

2,3-Dichloro-5,6-dicyano-1,4-benzoquinone-catalyzed aerobic
oxidation reactions via multistep electron transfers with iron(II)
phthalocyanine as an electron-transfer mediator

Yiming Hong,^a Tiantian Fang,^b Meichao Li,^a Zhenlu Shen,^{*a} Xinquan Hu,^{*a} Weimin
Mo,^a Baoxiang Hu,^a Nan Sun,^a and Liqun Jin^a

^a College of Chemical Engineering, Zhejiang University of Technology, Hangzhou
310014, China

e-mail: zhenlushen@zjut.edu.cn, xinquan@zjut.edu.cn

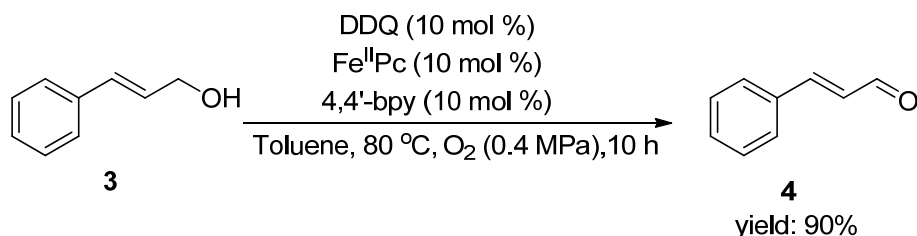
^b College of Pharmaceutical Sciences, Zhejiang University of Technology, Hangzhou
310014, China

General Remarks

GC analyses were conducted on an Agilent GC7890A system with a flame ionization detector (FID) and a PEG-20 capillary column. Conversions and selectivities were determined by area normalization. Phenylacetonitrile was selected as the internal standard for GC internal standard method in the optimization experiment. ^1H NMR spectra were carried out on a Bruker Avance III (500M Hz) spectrometer. CDCl_3 and $\text{DMSO-}d_6$ were used as the solvents with tetramethylsilane (TMS) as the internal standard. GC-MS was performed on Thermo Trace ISQ instrument. Low mass spectra were recorded in the ESI mode on an Agilent 6210 LC/TOF mass spectrometer.

All solvents and chemicals were used as received from commercial suppliers, unless otherwise noted. Multi-walled carbon nanotube (MWCNT) was purchased from Beijing Boyu GaoKe New Material Technology Co. Ltd. PMB ethers (**1a-1i**, **1k**, **1k'**) were obtained from corresponding alcohols and 4-methoxybenzyl chloride. PMB ether **1j** was prepared in our previous work.^[1] Bifunctional PMB ethers (**1l-1o**) were synthesized as follows: (1) One hydroxyl of 1,6-hexanediol was protected as PMB ether with 4-methoxybenzyl chloride to give 6-(4-methoxybenzyloxy)hexan-1-ol; (2) The hydroxyl of 6-(4-methoxybenzyloxy)hexan-1-ol was protected by other alcohol protecting groups (Me, MOM, Ac, Bn) to obtain **1l-1o**.

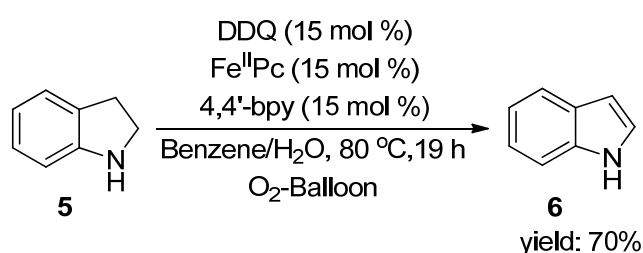
Oxidation of cinnamyl alcohol



To a teflon-lined 316L stainless steel autoclave (300 mL), was added 1 mmol of cinnamyl alcohol (**3**), 10 mol% of DDQ, 10 mol% of FePc , 10 mol% of 4,4'-bpy and 20 mL of toluene. Then closed the autoclave and charged O_2 to 0.4 MPa. Put the

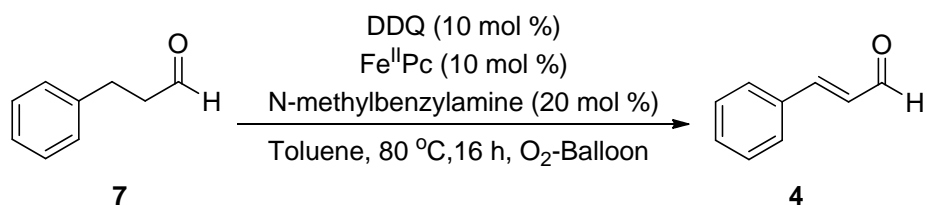
autoclave into an oil bath, which was preheated to 80 °C. After the reaction was finished, the autoclave was cooled to room temperature and carefully depressurized. Then the reaction mixture was concentrated by rotary evaporator and the residue was purified by column chromatography on silica gel to afford cinnamaldehyde (**4**) in 90% yield.

Aromatization of indoline (**5**)



A sealed tube (50 mL) equipped with a magnetic stirring bar was charged with 1 mmol of indoline (**5**), 15 mol% of DDQ, 15 mol% of FePc, 15 mol% of 4,4'-bpy, 5 mL of benzene and five drops of H₂O. Before reaction, air was replaced by purging with a stream of O₂. The reaction mixture was stirred under dioxygen atmosphere (balloon) at 80 °C for 19 h. Then the mixture was concentrated by rotary evaporator and the residue was purified by column chromatography on silica gel to afford indole (**6**) in 70% yield.

Transformation of 3-phenylpropanal (**7**) to cinnamaldehyde (**4**)



A sealed tube (50 mL) equipped with a magnetic stirring bar was charged with 1 mmol of 3-phenylpropanal (**7**), 10 mol% of DDQ, 10 mol% of FePc, 20 mol% of N-methylbenzylamine and 5 mL of toluene. Before reaction, air was replaced by

purging with a stream of O₂. The reaction mixture was stirred under dioxygen atmosphere (balloon) at 80 °C for 16 h. Then the mixture was concentrated by rotary evaporator and the residue was purified by column chromatography on silica gel to afford cinnamaldehyde (**4**) in 70% yield.

Immobilization Fe^{II}Pc onto multi-walled carbon nanotube

To a 50 mL flask was added a certain amount of Fe^{II}Pc and 25 mL of DMF. The flask was put into an ultrasonicator, and FePc was dissolved in DMF via ultrasonic oscillation for 30 mins. Then 250 mg multi-walled carbon nanotube (MWCNT) was added into the flask, and continued ultrasonic oscillation for 2 h. After the ultrasonic oscillation complete, filtrated, obtained supported FePc. The filtrate was colorless. This proved that Fe^{II}Pc has been fully supported on the MWCNT. The supported FePc (FePc-MWCNT) was put into an oven and parched overnight at 70 °C.

FePc-MWCNT was characterized by Fourier-transform infrared spectroscopy using a Nicolet 6700 spectrometer (Thermo Fisher Nicolet) coupled with a Continuum microscope and Hitachi S-4700 scanning electron microscope.

Reference

[1] Z. L. Shen, L. L. Sheng, X. C. Zhang, W. M. Mo, B. X. Hu, N. Sun, X. Q. Hu; Tetrahedron Lett. 2013, 54, 1579–1583.

Characterization of FePc-MWCNT

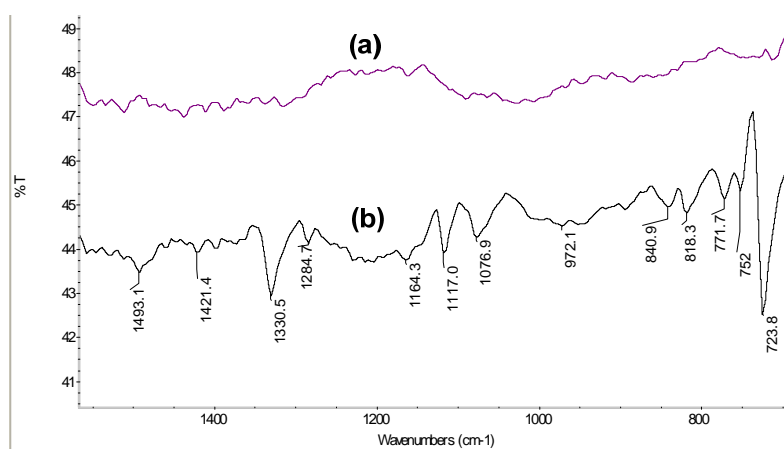


Figure S1. FTIR spectra of (a) MWCNT and (b) FePc-MWCNT

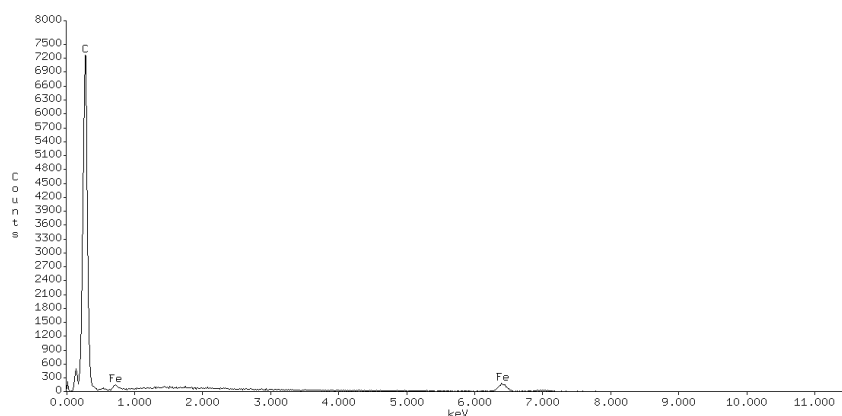


Figure S2. EDS spectrum of FePc-MWCNT

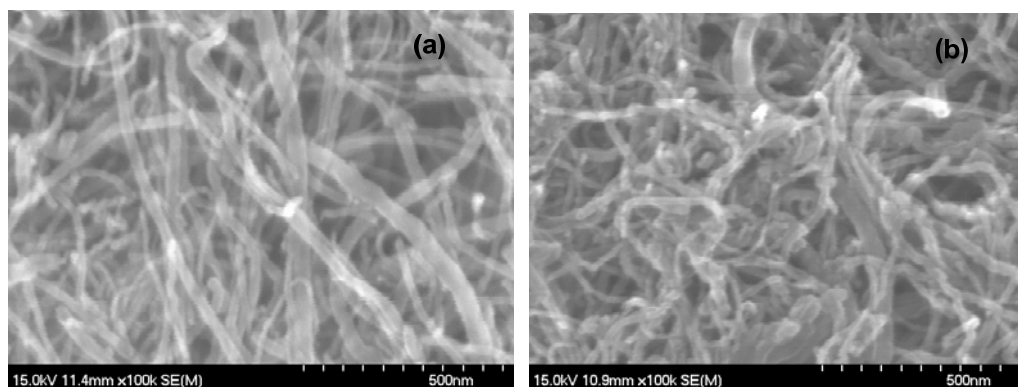
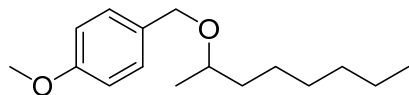


Figure S3. SEM images of (a) MWCNT and (b) FePc-MWCNT

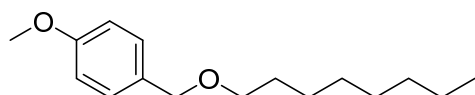
Spectral data of compounds 1a-1i, 1k, 1k', 1l-1o, 2a-2o, 4, 4' and 5

1-methoxy-4-((octan-2-yloxy)methyl)benzene (1a)



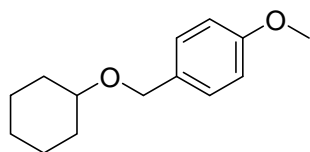
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 7.29(d, $J = 8.5$ Hz, 2 H), δ 6.90(d, $J = 8.5$ Hz, 2 H), δ 4.53(d, $J = 11.5$ Hz, 1 H), δ 4.42(d, $J = 11.5$ Hz, 1 H), δ 3.82(s, 1 H), δ 3.53-3.47(m, 1 H), δ 1.64-1.56(m, 1 H), δ 1.44-1.29(m, 1 H), δ 1.20(d, $J = 6$ Hz, 3 H), δ 0.90 (t, $J = 6.5$ Hz, 3 H). MS (EI), m/z , 250.14 [M^+].

