Supporting Information

Photoinduced copper-catalyzed three-component alkylarylation of alkenes involving C-S bonds cleavage of sulfonium salts

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1. General Information

Unless otherwise stated, all commercial reagents were used as received. Carboxylic acid (BK, 99%), benzaldehyde (Innochem, >98%) were used without further treatment. All reagents and solvents were commercially available and used without any further purification unless specified. All solvents were dried and distilled according to standard procedures. Flash column chromatography was performed using silica gel (0.25mm, 300-400 mesh). Analytical thin-layer chromatography was performed using glass plates pre-coated with 0.25mm 300-400 mesh silica gel impregnated with a fluorescent indicator (254 nm). All reactions were carried out with magnetic stirring and in dried glassware.Nuclear magnetic resonance (NMR) spectra are recorded in parts per million from internal tetramethylsilane on the δ scale. ^{1}H NMR, ^{19}F NMR and ^{13}C NMR spectra were recorded in $CDCl_3$ on a Bruker DRX-400 spectrometer operating at 400 MHz, 376 MHz and 100 MHz, respectively. All chemical shift values are quoted in ppm and coupling constants quated in Hz. The solvent peak was used as a reference value, for ^{1}H NMR: TMS = 0.00 ppm, for ^{13}C NMR: $CDCl_3$ = 77.00 ppm. The following abbreviations were used to explain multiplicities: s = singlet, d = doublet, dd = doublet of doublet, t = triplet, td = triplet of doublet, q = quartet, m = multiplet, and br = broad. High-resolution mass spectra (HRMS) were obtained on an Agilent mass spectrometer using ESI-TOF (electrospray ionization-time of flight).

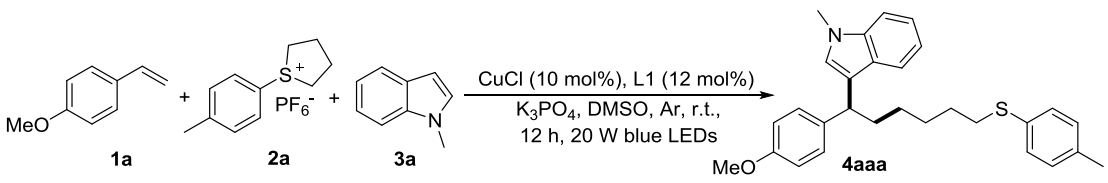
2. Experiment Section

2.1 General Procedure for the Synthesis of Substrates

General procedure for synthesis of 2a.

Sulfonium salt **2a**[1] were synthesized according to the known methods.

2.2 Typical Experimental Procedure



To a schlenk tube were added 1-methoxy-4-vinylbenzene **1a** (0.2 mmol, 26.8 mg),

sulfonium salt **2a** (2 equiv., 0.4 mmol, 129.6 mg), 1-methyl-1*H*-indole **3a** (0.6 mmol, 78.6 mg), K_3PO_4 (3 equiv., 0.6 mmol, 127.4 mg), CuCl (10 mol%, 2.0 mg), **L1** (12 mol%, 16.3 mg) and DMSO (2 mL). Then the tube was stirred at room temperature in Ar atmosphere for the indicated time until complete consumption of starting material as monitored by TLC analysis. The residue was purified by silica gel flash column chromatography (petroleum ether/ethyl acetate = 15 : 1) to afford the desired products.

2.3 Additional experimental details

The light source bought from SANYI (https://item.taobao.com/item.htm?_u=u10503hgcbe1&id=597700668537&spm=a1z09.2.0.0.1f8a2e8dVdegb2&skuId=4812351826113), 35 W blue LED light bulb (E27). The wavelength was about 400-440 nm and the wavelength of peak intensity was about 465.0 nm. The picture of the visible-light source (Figure S1) was shown as follow:

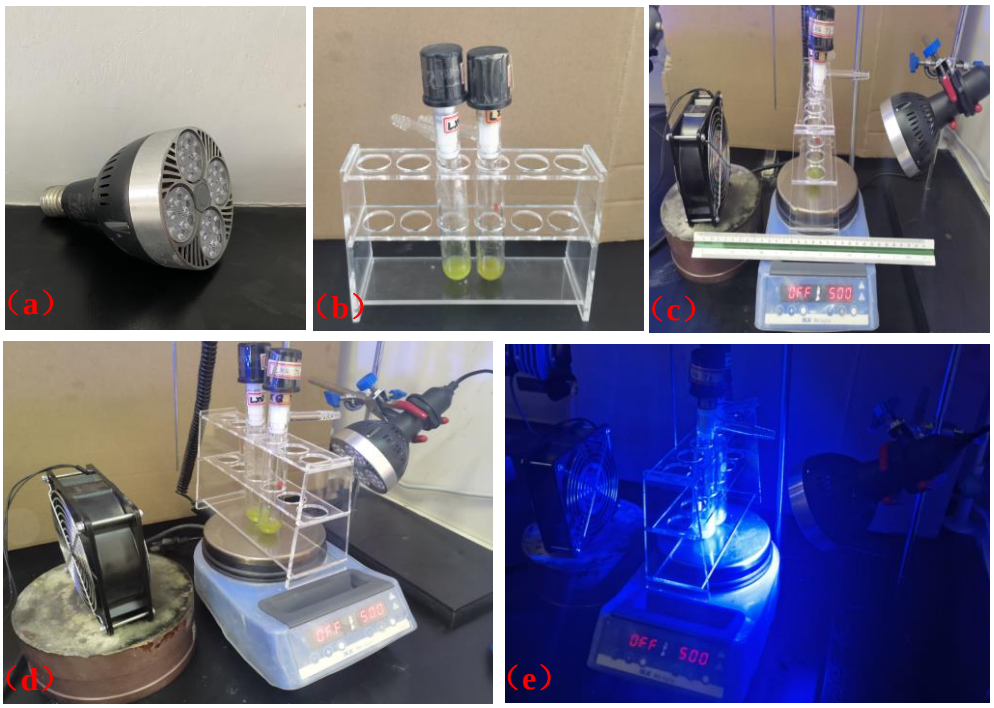
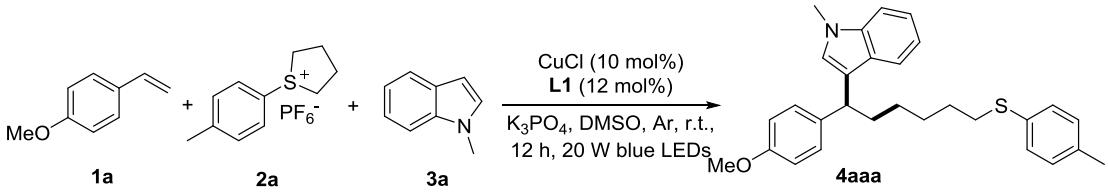


Figure S1. The light source and photographs of experimental setup: (a) 20 W blue LEDs. (b) Irradiation vial.; (c) The distance from the Blue LED to the vial. (d) and (e) Reaction setup.

2.4 The Light On/Off Experiments



Time/h	0	4 (on)	8 (off)	12 (on)	16 (off)	20 (on)
Yield/%	0	25	25	58	58	73

The above depicted reaction was performed according to the general protocol established. The reaction was irradiated with 20W blue LEDs for 12 hour and then stirred in the dark for 8 hour. This procedure was repeated for 20 hours, and the yield of the product was determined by ^{1}H NMR with dibromomethane as an internal standard at each point the light was turned off or on. The results are shown in the graph above. This result shows that constant light irradiation is needed to progress the reaction.

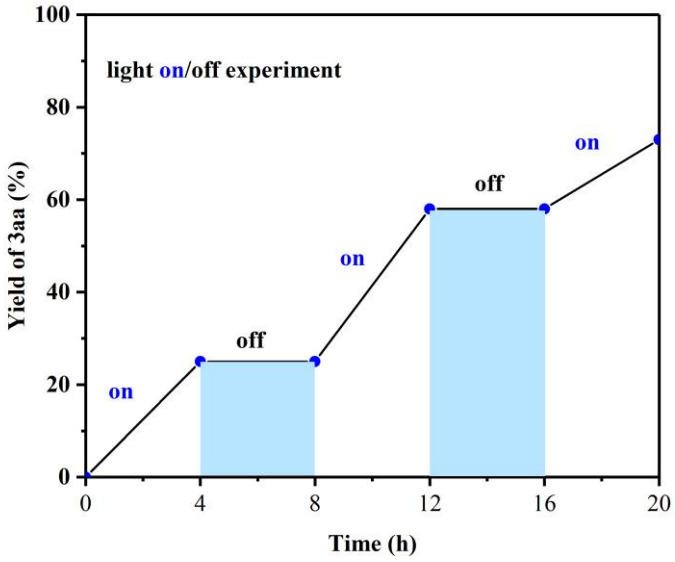


Figure S2 The light on/off Experiments

2.5 Stern-Volmer quenching experiments

Formulation solution: 1-methoxy-4-vinylbenzene **1a** (6.70 mg) was dissolved in DMSO in a 5 mL volumetric flask to set the concentration to be 0.01 M. Sulfonium salt **2a** (8.95 mg) was dissolved in DMSO in a 5 mL volumetric flask to set the

concentration to be 0.01 M. 1-methyl-1*H*-indole **3a** (6.55 mg) was dissolved in DMSO in a 5 mL volumetric flask to set the concentration to be 0.01 M. Catalyst CuCl (4.95 mg) and TolBINAP (33.9 mg) were dissolved in DMSO (5.0 mL) to set the concentration to be 0.01 M. The picture of the Stern-Volmer quenching experiments (Figure S3) was shown as follow:

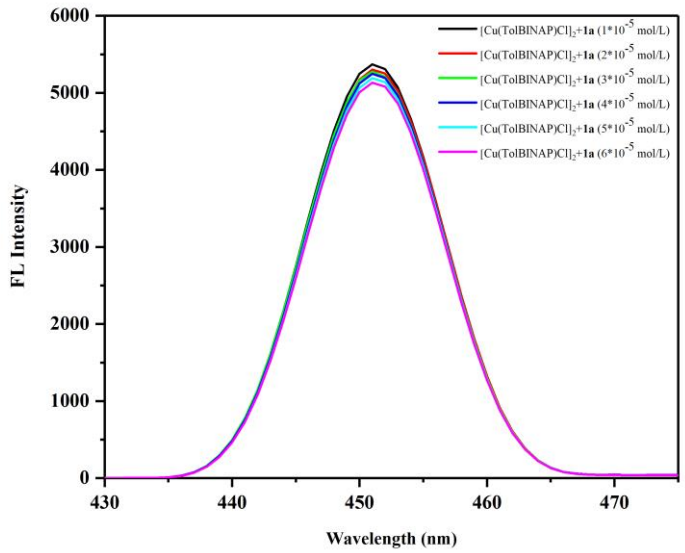


Figure S3 (a) [Cu(TolBINAP)Cl]$_2$ quenched by 1a in DMSO

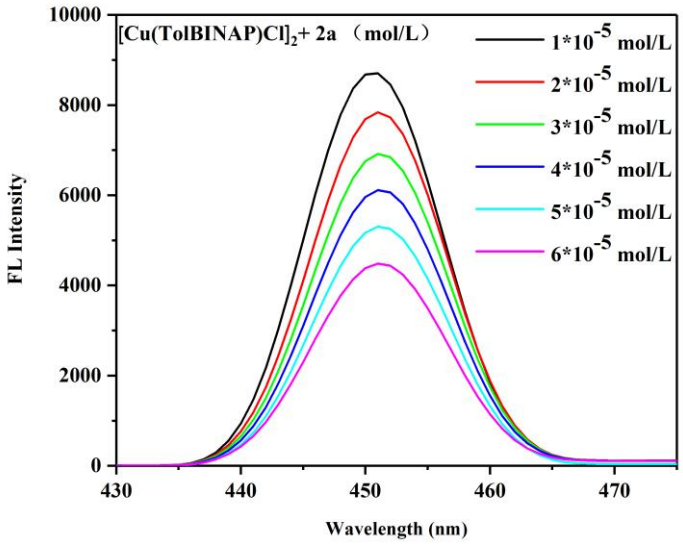


Figure S3 (b) [Cu(TolBINAP)Cl]$_2$ quenched by 2a in DMSO

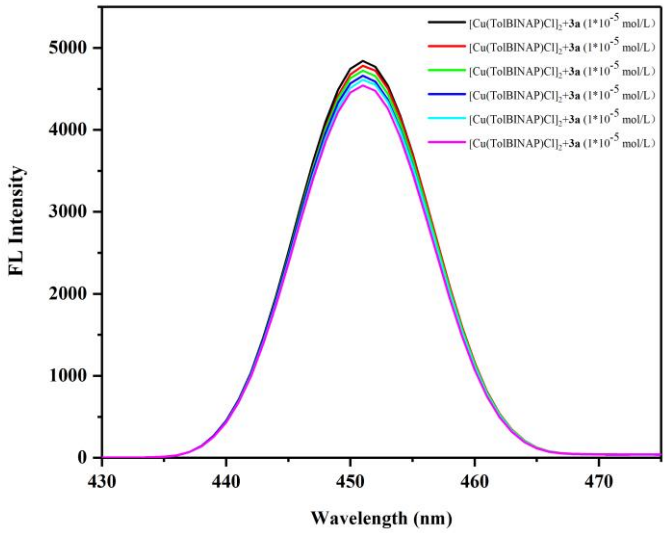


Figure S3 (c) $[Cu(TolBINAP)Cl]_2$ quenched by 3a in DMSO

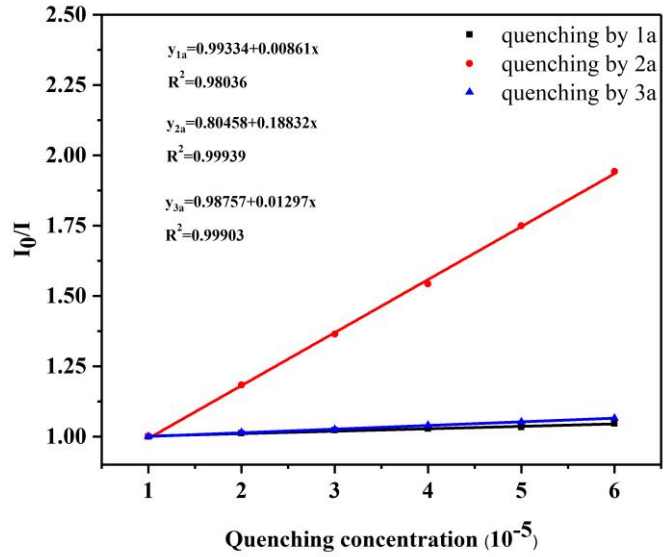


Figure S3 (d) Stern-Volmer plot of photocatalyst at different concentration

Additional experimental details: The samples were prepared by the copper-based photocatalyst $[Cu(TolBINAP)Cl]_2$ (5×10^{-4} M) with different amount of quencher 1a in DMSO in a light path quartz fluorescence cuvette. The concentration of quencher 1a is 0.01 M in DMSO. For each S3 quenching experiment, 3 μl of quencher solution was separately titrated to the copperbased photocatalyst $[Cu(TolBINAP)Cl]_2$ (3.0 mL).

The resulting mixture was sparged with nitrogen for 3 minutes and then irradiated at 450 nm. Fluorescence emission spectra were recorded (3 trials per sample). Into this solution, 3.0 μL of a 1-methoxy-4-vinylbenzene **1a** solution was successively added and uniformly stirred, and the resulting mixture was bubbled with nitrogen for 3 minutes and irradiated at 450 nm. Fluorescence emission spectra of 3.0 μL, 6.0 μL, 9.0 μL, 12.0 μL, 15.0 μL, 18.0 μL fluorescence intensity. Follow this method and make changes to the amount to obtain the Stern–Volmer relationship in turn.

Compared the figure S3 **(a)** of Stern-Volmer quenching experiments results, the emission intensity of the copperbased photocatalyst $[Cu(TolBINAP)Cl]_2$ solution strongly affected by the gradual increase of the amount of **2a**, and the influence is not observed to **1a** and **3a**. These indicated that the single electron transfer (SET) process occured in photocatalyst and sulfonium salt.

2.6 UV-Vis absorption experiments

UV-visible spectroscopy of reaction solution was recorded on a UV-2600 UV-Vis spectrophotometer. The sample was prepared by 1-methoxy-4-vinylbenzene **1a** (10^{-4} M), sulfonium salt **2a** (10^{-4} M), 1-methyl-1*H*-indole **3a** (10^{-4} M)**,** CuCl (10^{-4} M), Tol-BINAP (10^{-4} M), $[Cu(TolBINAP)Cl]_2$ (10^{-4} M) in DMSO. The absorption was collected and the result was listed in Figure S4.

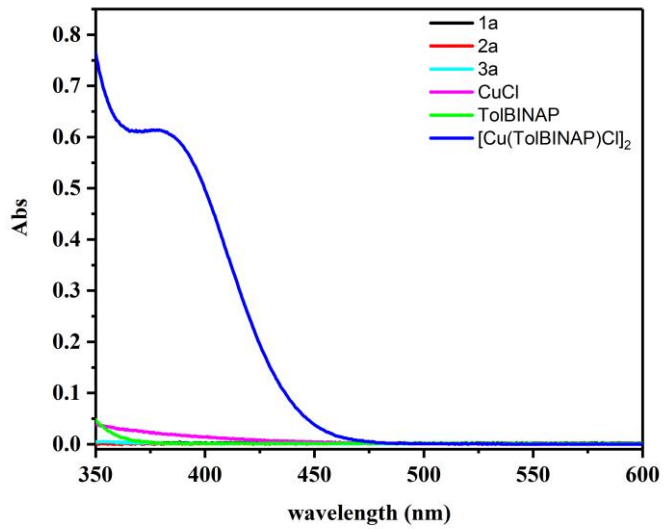


Figure S4 UV-Vis absorption experiments

2.7 Cyclic Voltammetry (CV) Experiments

Cyclic voltammetry was performed on a "computer-controlled CH Instrument Electrochemical Analyzer [CHI760E]" in a three-electrode cell connected to a schlenk line under argon at room temperature. The working electrode was a glassy carbon electrode (length: 80 mm, diameter: 3 mm), the counter electrode was a platinum wire (length: 37 mm, diameter: 0.5 mm, surface area: 0.59 cm^2). The electrode was polished with figureeightS34motions on a cloth polishing pad in a water-alumina slurry. The reference was an Ag/AgCl electrode submerged in saturated aqueous KCl solution, and separated from the reaction by a salt bridge. 6 mL DMSO containing 0.1 M $^{n}Bu_4NBF_4$ were poured into the electrochemical cell in all experiments. For the cyclic voltammetric measurement, IUPAC convention was followed. The scan rate was 0.1 V/s. All solutions used for the voltametric experiments were deoxygenated by purging with high purity argon gas up to 5 mins and measurements were performed in open air at room temperature (25 ±2 °C).

