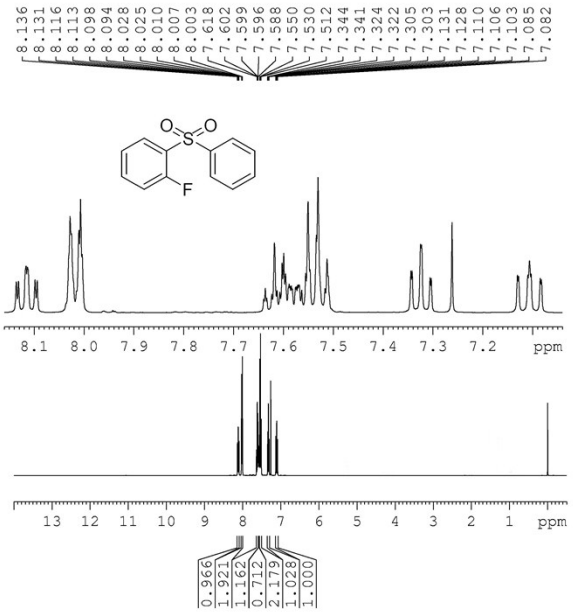

```
NAME          20150520hufei
EXPNO                     7
PROCNO                    1
Date_              20150520
Time                  18.10
INSTRUM               spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        2
SWH                8012.820 Hz
FIDRES            0.122266 Hz
AQ                4.0894966 sec
RG                    87.46
DW                   62.400 usec
DE                    6.50 usec
TE                   299.2 K
D1              1.00000000 sec
TD0                       1

======== CHANNEL f1 ========
SFO1           400.1324710 MHz
NUC1                     1H
P1                    9.70 usec
SI                    65536
SF             400.1300089 MHz
WDW                      EM
SSB                       0
LB                     0.30 Hz
GB                        0
PC                     1.00
```




```
NAME          20150520hufei
EXPNO                     8
PROCNO                    1
Date_              20150520
Time                  18.14
INSTRUM               spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        2
SWH                8012.820 Hz
FIDRES            0.122266 Hz
AQ                4.0894966 sec
RG                    87.46
DW                   62.400 usec
DE                    6.50 usec
TE                   299.2 K
D1              1.00000000 sec
TD0                       1

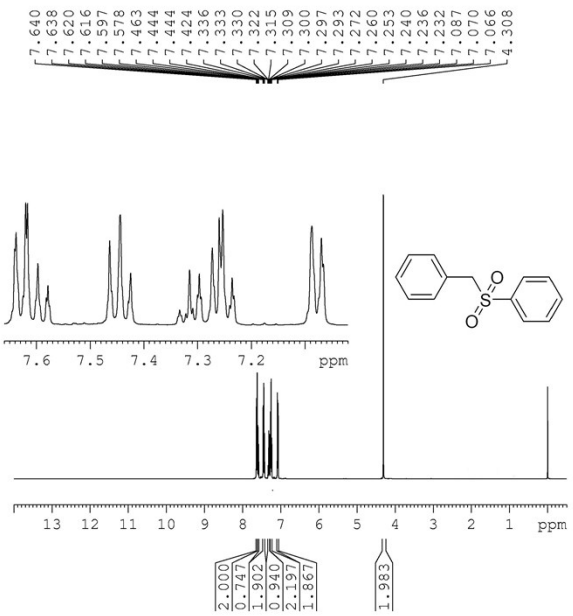
======== CHANNEL f1 ========
SFO1           400.1324710 MHz
NUC1                     1H
P1                    9.70 usec
SI                    65536
SF             400.1300089 MHz
WDW                      EM
SSB                       0
LB                     0.30 Hz
GB                        0
PC                     1.00
```