1-methoxy-4-((octyloxy)methyl)benzene (1b)



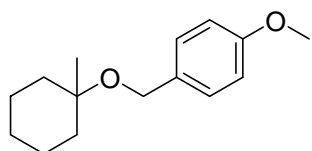
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 7.27(d, $J = 8.5$ Hz, 2 H), δ 6.88(d, $J = 8.5$ Hz, 2 H), δ 4.43(s, 2 H), δ 3.80(s, 3 H), δ 3.43(t, $J = 6.5$ Hz, 2 H), δ 1.62-1.56(m, 2 H), δ 1.35-1.29(m, 10 H), δ 0.88(t, $J = 7$ Hz, 3 H). MS (EI), m/z , 250.11 [M^+].

1-((cyclohexyloxy)methyl)-4-methoxybenzene (1c)



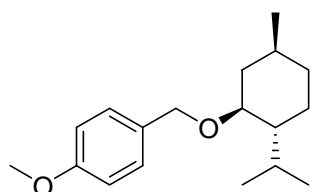
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 7.27(d, $J = 8.5$ Hz, 2 H), δ 6.87(d, $J = 8.5$ Hz, 2 H), δ 4.47(s, 2 H), δ 3.79(s, 3 H), δ 3.35-3.30 (m, 1 H), δ 1.94-1.92 (m, 1 H), δ 1.77-1.72(m, 1 H), δ 1.54-1.50(m, 1 H), δ 1.38-1.31(m, 1 H), δ 1.28-1.19(m, 1 H). MS (EI), m/z , 220.12 [M^+].

1-methoxy-4-(((1-methylcyclohexyl)oxy)methyl)benzene (1d)



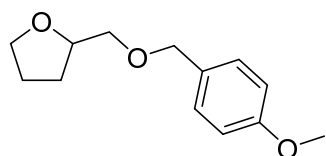
^1H NMR (500 MHz, CDCl_3): δ 7.29(d, $J = 8.5$ Hz, 2 H), δ 6.87(d, $J = 8.5$ Hz, 2 H), δ 4.34(s, 2 H), δ 3.79(s, 3 H), δ 1.81-1.78(m, 2 H), δ 1.69-1.60(m, 2 H), δ 1.56-1.51(m, 1 H), δ 1.46-1.28(m, 5 H), δ 1.22(s, 3 H). MS (EI), m/z , 234.13 [M^+].

1-(((1S,2R,5S)-2-isopropyl-5-methylcyclohexyl)oxy)methyl)-4-methoxybenzene (1e)



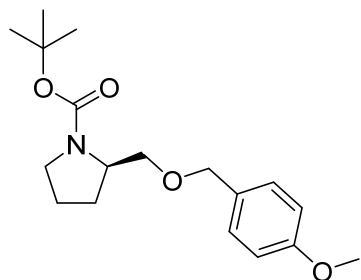
^1H NMR (500 MHz, CDCl_3): δ 7.27(d, $J = 9$ Hz, 2 H), δ 6.87(d, $J = 9$ Hz, 2 H), δ 4.59(d, $J = 11$ Hz, 1 H), δ 4.34(d, $J = 11$ Hz, 1 H), δ 3.79(s, 3 H), δ 3.17-3.13(m, 1 H), δ 2.28-2.17(m, 2 H), δ 1.63-1.60(m, 2 H), δ 1.27(m, 2 H), δ 0.94-0.88(m, 9 H), δ 0.71(d, $J = 7$ Hz, 3 H). MS (EI), m/z , 276.16 [M^+].

2-(((4-methoxybenzyl)oxy)methyl)tetrahydrofuran (1f)



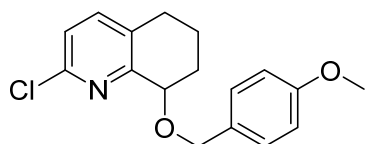
^1H NMR (500 MHz, CDCl_3): δ 7.28(d, $J = 8.5$ Hz, 2 H), δ 6.88(d, $J = 8.5$ Hz, 2 H), δ 4.54-4.47(dd $J = 12$ Hz, $J = 11.5$ Hz, 2 H), δ 4.06(m, 1 H), δ 3.88-3.87(m, 1 H), δ 3.86(s, 3 H), δ 3.80-3.45(m, 1 H), δ 3.44(m, 2 H), δ 1.96-1.86(m, 3 H), δ 1.64-1.59(m, 1 H). MS (EI), m/z , 222.08 [M^+].

tert-butyl (R)-2-(((4-methoxybenzyl)oxy)methyl)pyrrolidine-1-carboxylate (1g)



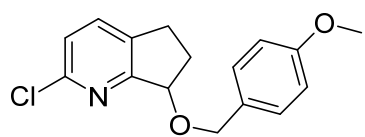
^1H NMR (500 MHz, CDCl_3): δ 7.25(d, $J = 8.5$ Hz, 2 H), δ 6.88(d, $J = 8.5$ Hz, 2 H), δ 4.45(s, 2 H), δ 4.01-3.88(m, 1 H), δ 3.79(s, 3 H), δ 3.61-3.32(m, 4 H), δ 1.95-1.76(m, 4 H), δ 1.43(s, 3 H). MS (EI), m/z , 321.06 [M^+].

2-chloro-8-((4-methoxybenzyl)oxy)-5,6,7,8-tetrahydroquinoline (1h)



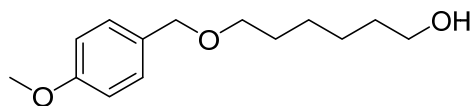
^1H NMR (500 MHz, CDCl_3): δ 7.38(d, $J = 8$ Hz, 1 H), δ 7.34(d, $J = 8.5$ Hz, 2 H), δ 7.16(d, $J = 8$ Hz, 1 H), δ 6.87(d, $J = 8.5$ Hz, 2 H), δ 4.77-4.70(dd, $J = 11$ Hz, $J = 11$ Hz, 2 H), δ 4.50(t, $J = 4$ Hz, 1 H), δ 3.79(s, 3 H), δ 2.83-2.79(m, 1 H), δ 2.70-2.67(m, 1 H), δ 2.24-2.20(m, 1 H), δ 2.08-2.05(m, 1 H), δ 1.81-1.74(m, 1 H), δ 1.63(s, 3 H). MS (EI), m/z , 301.03 [M^+].

2-chloro-7-((4-methoxybenzyl)oxy)-6,7-dihydro-5H-cyclopenta[b]pyridine (1i)



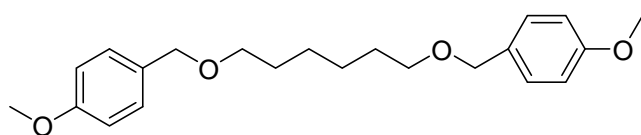
^1H NMR (500 MHz, CDCl_3): δ 7.51(d, $J = 8$ Hz, 1 H), δ 7.33(d, $J = 9$ Hz, 2 H), δ 7.19(d, $J = 8$ Hz, 1 H), δ 6.88(d, $J = 9$ Hz, 2 H), δ 4.88-4.86(m, 1 H), δ 4.83(d, $J = 11.5$ Hz, 1 H), δ 4.71(d, $J = 11.5$ Hz, 1 H), δ 3.79(s, 3 H), δ 3.07-3.04(m, 1 H), δ 2.79-2.77(m, 1 H), δ 2.36-2.33(m, 1 H), δ 2.19-2.18(m, 1 H). MS (EI), m/z , 289.68 [M^+].

6-((4-methoxybenzyl)oxy)hexan-1-ol (1k)



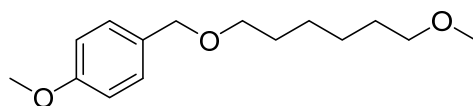
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 7.28(d, $J = 8.5$ Hz, 2 H), δ 6.90(d, $J = 8.5$ Hz, 2 H), δ 4.44(s, 2 H), δ 3.81(s, 3 H), δ 3.63(t, $J = 6.5$ Hz, 2 H), δ 3.45(t, $J = 6.5$ Hz, 2 H), δ 1.65-1.55(m, 4 H), δ 1.45(s, 1 H), δ 1.42-1.36(m, 4 H). MS (EI), m/z , 238.12 [M^+].

1,6-bis((4-methoxybenzyl)oxy)hexane (1k')



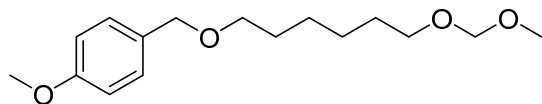
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 7.28(d, $J = 8.5$ Hz, 4 H), δ 6.90 (d, $J = 8.5$ Hz, 4 H), δ 4.44(s, 4 H), δ 3.82(s, 6 H), δ 3.44 (t, $J = 6.5$ Hz, 4 H), δ 1.63-1.60(m, 4 H), δ 1.40-1.37(m, 4 H). MS (ESI), m/z , 381.2 [$\text{M}+\text{Na}^+$].

1-methoxy-4-(((6-methoxyhexyl)oxy)methyl)benzene (1l)



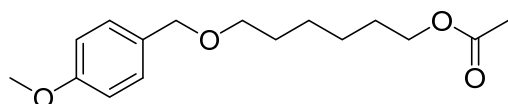
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 7.26(d, $J = 8.5$ Hz, 2 H), δ 6.88(d, $J = 8.5$ Hz, 2 H), δ 4.42(s, 2 H), δ 3.79(s, 3 H), δ 3.43(t, $J = 6.5$ Hz, 2 H), δ 3.36(t, $J = 6.5$ Hz, 2 H), δ 3.32(s, 3 H), δ 1.63-1.54(m, 4 H), δ 1.37-1.35(m, 4 H). MS (EI), m/z , 252.16 [M^+].

1-methoxy-4-(((6-(methoxymethoxy)hexyl)oxy)methyl)benzene (1m)



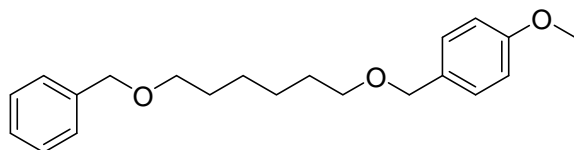
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 7.26(d, $J = 8$ Hz, 2 H), δ 6.88(d, $J = 9$ Hz, 2 H), δ 4.61(s, 2 H), δ 4.43(s, 2 H), δ 3.80(s, 3 H), δ 3.51(t, $J = 6.5$ Hz, 2 H), δ 3.43(t, $J = 6.5$ Hz, 2 H), δ 3.35(s, 3 H), δ 1.64-1.57(m, 4 H), δ 1.42-1.35(m, 4 H). MS (EI), m/z , 281.89 [M^+].

6-((4-methoxybenzyl)oxy)hexyl acetate (1n)



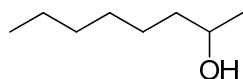
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 7.26(d, $J = 9$ Hz, 2 H), δ 6.88(d, $J = 8.5$ Hz, 2 H), δ 4.42(s, 2 H), δ 4.04(t, $J = 7$ Hz, 2 H), δ 3.80 s, 3 H), δ 3.43(t, $J = 6.5$ Hz, 2 H), δ 2.03(s, 3 H), δ 1.65-1.58(m, 4 H), δ 1.41-1.34(m, 4 H). MS (EI), m/z , 280.01 [M^+].