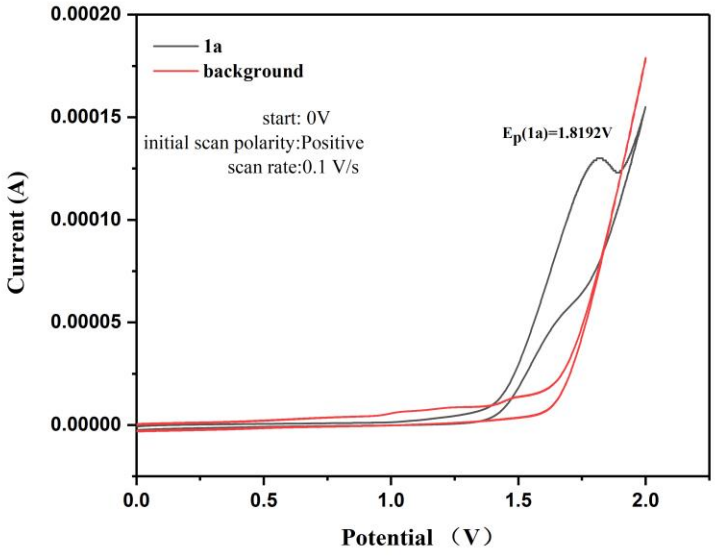


Figure S5 CV spectra of 1a (0.008 M) in 0.1 M tetrabutylammonium tetrafluoroborate in DMSO. Ep = 1.8129 V (vs. Ag/AgCl)

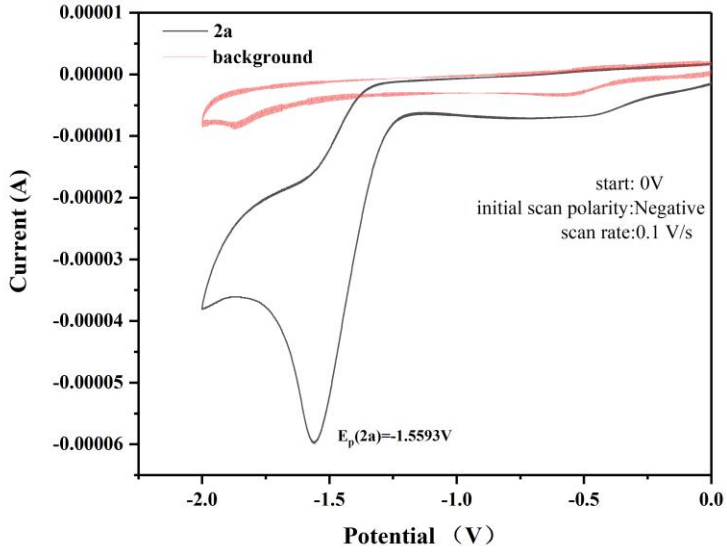


Figure S6 CV spectra of 2a (0.008 M) in 0.1 M tetrabutylammonium tetrafluoroborate in DMSO. Ep = -1.5593 V (vs. Ag/AgCl)

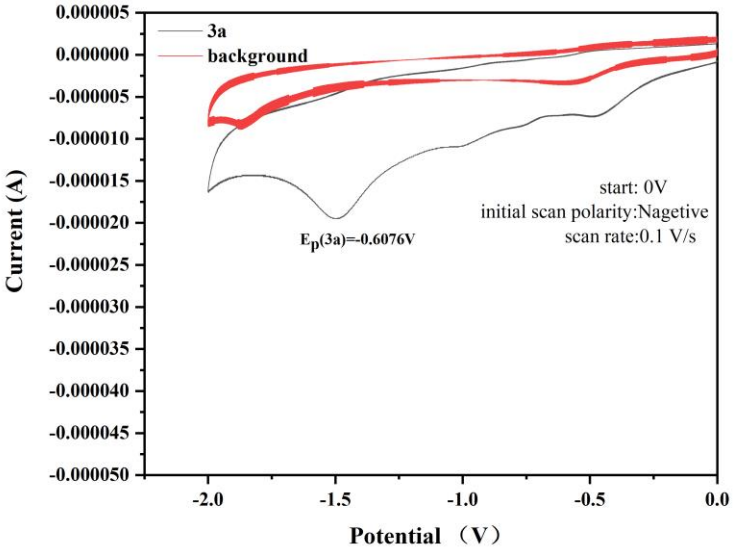


Figure S7 CV spectra of 3a (0.008 M) in 0.1 M tetrabutylammonium tetrafluoroborate in DMSO. Ep = -0.6076 V (vs. Ag/AgCl)

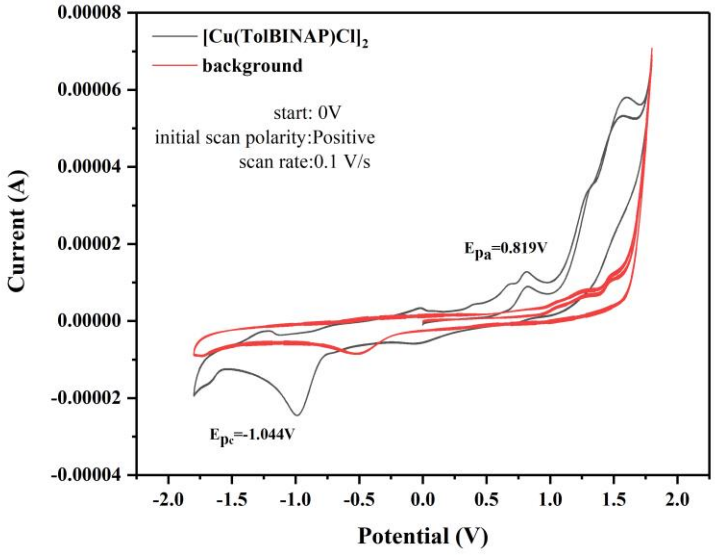


Figure S8 CV spectra of the copper-based photocatalyst [Cu(TolBINAP)Cl]$_2$ (1 mM) in 0.01 M tetrabutylammonium tetrafluoroborate in DMSO.

According to the emission spectra of the copper-based photocatalyst [Cu(TolBINAP)Cl]$_2$, the maximum emission wavelength is 549 nm.

$$E_{1/2}(Cu^{II}/Cu^{I}) = 0.113V$$

$$E_{0\text{-}0} = hv = \frac{hc}{\lambda} = 2.26V$$

$$E_{1/2}(Cu^{II}/Cu^{I}*) = E_{1/2}(Cu^{II}/Cu^{I}) - E_{0\text{-}0} = 0.113 - 2.26 = -2.147V$$

Where **h** (J·s) is Planck's constant, **c** (m s^{-1}) is the speed of light and **λ** (m) is themaximum emission wavelength.

2.8 Quantum yield determination

Determination of the light intensity at 415 nm:

According to the procedure of Yoon[2] the photon flux of the blue LED (λ_{max} = 415 nm) was determined by standard ferrioxalate actinometry. A 0.15 M solution of ferrioxalate was prepared by dissolving 2.21 g of potassium ferrioxalate hydrate in 30 mL of 0.05 M H_2SO_4. A buffered solution of phenanthroline was prepared by dissolving 50 mg of phenanthroline and 11.25 g of sodium acetate in 50 mL of 0.5 M H_2SO_4. Both solutions were stored in the dark. To determine the photon flux of the spectrophotometer, 3.0 mL of the ferrioxalate solution was placed in a cuvette and

irradiated for 90.0 seconds at λ = 415 nm with an emission slit width at 10.0 nm. After irradiation, 0.53 mL of the phenanthroline solution was added to the cuvette. The solution was then allowed to rest for 1 h to allow the ferrous ions to completely coordinate to the phenanthroline. The absorbance of the solution was measured at 510 nm. A nonirradiated sample was also prepared and the absorbance at 510 nm measured. Conversion was calculated using eq 1.

$$mol \text{ of } Fe^{2+} = \frac{V \cdot \Delta A_{510nm}}{l \cdot \varepsilon} \qquad (1)$$

$$mol \text{ of } Fe^{2+} = \frac{(0.00353L) \cdot (2.094 - 0.197)}{(1.00cm) \cdot (11100 \frac{L}{mol} cm^{-1})} = 6.03 \times 10^{-7}$$

Where **V** is the total volume (0.00353 L) of the solution after addition of phenanthroline, **ΔA** is the difference in absorbance at 510 nm between the irradiated and non-irradiated solutions, **l** is the path length (1.00 cm), and **ε** is the molar absorptivity of the ferrioxalate actinometer at 510 nm (11,100 L mol^{-1} cm^{-1}).[3] The photon flux can be calculated using eq 2.

$$Photo \text{ flux} = \frac{\text{mol of } Fe^{2+}}{\phi \cdot t \cdot f} \qquad (2)$$

$$Photo \text{ flux} = \frac{6.03 \times 10^{-7}}{(1.12) \cdot (90s) \cdot (0.999)} = 5.99 \times 10^{-9} einstein / s$$

Where **Φ** is the quantum yield for the ferrioxalate actinometer (1.12 at λ = 415 nm), **t** is the time (90.0 s), and **f** is the fraction of light absorbed at 415 nm by the ferrioxalate actinometer. This value is calculated using eq 3 where A415 nm is the absorbance of the ferrioxalate solution at 415 nm. An absorption spectrum gave an A415 nm value of > 3, indicating that the fraction of absorbed light (f) is > 0.999.

$$f = 1 - 10^{-A_{415nm}} \qquad (3)$$

The photon flux was thus calculated to be 5.99 × 10^{-9} einsteins s^{-1}

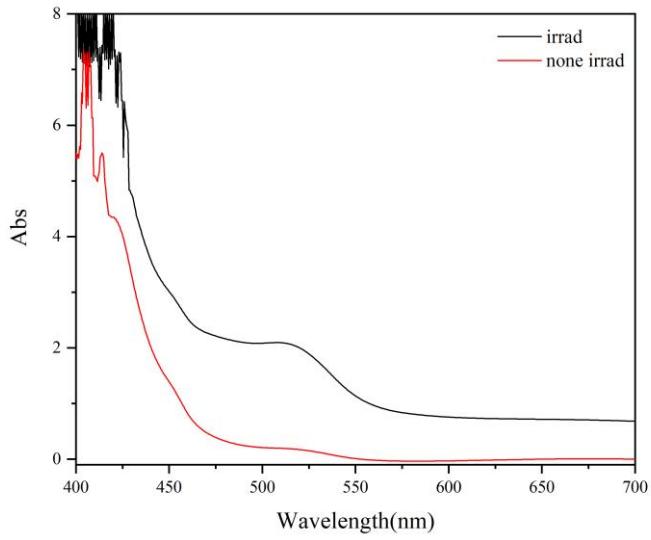
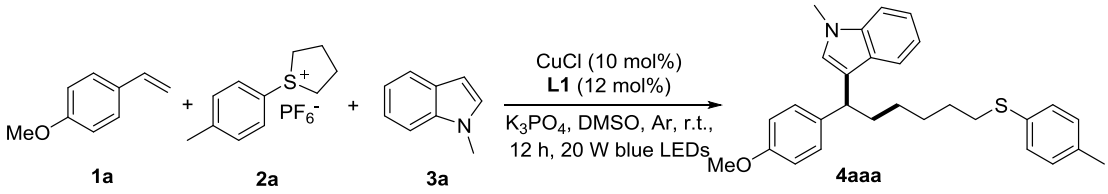


Figure S9 Absorbance of the ferrioxalate actinometer solution

Determination of the reaction quantum yield.



A cuvette was charged with 1-methoxy-4-vinylbenzene **1a** (0.2 mmol, 26.8 mg), sulfonium salt **2a** (2 equiv, 0.4 mmol, 129.6 mg), 1-methyl-1*H*-indole **3a** (0.6 mmol, 78.6 mg), K_3PO_4 (3 equiv, 0.4 mmol, 127.4 mg), CuCl (10 mol%, 2.0 mg), **L1** (12 mol%, 16.3 mg) and DMSO (2 mL). The reaction mixture was stirred at room temperature for 2 h (7200 s) under blue LED irradiation (λ = 415 nm). The solvent was removed in vacuo and the yield of formed product was determined by ^{1}H NMR based on dibromomethane as internal standard. The quantum yield was determined using eq 4.

$$\phi = \frac{\text{mol of product}}{flux \cdot t \cdot f} \qquad (4)$$

$$\phi = \frac{1.45\times10^{-5}}{(5.99\times10^{-9}\,einstein/s)\cdot(7200s)\cdot(0.989)} = 0.34 < 1$$

The photon flux is 5.99 × 10^{-9} einsteins s^{-1}, t is the reaction time (7200 s). *f* is the fraction of incident light absorbed by the catalyst, determined using eq 3. An

absorption spectrum of the catalyst (0.001 M) gave an absorbance value of 0.658 at 415 nm (figure **S6**), indicating that the fraction of light absorbed by the photocatalyst (*f*) is 0.989.

Absorbance of catalyst:

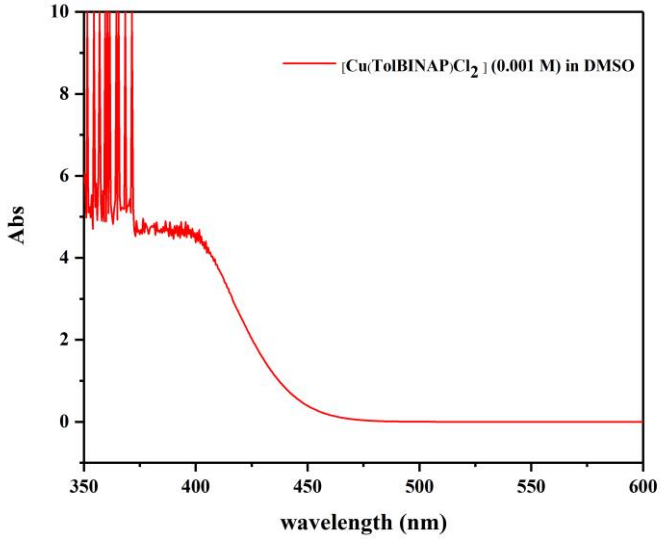
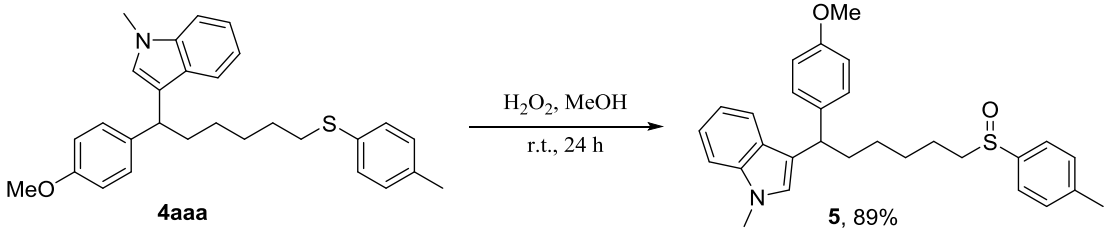


Figure S10 Absorption spectrum of [Cu(TolBINAP)Cl]$_2$ [0.001 M] in DMSO

2.9 Product Derivatization[2][3]



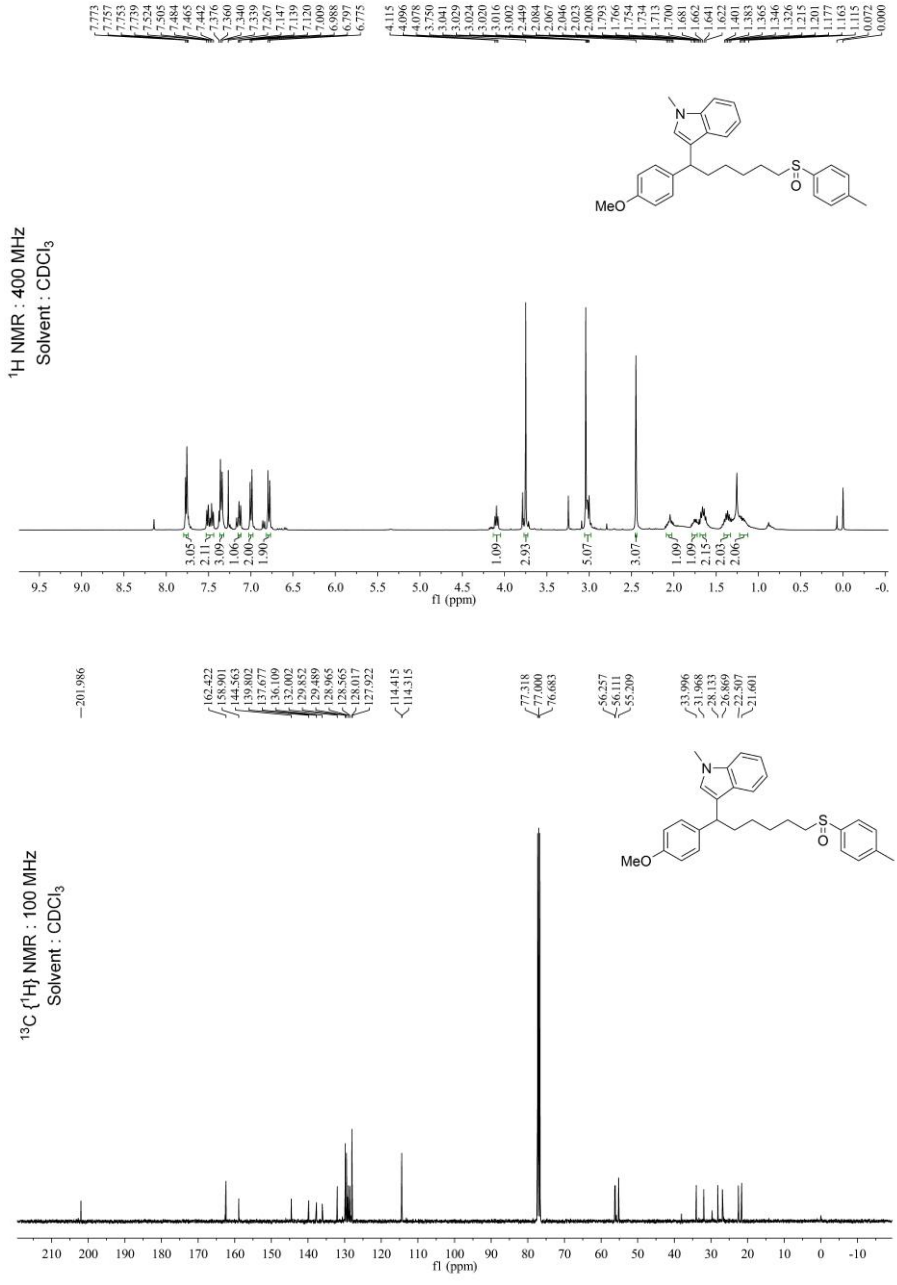
To a stirred solution of **4aaa** (88.6 mg, 0.2 mmol) in 1 mL methanol was added H_2O_2 (30% in water, 0.017 ml, 0.22 mmol, 1.1 equiv.) at room temperature. Then the reaction was kept stirring overnight at room temperature for 24 h. The crude product was further purified by silica gel flash chromatography to give **5** in yield of 89% as yellow oil.

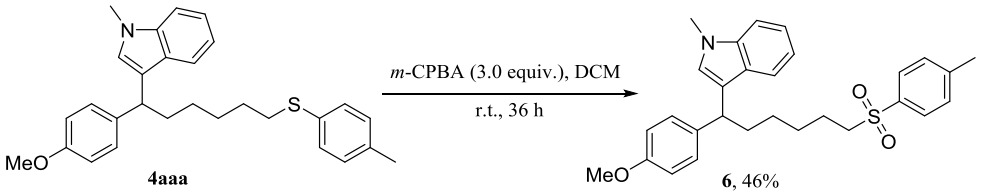
The date and NMR spectra of 5.

3-(1-(4-Methoxyphenyl)-6-(*p*-tolylsulfinyl)hexyl)-1-methyl-1*H*-indole (**5**)**.** The title compound was prepared according to the general procedure and purified by column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (1 : 1) to afford a yellow oil in 89% yield (81.7 mg). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.77-7.74

(m, 3H), 7.52-7.44 (m, 2H), 7.38-7.34 (m, 3H), 7.15-7.12 (m, 1H), 7.00 (d, J = 8.4 Hz, 2H), 6.79 (d, J = 8.8 Hz, 2H), 4.10 (t, J = 7.6 Hz, 1H), 3.75 (s, 3H), 3.04-3.00 (m, 5H), 2.45 (s, 3H), 2.08-2.00 (m, 1H), 1.79-1.70 (m, 1H), 1.68-1.62 (m, 2H), 1.40-1.33 (m, 2H), 1.22-1.12 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ 202.0, 162.4, 158.9, 144.6, 139.8, 137.7, 136.1, 132.0, 129.9 (2C), 129.5 (2C), 129.0, 128.6, 128.0 (2C), 127.9, 114.4 (2C), 114.3, 56.3, 56.1, 55.2, 34.0, 32.0, 28.1, 26.9, 22.5, 21.6; HRMS (ESI-TOF) m/z: $C_{29}H_{34}NO_2S^+$ $(M + H)^+$ calcd for 460.2305, found 460.2306.