BRUKER

```
NAME          20150520hufei
EXPNO                     9
PROCNO                    1
Date_              20150520
Time                  18.18
INSTRUM               spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        2
SWH                8012.820 Hz
FIDRES             0.122266 Hz
AQ                 4.0894966 sec
RG                    87.46
DW                   62.400 usec
DE                    6.50 usec
TE                   299.2 K
D1              1.00000000 sec
TD0                       1

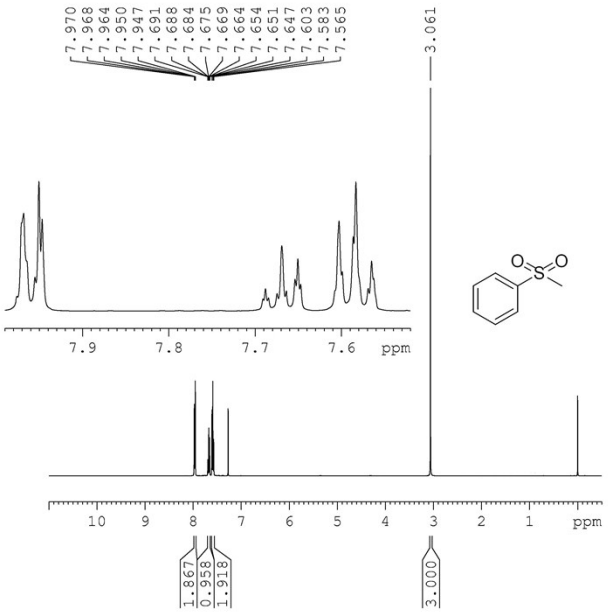
======== CHANNEL f1 ========
SFO1            400.1324710 MHz
NUC1                      1H
P1                     9.70 usec
SI                    65536
SF              400.1300092 MHz
WDW                      EM
SSB                       0
LB                     0.30 Hz
GB                        0
PC                     1.00
```




BRUKER

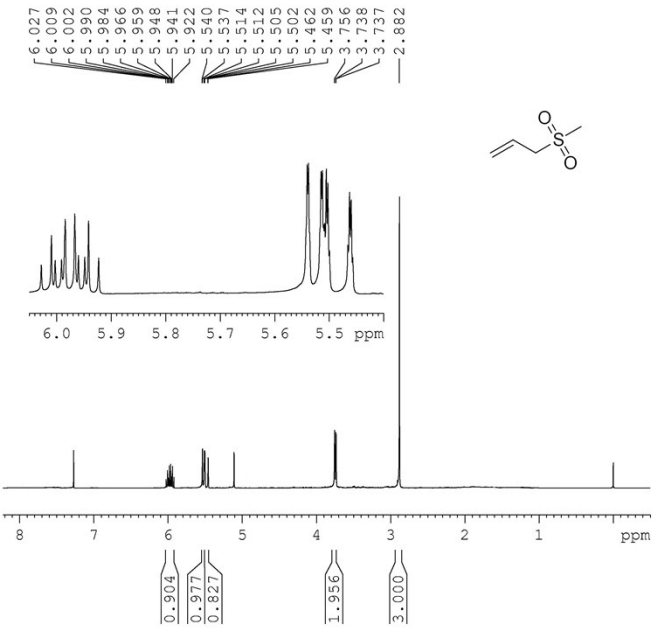
```
NAME       20150526 hufei
EXPNO                     2
PROCNO                    1
Date_              20150526
Time                  18.19
INSTRUM               spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        2
SWH                8012.820 Hz
FIDRES             0.122266 Hz
AQ                 4.0894966 sec
RG                    87.46
DW                   62.400 usec
DE                    6.50 usec
TE                   300.0 K
D1              1.00000000 sec
TD0                       1

======== CHANNEL f1 ========
SFO1            400.1324710 MHz
NUC1                      1H
P1                     9.70 usec
SI                    65536
SF              400.1300101 MHz
WDW                      EM
SSB                       0
LB                     0.30 Hz
GB                        0
PC                     1.00
```




```
NAME          20150530hufei
EXPNO                     4
PROCNO                    1
Date_              20150530
Time                  10.26
INSTRUM               spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        2
SWH                8012.820 Hz
FIDRES             0.122266 Hz
AQ                 4.0894966 sec
RG                     94.93
DW                    62.400 usec
DE                     6.50 usec
TE                    297.5 K
D1              1.00000000 sec
TD0                       1

======== CHANNEL f1 ========
SFO1           400.1324710 MHz
NUC1                     1H
P1                     9.70 usec
SI                    65536
SF             400.1300079 MHz
WDW                      EM
SSB                       0
LB                     0.30 Hz
GB                        0
PC                     1.00
```




```
NAME      2016-04-27 tyut-chh
EXPNO                    10
PROCNO                    1
Date_              20160427
Time                  21.55
INSTRUM               spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        2
SWH                8012.820 Hz
FIDRES             0.122266 Hz
AQ                 4.0894966 sec
RG                     60.71
DW                    62.400 usec
DE                     6.50 usec
TE                    296.6 K
D1              1.00000000 sec
TD0                       1

======== CHANNEL f1 ========
SFO1           400.1324710 MHz
NUC1                     1H
P1                     9.70 usec
SI                    65536
SF             400.1300041 MHz
WDW                      EM
SSB                       0
LB                     0.30 Hz
GB                        0
PC                     1.00
```