1-(((6-(benzyloxy)hexyl)oxy)methyl)-4-methoxybenzene (1o)



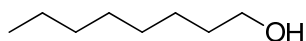
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 7.33(d, $J = 4.5$ Hz, 4 H), δ 7.28-7.26(m, 1 H), δ 7.26(d, $J = 2$ Hz, 2 H), δ 7.25(d, $J = 2.5$ Hz, 2 H), δ 4.49(s, 2 H), δ 4.42(s, 2 H), δ 3.79(s, 3 H), δ 3.46(t, $J = 6.5$ Hz, 2 H), δ 3.43(t, $J = 6.5$ Hz, 2 H), δ 1.63-1.59(m, 4 H), δ 1.39-1.36(m, 4 H). MS (EI), m/z , 327.97 [M^+].

2-octanol (2a)



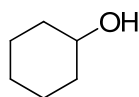
MS (EI), m/z , 129.02 [M^+].

***n*-octyl alcohol (2b)**



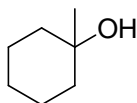
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 3.64(t, $J = 6.5$ Hz, 2 H), δ 1.58-1.55(m, $J = 7$ Hz 2 H), δ 1.36-1-1.33(m, 2 H), δ 1.30-1-1.27(m, 8 H), δ 0.88(t, $J = 7$ Hz, 3 H). MS (EI), m/z , 129.52 [M^+].

cyclohexanol (2c)



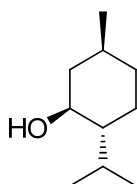
MS (EI), m/z , 100.09 [M^+].

methylcyclohexanol (2d)



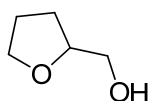
MS (EI), m/z, 114.01[M⁺].

(1S,2R,5S)-2-isopropyl-5-methylcyclohexan-1-ol (2e)



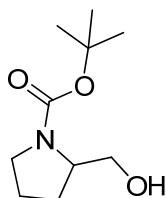
¹H NMR (500 MHz, CDCl₃): δ 3.63(t, *J*=6.5 Hz, 2H), δ 1.78(s, 1H), δ 1.59-1.53(m, 2H), δ 1.35-1.27(m, 10H), δ 0.88(t, *J*=7 Hz, 3H). MS (EI), m/z, 155.02 [M⁺].

(tetrahydrofuran-2-yl)methanol (2f)



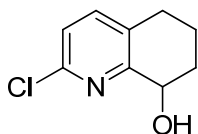
¹H NMR (500 MHz, CDCl₃): δ 4.04-3.99(m, 1H), δ 3.89-3.85(m, 1H), δ 3.81-3.77(m, 1H), δ 3.68-3.65(dd, *J* = 2, 2 Hz, 1H), δ 3.52-3.49(m, 1H), δ 2.66(s, 1H), δ 1.97-1.87(m, 3H), δ 1.68-1.63(m, 1H). MS (EI), m/z, 102.12 [M⁺].

***t*-Butyl-2-(hydroxymethyl)pyrrolidine-1-carboxylate (2g)**



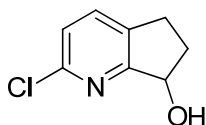
¹H NMR (500 MHz, CDCl₃): δ 4.79(d, *J*=6 Hz, 1H), δ 3.98(d, *J*=6.5 Hz, 1H), δ 3.64-3.58(m, 2H), δ 3.46-3.32(m, 2H), δ 2.03-1.99(m, 1H), δ 1.85-1.76(m, 2H), δ 1.66-1.51(m, 1H), δ 1.47(s, 9H). MS (EI), m/z, 201.01 [M⁺].

2-chloro-5,6,7,8-tetrahydroquinolin-8-ol (2h)



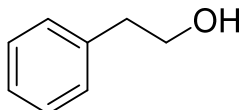
^1H NMR (500 MHz, CDCl_3): δ 7.40-7.38(d, $J=8.5$ Hz, 1H), δ 7.16-7.14(d, $J=8$ Hz, 1H), δ 4.70-4.68(m, 1H), δ 3.61(s, 1H), δ 2.83-2.72(m, 2H), δ 2.24-2.23(m, 1H), δ 2.02-2.00(m, 1H), δ 1.85-1.80(m, 2H). MS (EI), m/z , 181.92 [M^+].

2-chloro-6,7-dihydro-5H-cyclopenta[b]pyridin-7-ol (2i)



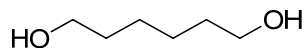
^1H NMR (500 MHz, CDCl_3): δ 7.54-7.52(d, $J=8$ Hz, 1H), δ 7.19-7.17(d, $J=8$ Hz, 1H), δ 5.14(t, $J=7$ Hz, 1H), δ 3.70(s, 1H), δ 3.01-3.00(m, 1H), δ 2.82-2.79(m, 1H), δ 2.57-2.56(m, 1H), δ 2.12-2.05(m, 1H). MS (EI), m/z , 168.95 [M^+].

1,6-Hexane-diol (2j)



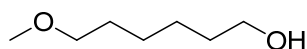
^1H NMR (500 MHz, CDCl_3): δ 7.32-7.29(m, 2H), δ 7.24-7.21(m, 3H), δ 3.84(t, $J = 6.5$ Hz, 2H), δ 2.85(t, $J = 6.5$ Hz, 2H), δ 1.69(s, 1H). MS (EI), m/z , 122.05 [M^+].

1,6-Hexane-diol (2k)



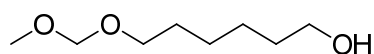
^1H NMR (500 MHz, CDCl_3): δ 3.83(s, 2H), δ 3.38(t, $J = 7$ Hz, 4H), δ 1.40(t, $J = 6.5$ Hz, 4H), δ 1.30-1.24(m, 4H). MS (EI), m/z , 118.90 [M^+].

6-methoxyhexan-1-ol (2l)



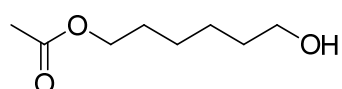
^1H NMR (500 MHz, CDCl_3): δ 3.63 (t, $J = 6.5$ Hz, 2H), δ 3.38(t, $J = 6.5$ Hz, 2H), δ 3.33(s, 3H), δ 1.61-1.55(m, 4H), δ 1.39-1.36(m, 4H). MS (EI), m/z , 132.12 [M^+].

6-(methoxymethoxy)hexan-1-ol (2m)



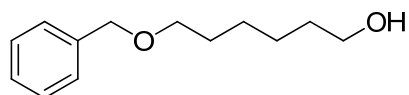
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 4.62(s, 2H), δ 3.63(t, $J = 6.5$ Hz, 2H), δ 3.53(t, $J = 6.5$ Hz, 2H), δ 3.36(s, 3H), δ 2.05(s, 1H), δ 1.64-1.55(m, 4H), δ 1.40(t, $J = 3.5$ Hz, 4H). MS (EI), m/z , 163.07 [M^+].

6-hydroxyhexyl acetate (2n)



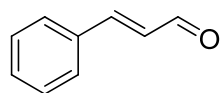
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 4.08-4.05(m, 2H), δ 3.65-3.62(m, 2H), δ 2.05-2.04(d, $J = 2$ Hz, 3H), δ 1.91(t, $J = 6$ Hz, 2 H), δ 1.65-1.57(m, 4 H), δ 1.39(m, Hz, 4 H). MS (EI), m/z , 160.98 [M^+].

6-(benzyloxy)hexan-1-ol (2o)



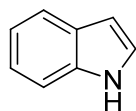
$^1\text{H NMR}$ (500 MHz, CDCl_3): δ 7.35- 7.26(m, 5 H), δ 4.50(s, 2 H), δ 3.63(t, $J=6.5$ Hz, 2 H), δ 3.47(t, $J=6.5$ Hz, 2 H), δ 1.66-1.54(m, 4 H), δ 1.42-1.35(m, 4 H). MS (EI), m/z , 208.12 [M^+].

cinnamic aldehyde (4)



Yellow liquid. $^1\text{H NMR}$ (500 MHz, CDCl_3): δ 9.72(d, $J = 7.5$ Hz, 1 H), δ 7.59-7.47(m, 2H), δ 7.45(d, $J = 2$ Hz, 1H), δ 7.44-7.43(m, 3H), δ 6.76-6.71(m, 1H). MS (EI), m/z , 132.10 [M^+].

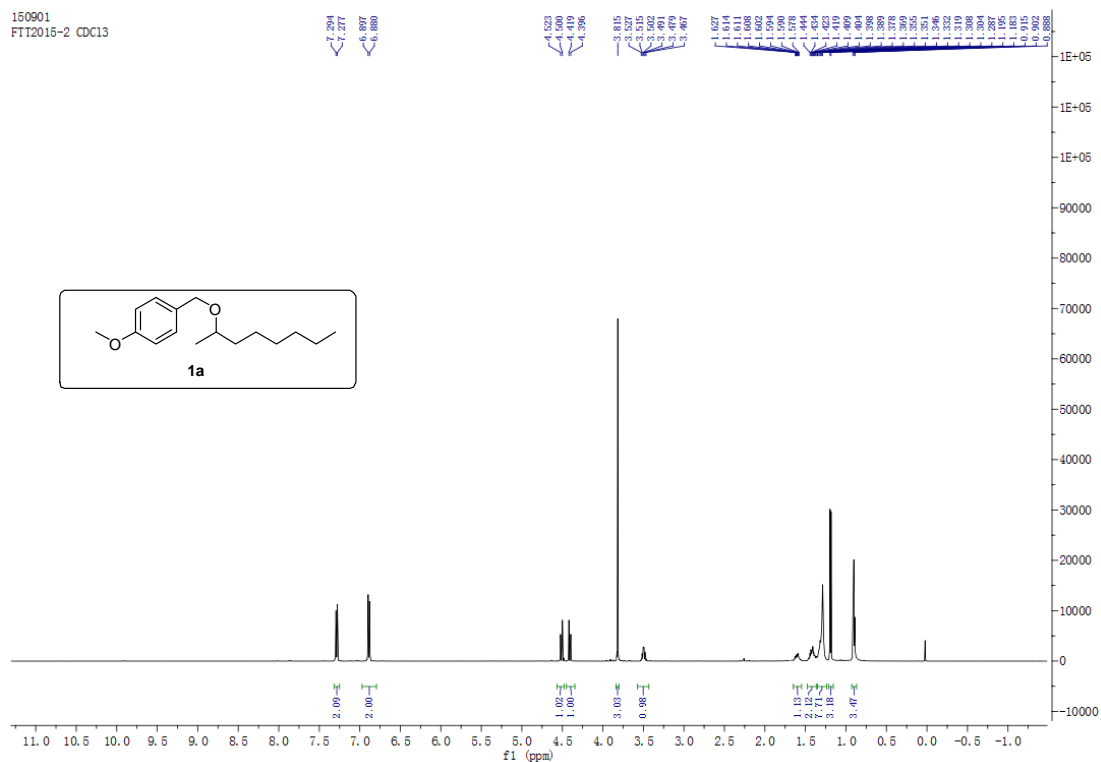
indole (5)