3-(1-(4-Methoxyphenyl)-6-(*p*-tolylsulfinyl)hexyl)-1-methyl-1*H*-indole (5)



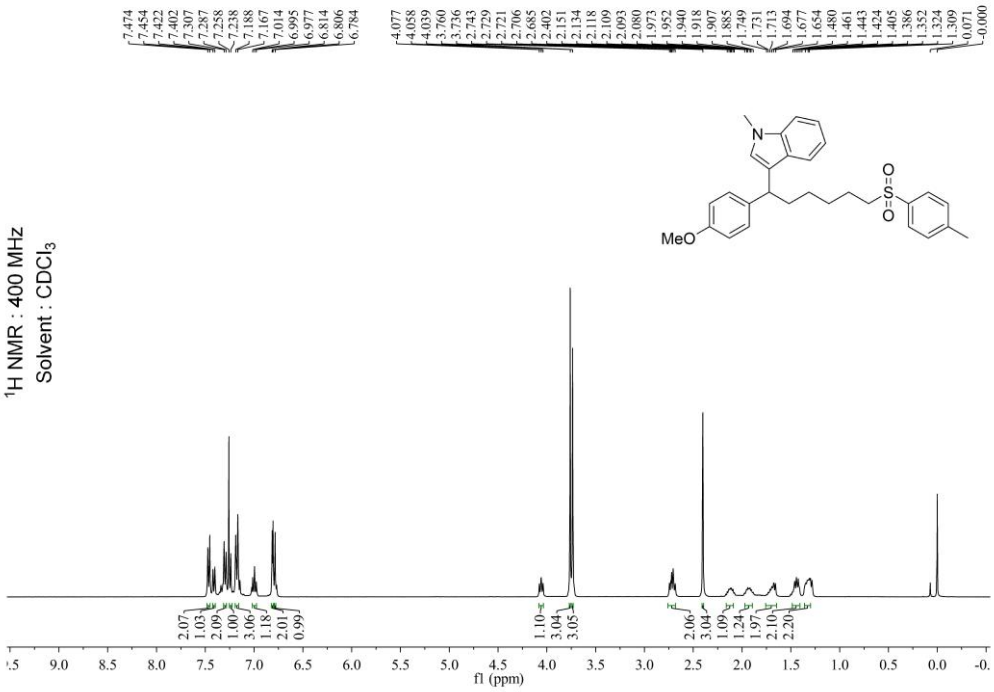


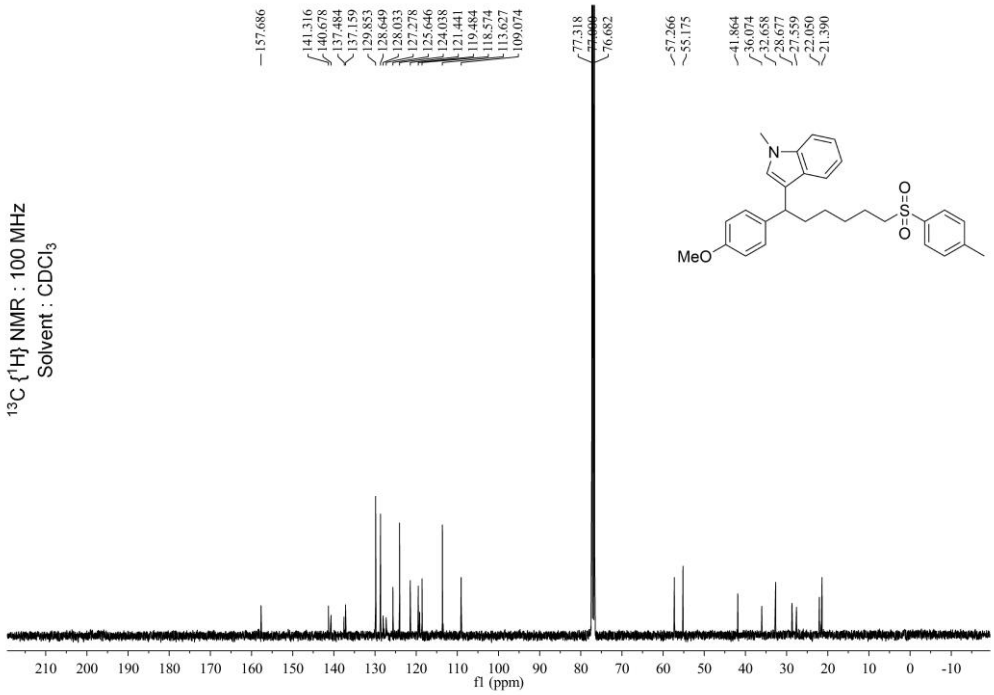
To a stirred solution of **4aaa** (88.6 mg, 0.2 mmol) in 1 mL CH_2Cl_2 was added *m*-CPBA (0.1032 g, 0.6 mmol, 3.0 equiv.) at room temperature. Then the reaction was kept stirring overnight at room temperature for 36 h. The reaction was then quenched with saturated 10 mL Na_2SO_3, extracted with 10 mL DCM, washed with saturated Na_2SO_3, dried over sodium sulfate, filtered and concentrated in vacuo in ice bath. The crude product was further purified by silica gel flash chromatography (DCM as the eluent) to give **6** (46% yield) as yellow oil.

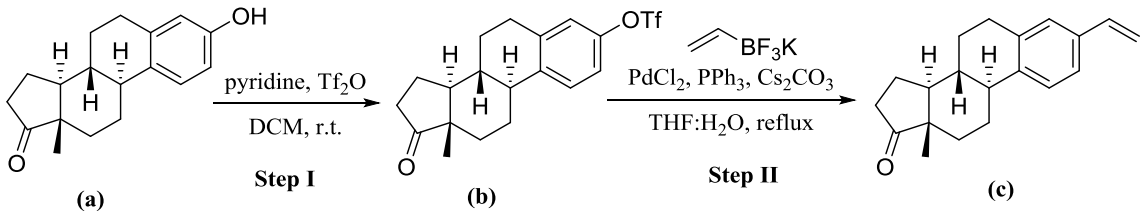
The date and NMR spectra of 6.

3-(1-(4-Methoxyphenyl)-6-tosylhexyl)-1-methyl-1*H*-indole (6). The title compound was prepared according to the general procedure and purified by column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (1 : 1) to afford a yellow oil in 46% yield (43.9 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46 (d, J = 8.0 Hz, 2H), 7.41 (d, J = 8.0 Hz, 1H), 7.30 (d, J = 8.0 Hz, 2H), 7.24 (s, 1H), 7.18 (d, J = 8.4 Hz, 3H), 7.00 (t, J = 7.6 Hz, 1H), 6.81 (d, J = 3.2 Hz, 2H), 6.78 (s, 1H), 4.06 (t, J = 7.6 Hz, 1H), 3.76 (s, 3H), 3.74 (s, 3H), 2.74-2.69 (m, 2H), 2.40 (s, 3H), 2.15-2.08 (m, 1H), 1.97-1.89 (m, 1H), 1.75-1.65 (m, 2H), 1.48-1.39 (m, 2H), 1.35-1.31 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ 157.7, 141.3, 140.7, 137.5, 137.2, 129.9, 128.6 (2C), 128.0 (2C), 127.3, 125.6, 124.0 (2C), 121.4, 119.5, 118.6, 113.6 (2C), 109.1, 57.3, 55.2, 41.9, 36.1, 32.7, 28.7, 27.6, 22.1, 21.4; HRMS (ESI-TOF) m/z: $C_{29}H_{34}NO_3S^+$ $(M + H)^+$ calcd for 476.2254, found 476.2258.

3-(1-(4-Methoxyphenyl)-6-tosylhexyl)-1-methyl-1*H*-indole (6)





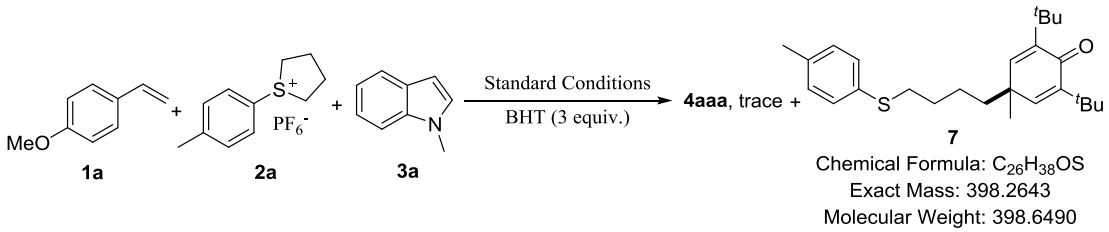


Step I: An oven dried 2-neck round bottom flask was charged with estrone (**(a)**, 2.70 g, 10 mmol, 1 equiv.), pyridine (1.62 mL, 20 mmol, 2 equiv.), DCM (30 mL) and cooled to 0 ℃. Triflic anhydride (2.02 mL, 12 mmol, 1.2 equiv.) was then added dropwise and the reaction was stirred at that temperature until completion (monitored by GC/MS). The reaction mixture was diluted with 30 mL H_2O and extracted 3 times with 25 mL DCM. Combined organic phases were dried over magnesium sulfate, filtered through short celite pad and concentrated under reduced pressure. Purification by silica gel column chromatography (hexane/ethyl acetate, 5/1) afforded corresponding triflate product as white solid (3.9 g, 97% yield).

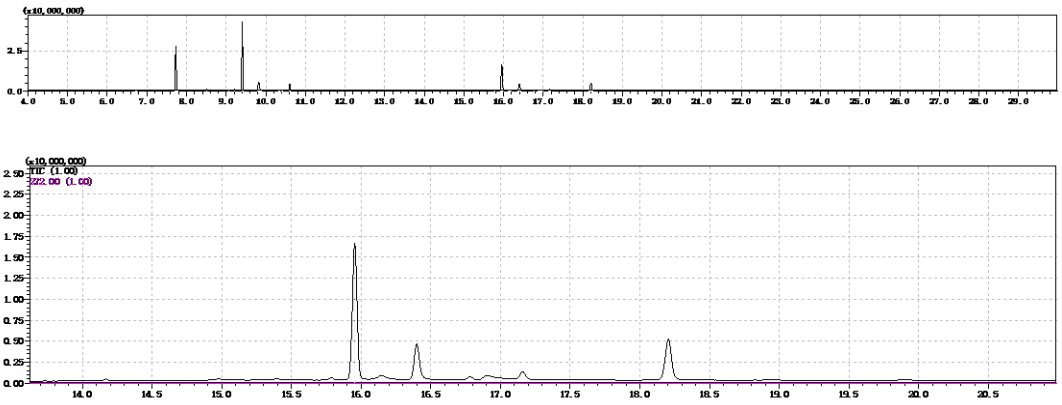
Step II: An oven dried 2-neck round bottom flask was charged with (**(b)**, 2.01 g, 5 mmol, 1 equiv.), potassium vinyltrifluoroborate (1.01 g, 7.5 mmol, 1.5 equiv.), $PdCl_2$ (17.7 mg, 0.1 mmol, 0.02 equiv.), PPh_3 (78.7 mg, 0.3 mmol, 0.06 equiv.), Cs_2CO_3 (4.89 g, 15 mmol, 3 equiv.), THF (18 mL), H_2O (2 mL) and stirred under reflux until completion (monitored by TLC). Reaction mixture was then diluted with 50 mL H_2O and extracted 3 times with 25 mL DCM. Combined organic phases were dried over Na_2SO_4, filtered through short celite pad and concentrated under reduced pressure. Purification by silica gel column chromatography (hexane/ethyl acetate, 10/1) afforded corresponding alkenes **(c)** as a white solid (1.15 g, 82% yield). The spectroscopic data correspond to those were reported in the literature.

2.10 Control Experiments

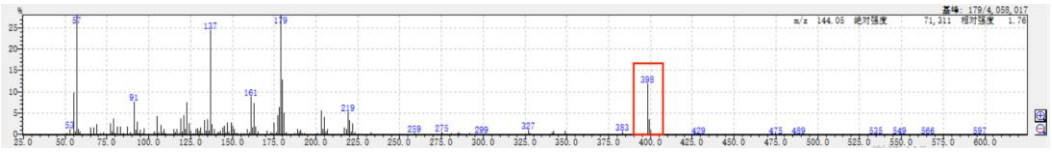
2.10.1 GC-MS Analysis of trapping product 7[4]



The GC spectra of raw reaction mixture



The MS spectra of the peak at 15.955 min



[MS Spectrum]

# of Peaks 548

Raw Spectrum 15.955 (scan : 2392)

Background No Background Spectrum

Base Peak m/z 179.00 (Inten : 4,058,017)

Event# 1

m/z	Absolute Intensity	Relative Intensity						
50.00	3079	0.08	70.00	9340	0.23	90.05	9804	0.24
51.00	13226	0.33	71.00	14052	0.35	91.05	319934	7.88
52.05	5349	0.13	72.00	1561	0.04	92.05	42789	1.05
53.00	54089	1.33	73.00	26212	0.65	93.05	120991	2.98
54.05	8499	0.21	74.00	3348	0.08	94.05	14939	0.37
55.05	402025	9.91	75.00	3580	0.09	95.05	46961	1.16
56.05	34630	0.85	76.05	3039	0.07	96.05	12694	0.31
57.05	1242640	30.62	77.00	109713	2.70	97.00	58319	1.44
58.05	57726	1.42	78.05	30962	0.76	98.05	5446	0.13
59.00	27158	0.67	79.00	158682	3.91	99.05	3953	0.10
60.00	3393	0.08	80.05	16966	0.42	100.05	722	0.02
61.00	3713	0.09	81.05	74023	1.82	101.00	3378	0.08
62.05	2507	0.06	82.05	9137	0.23	102.00	4422	0.11
63.00	11066	0.27	83.05	76039	1.87	103.00	29634	0.73
64.05	4305	0.11	84.05	6615	0.16	104.05	18990	0.47
65.00	66601	1.64	85.00	12665	0.31	105.05	181907	4.48
66.00	9244	0.23	86.05	3535	0.09	106.05	25037	0.62
67.00	71666	1.77	87.00	76306	1.88	107.05	94587	2.33
68.05	6692	0.16	88.05	6165	0.15	108.05	24506	0.60
69.00	102537	2.53	89.05	19690	0.49	109.05	55426	1.37

110.05	14205	0.35	153.95	4714	0.12	197.00	1343	0.03
111.05	11544	0.28	155.05	12759	0.31	198.05	870	0.02
112.15	1319	0.03	156.05	10800	0.27	199.05	86110.21	
113.10	1937	0.05	157.00	18364	0.45	200.00	3529	0.09
114.05	1416	0.03	158.05	10039	0.25	201.05	15235	0.38
115.00	56137	1.38	159.05	50870	1.25	202.05	7288	0.18
116.05	23838	0.59	160.05	19428	0.48	203.05	232952	5.74
117.05	55796	1.37	161.05	367500	9.06	204.05	53064	1.31
118.15	17405	0.43	162.05	73325	1.81	205.05	168096	4.14
119.05	157347	3.88	163.05	304717	7.51	206.05	28825	0.71
120.15	29624	0.73	164.05	77660	1.91	206.95	53324	1.31
121.05	183278	4.52	165.05	28446	0.70	207.95	11126	0.27
122.05	52134	1.28	166.05	9166	0.23	208.90	6970	0.17
123.00	309481	7.63	167.00	4921	0.12	209.90	1486	0.04
124.05	106916	2.63	167.60	1481	0.04	210.95	11410.03	
125.05	38952	0.96	168.65	2669	0.07	212.00	654	0.02
126.05	7775	0.19	169.65	4153	0.10	213.05	1488	0.04
127.10	15252	0.38	170.60	34975	0.86	214.05	815	0.02
128.10	50407	1.24	171.55	6931	0.17	215.05	35110.09	
129.05	65641	1.62	171.95	6908	0.17	216.05	2652	0.07
130.10	38905	0.96	173.05	24363	0.60	217.05	70566	1.74
131.05	68198	1.68	174.05	15071	0.37	218.10	50402	1.24
132.10	17100	0.42	175.05	117678	2.90	219.05	218541	5.39
133.10	136910	3.37	176.05	25145	0.62	220.05	141578	3.49
134.05	41778	1.03	177.05	182392	4.49	221.05	31536	0.78
135.05	147678	3.64	178.05	260918	6.43	222.10	111241	2.74
136.05	36512	0.90	179.00	4058017	100.00	223.10	20130	0.50
137.00	996754	24.56	180.00	530631	13.08	224.00	2471	0.06
138.05	102031	2.51	181.00	211145	5.20	224.95	798	0.02
139.05	53104	1.31	182.00	23772	0.59	225.95	646	0.02
140.05	5392	0.13	183.00	4010	0.10	226.95	11040.03	
141.05	27054	0.67	184.05	3390	0.08	227.95	794	0.02
142.05	21174	0.52	185.05	10472	0.26	229.00	1415	0.03
143.05	35678	0.88	186.05	5454	0.13	230.00	11140.03	
144.05	71311	1.76	187.05	16698	0.41	231.05	9881	0.24
145.05	82336	2.03	188.05	7199	0.18	232.05	3843	0.09
146.05	26102	0.64	189.05	53334	1.31	233.10	24386	0.60
147.05	113118	2.79	190.05	30076	0.74	234.05	7476	0.18
148.05	28364	0.70	191.00	47265	1.16	235.00	4482	0.11
149.05	116979	2.88	191.95	14089	0.35	236.00	1740	0.04
150.05	83782	2.06	193.00	14494	0.36	237.00	1314	0.03
151.00	52366	1.29	193.95	3887	0.10	238.05	463	0.01
152.05	15787	0.39	194.95	3197	0.08	238.95	582	0.01
153.00	14105	0.35	195.95	11780.03		239.90	380	0.01

240.95	1714	0.04	285.00	21030	0.52	329.05	5652	0.14
242.05	1073	0.03	286.00	12009	0.30	330.10	1454	0.04
243.05	2330	0.06	287.00	4230	0.10	331.00	404	0.01
244.00	934	0.02	288.00	11380	0.03	332.00	1202	0.03
245.00	4526	0.11	288.95	299	0.01	333.15	434	0.01
246.05	1804	0.04	289.90	762	0.02	334.10	5217	0.13
247.10	3132	0.08	291.05	493	0.01	335.05	1779	0.04
247.85	1430	0.04	292.05	18412	0.45	336.00	225	0.01
248.85	3272	0.08	293.00	4494	0.11	337.00	95	0.00
249.95	1259	0.03	294.00	698	0.02	337.80	130	0.00
251.00	2362	0.06	295.00	1908	0.05	338.75	727	0.02
251.95	912	0.02	295.85	559	0.01	340.05	1184	0.03
252.95	1570	0.04	296.80	742	0.02	341.05	25343	0.62
253.90	686	0.02	298.05	380	0.01	342.05	39793	0.98
254.90	530	0.01	299.05	4613	0.11	343.00	11071	0.27
256.05	481	0.01	300.10	1487	0.04	344.10	3641	0.09
257.05	2041	0.05	301.00	918	0.02	344.95	773	0.02
258.15	1063	0.03	302.15	960	0.02	345.90	289	0.01
259.10	16254	0.40	303.10	273	0.01	347.10	244	0.01
260.00	4801	0.12	304.10	138	0.00	348.15	8725	0.22
261.15	3273	0.08	305.10	95	0.00	349.10	39678	0.98
262.10	1596	0.04	305.80	222	0.01	350.10	10102	0.25
262.95	1086	0.03	306.80	335	0.01	351.05	1573	0.04
263.90	682	0.02	307.80	185	0.00	352.05	301	0.01
264.90	3119	0.08	308.95	645	0.02	352.90	554	0.01
265.95	622	0.02	309.90	234	0.01	354.00	177	0.00
266.90	4934	0.12	310.90	738	0.02	355.00	7914	0.20
267.90	1962	0.05	312.00	217	0.01	356.00	3108	0.08
268.95	1577	0.04	313.00	1988	0.05	356.95	1778	0.04
269.90	585	0.01	314.15	938	0.02	357.90	740	0.02
271.00	1417	0.03	315.15	1216	0.03	358.90	343	0.01
271.95	548	0.01	316.15	980	0.02	359.90	100	0.00
273.05	1080	0.03	317.05	360	0.01	360.90	81	0.00
274.15	3747	0.09	318.05	867	0.02	361.90	122	0.00
275.15	24971	0.62	319.05	439	0.01	362.90	281	0.01
276.10	7036	0.17	320.00	127	0.00	363.90	217	0.01
277.05	1629	0.04	321.00	98	0.00	365.05	1278	0.03
278.05	703	0.02	322.00	164	0.00	366.00	284	0.01
278.90	609	0.02	323.05	1003	0.02	367.10	746	0.02
279.90	207	0.01	324.05	575	0.01	368.00	247	0.01
280.95	15586	0.38	325.00	7847	0.19	369.05	1241	0.03
281.90	4674	0.12	326.05	2733	0.07	370.10	412	0.01
282.95	3367	0.08	327.05	47480	1.17	371.00	522	0.01
283.95	1388	0.03	328.00	11882	0.29	372.00	183	0.00

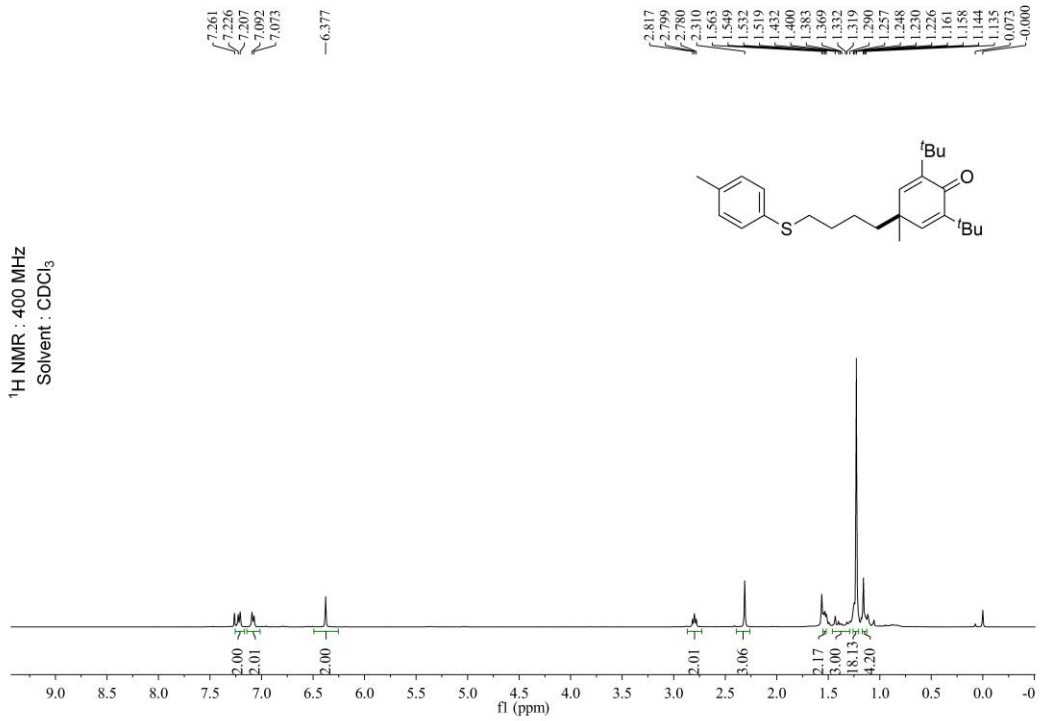
373.00	254	0.01	384.10	7838	0.19	394.80	84	0.00
374.00	111	0.00	385.05	2895	0.07	396.15	414	0.01
375.00	16	0.00	385.85	515	0.01	**397.15**	**9671**	**0.24**
376.00	57	0.00	386.80	873	0.02	**398.10**	**489009**	**12.05**
377.00	81	0.00	387.80	508	0.01	**399.10**	**143673**	**3.54**
378.00	34	0.00	388.80	316	0.01	400.10	44668	1.10
379.00	60	0.00	389.80	78	0.00	401.05	10772	0.27
380.00	66	0.00	390.80	36	0.00	402.00	2649	0.07
381.00	409	0.01	391.80	11	0.00	402.95	928	0.02
382.15	665	0.02	392.80	22	0.00	404.00	263	0.01
383.10	28079	0.69	393.80	81	0.00	405.00	193	0.00

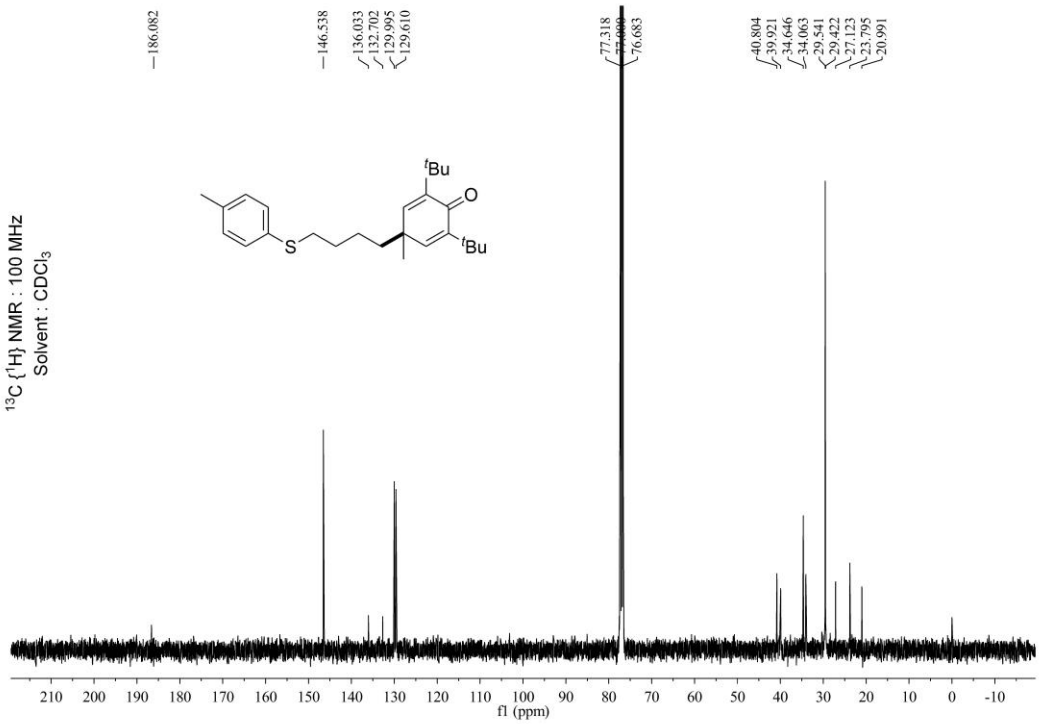
The date and NMR spectra of 7.

2,6-Di-*tert*-butyl-4-methyl-4-(4-(*p*-tolylthio)butyl)cyclohexa-2,5-dien-1-one (7).

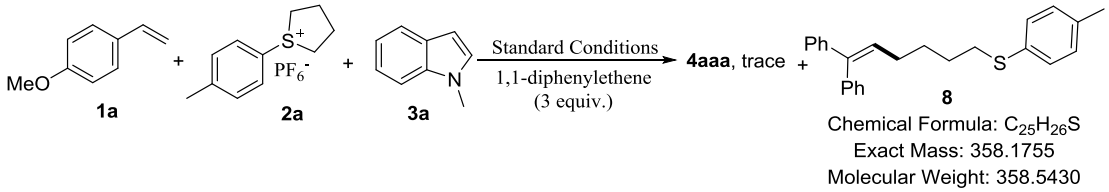
The title compound was prepared according to the general procedure and purified by column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (40 : 1) to afford a yellow oil in 45% yield (36.0 mg). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.22 (d, J = 7.6 Hz, 2H), 7.08 (d, J = 7.6 Hz, 2H), 6.38 (s, 2H), 2.80 (t, J = 7.2 Hz, 2H), 2.31 (s, 3H), 1.56-1.52 (m, 2H), 1.431.29 (m, 3H), 1.26-1.23 (m, 18H), 1.16-1.14 (m, 4H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 186.1, 146.5 (4C), 136.0, 132.7, 130.0 (2C), 129.6 (2C), 40.8, 39.9, 34.6 (2C), 34.1, 29.5 (6C), 29.4, 27.1, 23.8, 21.0.

2,6-Di-*tert*-butyl-4-methyl-4-(4-(*p*-tolylthio)butyl)cyclohexa-2,5-dien-1-one (7)



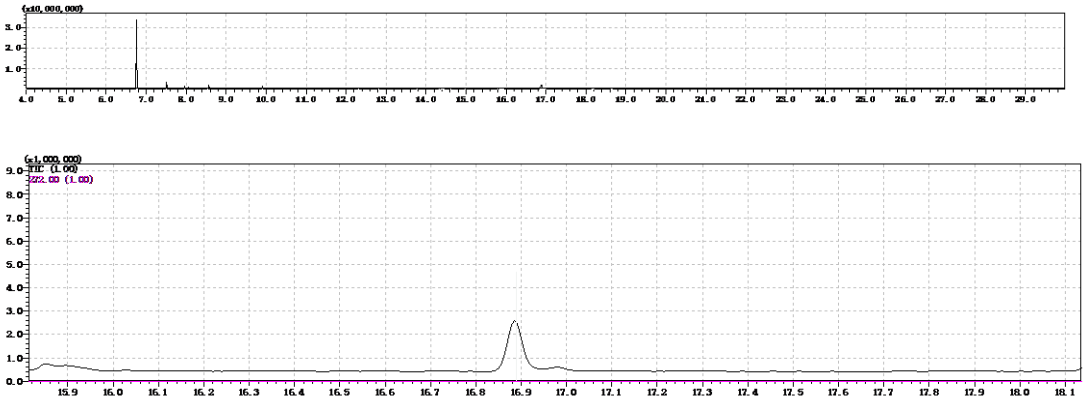


2.10.2 GC-MS Analysis of trapping product 8[4]

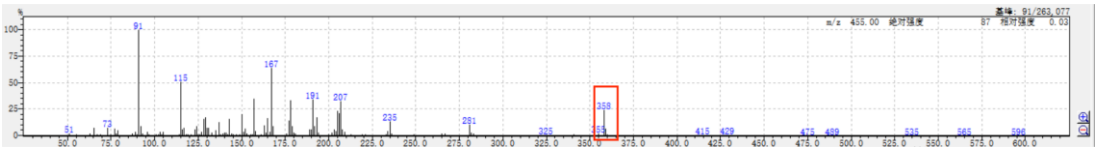


Chemical Formula: $C_{25}H_{26}S$
Exact Mass: 358.1755
Molecular Weight: 358.5430

Spectra of GC-MS



MS Spectra of the peak at 16.885 min



[MS Spectrum]
# of Peaks 550
Raw Spectrum 16.890 (scan : 2579)
Background No Background Spectrum
Base Peak m/z 91.05 (Inten : 263,077)
Event# 1

m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity
50.05	1501	0.57	62.05	1089	0.41	74.00	2564	0.97
51.05	5229	1.99	63.05	5147	1.96	75.00	3414	1.30
52.05	11180	0.42	64.05	1242	0.47	76.05	2478	0.94
53.00	2857	1.09	65.05	19308	7.34	77.05	18900	7.18
54.05	380	0.14	66.05	1657	0.63	78.05	6345	2.41
55.05	4717	1.79	67.05	4751	1.81	79.05	13941	5.30
56.05	1259	0.48	68.05	621	0.24	80.05	1290	0.49
57.05	2351	0.89	69.00	3023	1.15	81.00	1844	0.70
58.00	828	0.31	70.05	1337	0.51	82.05	1899	0.72
59.00	2812	1.07	71.05	2447	0.93	83.00	2447	0.93
60.05	624	0.24	72.05	453	0.17	84.00	874	0.33
61.05	1570	0.60	73.00	19407	7.38	85.00	2068	0.79

86.00	11640.44		130.10	19468	7.40	174.00	209	0.08
87.00	6034	2.29	131.10	20135	7.65	175.00	1049	0.40
88.00	1950	0.74	132.05	2903	1.10	176.00	6188	2.35
89.05	10054	3.82	133.00	7215	2.74	177.00	37292	14.18
90.15	4993	1.90	134.00	2292	0.87	178.00	88801	33.75
91.05	263077	100.00	135.00	14519	5.52	179.00	23441	8.91
92.05	23231	8.83	136.05	2152	0.82	180.00	8247	3.13
93.10	5721	2.17	137.05	34477	13.11	181.00	5098	1.94
94.05	1230	0.47	138.05	3948	1.50	181.95	1551	0.59
95.05	1937	0.74	139.10	5297	2.01	183.10	439	0.17
96.00	9084	3.45	140.10	7250	2.76	184.10	220	0.08
96.95	4663	1.77	141.10	8527	3.24	185.10	151	0.06
98.05	756	0.29	142.10	3734	1.42	185.90	153	0.06
99.05	1767	0.67	143.10	41482	15.77	186.95	1030	0.39
99.95	667	0.25	144.10	5694	2.16	187.95	1548	0.59
101.05	4095	1.56	145.05	3896	1.48	189.00	15305	5.82
102.05	4645	1.77	146.05	598	0.23	190.00	15730	5.98
103.05	9127	3.47	147.00	4855	1.85	191.00	90111	34.25
104.05	4077	1.55	148.00	2038	0.77	192.00	24876	9.46
105.10	9266	3.52	149.00	4892	1.86	193.00	46895	17.83
106.05	11330.43		150.00	55018	20.91	193.95	7644	2.91
107.00	590	0.22	151.00	10801	4.11	195.05	1396	0.53
108.00	1753	0.67	152.00	17809	6.77	196.00	199	0.08
109.10	1556	0.59	153.00	5103	1.94	196.95	683	0.26
110.05	439	0.17	154.05	1352	0.51	198.05	535	0.20
111.10	11850.45		155.05	3500	1.33	199.05	431	0.16
112.10	561	0.21	156.15	4576	1.74	200.00	3406	1.29
113.15	1757	0.67	157.05	92189	35.04	201.00	15110.57	
114.15	3090	1.17	158.05	11541	4.39	202.00	7287	2.77
115.05	135207	51.39	159.05	840	0.32	203.00	15343	5.83
116.05	15402	5.85	160.05	563	0.21	204.05	11540	4.39
117.10	20484	7.79	161.00	3185	1.21	205.00	61604	23.42
118.10	3535	1.34	162.05	1337	0.51	206.00	57116	21.71
119.05	3385	1.29	163.00	26551	10.09	206.95	86703	32.96
120.00	378	0.14	164.05	7371	2.80	207.95	16831	6.40
121.00	3801	1.44	165.00	43257	16.44	208.95	10059	3.82
122.00	2234	0.85	166.05	9923	3.77	210.05	1860	0.71
123.05	16956	6.45	167.05	169718	64.51	210.95	910	0.35
124.05	24931	9.48	168.05	23145	8.80	212.05	400	0.15
125.05	4700	1.79	169.00	2217	0.84	213.00	4468	1.70
126.10	4142	1.57	170.10	1351	0.51	213.85	1007	0.38
127.10	9802	3.73	171.10	468	0.18	215.05	1679	0.64
128.10	42102	16.00	172.10	182	0.07	216.00	534	0.20
129.10	46230	17.57	173.10	110	0.04	217.05	919	0.35

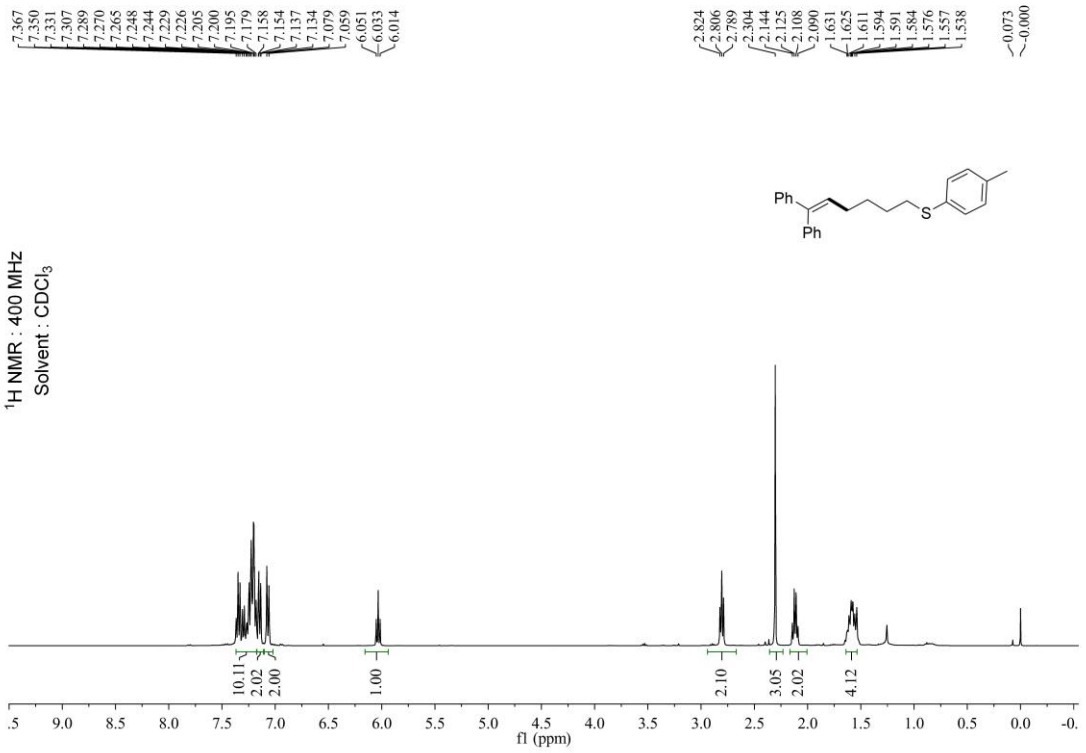
218.05	648	0.25	262.00	150	0.06	306.10	130	0.05
219.05	3852	1.46	263.00	132	0.05	307.00	433	0.16
220.05	1412	0.54	263.90	113	0.04	308.00	297	0.11
221.00	4103	1.56	264.90	5578	2.12	309.00	150	0.06
222.00	996	0.38	265.90	1926	0.73	310.00	134	0.05
223.05	1148	0.44	266.90	6070	2.31	311.00	183	0.07
224.00	375	0.14	267.85	1700	0.65	312.00	138	0.05
225.10	700	0.27	268.95	1982	0.75	313.00	287	0.11
226.10	258	0.10	270.00	582	0.22	314.00	119	0.05
227.10	177	0.07	271.00	676	0.26	315.00	127	0.05
228.10	260	0.10	272.00	223	0.08	316.00	108	0.04
229.10	212	0.08	273.00	161	0.06	317.00	140	0.05
230.10	250	0.10	274.00	105	0.04	318.00	55	0.02
231.10	281	0.11	275.00	151	0.06	319.00	92	0.03
232.05	413	0.16	276.00	137	0.05	320.00	97	0.04
233.05	3030	1.15	277.00	118	0.04	321.00	217	0.08
234.05	12945	4.92	278.00	214	0.08	322.00	62	0.02
235.05	35595	13.53	278.95	458	0.17	323.00	311	0.12
236.05	6145	2.34	280.05	570	0.22	323.90	142	0.05
237.00	1103	0.42	280.95	28442	10.81	324.90	1263	0.48
238.00	257	0.10	281.95	8765	3.33	325.95	393	0.15
239.05	477	0.18	283.00	5882	2.24	326.95	1527	0.58
240.00	172	0.07	283.90	1583	0.60	327.95	368	0.14
241.00	262	0.10	284.95	517	0.20	329.00	497	0.19
242.00	212	0.08	286.00	178	0.07	330.00	90	0.03
243.00	124	0.05	287.00	162	0.06	331.00	108	0.04
244.00	34	0.01	288.00	47	0.02	332.00	124	0.05
245.00	129	0.05	289.00	202	0.08	333.00	82	0.03
246.00	73	0.03	290.00	81	0.03	334.00	153	0.06
247.00	231	0.09	291.00	113	0.04	335.00	129	0.05
247.90	249	0.09	292.00	108	0.04	336.00	58	0.02
248.90	3852	1.46	293.05	434	0.16	337.00	159	0.06
249.95	1367	0.52	294.00	199	0.08	338.00	70	0.03
250.90	1801	0.68	295.00	951	0.36	338.90	409	0.16
251.85	897	0.34	296.05	381	0.14	339.90	137	0.05
252.95	1094	0.42	297.10	412	0.16	340.90	3759	1.43
253.95	478	0.18	298.10	222	0.08	341.95	1112	0.42
254.90	591	0.22	299.10	338	0.13	342.90	1084	0.41
255.90	119	0.05	300.10	102	0.04	343.90	302	0.11
257.05	541	0.21	301.10	375	0.14	344.90	188	0.07
258.00	220	0.08	302.10	209	0.08	345.90	76	0.03
259.00	217	0.08	303.10	220	0.08	346.90	34	0.01
260.00	95	0.04	304.10	113	0.04	347.90	52	0.02
261.00	153	0.06	305.10	124	0.05	348.90	95	0.04

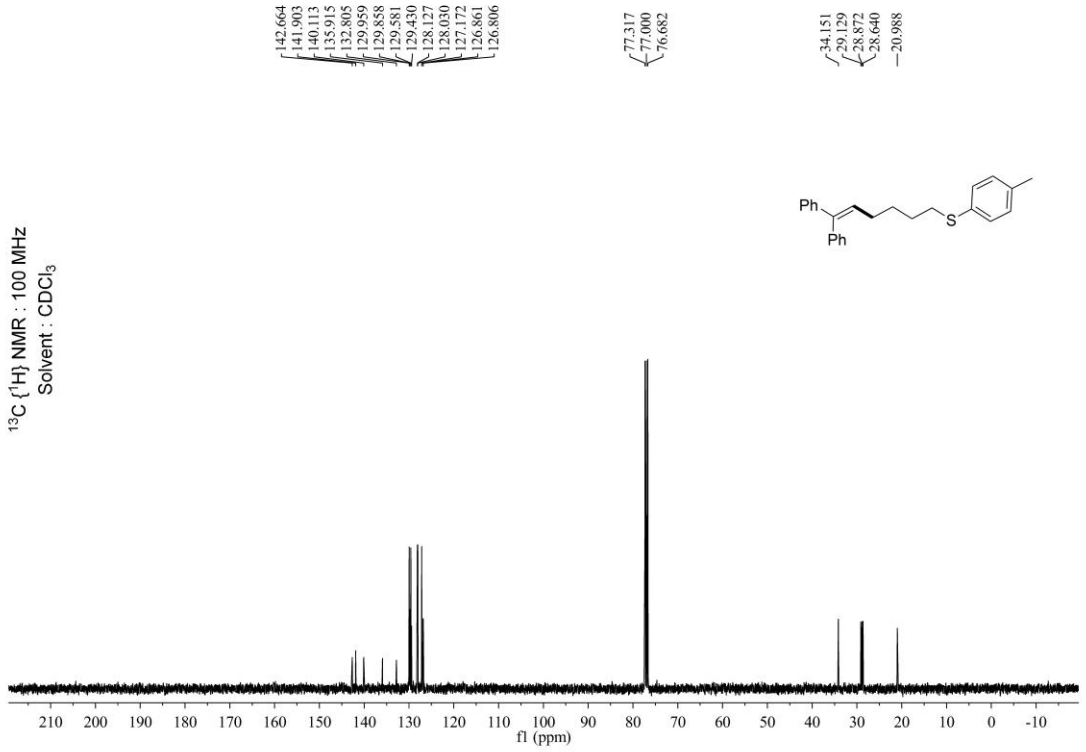
349.90	60	0.02	**357.00**	**2182**	**0.83**	364.10	33	0.01
350.90	137	0.05	**358.05**	**64445**	**24.50**	365.10	55	0.02
351.90	87	0.03	**359.00**	**17498**	**6.65**	366.10	27	0.01
352.90	193	0.07	360.00	5014	1.91	367.10	65	0.02
354.00	87	0.03	361.10	959	0.36	368.10	121	0.05
355.00	5385	2.05	362.10	167	0.06	369.00	558	0.21
355.95	2012	0.76	363.10	34	0.01	370.00	127	0.05

The date and NMR spectra of 8.