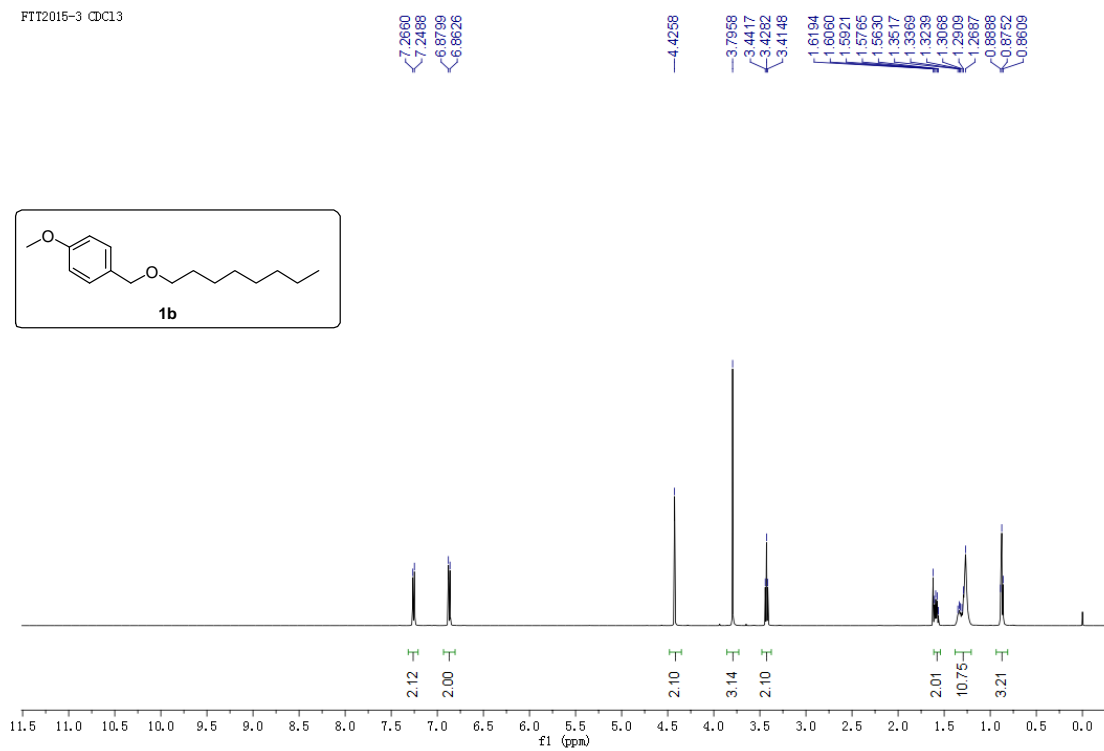
pale yellow solid. ^1H NMR (500 MHz, CDCl_3): δ 8.16(s, 1H), δ 7.69(d, $J = 8$ Hz, 1 H), δ 7.43(d, $J = 8$ Hz, 1 H), δ 7.24 -7.15(m, 2H), δ 7.17-7.14(m, 1H), δ 6.60-6.59(m, 1 H). MS (EI), m/z , 117.05 [M^+].

Copies of ¹H NMR for the compounds **1a-1i**, **1k**, **1k'**, **1l-1o**

150901
FTI2015-2 CDCl₃



FTI2015-3 CDCl₃



FT12015-4 CDCl3

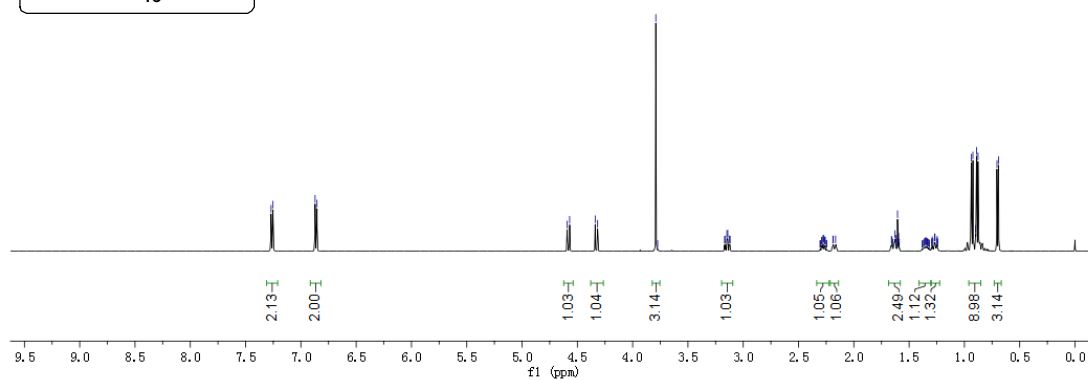
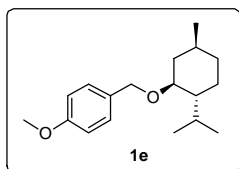
7.2696
7.2524
6.8716
6.8544

4.5920
4.5698
4.3387
4.3166

3.7905
3.7738
3.1689
3.1606
3.1478
3.1396
3.1268
3.1185

2.2778
2.2724
2.1893
2.1858
2.1648

1.6271
1.6049
1.5949
1.2701
0.9232
0.8984
0.8910
0.8769
0.7055
0.6916



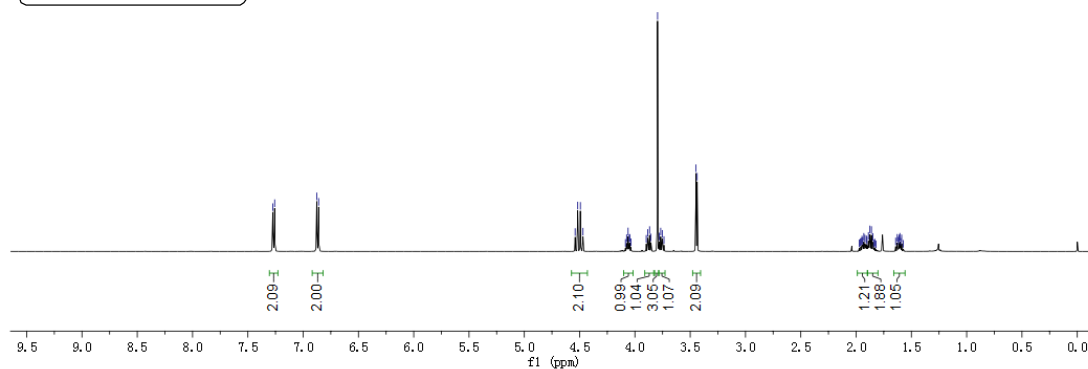
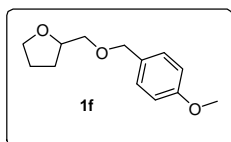
FT12015-2 CDCl3

7.2747
7.2576
6.8773
6.8601

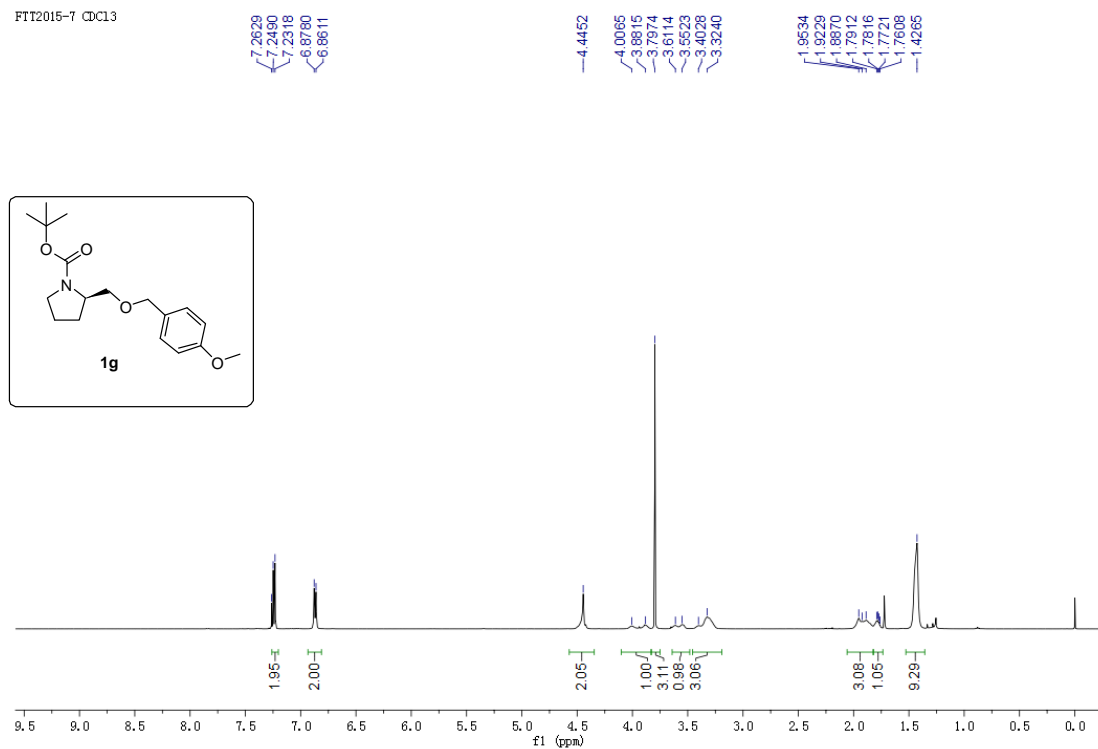
4.5405
4.5171
4.4932
4.4697

4.0615
3.8840
3.8675
3.8546
3.7890
3.7800
3.7688
3.7529
3.4474
3.4570

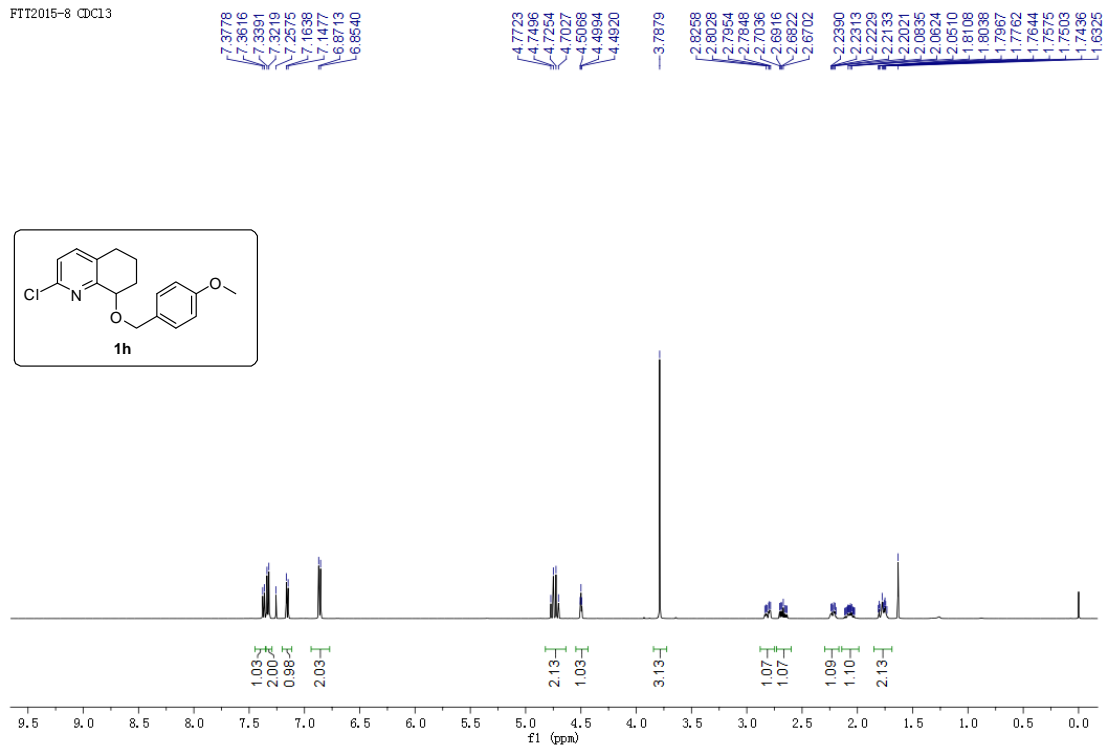
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1.9401
1.9300
1.9206
1.9077
1.8975
1.8868
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1.8473
1.6423
1.6277
1.6185
1.6105
1.6039
1.5964
1.5878