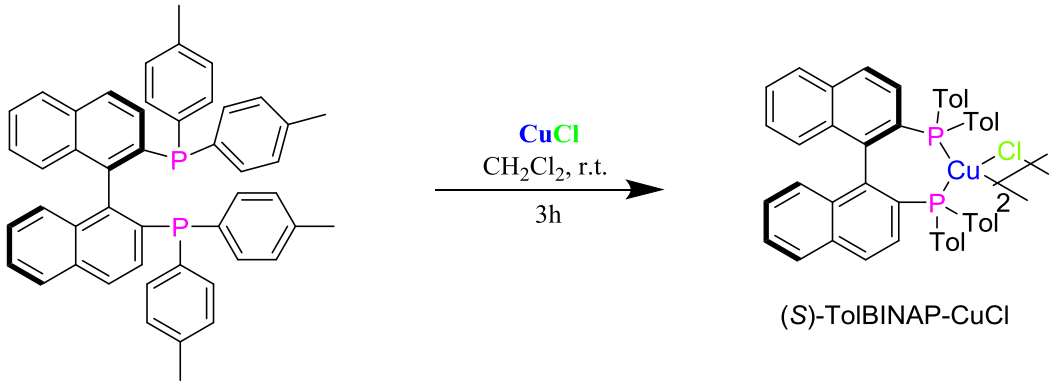
(6,6-Diphenylhex-5-en-1-yl)(*p*-tolyl)sulfane (8). The title compound was prepared according to the general procedure and purified by column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (40 : 1) to afford a yellow oil in 62% yield (44.4 mg). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37-7.18 (m, 10H), 7.16-7.13 (m, 2H), 7.07 (d, J = 8.0 Hz, 2H), 6.03 (t, J = 7.2 Hz, 1H), 2.81 (t, J = 7.2 Hz, 2H), 2.30 (s, 3H), 2.14-2.09 (m, 2H), 1.63-1.54 (m, 4H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 142.7, 141.9, 140.1, 135.9, 132.8, 130.0 (2C), 129.9 (2C), 129.6 (2C), 129.4, 128.1 (2C), 128.0 (2C), 127.2 (2C), 126.9, 126.8, 34.2, 29.1, 28.9, 28.6, 21.0.

(6,6-Diphenylhex-5-en-1-yl)(*p*-tolyl)sulfane (8)





2.11 Synthesis of Copper-Based Photocatalyst[2]



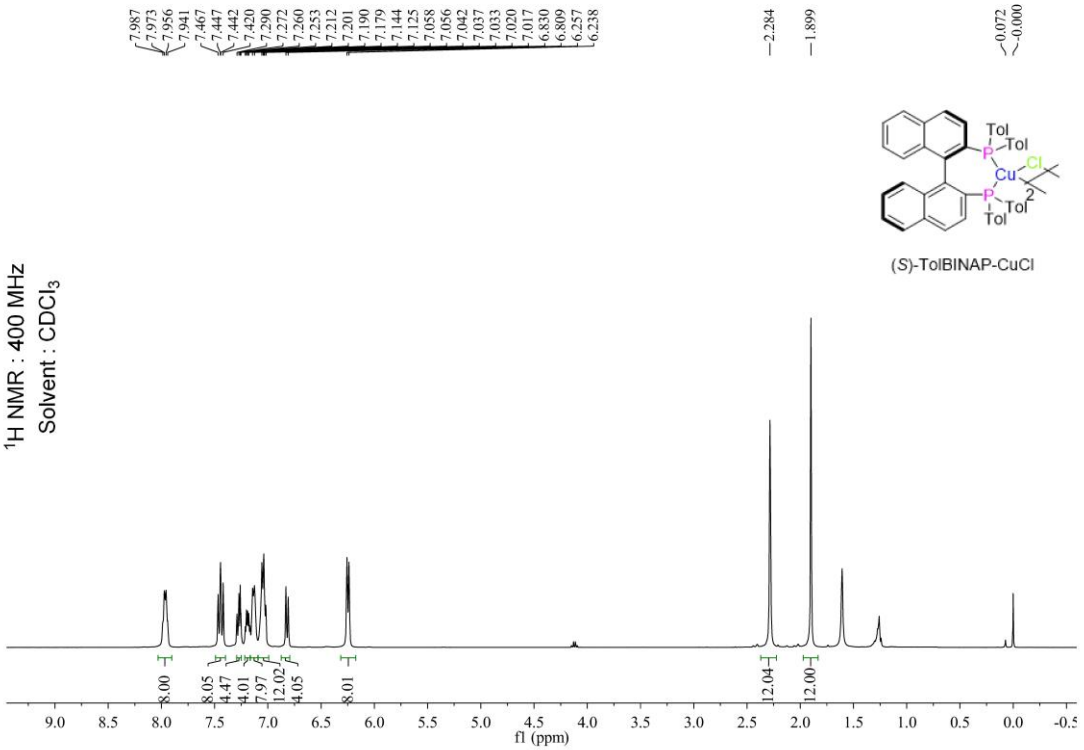
(*S*)-TolBINAP-CuCl

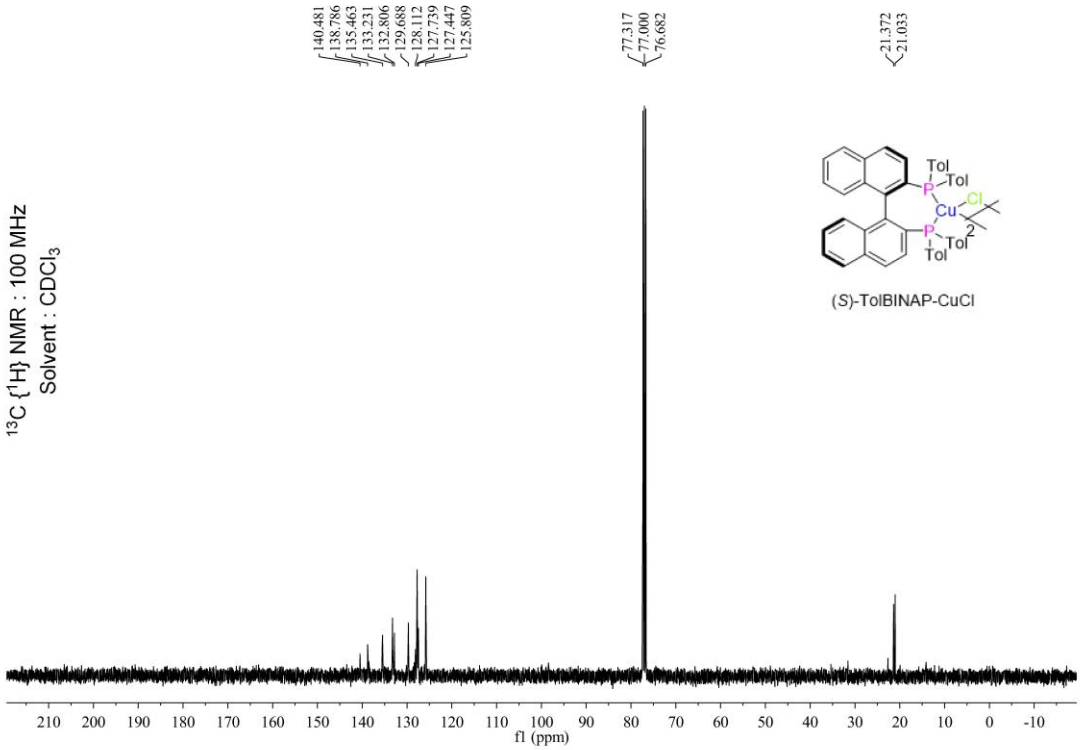
A solution of CuCl (0.099 g, 1 mmol) in 10 mL of DCM was added to a DCM solution of 35 mL with (*S*)-TolBINAP (0.679 g, 1 mmol). The solution was allowed to stir for 3 hours and the solvent was reduced in vacuo to 15 mL. Approximately 20 mL of hexanes was added to precipitate a yellow solid. The resulting solid was collected by vacuum filtration and dried under reduced pressure.

The date and NMR spectra of (*S*)-TolBINAP-CuCl.

(*S*)-TolBINAP-CuCl. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99-7.94 (m, 8H), 7.46-7.42 (m, 8H), 7.29-7.25 (m, 4H), 7.21-7.18 (m, 4H), 7.13 (d, *J* = 7.6 Hz, 8H), 7.06-7.02 (m, 12H), 6.82 (d, *J* = 8.4 Hz, 4H), 6.25 (d, *J* = 7.6 Hz, 8H), 2.28 (s, 12H), 1.90 (s, 12H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 140.5 (8C), 138.8 (8C), 135.5 (8C), 133.2 (4C), 132.8 (4C), 129.7 (8C), 128.1 (8C), 127.7 (16C), 127.4 (8C), 125.8 (16C), 21.4 (4C), 21.0 (4C).

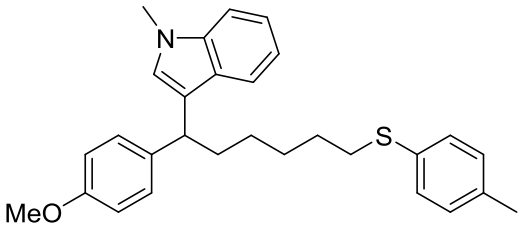
(*S*)-TolBINAP-CuCl



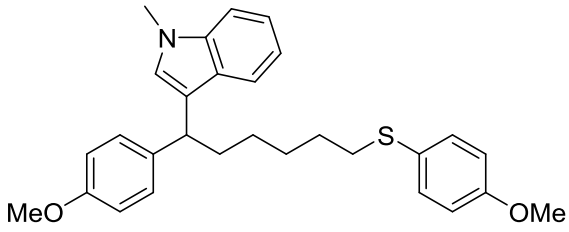


3. Characterization Data

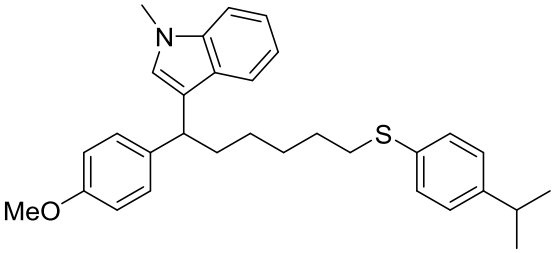
3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aaa), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 64.7 mg, 73%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 (d, *J* = 7.6 Hz, 1H), 7.22-7.14 (m, 6H), 7.07 (d, *J* = 8.0 Hz, 2H), 6.99 (t, *J* = 8.0 Hz, 1H), 6.81 (d, *J* = 2.4 Hz, 2H), 6.78 (s, 1H), 4.07 (t, *J* = 7.6 Hz, 1H), 3.75 (s, 3H), 3.71 (s, 3H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.30 (s, 3H), 2.17-2.10 (m, 1H), 1.98-1.89 (m, 1H), 1.62-1.54 (m, 2H), 1.49-1.40 (m, 2H), 1.36-1.25 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 157.6, 137.6, 137.1, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 128.7 (2C), 127.3, 125.6, 121.4, 119.5, 119.3, 118.5, 113.6 (2C), 109.0, 55.1, 41.8, 36.2, 34.2, 32.6, 29.1, 28.8, 27.5, 21.0; HRMS (ESI-TOF) m/z: $C_{29}H_{34}NOS^+$ $(M + H)^+$ calcd for 444.2356, found 444.2357.



3-(1-(4-Methoxyphenyl)-6-((4-methoxyphenyl)thio)hexyl)-1-methyl-1*H*-indole (4aba), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 59.7 mg, 65%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): *δ* 7.42 (d, *J* = 8.0 Hz, 1H), 7.30 (d, *J* = 6.8 Hz, 2H), 7.24 (d, *J* = 7.2 Hz, 1H), 7.19-7.14 (m, 3H), 6.99 (t, *J* = 7.6 Hz, 1H), 6.82-6.78 (m, 5H), 4.07 (t, *J* = 7.6 Hz, 1H), 3.77 (s, 3H), 3.75 (s, 3H), 3.72 (s, 3H), 2.76 (t, *J* = 6.8 Hz, 2H), 2.16-2.08 (m, 1H), 1.97-1.88 (m, 1H), 1.54-1.47 (m, 2H), 1.45-1.35 (m, 2H), 1.33-1.27 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): *δ* 158.7, 157.6, 137.7, 137.1, 132.9 (2C), 128.7 (2C), 127.3, 126.8, 125.6, 121.4, 119.5, 119.3, 118.5, 114.4 (2C), 113.6 (2C), 109.0, 55.3, 55.2, 41.9, 36.2, 35.7, 32.6, 29.2, 28.7, 27.6; HRMS (ESI-TOF) m/z: $C_{29}H_{34}NO_2S^+$ $(M + H)^+$ calcd for 460.2305, found 460.2308.

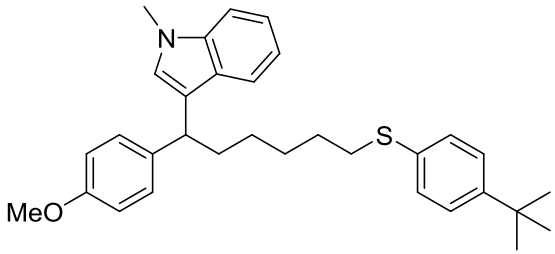


3-(6-((4-Isopropylphenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4aca), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 56.5 mg, 60 %; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): *δ* 7.43 (d, *J* = 8.0 Hz, 1H), 7.25-7.23 (m, 3H), 7.18 (t, *J* = 8.0 Hz, 3H), 7.12 (d, *J* = 8.4 Hz, 2H), 7.00 (t, *J* = 8.0



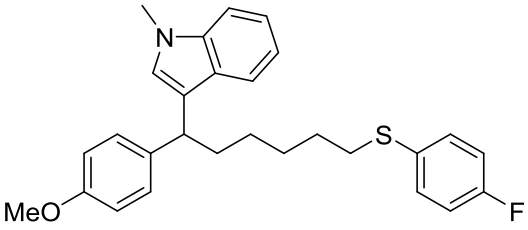
Hz, 1H), 6.81 (d, *J* = 4.0 Hz, 2H), 6.79 (s, 1H), 4.08 (t, *J* = 7.2 Hz, 1H), 3.76 (s, 3H), 3.73 (s, 3H), 2.88-2.82 (m, 3H), 2.18-2.09 (m, 1H), 1.99-1.90 (m, 1H), 1.64-1.58 (m, 2H), 1.49-1.41 (m, 2H), 1.37-1.29 (m, 2H), 1.22 (d, *J* = 6.8 Hz, 1H); ^{13}C {^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.6, 146.7, 137.7, 137.2, 133.5, 130.2, 129.5 (2C), 128.7 (2C), 127.3, 126.9 (2C), 125.6, 121.4, 119.5, 119.3, 118.5, 113.6 (2C), 109.0, 55.2, 41.9, 36.2, 34.1, 33.6, 32.6, 29.1, 28.8, 27.6, 23.9; HRMS (ESI-TOF) *m/z*: $C_{31}H_{38}NOS^+$ $(M + H)^+$ calcd for 472.2669, found 472.2662.

3-(6-((4-(*Tert*-butyl)phenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole



(4ada), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 65.0 mg, 67%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, *J* = 8.0 Hz, 1H), 7.29-7.14 (m, 8H), 6.99 (t, *J* = 8.0 Hz, 1H), 6.81 (d, *J* = 3.2 Hz, 2H), 6.78 (s, 1H), 4.08 (t, *J* = 8.0 Hz, 1H), 3.74 (s, 3H), 3.71 (s, 3H), 2.84 (t, *J* = 7.2 Hz, 2H), 2.18-2.09 (m, 1H), 1.99-1.90 (m, 1H), 1.64-1.57 (m, 2H), 1.48-1.41 (m, 2H), 1.39-1.32 (m, 2H), 1.29 (s, 9H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.6, 148.9, 137.6, 137.1, 133.2, 129.0 (2C), 128.7 (2C), 127.3, 125.8 (2C), 125.6, 121.4, 119.5, 119.3, 118.5, 113.6 (2C), 109.0, 55.1, 41.9, 36.2, 34.4, 33.9, 32.6, 31.3 (3C), 29.1, 28.8, 27.6; HRMS (ESI-TOF) *m/z*: $C_{32}H_{40}NOS^+$ $(M + H)^+$ calcd for 486.2825, found 486.2829.

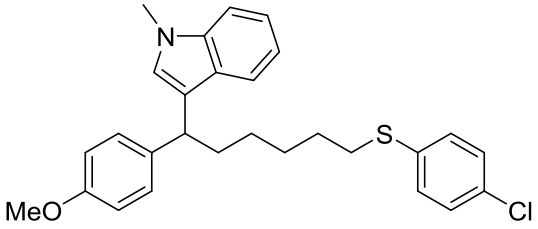
3-(6-((4-Fluorophenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole



(4aea), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 65.3 mg, 73%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, *J* = 8.0 Hz, 1H), 7.30-7.14 (m, 6H), 7.02-6.93 (m, 3H), 6.81-6.78 (m, 3H), 4.07 (t, *J* = 8.4 Hz, 1H), 3.74 (s, 3H), 3.71 (s, 3H), 2.80 (t, *J* = 6.8 Hz, 2H), 2.17-2.08 (m, 1H),

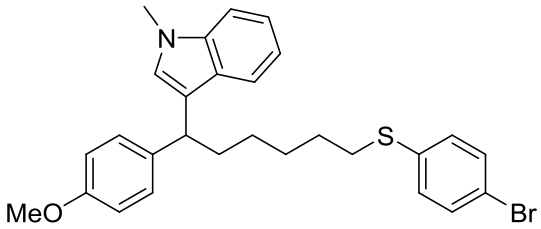
1.98-1.89 (m, 1H), 1.58-1.53 (m, 2H), 1.48-1.39 (m, 2H), 1.34-1.28 (m, 2H); ^{19}F NMR (282 MHz, $CDCl_3$) δ: -116.1 (s, 1F); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$): δ 160.5 (d, $J_{C\text{-}F}$ = 244.3 Hz, 1C), 157.6, 137.6, 137.1 131.9 (d, $J_{C\text{-}F}$ = 7.9 Hz, 2C), 131.6 (d, $J_{C\text{-}F}$ = 3.3 Hz, 1C), 128.7 (2C), 127.3, 125.6, 121.4, 119.5, 119.3, 118.5, 115.8 (d, $J_{C\text{-}F}$ = 21.7 Hz, 2C), 113.6 (2C), 109.0, 55.1, 41.8, 36.2, 34.8, 32.6, 29.0, 28.6, 27.5; HRMS (ESI-TOF) *m/z*: $C_{28}H_{31}FNOS^+$ $(M + H)^+$ calcd for 448.2105, found 448.2112.

3-(6-((4-Chlorophenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole



(4afa), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 72.2 mg, 78%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, *J* = 8.0 Hz, 1H), 7.23-7.14 (m, 8H), 7.00 (t, *J* = 7.2 Hz, 1H), 6.81 (s, 2H), 6.78 (s, 1H), 4.08 (t, *J* = 7.6 Hz, 1H), 3.75 (s, 3H), 3.72 (s, 3H), 2.83 (t, *J* = 7.2 Hz, 2H), 2.18-2.09 (m, 1H), 1.99-1.89 (m, 1H), 1.62-1.57 (m, 2H), 1.49-1.42 (m, 2H), 1.37-1.26 (m, 2H); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$): δ 157.6, 137.6, 137.1, 135.4, 131.5, 130.1 (2C), 128.9 (2C), 128.7 (2C), 127.3, 125.6, 121.4, 119.5, 119.2, 118.5, 113.6 (2C), 109.1, 55.1, 41.8, 36.2, 33.7, 32.6, 28.8, 28.7, 27.5; HRMS (ESI-TOF) *m/z*: $C_{28}H_{31}ClNOS^+$ $(M + H)^+$ calcd for 464.1809, found 464.1815.

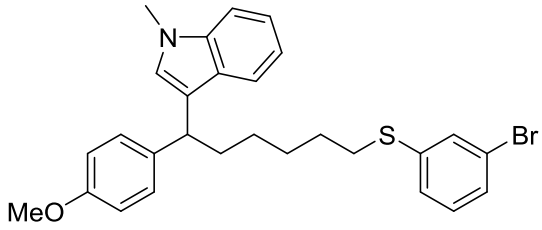
3-(6-((4-Bromophenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole



(4aga), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 62.9 mg, 62%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, *J* = 8.0 Hz, 1H), 7.35 (d, *J* = 8.4 Hz, 2H), 7.24 (d, *J* = 8.4 Hz, 1H), 7.20-7.16 (m, 3H), 7.12 (d, *J* = 8.4 Hz, 2H), 7.00 (t, *J* = 8.0 Hz, 1H), 6.80 (s, 2H), 6.78 (s, 1H), 4.08 (t, *J* = 8.0 Hz, 1H), 3.75 (s, 3H), 3.71 (s, 3H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.18-2.10 (m, 1H), 1.98-1.89 (m, 1H), 1.62-1.55 (m, 2H), 1.49-1.39 (m, 2H), 1.37-1.26 (m, 2H); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$): δ 157.6, 137.6, 137.1, 136.2, 131.8 (2C), 130.3 (2C), 128.7 (2C), 127.3, 125.6, 121.4, 119.5, 119.3, 119.2, 118.5, 113.6 (2C), 109.1,

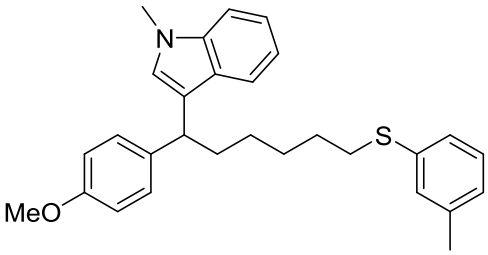
55.1, 41.8, 36.1, 33.5, 32.6, 28.8, 28.7, 27.5; HRMS (ESI-TOF) *m/z*: $C_{28}H_{31}BrNOS^+$ $(M + H)^+$ calcd for 508.1304, found 508.1305.