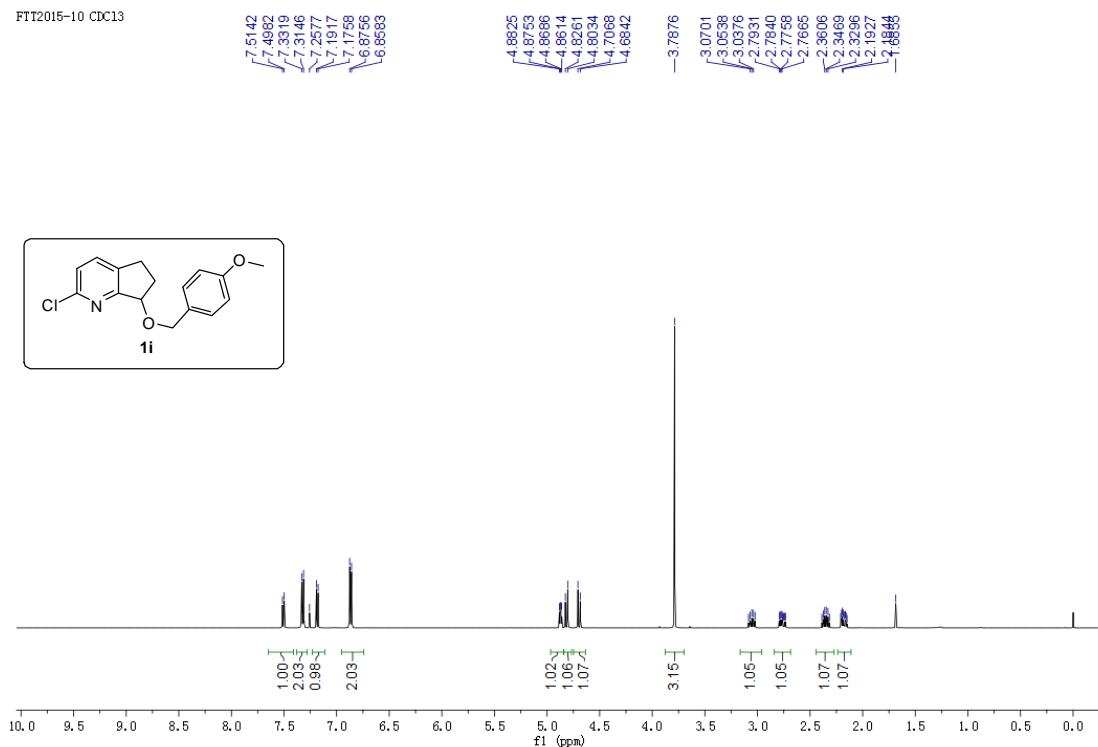
FTT2015-7 CDCl3



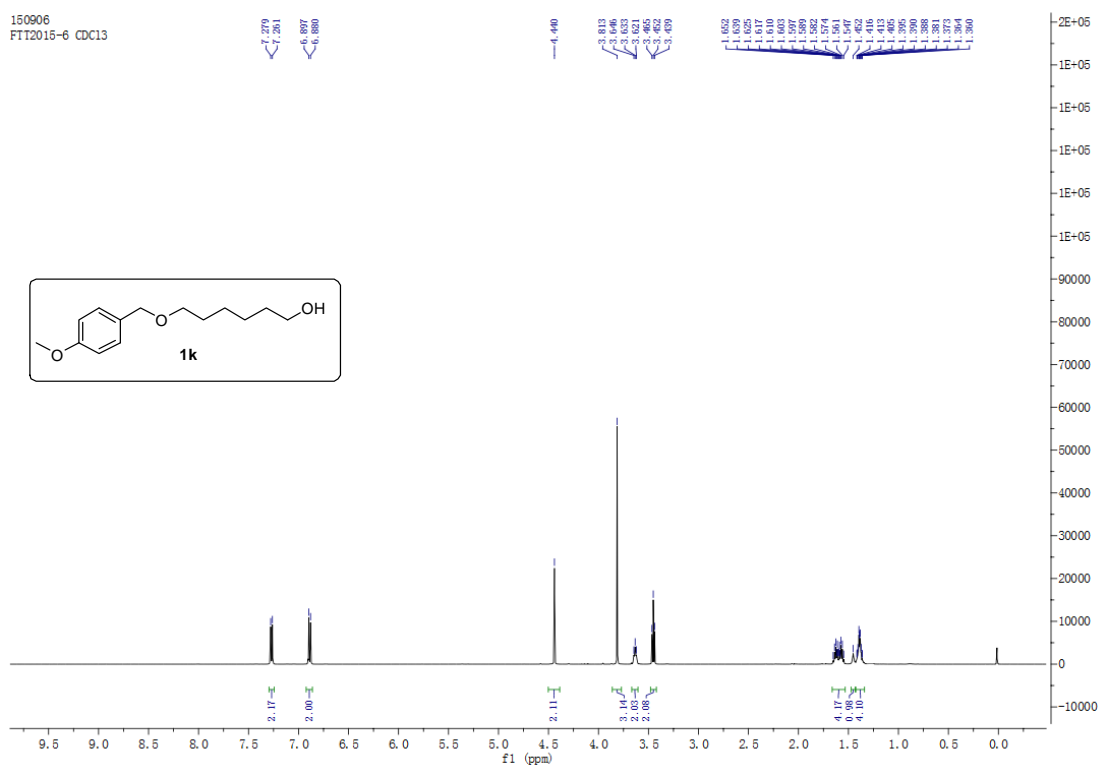
FTT2015-8 CDCl3



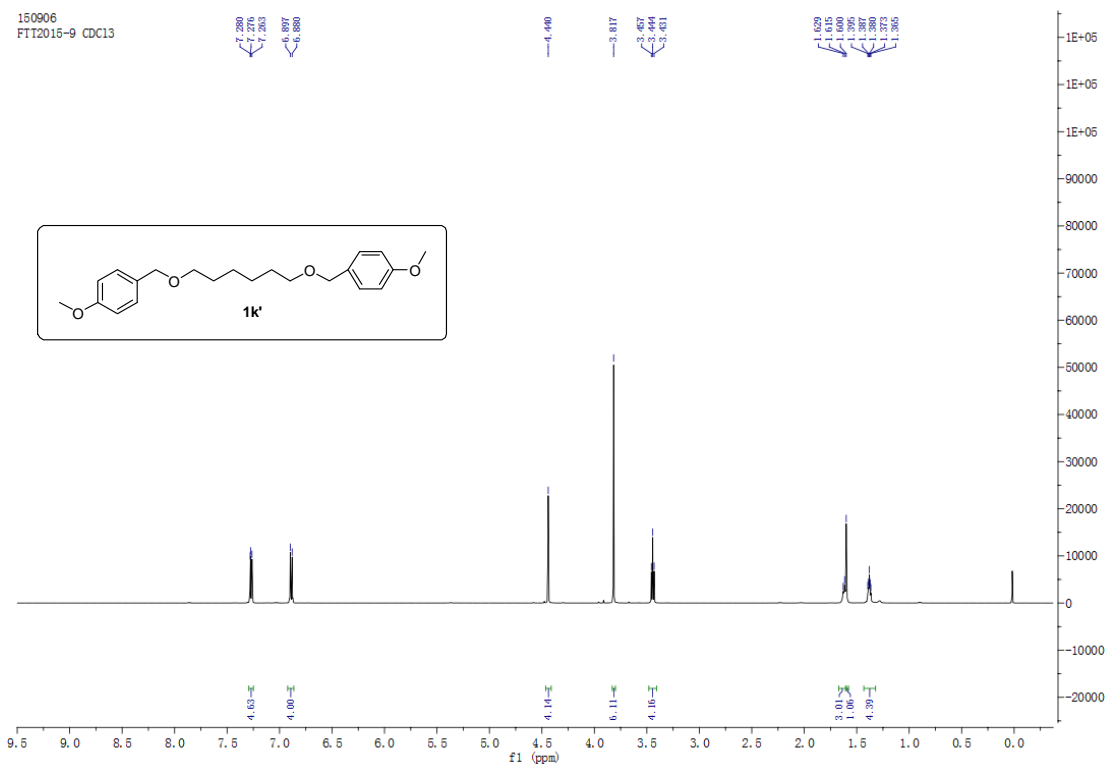
FIT2015-10 CDC13



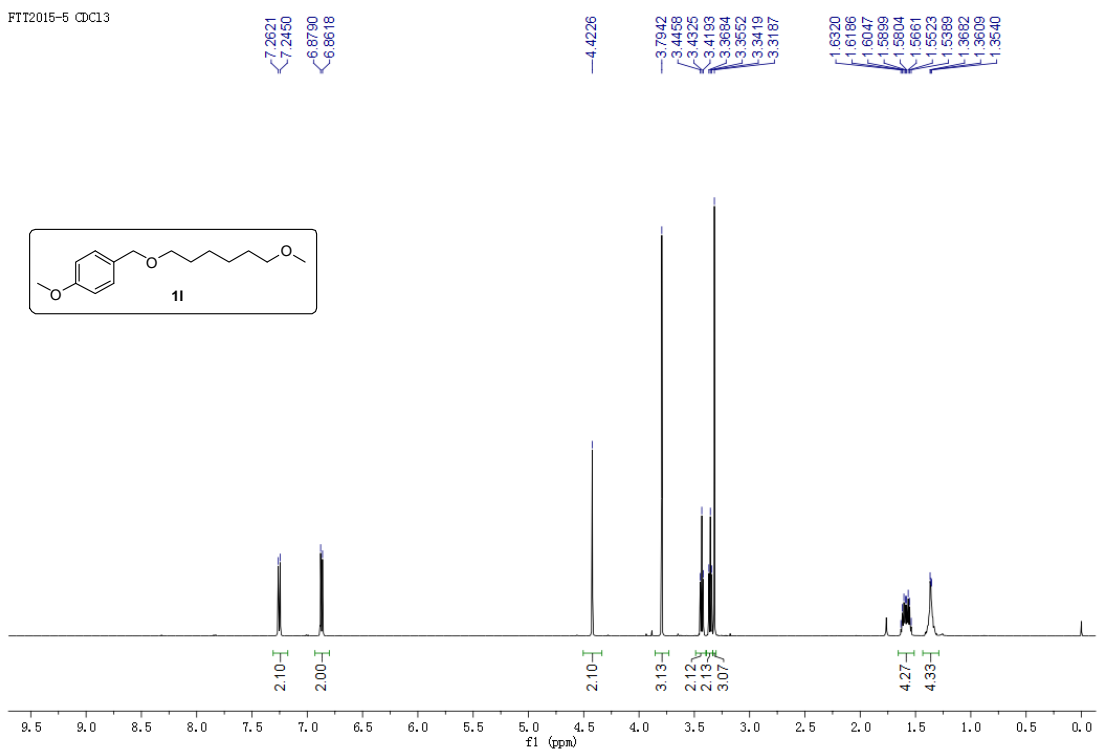
150906
FIT2015-6 CDC13



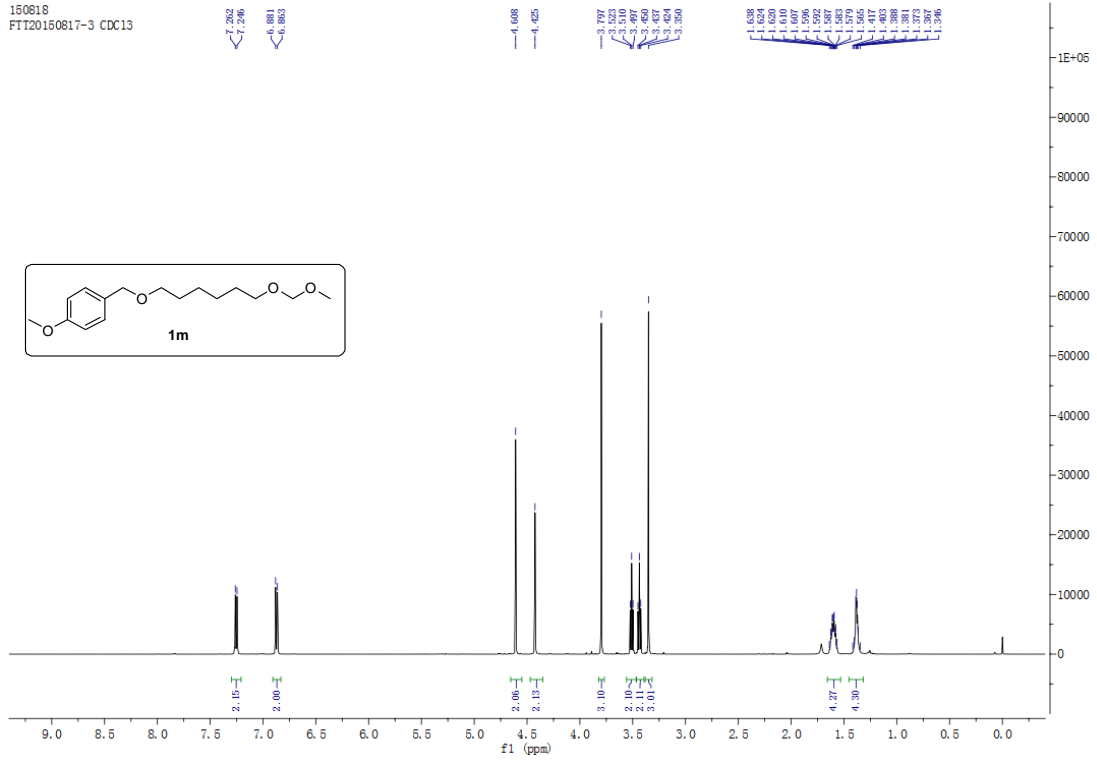
150906
FT12015-9 CDCl3



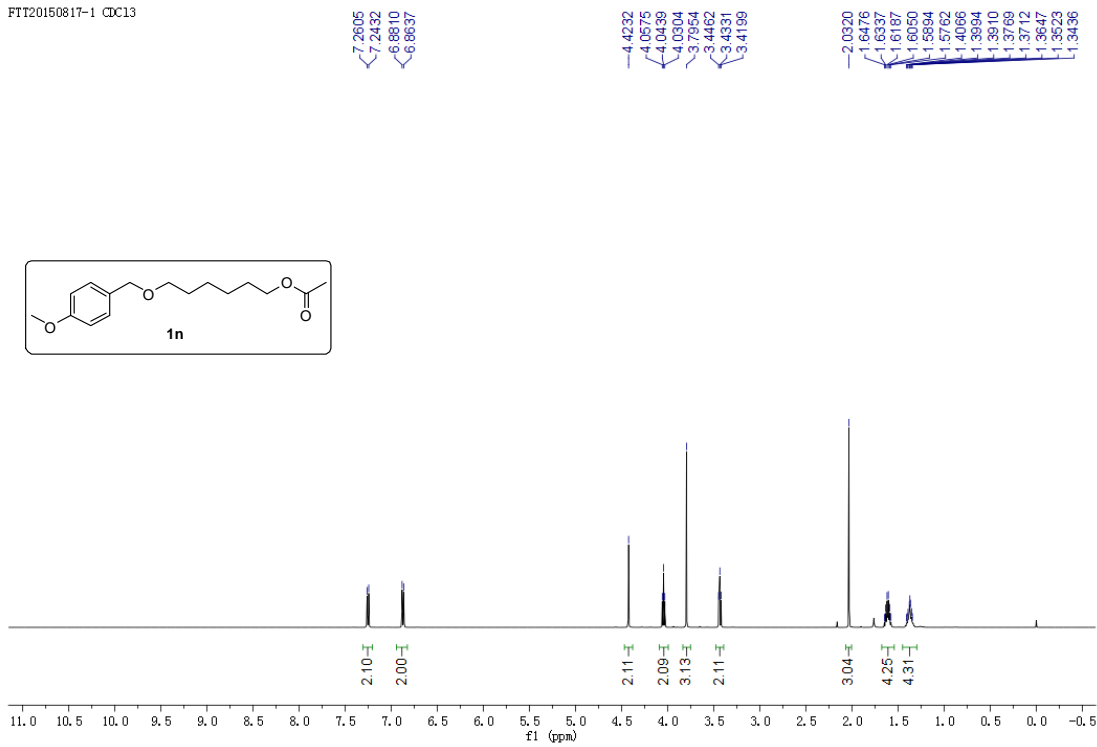
FT12015-5 CDCl3