3-(6-((3-Bromophenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole

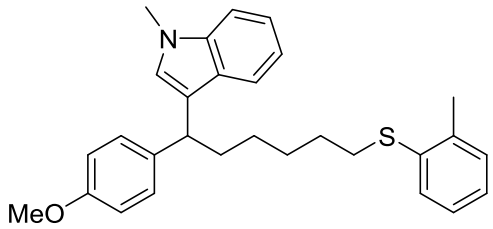


(4aha), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 57.8 mg, 57%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.44-7.40 (m, 2H), 7.26-7.23 (m, 2H), 7.20-7.14 (m, 4H), 7.09 (t, *J* = 8.0 Hz, 1H), 7.00 (t, *J* = 7.2 Hz, 1H), 6.81 (d, *J* = 7.6 Hz, 2H), 6.79 (s,1H), 4.06 (t, *J* = 8.0 Hz, 1H), 3.75 (s, 3H), 3.72 (s, 3H), 2.85 (t, *J* = 7.6 Hz, 2H), 2.18-2.10 (m, 1H), 1.99-1.90 (m, 1H), 1.65-1.57 (m, 2H), 1.51-1.42 (m, 2H), 1.38-1.28 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, CDCl3): δ 157.6, 139.6, 137.6, 137.1, 130.7, 130.0, 128.7 (2C), 128.4, 127.3, 126.8, 125.6, 122.7, 121.4, 119.5, 119.2, 118.5, 113.6 (2C), 109.1, 55.1, 41.9, 36.2, 33.2, 32.6, 28.7, 28.7, 27.5; HRMS (ESI-TOF) *m/z*: $C_{28}H_{31}BrNOS^+$ $(M + H)^+$ calcd for 508.1304, found 508.1299.

3-(1-(4-Methoxyphenyl)-6-(*m*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aia), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 59.4 mg, 67 %; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 (d, *J* = 8.0 Hz, 1H), 7.24 (d, *J* = 8.8 Hz, 1H), 7.20-7.08 (m, 6H), 7.01-6.94 (m, 1H), 6.81 (d, *J* = 3.6 Hz, 2H), 6.78 (s, 1H), 4.08 (d, *J* = 7.6 Hz, 2H), 3.75 (s, 3H), 3.72 (s, 3H), 2.86 (t, *J* = 7.6 Hz, 2H), 2.30 (s, 3H), 2.18-2.09 (m, 1H), 1.99-1.90 (m, 1H), 1.65-1.57 (m, 2H), 1.51-1.40 (m, 2H), 1.36-1.26 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.6, 138.5, 137.6, 137.1, 136.6, 129.4, 128.7 (2C), 128.6, 127.3, 126.5, 125.7, 125.6, 121.4, 119.5, 119.3, 118.5, 113.6 (2C), 109.0, 55.1, 41.9, 36.2, 33.4, 32.6, 29.0, 28.8, 27.6, 21.3; HRMS (ESI-TOF) *m/z*: $C_{29}H_{34}NOS^+$ $(M + H)^+$ calcd for 444.2356, found 444.2357.

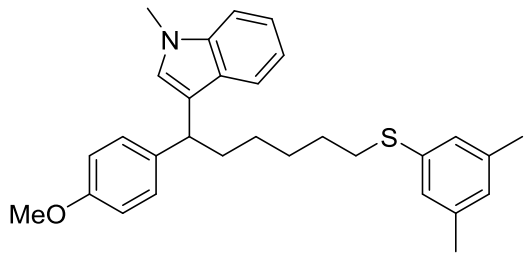


3-(1-(4-Methoxyphenyl)-6-(*o*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aja), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 55.8 mg, 63%;

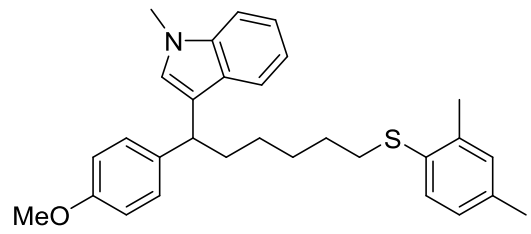


yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, J = 7.6 Hz, 1H), 7.24-7.18 (m, 4H), 7.16-7.11 (m, 3H), 7.07 (d, J = 8.0 Hz, 1H), 7.00 (t, J = 6.8 Hz, 1H), 6.81 (d, J = 4.4 Hz, 2H), 6.79 (s, 1H), 4.09 (t, J = 7.6 Hz, 1H), 3.76 (s, 3H), 3.73 (s, 3H), 2.85 (t, J = 7.2 Hz, 2H), 2.34 (s, 3H), 2.19-2.10 (m, 1H), 2.00-1.91 (m, 1H), 1.68-1.60 (m, 2H), 1.51-1.44 (m, 2H), 1.39-1.29 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.7, 137.6, 137.2, 137.1, 136.3, 130.0, 128.7 (2C), 127.3, 127.2, 126.3, 125.6, 125.2, 121.4, 119.5, 119.3, 118.6, 113.6 (2C), 109.0, 55.2, 41.9, 36.2, 32.7, 32.6, 28.9, 28.8, 27.6, 20.3; HRMS (ESI-TOF) *m/z*: $C_{29}H_{34}NOS^+$ $(M + H)^+$ calcd for 444.2356, found 444.2357.

3-(6-((3,5-Dimethylphenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4aka), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 63.1 mg, 69%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 (d, J = 8.0 Hz, 1H), 7.23 (s, 1H), 7.19 (d, J = 8.8 Hz, 2H), 7.16-7.14 (m, 1H), 6.99 (t, J = 7.2 Hz, 1H), 6.91 (s, 2H), 6.81 (d, J = 4.8 Hz, 2H), 6.78 (s, 2H), 4.08 (t, J = 8.0 Hz, 1H), 3.75 (s, 3H), 3.72 (s, 3H), 2.85 (t, J = 7.6 Hz, 2H), 2.26 (s, 6H), 2.17-2.10 (m, 1H), 1.99-1.90 (m, 1H), 1.65-1.57 (m, 2H), 1.51-1.42 (m, 2H), 1.36-1.28 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.6, 138.3, 137.6, 137.1, 136.4, 128.7 (2C), 127.5 (2C), 127.3, 126.4 (2C), 125.6, 121.4, 119.5, 119.3, 118.5, 113.6 (2C), 109.0, 55.1, 41.9, 36.2, 33.4, 32.6, 29.0, 28.8, 27.6, 21.2 (2C); HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2519.

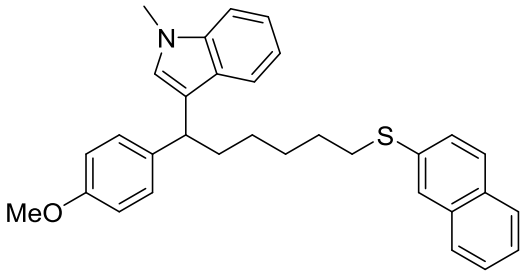


3-(6-((2,4-Dimethylphenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4ala), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 61.2 mg, 67%; yellow oil;



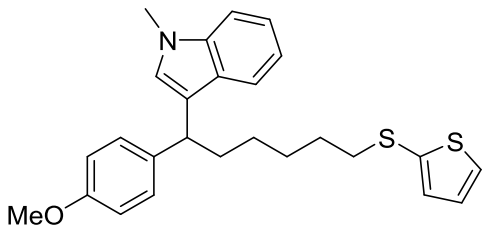
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 (d, J = 8.0 Hz, 1H), 7.22-7.13 (m, 5H), 7.01-6.98 (m, 2H), 6.94 (d, J = 8.0 Hz, 1H), 6.81 (d, J = 4.0 Hz, 2H), 6.78 (s, 1H), 4.08 (t, J = 7.6 Hz, 1H), 3.75 (s, 3H), 3.72 (s, 3H), 2.79 (t, J = 6.8 Hz, 2H), 2.33 (s, 3H), 2.27 (s, 3H), 2.18-2.09 (m, 1H), 1.99-1.90 (m, 1H), 1.63-1.56 (m, 2H), 1.51-1.41 (m, 2H), 1.40-1.25 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.6, 137.7, 137.6, 137.1, 135.4, 132.3, 130.9, 128.8, 128.7 (2C), 127.3, 127.0, 125.6, 121.4, 119.5, 119.3, 118.5, 113.6 (2C), 109.0, 55.1, 41.9, 36.2, 33.4, 32.6, 29.0, 28.9, 27.6, 20.8, 20.3; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^{+}$ $(M + H)^{+}$ calcd for 458.2512, found 458.2519.

3-(1-(4-Methoxyphenyl)-6-(naphthalen-2-ylthio)hexyl)-1-methyl-1*H*-indole



(4ama), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 63.2 mg, 66%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.76 (d, J = 7.8 Hz, 1H), 7.72-1.69 (m, 3H), 7.46-7.37 (m, 4H), 7.24 (d, J = 8.0 Hz, 1H), 7.18 (d, J = 8.6 Hz, 2H), 7.15 (d, J = 7.6 Hz, 1H), 6.99 (t, J = 8.0 Hz, 1H), 6.80 (d, J = 3.6 Hz, 2H), 6.77 (s, 1H), 4.08 (d, J = 8.0 Hz, 1H), 3.74 (s, 3H), 3.70 (s, 3H), 2.97 (t, J = 7.6 Hz, 2H), 2.18-2.09 (m, 1H), 1.99-1.90 (m, 1H), 1.70-1.63 (m, 2H), 1.50-1.44 (m, 2H), 1.39-1.29 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.6, 137.6, 137.1, 134.5, 133.7, 131.5, 128.7 (2C), 128.2, 127.7, 127.3, 127.2, 126.9, 126.4, 126.2, 125.6, 125.4, 121.4, 119.5, 119.3, 118.5, 113.6 (2C), 109.0, 55.1, 41.8, 36.2, 33.3, 32.6, 28.9, 28.8, 27.5; HRMS (ESI-TOF) *m/z*: $C_{32}H_{34}NOS^{+}$ $(M + H)^{+}$ calcd for 480.2356, found 480.2349.

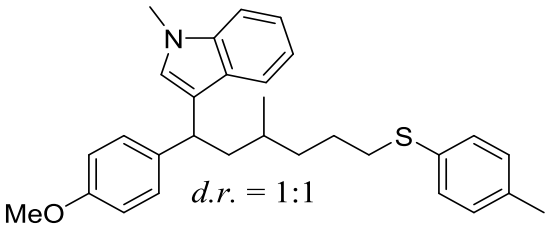
3-(1-(4-Methoxyphenyl)-6-(thiophen-2-ylthio)hexyl)-1-methyl-1*H*-indole (4ana),



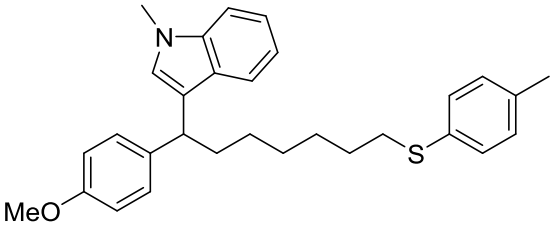
by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 51.3 mg, 59%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, J = 8.0 Hz, 1H), 7.28 (d, J = 5.6 Hz, 1H), 7.24 (d, J = 8.0 Hz, 1H), 7.19 (d, J = 8.8 Hz, 2H), 7.15 (d, J = 8.0 Hz, 1H), 7.06 (d, J = 3.6 Hz, 1H), 6.99 (t, J = 6.8 Hz, 1H), 6.93 (t, J = 4.8 Hz, 1H), 6.80 (s, 2H), 6.78 (s, 1H), 4.07 (d, J = 7.6 Hz, 1H), 3.75 (s, 3H), 3.71 (s, 3H), 2.73 (t, J = 7.6 Hz,

2H), 2.17-2.08 (m, 1H), 1.98-1.88 (m, 1H), 1.59-1.53 (m, 2H), 1.47-1.38 (m, 2H), 1.34-1.26 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.6, 137.6, 137.1, 134.8, 133.2, 128.8, 128.7 (2C), 127.4, 127.3, 125.6, 121.4, 119.5, 119.3, 118.5, 113.6 (2C), 109.0, 55.1, 41.9, 38.8, 36.2, 32.6, 29.2, 28.4, 27.5; HRMS (ESI-TOF) *m/z*: $C_{26}H_{30}NOS^+$ $(M + H)^+$ calcd for 436.1763, found 436.1768.

3-(1-(4-Methoxyphenyl)-3-methyl-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aoa) (*d.r.* = 1:1), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 52.8 mg, 55%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.47-7.44 (m, 1H), 7.25-7.16 (m, 6H), 7.07 (d, *J* = 8.4 Hz, 2H), 7.03-6.98 (m, 1H), 6.82-6.76 (m, 3H), 4.26-4.21 (m, 1H), 3.75 (d, *J* = 4.8 Hz, 3H), 3.70 (d, *J* = 4.0 Hz, 3H), 2.81 (t, *J* = 6.4 Hz, 1H), 2.76 (t, *J* = 8.0 Hz, 1H), 2.30 (s, 3H), 2.15-2.10 (m, 0.5H), 2.02-1.96 (m, 0.5H), 1.92-1.86 (m, 0.5H), 1.79-1.72 (m, 0.5H), 1.62-1.59 (m, 1H), 1.46-1.40 (m, 2H), 1.35-1.26 (m, 2H), 0.96 (d, *J* = 6.0 Hz, 1.5H), 0.87 (d, *J* = 6.4 Hz, 1.5H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.7, 157.6, 138.1, 137.2, 137.1, 135.8, 133.0, 129.7, 129.6, 129.5, 129.5, 128.7, 128.7, 128.6, 125.7, 125.6, 121.4, 119.8, 119.5, 119.4, 118.8, 118.6, 118.5, 113.6, 113.6, 109.1, 55.1, 44.0, 43.5, 39.2, 36.5, 35.6, 34.5, 32.6, 30.0, 29.8, 26.4, 26.3, 21.0, 20.0, 19.5; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2513.

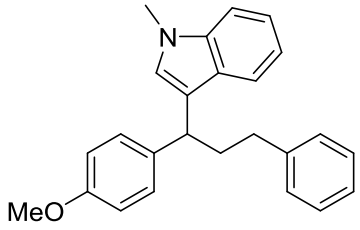


3-(1-(4-Methoxyphenyl)-7-(*p*-tolylthio)heptyl)-1-methyl-1*H*-indole (4apa), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 53.0 mg, 58%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, *J* = 8.0 Hz, 1H), 7.25-7.14 (m, 6H), 7.08 (d, *J* = 8.0 Hz, 2H), 7.00 (t, *J* = 8.0 Hz, 1H), 6.81 (d, *J* = 3.2 Hz, 2H), 6.79 (s, 1H), 4.07 (t, *J* = 8.0 Hz, 1H), 3.76 (s, 3H), 3.73 (s, 3H), 2.83 (t, *J* = 7.6 Hz, 2H), 2.30 (s, 3H), 2.17-2.08 (m, 1H), 1.98-1.91 (m, 1H), 1.61-1.58 (m, 2H), 1.36-1.29 (m, 6H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.6, 137.7, 137.1, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 128.7 (2C), 127.3, 125.6, 121.4, 119.5, 119.4, 118.5,



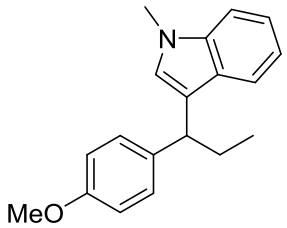
113.6 (2C), 109.0, 55.2, 41.9, 36.3, 34.2, 32.6, 29.2 (2C), 28.7, 27.9, 21.0; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2519.

3-(1-(4-Methoxyphenyl)-3-phenylpropyl)-1-methyl-1*H*-indole (4aqa), by silica gel



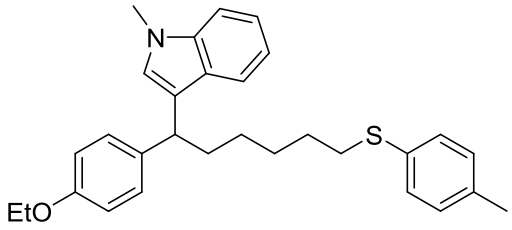
column chromatography (hexane/ethyl acetate = 15 : 1), yield: 34.1 mg, 48%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.41 (d, J = 8.0 Hz, 1H), 7.27-7.22 (m, 5H), 7.19-7.15 (m, 4H), 7.00 (t, J = 7.6 Hz, 1H), 6.84 (d, J = 4.4 Hz, 2H), 6.81 (s, 1H), 4.13 (d, J = 6.8 Hz, 1H), 3.77 (s, 3H), 3.73 (s, 3H), 2.63 (t, J = 8.0 Hz, 2H), 2.54-2.45 (m, 1H), 2.34-2.27 (m, 1H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.8, 142.4, 137.3, 137.2, 128.8 (2C), 128.5 (2C), 128.3 (2C), 127.3, 125.7, 125.7, 121.5, 119.5, 119.1, 118.6, 113.7 (2C), 109.1, 55.2, 41.4, 38.0, 34.2, 32.7; HRMS (ESI-TOF) *m/z*: $C_{25}H_{26}NO^+$ $(M + H)^+$ calcd for 356.2009, found 356.2012.

3-(1-(4-Methoxyphenyl)propyl)-1-methyl-1*H*-indole (4ara), by silica gel column



chromatography (hexane/ethyl acetate = 15 : 1), yield: 34.6 mg, 62%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, J = 8.0 Hz, 1H), 7.24-7.14 (m, 4H), 7.00 (t, J = 8.0 Hz, 1H), 6.81 (t, J = 6.0 Hz, 3H), 3.99 (t, J = 6.8 Hz, 1H), 3.76 (s, 3H), 3.73 (s, 3H), 2.22-2.16 (m, 1H), 2.00-1.93 (m, 1H), 0.93 (t, J = 7.2 Hz, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.6, 137.6, 137.2, 128.8 (2C), 127.4, 125.7, 121.4, 119.6, 119.3, 118.5, 113.5 (2C), 109.0, 55.2, 43.9, 32.6, 29.2, 12.9; HRMS (ESI-TOF) *m/z*: $C_{19}H_{22}NO^+$ $(M + H)^+$ calcd for 280.1696, found 280.1699.

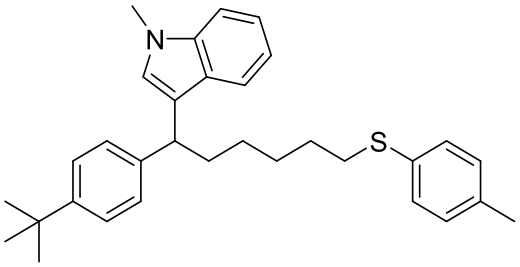
3-(1-(4-Ethoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-*1H*-indole (4baa), by silica



gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 72.2 mg, 79%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 (d, J = 8.0 Hz, 1H), 7.23-7.12 (m, 6H), 7.05 (d, J = 8.0 Hz, 2H), 6.98 (t, J = 7.6 Hz, 1H), 6.78 (s, 2H), 6.76 (s, 1H), 4.06 (t, J = 7.2 Hz, 1H), 3.97-3.92 (m, 2H), 3.67 (s, 3H), 2.80 (t, J = 7.2 Hz, 2H), 2.28 (s, 3H), 2.16-2.07 (m, 1H), 1.97-1.89 (m, 1H), 1.61-1.54 (m, 2H), 1.48-1.40 (m, 2H),

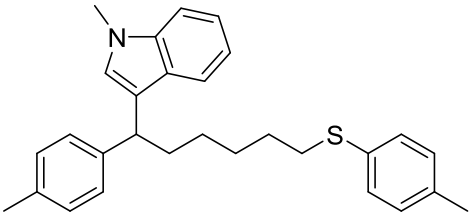
1.37-1.26 (m, 5H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.0, 137.5, 137.1, 135.7, 133.0, 129.7 (2C), 129.5 (2C), 128.6 (2C), 127.3, 125.6, 121.3, 119.5, 119.3, 118.5, 114.1 (2C), 109.0, 63.2, 41.8, 36.2, 34.2, 32.5, 29.1, 28.7, 27.5, 20.9, 14.9; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2516.