150818
FTT20150817-3 CDC13



FTT20150817-1 CDC13



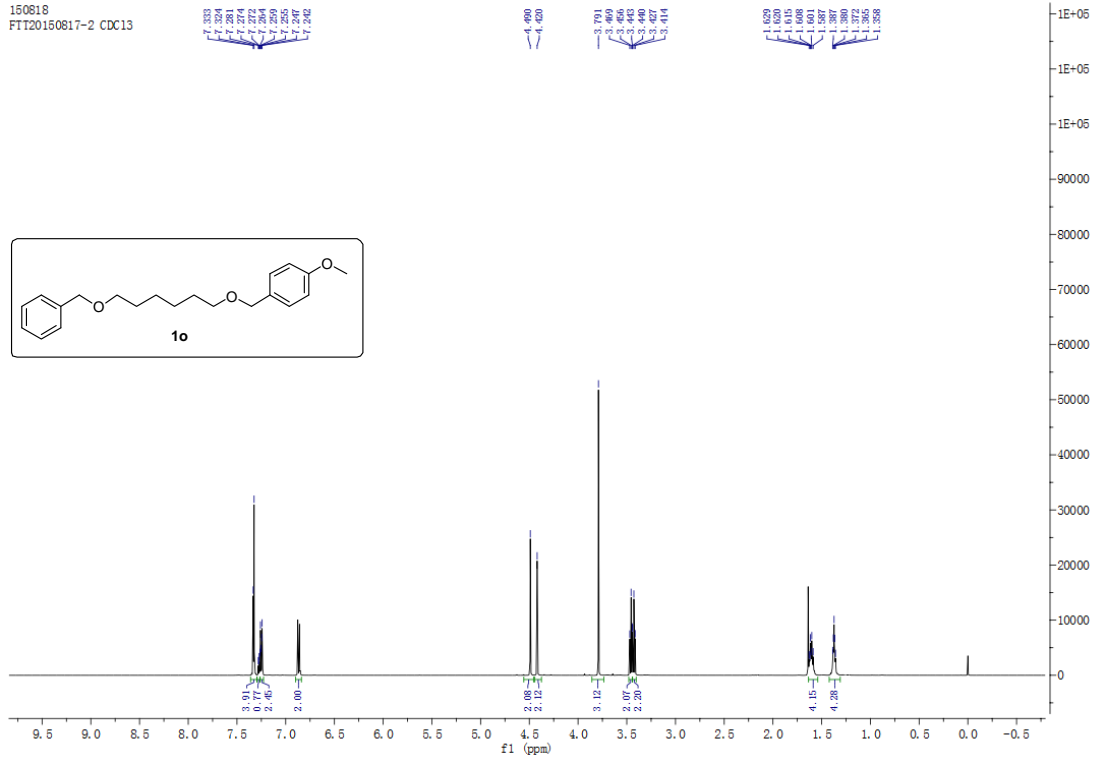
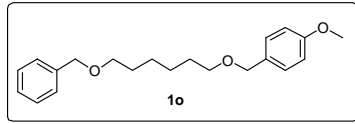
150818
FTI20150817-2 CDC13

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7.264
7.259
7.247
7.242

4.420
4.420

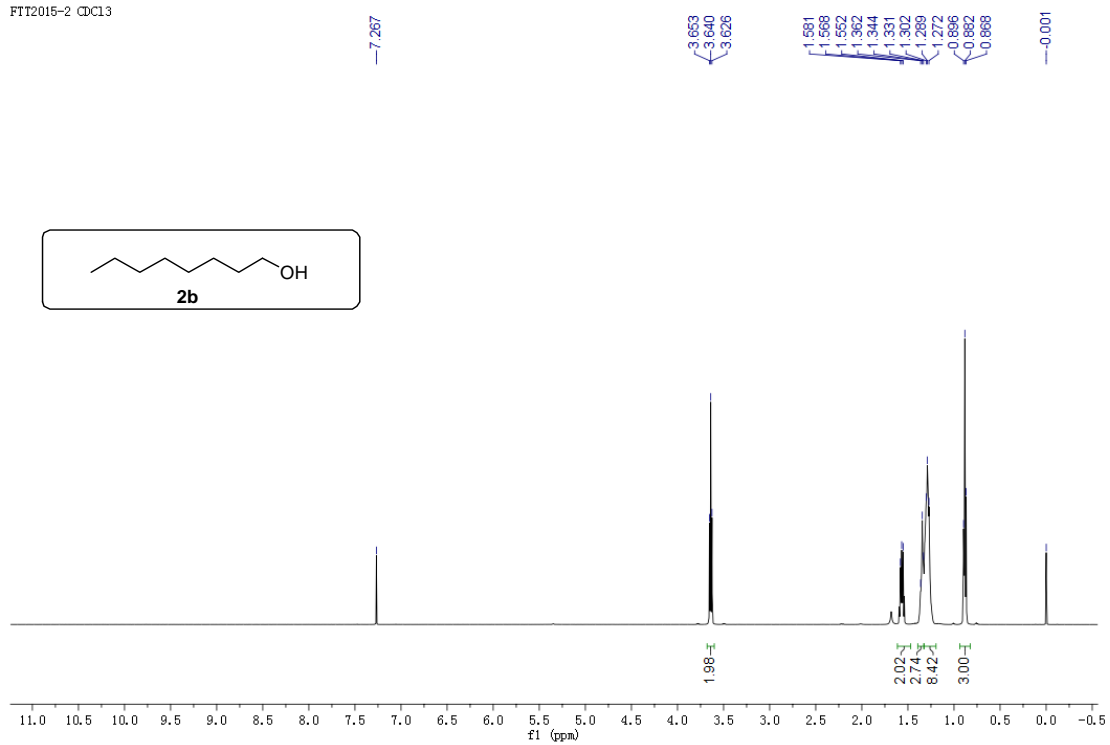
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3.427
3.414

1.629
1.616
1.608
1.601
1.587
1.580
1.565
1.558



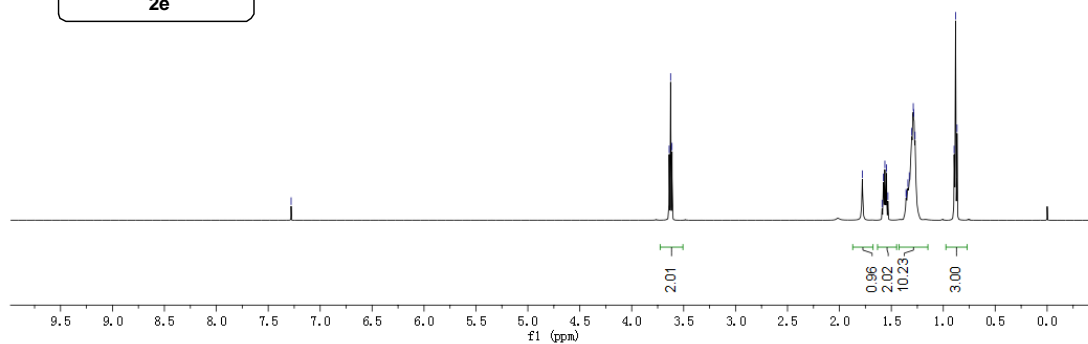
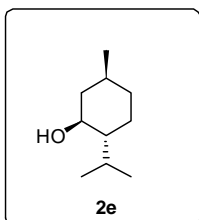
Copies of ^1H NMR for the compounds **2b**, **2e-2o**, **4** and **5**

FTT2015-2 CDCl₃



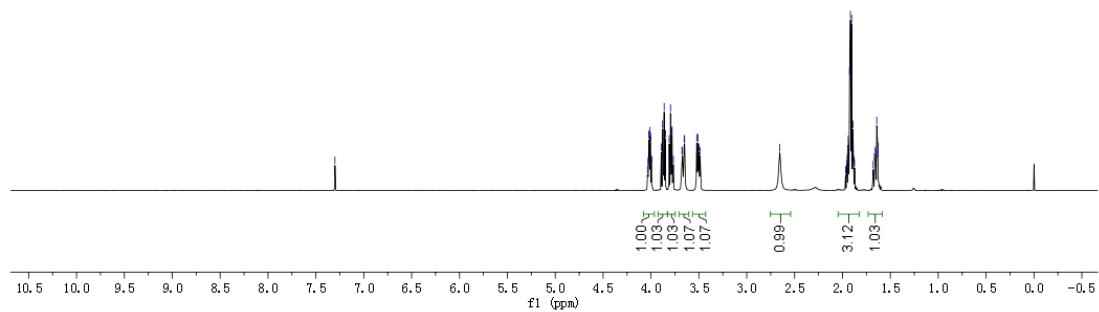
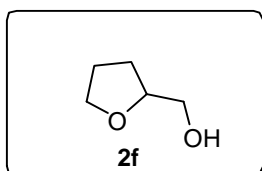
FTI20150627-1 CDC13