3-(1-(4-(*Tert*-butyl)phenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-*1H*-indole (4caa), by



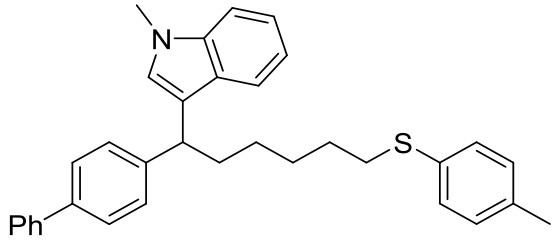
silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 54.4 mg, 58%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.49 (d, J = 8.0 Hz, 1H), 7.24-7.15 (m, 8H), 7.07 (d, J = 8.0 Hz, 2H), 7.01 (t, J = 7.6 Hz, 1H), 6.84 (s, 1H), 4.10 (t, J = 7.6 Hz, 1H), 3.73 (s, 3H), 2.82 (t, J = 7.2 Hz, 2H), 2.30 (s, 3H), 2.16-2.09 (m, 1H), 2.03-1.94 (m, 1H), 1.62-1.56 (m, 2H), 1.47-1.43 (m, 2H), 1.30-1.26 (s, 11H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 148.4, 142.5, 137.1, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 127.4 (2C), 127.3, 125.7 (2C), 125.1, 121.4, 119.6, 119.1, 118.5, 109.0, 42.2, 36.2, 34.3, 32.6, 31.4 (4C), 29.1, 28.8, 27.7, 21.0; HRMS (ESI-TOF) *m/z*: $C_{32}H_{40}NS^+$ $(M + H)^+$ calcd for 470.2876, found 470.2878.

1-Methyl-3-(1-(*p*-tolyl)-6-(*p*-tolylthio)hexyl)-*1H*-indole (4daa), by silica gel column

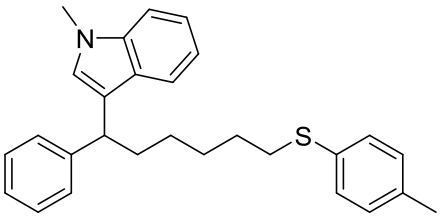


chromatography (hexane/ethyl acetate = 15 : 1), yield: 40.1 mg, 47%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.44 (d, J = 8.0 Hz, 1H), 7.23-7.14 (m, 5H), 7.08-7.04 (m, 5H), 7.00 (t, J = 8.0 Hz, 1H), 6.82 (s, 1H), 4.09 (t, J = 7.6 Hz, 1H), 3.72 (s, 3H), 2.82 (t, J = 7.2 Hz, 2H), 2.30 (s, 3H), 2.28 (s, 3H), 2.18-2.09 (m, 1H), 1.99-1.93 (m, 1H), 1.62-1.56 (m, 2H), 1.47-1.42 (m, 2H), 1.36-1.28 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 142.5, 137.1, 135.8, 135.2, 133.0, 129.7 (2C), 129.6 (2C), 128.9 (2C), 127.7 (2C), 127.4, 125.7, 121.4, 119.5, 119.2, 118.5, 109.0, 42.3, 36.2, 34.3, 32.6, 29.1, 28.8, 27.6, 21.0, 21.0; HRMS (ESI-TOF) *m/z*: $C_{29}H_{34}NS^+$ $(M + H)^+$ calcd for 428.2406, found 428.2409.

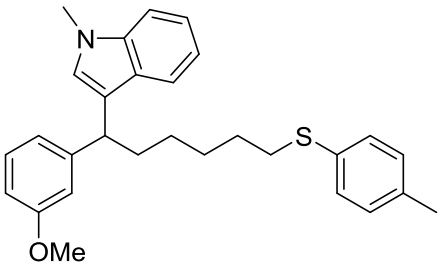
3-(1-([1,1'-Biphenyl]-4-yl)-6-(*p*-tolylthio)hexyl)-1-methyl-*1H*-indole (4eaa), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 40.1 mg, 41%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.55 (d, J = 7.6 Hz, 2H), 7.48 (d, J = 8.0 Hz, 3H), 7.40 (t, J = 7.2 Hz, 2H), 7.35 (d, J = 8.0 Hz, 2H), 7.29 (t, J = 7.6 Hz, 1H), 7.25-7.16 (m, 4H), 7.06 (d, J = 8.0 Hz, 2H), 7.02 (t, J = 7.2 Hz, 1H), 6.88 (s, 1H), 4.17 (t, J = 7.6 Hz, 1H), 3.75 (s, 3H), 2.83 (t, J = 7.2 Hz, 2H), 2.29 (s, 3H), 2.23-2.14 (m, 1H), 2.03-1.98 (m, 1H), 1.62-1.57 (m, 2H), 1.50-1.43 (m, 2H), 1.39-1.31 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 144.7, 141.1, 138.7, 137.2, 135.8, 133.0, 129.8 (2C), 129.6 (2C), 128.6 (2C), 128.2 (2C), 127.4, 127.0 (2C), 126.9 (3C), 125.8, 121.5, 119.5, 118.8, 118.6, 109.1, 42.4, 36.1, 34.3, 32.7, 29.1, 28.8, 27.6, 21.0; HRMS (ESI-TOF) *m/z*: $C_{34}H_{36}NS^+$ $(M + H)^+$ calcd for 490.2563, found 490.2566.



1-Methyl-3-(1-phenyl-6-(*p*-tolylthio)hexyl)-*1H*-indole (4faa), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 34.7 mg, 42%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, J = 8.0 Hz, 1H), 7.27.18 (m, 8H), 7.15 (d, J = 7.6 Hz, 1H), 7.07 (d, J = 8.0 Hz, 2H), 7.00 (t, J = 7.6 Hz, 1H), 6.84 (s, 1H), 4.13 (t, J = 7.2 Hz, 1H), 3.73 (s, 3H), 2.82 (t, J = 7.6 Hz, 2H), 2.30 (s, 3H), 2.20-2.11 (m, 1H), 2.00-1.95 (m, 1H), 1.60-1.55 (m, 2H), 1.46-1.41 (m, 2H), 1.36-1.32 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 145.5, 137.1, 135.8, 133.0, 129.8 (2C), 129.6 (2C), 128.3 (2C), 128.2 (2C), 127.8, 125.8, 125.7, 121.4, 119.5, 118.9, 118.6, 109.1, 42.8, 36.1, 34.3, 32.6, 29.1, 28.8, 27.6, 21.0; HRMS (ESI-TOF) *m/z*: $C_{28}H_{32}NS^+$ $(M + H)^+$ calcd for 414.2250, found 414.2259.

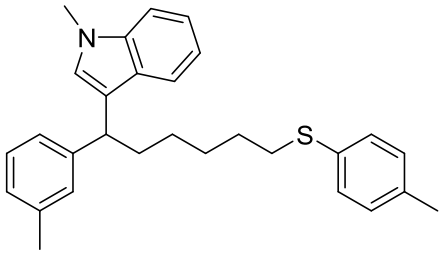


3-(1-(3-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-*1H*-indole (4haa), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 48.7 mg, 55%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.46 (d, J = 8.0 Hz, 1H), 7.23-7.15 (m, 5H), 7.07 (d, J = 8.0 Hz, 2H), 7.02-6.98 (m, 1H), 6.89 (d, J = 8.0 Hz, 1H), 6.84 (s, 2H),



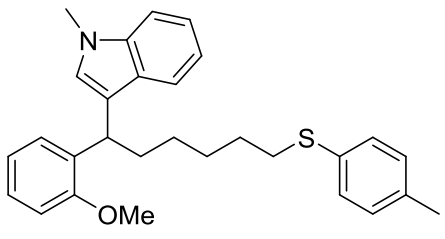
6.70 (d, *J* = 8.0 Hz, 1H), 4.10 (t, *J* = 8.0 Hz, 1H), 3.75 (s, 3H), 3.73 (s, 3H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.30 (s, 3H), 2.18-2.09 (m, 1H), 2.02-1.92 (m, 1H), 1.60-1.55 (m, 2H), 1.48-1.42 (m, 2H), 1.35-1.28 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 159.5, 147.3, 137.1, 135.8, 133.0, 129.8 (2C), 129.6 (2C), 129.1, 127.4, 125.7, 121.4, 120.4, 119.5, 118.8, 118.6, 114.0, 110.6, 109.0, 55.1, 42.8, 36.1, 34.3, 32.7, 29.1, 28.8, 27.6, 21.0; HRMS (ESI-TOF) *m/z*: $C_{29}H_{34}NOS^+$ $(M + H)^+$ calcd for 444.2356, found 444.2351.

1-Methyl-3-(1-(*m*-tolyl)-6-(*p*-tolylthio)hexyl)-*1H*-indole (4iaa), by silica gel column



chromatography (hexane/ethyl acetate = 15 : 1), yield: 50.4 mg, 59%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.46 (d, *J* = 8.0 Hz, 1H), 7.25-7.12 (m, 5H), 7.10-7.06 (m, 4H), 7.01 (t, *J* = 7.6 Hz, 1H), 6.96 (d, *J* = 7.6 Hz, 1H), 6.83 (s, 1H), 4.08 (t, *J* = 7.6 Hz, 1H), 3.73 (s, 3H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.30 (s, 3H), 2.29 (s, 3H), 2.16-2.08 (m, 1H), 2.01-1.94 (m, 1H), 1.62-1.57 (m, 2H), 1.48-1.41 (m, 2H), 1.37-1.29 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 145.5, 137.7, 137.1, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 128.6, 128.1, 127.4, 126.6, 125.7, 124.8, 121.4, 119.5, 119.1, 118.6, 109.0, 42.7, 36.2, 34.3, 32.7, 29.1, 28.8, 27.6, 21.5, 21.0; HRMS (ESI-TOF) *m/z*: $C_{29}H_{34}NS^+$ $(M + H)^+$ calcd for 428.2406, found 428.2409.

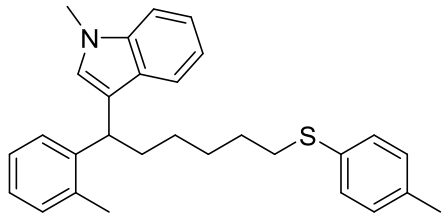
3-(1-(2-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4jaa), by silica



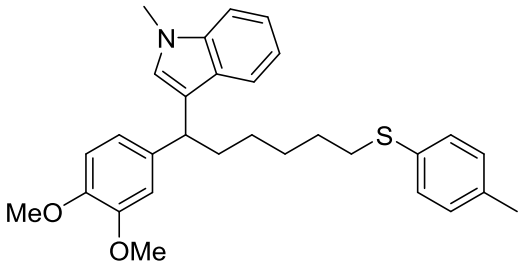
gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 47.0 mg, 53%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.49 (d, *J* = 8.0 Hz, 1H), 7.24-7.20 (m, 3H), 7.16 (d, *J* = 7.2 Hz, 2H), 7.11 (t, *J* = 8.0 Hz, 1H), 7.06 (d, *J* = 8.0 Hz, 2H), 6.99 (t, *J* = 7.6 Hz, 1H), 6.86-6.80 (m, 3H), 4.71 (t, *J* = 7.6 Hz, 1H), 3.84 (s, 3H), 3.71 (s, 3H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.29 (s, 3H), 2.14-2.03 (m, 1H), 2.00-1.91 (m, 1H), 1.62-1.55 (m, 2H), 1.47-1.29 (m, 4H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 156.9, 137.0, 135.7, 134.1,

133.1, 129.7 (2C), 129.5 (2C), 128.0, 127.8, 126.6, 126.0, 121.3, 120.5, 119.6, 118.9, 118.4, 110.4, 108.9, 55.5, 35.5, 34.3, 33.9, 32.6, 29.1, 28.8, 27.5, 21.0; HRMS (ESI-TOF) *m/z*: $C_{29}H_{34}NOS^+$ $(M + H)^+$ calcd for 444.2356, found 444.2351.

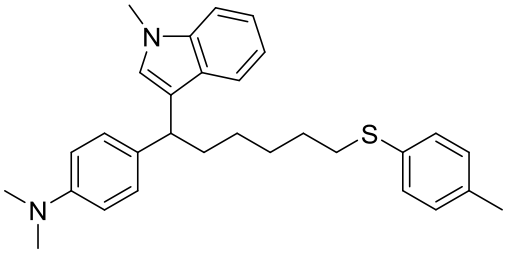
1-Methyl-3-(1-(*o*-tolyl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4kaa), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 38.4 mg, 45%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.44 (d, J = 8.0 Hz, 1H), 7.26-7.06 (m, 10H), 7.02 (t, J = 7.6 Hz, 1H), 6.68 (s, 1H), 4.37 (t, J = 7.6 Hz, 1H), 3.70 (s, 3H), 2.82 (t, J = 7.2 Hz, 2H), 2.36 (s, 3H), 2.30 (s, 3H), 2.18-2.10 (m, 1H), 2.00-1.91 (m, 1H), 1.63-1.55 (m, 2H), 1.49-1.33 (m, 4H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 143.4, 137.0, 135.8 (2C), 133.0, 130.3, 129.7 (2C), 129.6 (2C), 127.6, 126.7, 126.3, 125.9, 125.6, 121.4, 119.2, 118.8, 118.6, 109.1, 37.9, 36.2, 34.3, 32.6, 29.2, 28.9, 27.7, 21.0, 19.8; HRMS (ESI-TOF) *m/z*: $C_{29}H_{34}NS^+$ $(M + H)^+$ calcd for 428.2406, found 444.2409.



3-(1-(3,4-dimethoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4laa), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 75.7 mg, 80%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.45 (d, J = 8.0 Hz, 1H), 7.25-7.15 (m, 4H), 7.07 (d, J = 8.0 Hz, 2H), 7.01 (t, J = 8.0 Hz, 1H), 6.85-6.76 (m, 4H), 4.07 (t, J = 8.4 Hz, 1H), 3.83 (s, 3H), 3.81 (s, 3H), 3.73 (s, 3H), 2.83 (t, J = 7.2 Hz, 1H), 2.30 (s, 3H), 2.19-2.10 (m, 1H), 2.001.92 (m, 1H), 1.61-1.56 (m, 2H), 1.51-1.41 (m, 2H), 1.37-1.27 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 148.7, 147.1, 138.1, 137.2, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 127.3, 125.7, 121.4, 119.6, 119.5, 119.2, 118.6, 111.2, 110.9, 109.1, 55.8, 42.4, 36.2, 34.2, 32.6, 29.1, 28.8, 27.6, 21.0; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NO_2S^+$ $(M + H)^+$ calcd for 474.2461, found 474.2466.

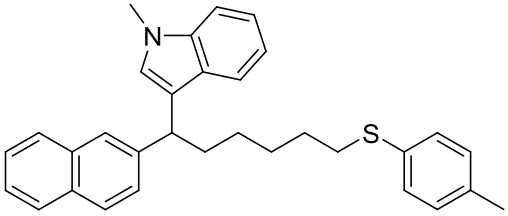


***N,N*-Dimethyl-4-(1-(1-methyl-1*H*-indol-3-yl)-6-(*p*-tolylthio)hexyl)aniline (4maa),** by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 62.0 mg, 68%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.47 (d, J = 8.0 Hz, 1H), 7.23-7.20



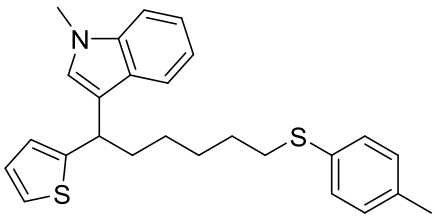
(m, 3H), 7.17-7.13 (m, 3H), 7.07 (d, *J* = 8.0 Hz, 2H), 6.99 (t, *J* = 8.0 Hz, 1H), 6.79 (s, 1H), 6.66 (d, *J* = 8.8 Hz, 2H), 4.04 (t, *J* = 8.0 Hz, 1H), 3.71 (s, 3H), 2.88 (s, 6H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.30 (s, 3H), 2.16-2.07 (m, 1H), 1.99-1.91 (m, 1H), 1.62-1.55 (m, 2H), 1.47-1.42 (m, 2H), 1.35-1.29 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 148.9, 137.1, 135.7, 133.8, 133.1, 129.7 (2C), 129.6 (2C), 128.4 (2C), 127.4, 125.7, 121.3, 119.8, 119.6, 118.4, 112.8 (2C), 109.0, 41.7, 40.8 (2C), 36.3, 34.3, 32.6, 29.1, 28.8, 27.6, 21.0; HRMS (ESI-TOF) *m/z*: $C_{30}H_{37}N_2S^+$ $(M + H)^+$ calcd for 457.2672, found 457.2673.

1-Methyl-3-(1-(naphthalen-2-yl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4naa), by silica



gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 49.1 mg, 53%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.78-7.70 (m, 4H), 7.46-7.38 (m, 4H), 7.25-7.13 (m, 4H), 7.04 (d, *J* = 8.0 Hz, 2H), 6.97 (t, *J* = 7.2 Hz, 1H), 6.86 (s, 1H), 4.29 (t, *J* = 8.8 Hz, 1H), 3.71 (s, 3H), 2.81 (t, *J* = 6.8 Hz, 2H), 2.28 (s, 3H), 2.24-2.17(m, 1H), 2.13-2.06 (m, 1H), 1.59-1.54 (m, 2H), 1.49-1.39 (m, 2H), 1.33-1.28 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 142.9, 137.1, 135.8, 133.5, 133.0, 132.1, 129.7 (2C), 129.6 (2C), 127.9, 127.6, 127.5, 127.4, 126.6, 125.9, 125.8, 125.7, 125.1, 121.5, 119.5, 118.8, 118.6, 109.1, 42.8, 35.9, 34.2, 32.6, 29.1, 28.8, 27.6, 21.0; HRMS (ESI-TOF) *m/z*: $C_{32}H_{34}NS^+$ $(M + H)^+$ calcd for 464.2406, found 464.2402.

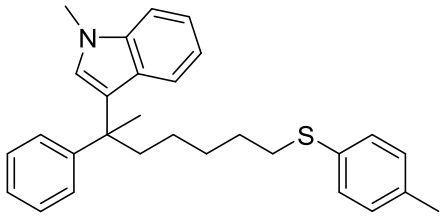
1-Methyl-3-(1-(thiophen-2-yl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4oaa), by silica gel



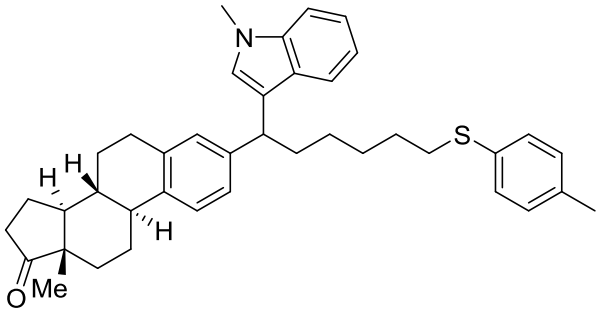
column chromatography (hexane/ethyl acetate = 15 : 1), yield: 51.1 mg, 61%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.51 (d, *J* = 8.0 Hz, 1H), 7.26-7.19 (m, 4H), 7.10-7.02 (m, 4H), 6.90-6.87 (m, 3H), 4.41 (t, *J* = 7.6 Hz, 1H), 3.74 (s, 3H), 2.82 (t, *J* = 6.8 Hz, 2H), 2.30 (s, 3H), 2.21-2.13 (m, 1H), 2.12-2.04 (m, 1H), 1.62-1.59 (m, 2H), 1.49-1.42 (m, 2H), 1.39-1.32 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 150.3, 137.1, 135.8, 133.0,

129.8 (2C), 129.6 (2C), 127.0, 126.3, 126.0, 123.6, 122.9, 121.5, 119.4, 118.7, 118.4, 109.2, 38.0, 37.3, 34.3, 32.7, 29.1, 28.6, 27.5, 21.0; HRMS (ESI-TOF) *m/z*: $C_{26}H_{30}NS_2^+$ $(M + H)^+$ calcd for 420.1814, found 420.1807.

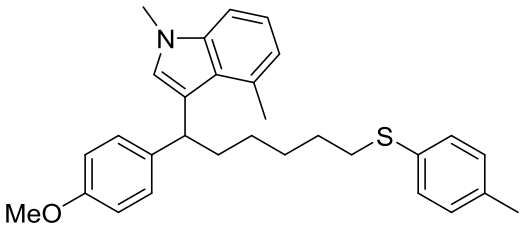
1-Methyl-3-(2-phenyl-7-(*p*-tolylthio)heptan-2-yl)-1*H*-indole (4qaa), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 41.0 mg, 48%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30-7.18 (m, 7H), 7.12 (d, J = 8.4 Hz, 2H), 7.06 (d, J = 8.0 Hz, 2H), 6.97 (d, J = 8.0 Hz, 1H), 6.91 (s, 1H), 6.83 (t, J = 7.6 Hz, 1H), 3.77 (s, 3H), 2.76 (t, J = 7.2 Hz, 2H), 2.30 (s, 3H), 2.24-2.19 (m, 1H), 2.11-2.04 (m, 1H), 1.56-1.50 (m, 4H), 1.39-1.32 (m, 3H), 1.15-1.06 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 149.0, 137.6, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 127.8 (2C), 126.9 (2C), 126.4, 126.1, 125.4, 123.4, 121.3, 121.1, 118.2, 109.0, 42.2, 41.4, 34.2, 32.7, 29.7, 29.4, 29.1, 27.6, 24.1, 21.0; HRMS (ESI-TOF) *m/z*: $C_{29}H_{34}NS^+$ $(M + H)^+$ calcd for 428.2406, found 428.2409.