-7.2796

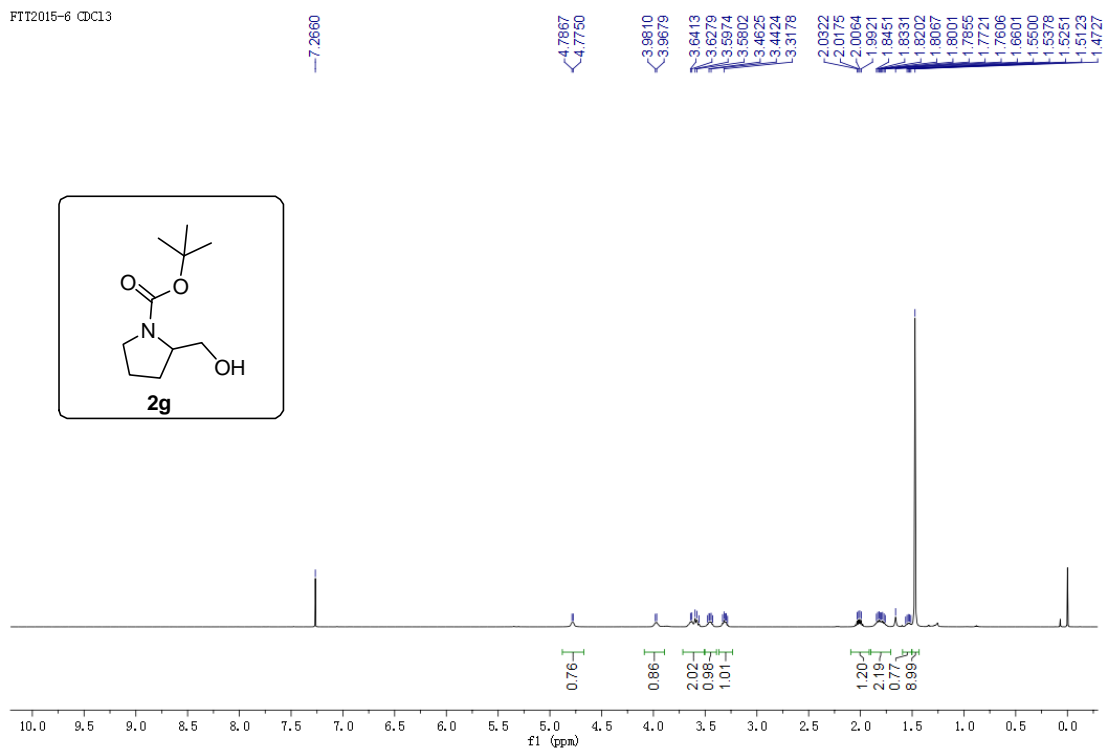


FTI-1 CDC13

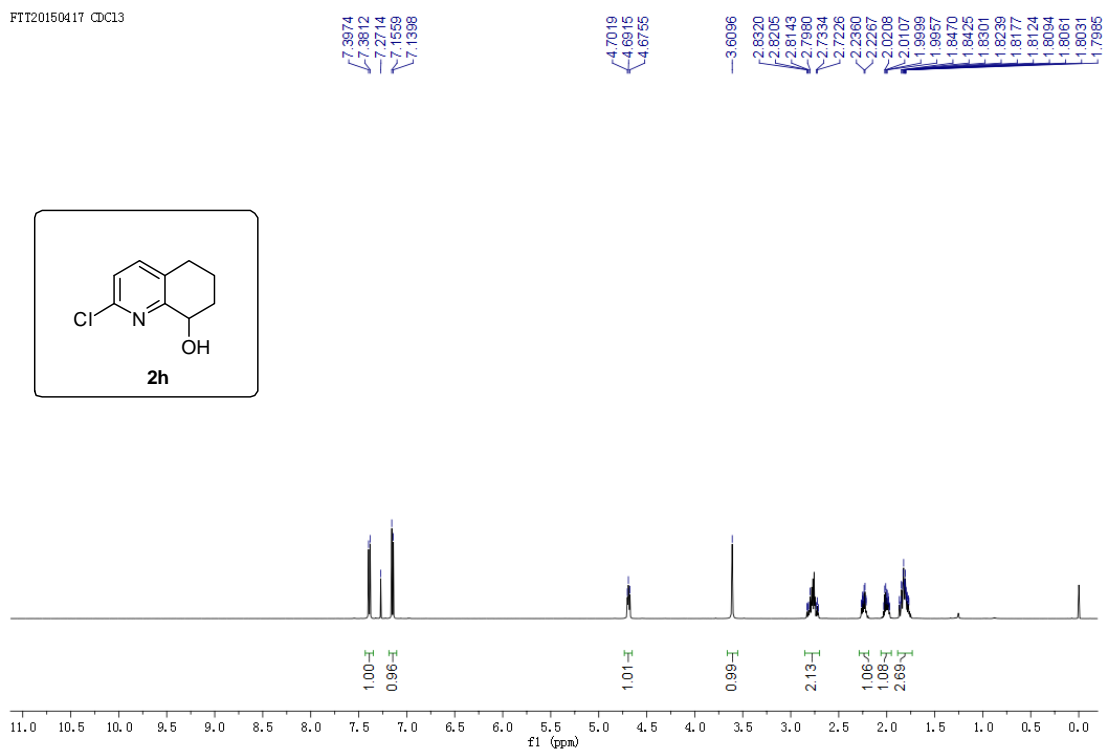
-7.3007



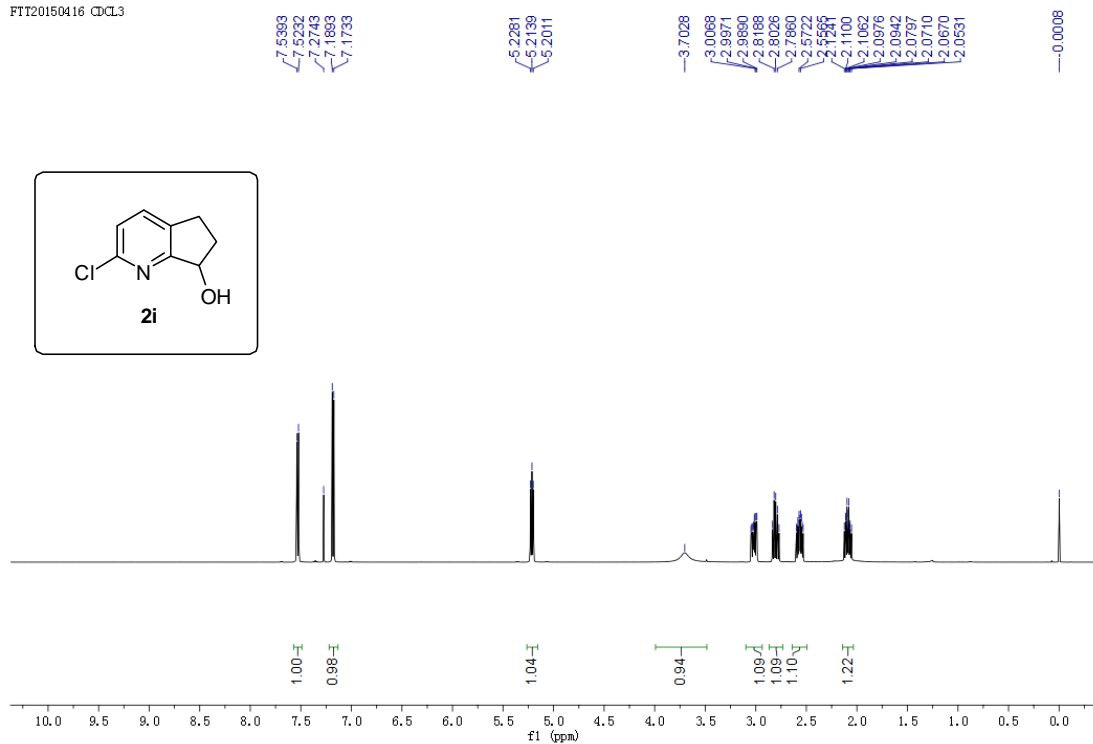
FTI2015-6 CDCl3



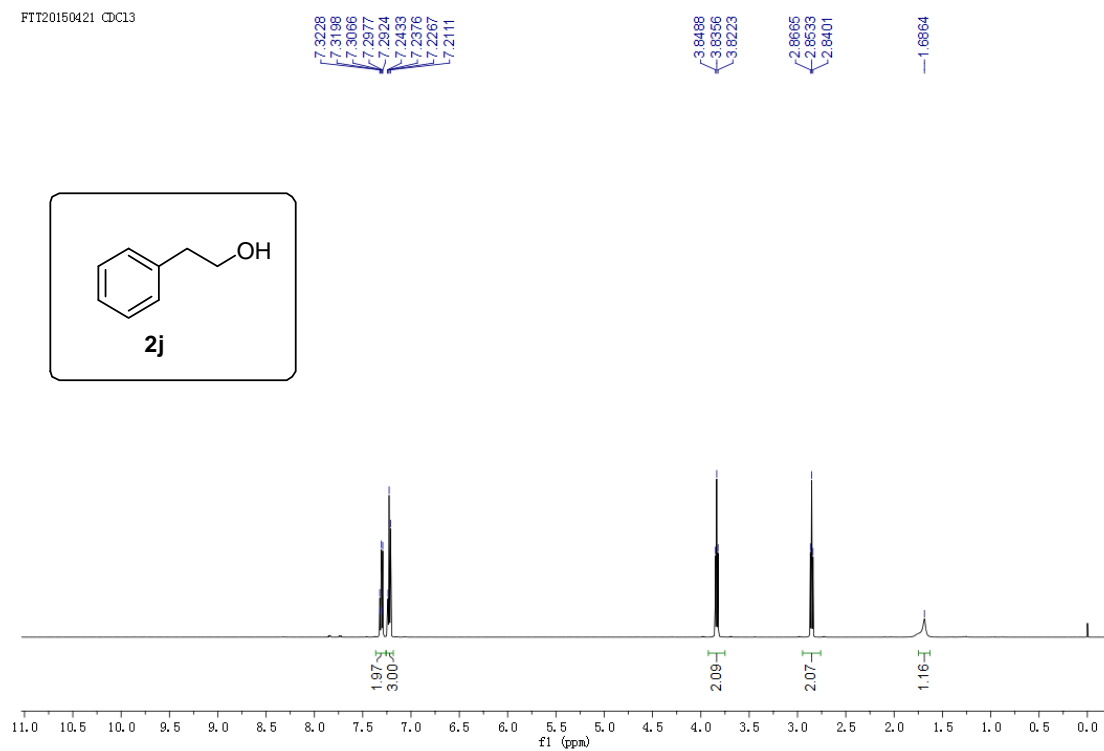
FTI20150417 CDCl3



FTI20150416 CDCl3



FTI20150421 CDCl3



FTT20150612 DMSO

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3.3695

3.3764

3.3633

1.4180

1.4050

1.3820

1.2879

1.2836

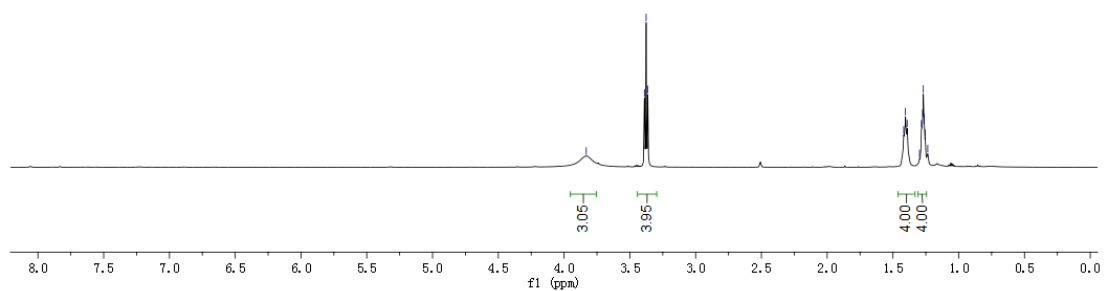
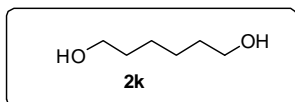
1.2748

1.2693

1.2622

1.2550

1.2353



FTT-2 CDC13

7.2876

3.6416

3.6284

3.6152

3.3916

3.3785

3.3653

3.3304

1.6127

1.5990

1.5856

1.5722

1.5588

1.5456

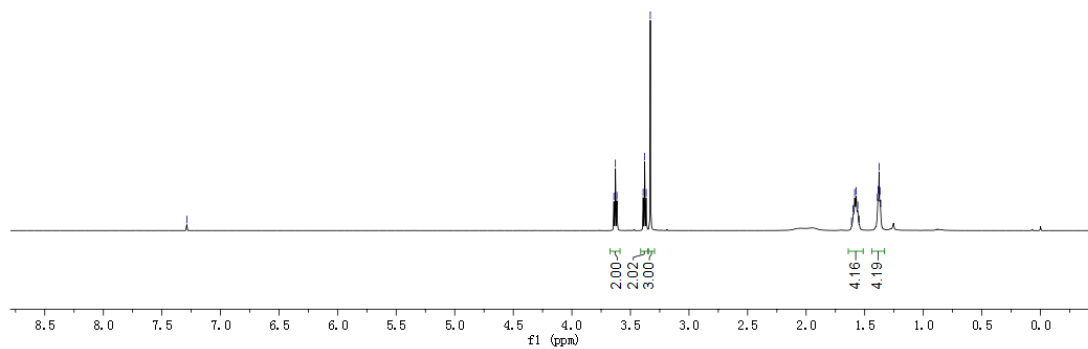
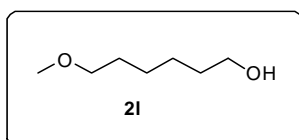
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1.3847

1.3773

1.3699

1.3630



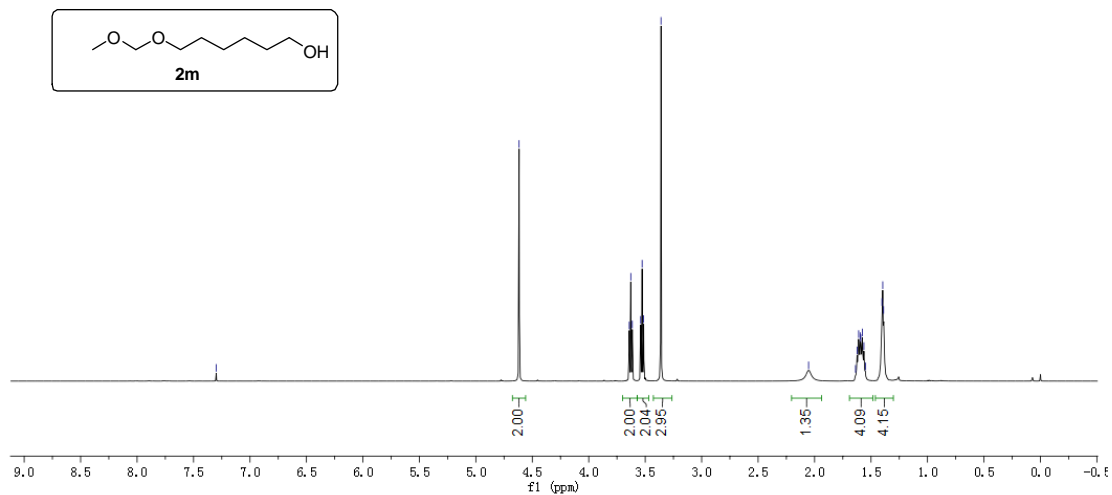
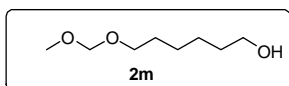
FTT2015-2 CDCl3

7.2988

4.6170

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3.6277
3.6144
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3.5272
3.5139
3.3602

2.0531
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1.6096
1.5958
1.5820
1.5682
1.5544
1.4033
1.3895
1.3657



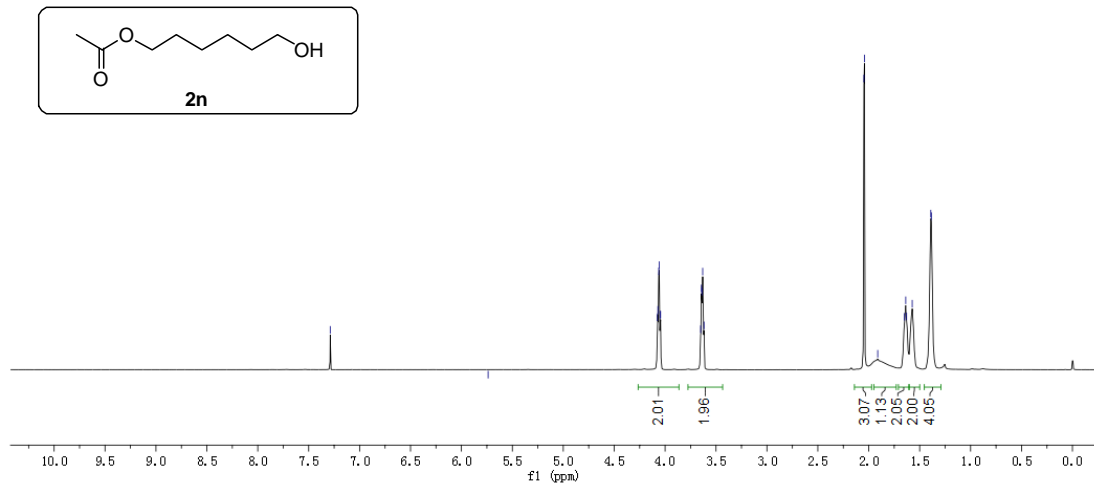
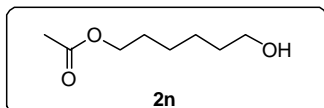
FTT2015-1 CDCl3

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5.7380

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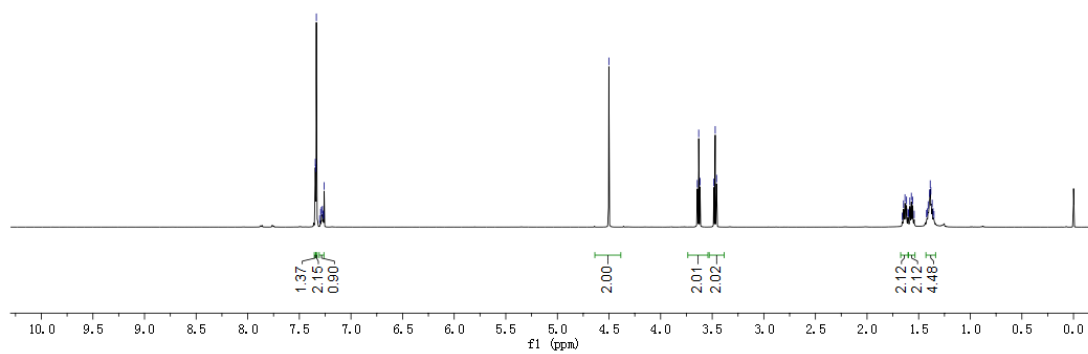
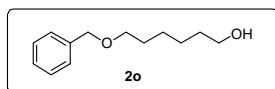


FTT2015-7 CDCl3

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7.2939
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7.2659
7.2593

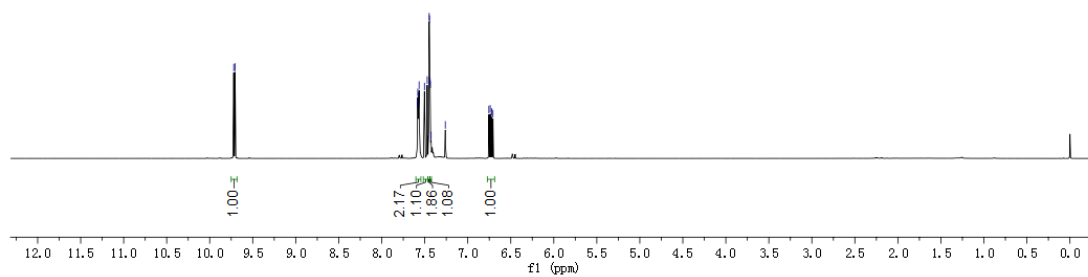
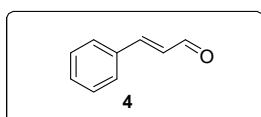
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3.6180
3.4841
3.4710
3.4579
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1.6464
1.6327
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1.5568
1.5435
1.4239
1.4165
1.4078
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1.3880
1.3817
1.3690
1.3603
1.3515



FTT20150205 CDCl3

9.7206
9.7052
7.5846
7.5809
7.5737
7.5657
7.5035
7.4716
7.4486
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7.4382
7.4346
7.4262
7.2611
6.7546
6.7389
6.7227
6.7073



151214
FT12015-4 CDCl3

8.105
7.418
7.276
7.239
7.228
7.197
6.595
6.591
6.587
6.585

1.576