(8*R*,9*S*,13*S*,14*S*)-13-Methyl-3-(1-(1-methyl-1*H*-indol-3-yl)-6-(*p*-tolylthio)hexyl)-6,7,8,9,11,12,13,14,15,16-decahydro-17*H*-cyclopenta*[a]*phenanthren-17-one (4raa), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 61.3 mg, 52%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 (d, J = 8.0 Hz, 1H), 7.25-7.15 (m, 5H), 7.08-6.99 (m, 5H), 6.84 (s, 1H), 4.06 (t, J = 7.2 Hz, 1H), 3.73 (s, 3H), 2.86-2.80 (m, 4H), 2.52-2.45 (m, 1H), 2.40-2.36 (m, 1H), 2.30 (s, 3H), 2.27-2.21 (m, 1H), 2.17-2.08 (m, 2H), 2.02-1.92 (m, 3H), 1.65-1.62 (m, 2H), 1.59-1.55 (m, 2H), 1.52-1.41 (m, 6H), 1.38-1.30 (m, 3H), 0.89 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 221.1, 143.1, 137.1, 136.1, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 128.3, 128.3, 127.4, 125.7, 125.7, 125.1, 125.0, 121.4, 119.5, 118.5, 109.0, 50.5, 48.0, 44.3, 42.2, 38.1, 35.9, 34.3, 32.7, 31.6, 29.7, 29.5, 29.1, 28.8, 27.7, 26.6, 25.6, 21.6, 21.0, 13.9; HRMS (ESI-TOF) m/z: $C_{40}H_{48}NOS^+$ $(M + H)^+$ calcd for 590.3451, found 590.3455.

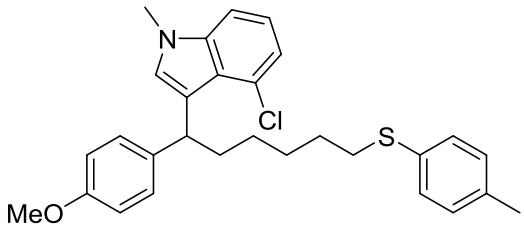


3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,4-dimethyl-1*H*-indole (4aab), by



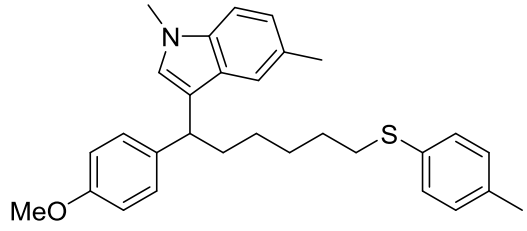
silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 72.2 mg, 79%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.21 (d, *J* = 8.0 Hz, 2H), 7.10-7.02 (m, 6H), 6.84 (s, 1H), 6.77 (d, *J* = 8.4 Hz, 2H), 6.73 (d, *J* = 6.8 Hz, 1H), 4.40 (t, *J* = 7.6 Hz, 1H), 3.73 (s, 3H), 3.71 (s, 3H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.53 (s, 3H), 2.29 (s, 3H), 2.07-1.98 (m, 1H), 1.92-1.82 (m, 1H), 1.63-1.56 (m, 2H), 1.47-1.40 (m, 4H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 157.5, 138.7, 137.4, 135.8, 133.0, 131.0, 129.7 (2C), 129.5 (2C), 128.9 (2C), 126.2, 126.1, 121.4, 120.6, 119.5, 113.5 (2C), 106.9, 55.1, 42.4, 38.4, 34.2, 32.8, 29.1, 28.8, 27.8, 20.9, 20.8; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2519.

4-Chloro-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aac),



by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 64.9 mg, 68%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) *δ* 7.20 (d, *J* = 8.4 Hz, 4H), 7.11 (d, *J* = 7.6 Hz, 1H), 7.06-6.99 (m, 4H), 6.81 (d, *J* = 6.8 Hz, 2H), 6.75 (s, 1H), 4.75 (t, *J* = 7.6 Hz, 1H), 3.75 (s, 3H), 3.66 (s, 3H), 2.81 (t, *J* = 6.4 Hz, 2H), 2.28 (s, 3H), 2.14-2.06 (m, 1H), 1.92-1.87 (m, 1H), 1.61-1.56 (m, 2H), 1.47-1.30 (m, 4H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ 157.6, 138.4, 137.7, 135.7, 133.0, 129.7 (2C), 129.5 (2C), 129.0 (2C), 127.3, 126.3, 123.8, 121.8, 120.2, 120.1, 113.5 (2C), 107.9, 55.1, 41.1, 37.9, 34.2, 32.9, 29.1, 28.8, 27.7, 20.9; HRMS (ESI-TOF) *m/z*: $C_{29}H_{33}ClNOS^+$ $(M + H)^+$ calcd for 478.1966, found 478.1959.

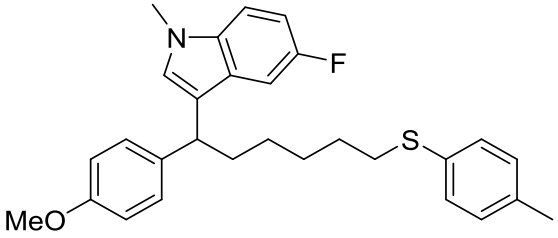
3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,5-dimethyl-1*H*-indole (4aad), by



silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 63.1 mg, 69%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.21 (d, *J* = 8.0 Hz, 4H), 7.18 (s, 1H), 7.12 (d, *J* = 8.4 Hz, 1H), 7.06 (d, *J* = 8.0 Hz, 2H), 6.98 (d, *J* = 8.4 Hz, 1H), 6.79

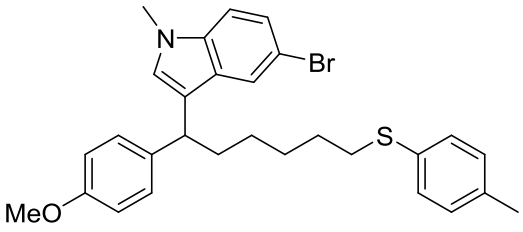
(d, *J* = 8.4 Hz, 2H), 6.75 (s, 1H), 4.04 (t, *J* = 7.6 Hz, 1H), 3.75 (s, 3H), 3.67 (s, 3H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.39 (s, 3H), 2.29 (s, 3H), 2.15-2.06 (m, 1H), 1.97-1.89 (m, 1H), 1.62-1.55 (m, 2H), 1.49-1.40 (m, 2H), 1.36-1.26 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.6, 137.8, 135.7, 135.6, 133.0, 129.7 (2C), 129.5 (2C), 128.6 (2C), 127.7, 127.5, 125.7, 123.0, 119.1, 118.7, 113.6 (2C), 108.8, 55.1, 41.8, 36.3, 34.2, 32.6, 29.1, 28.8, 27.6, 21.5, 21.0; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2519.

5-Fluoro-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aae),



by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 61.8 mg, 67%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.21 (d, *J* = 6.8 Hz, 2H), 7.16 (d, *J* = 7.6 Hz, 2H), 7.12 (t, *J* = 5.6 Hz, 1H), 7.08-7.02 (m, 3H), 6.90 (d, *J* = 8.8 Hz, 1H), 6.86 (s, 1H), 6.80 (d, *J* = 7.6 Hz, 2H), 3.98 (t, *J* = 7.6 Hz, 1H), 3.75 (s, 3H), 3.69 (s, 3H), 2.82 (t, *J* = 6.8 Hz, 2H), 2.29 (s, 3H), 2.15-2.04 (m, 1H), 1.96-1.87 (m, 2H), 1.62-1.55 (m, 2H), 1.49-1.40 (m, 2H), 1.35-1.26 (m, 2H); ^{19}F NMR (282 MHz, $CDCl_3$) δ: -125.6 (s, 1F); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.7, 157.3 (d, $J_{C\text{-}F}$ = 232.2 Hz, 1C), 137.2, 135.8, 133.8, 133.0, 129.7 (2C), 129.6 (2C), 128.6 (2C), 127.5 (d, $J_{C\text{-}F}$ = 9.6 Hz, 1C), 127.2, 119.2 (d, $J_{C\text{-}F}$ = 4.9 Hz, 1C), 113.7 (2C), 109.7 (d, $J_{C\text{-}F}$ = 16.0 Hz, 1C), 109.6, 104.4 (d, $J_{C\text{-}F}$ = 23.2 Hz, 1C), 55.1, 41.8, 36.0, 34.2, 32.9, 29.1, 28.7, 27.5, 20.9; HRMS (ESI-TOF) *m/z*: $C_{29}H_{33}FNOS^+$ $(M + H)^+$ calcd for 462.2261, found 462.2269.

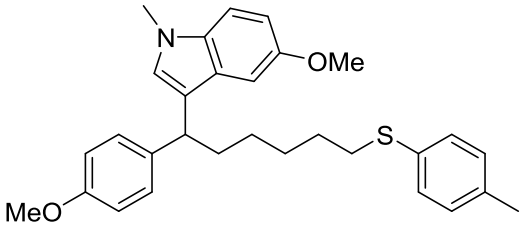
5-Bromo-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aaf),



by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 68.8 mg, 66%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.53 (s, 1H), 7.23-7.20 (m, 3H), 7.15 (d, *J* = 8.4 Hz, 2H), 7.07 (t, *J* = 8.0 Hz, 3H), 6.81 (s, 2H), 6.79 (s, 1H), 3.99 (t, *J* = 7.6 Hz, 1H), 3.75 (s, 3H), 3.68 (s, 3H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.29 (s, 3H), 2.11-2.02 (m, 1H), 1.95-1.87 (m, 1H), 1.61-1.54 (m, 2H), 1.48-1.39 (m, 2H),

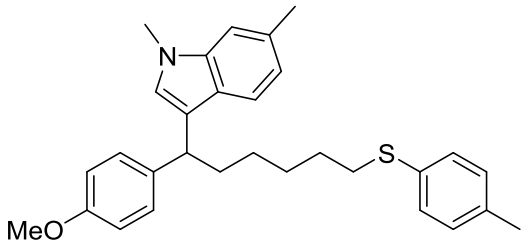
1.34-1.26 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.8, 137.1, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 129.0, 128.5 (2C), 126.8, 124.2, 121.9, 119.0, 113.7 (2C), 112.0, 110.6, 55.2, 41.6, 36.2, 34.2, 32.8, 29.1, 28.7, 27.5, 21.0; HRMS (ESI-TOF) *m/z*: $C_{29}H_{33}BrNOS^+$ $(M + H)^+$ calcd for 522.1461, found 522.1459.

5-Methoxy-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole



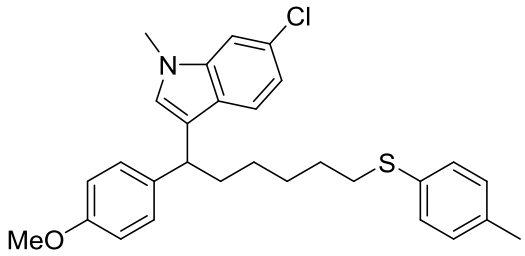
(4aag), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 58.7 mg, 62%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.26 (s, 1H), 7.22-7.18 (m, 4H), 7.13 (d, *J* = 8.4 Hz, 1H), 7.07 (d, *J* = 7.6 Hz, 2H), 6.85-6.83 (m, 1H), 6.81-7.89 (m, 3H), 4.01 (t, *J* = 7.6 Hz, 1H), 3.76 (s, 6H), 3.70 (s, 3H), 2.83 (t, *J* = 6.8 Hz, 2H), 2.30 (s, 3H), 2.15-2.07 (m, 1H), 1.97-1.88 (m, 1H), 1.64-1.59 (m, 2H), 1.49-1.40 (m, 2H), 1.35-1.28 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.6, 153.3, 137.6, 135.8, 133.0, 132.6, 129.7 (2C), 129.6 (2C), 128.7 (2C), 127.6, 126.3, 118.7, 113.6 (2C), 111.3, 109.7, 101.8, 55.9, 55.2, 41.9, 36.1, 34.3, 32.8, 29.1, 28.8, 27.6, 21.0; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NO_2S^+$ $(M + H)^+$ calcd for 474.2461, found 474.2462.

3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,6-dimethyl-1*H*-indole (4aah), by



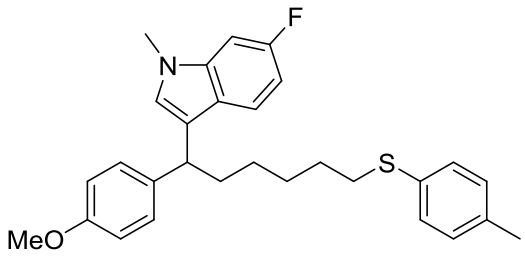
silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 62.2 mg, 68%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25 (d, *J* = 6.8 Hz, 1H), 7.22-7.16 (m, 4H), 7.06 (d, *J* = 7.2 Hz, 2H), 6.87-6.84 (m, 2H), 6.78 (d, *J* = 6.8 Hz, 2H), 6.69 (s, 1H), 4.03 (t, *J* = 7.6 Hz, 1H), 3.96 (s, 3H), 3.73 (s, 3H), 2.82 (t, *J* = 6.8 Hz, 2H), 2.70 (s, 3H), 2.29 (s, 3H), 2.14-2.05 (m, 1H), 1.95-1.87 (m, 1H), 1.61-1.54 (m, 2H), 1.48-1.39 (m, 2H), 1.36-1.26 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.6, 137.6, 135.8, 135.7, 133.0, 129.7 (2C), 129.5 (2C), 128.6 (2C), 128.4, 127.3, 124.1, 121.0, 118.9, 118.8, 117.5, 113.5 (2C), 55.1, 41.7, 36.6, 36.2, 34.2, 29.1, 28.8, 27.5, 20.9, 19.7; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2519.

6-Chloro-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aai),



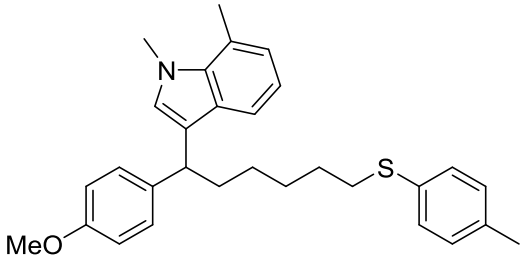
by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 67.7 mg, 71%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.28 (d, J = 8.4 Hz, 1H), 7.21 (d, J = 7.2 Hz, 3H), 7.15 (d, J = 8.0 Hz, 2H), 7.07 (d, J = 8.0 Hz, 2H), 6.94 (d, J = 8.4 Hz, 1H), 6.80 (s, 2H), 6.78 (s, 1H), 4.02 (t, J = 7.6 Hz, 1H), 3.75 (s, 3H), 3.67 (s, 3H), 2.82 (t, J = 6.8 Hz, 2H), 2.30 (s, 3H), 2.13-2.04 (m, 1H), 1.96-1.87 (m, 1H), 1.62-1.56 (m, 2H), 1.47-1.41 (m, 2H), 1.34-1.27 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.7, 137.6, 137.3, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 128.6 (2C), 127.5, 126.3, 125.9, 120.4, 119.6, 119.2, 113.6 (2C), 109.1, 55.1, 41.7, 36.1, 34.2, 32.7, 29.1, 28.7, 27.5, 21.0; HRMS (ESI-TOF) *m/z*: $C_{29}H_{33}ClNOS^{+}$ $(M + H)^{+}$ calcd for 478.1966, found 478.1967.

6-Fluoro-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aaj),



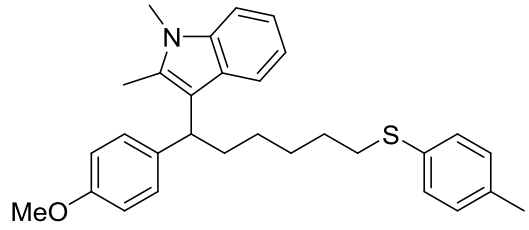
by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 67.3 mg, 73%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29-7.26 (m, 1H), 7.21 (d, J = 8.0 Hz, 2H), 7.16 (d, J = 8.8 Hz, 2H), 7.06 (d, J = 8.0 Hz, 2H), 6.90-6.87 (m, 1H), 6.80-6.78 (m, 2H), 6.76-6.71 (m, 1H), 4.02 (t, J = 6.8 Hz, 1H), 3.74 (s, 3H), 3.64 (s, 3H), 2.82 (t, J = 7.2 Hz, 2H), 2.29 (s, 3H), 2.13-2.05 (m, 1H), 1.96-1.87 (m, 1H), 1.62-1.54 (m, 2H), 1.49-1.40 (m, 2H), 1.35-1.26 (m, 2H); ^{19}F NMR (282 MHz, $CDCl_3$) δ: -121.3 (s, 1F); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 159.8 (d, $J_{C\text{-}F}$ = 235.4 Hz, 1C), 157.7, 137.4, 137.1 (d, $J_{C\text{-}F}$ = 12.0 Hz, 1C), 135.8, 133.0, 129.7 (2C), 129.6 (2C), 128.6 (2C), 125.8 (d, $J_{C\text{-}F}$ = 3.8 Hz, 1C), 123.9, 120.3 (d, $J_{C\text{-}F}$ = 10.1 Hz, 1C), 119.6, 113.6 (2C), 107.2 (d, $J_{C\text{-}F}$ = 24.5 Hz, 1C), 95.4 (d, $J_{C\text{-}F}$ = 25.9 Hz, 1C), 55.1, 41.8, 36.1, 34.2, 32.7, 29.1, 28.7, 27.5, 20.9; HRMS (ESI-TOF) *m/z*: $C_{29}H_{33}FNOS^{+}$ $(M + H)^{+}$ calcd for 462.2261, found 462.2268.

3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,7-dimethyl-1*H*-indole (4aak), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 61.2 mg,



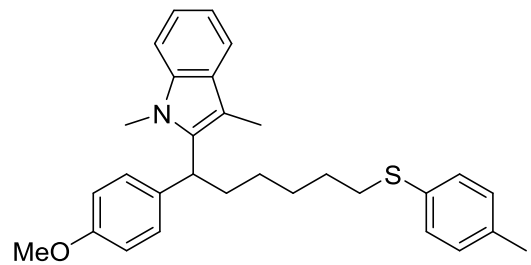
67%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25 (d, J = 6.8 Hz, 1H), 7.21 (d, J = 6.8 Hz, 2H), 7.17 (d, J = 7.2 Hz, 2H), 7.06 (d, J = 7.2 Hz, 2H), 6.87-6.84 (m, 2H), 6.78 (d, J = 6.8 Hz, 2H), 6.69 (s, 1H), 4.03 (t, J = 7.6 Hz, 1H), 3.96 (s, 3H), 3.73 (s, 3H), 2.82 (t, J = 6.8 Hz, 2H), 2.70 (s, 3H), 2.29 (s, 3H), 2.14-2.05 (m, 1H), 1.96-1.87 (m, 1H), 1.61-1.54 (m, 2H), 1.48-1.39 (m, 2H), 1.36-1.26 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.6, 137.6, 135.8, 135.7, 133.0, 129.7 (2C), 129.5 (2C), 128.6 (2C), 128.4, 127.3, 124.1, 121.0, 118.9, 118.8, 117.5, 113.5 (2C), 55.1, 41.7, 36.6, 36.2, 34.2, 29.1, 28.8, 27.5, 20.9, 19.7; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2519.

3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,2-dimethyl-1*H*-indole (4aal), by



silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 59.4 mg, 65%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.51 (d, J = 8.0 Hz, 1H), 7.23-7.17 (m, 5H), 7.10 (t, J = 7.2 Hz, 1H), 7.05 (d, J = 8.0 Hz, 2H), 6.97 (t, J = 8.0 Hz, 1H), 6.76 (d, J = 8.8 Hz, 2H), 4.11 (t, J = 6.4 Hz, 1H), 3.72 (s, 3H), 3.60 (s, 3H), 2.78 (t, J = 7.2 Hz, 2H), 2.33 (s, 3H), 2.29 (s, 3H), 2.23-2.16 (m, 2H), 1.59-1.53 (m, 2H), 1.47-1.40 (m, 2H), 1.27-1.23 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.3, 138.1, 136.7, 135.7, 133.0, 133.0, 129.7 (2C), 129.5 (2C), 128.4 (2C), 126.8, 120.1, 119.4, 118.5, 113.7, 113.4 (2C), 108.5, 55.1, 41.4, 34.6, 34.2, 29.5, 29.1, 28.7, 27.9, 20.9, 10.6; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2519.

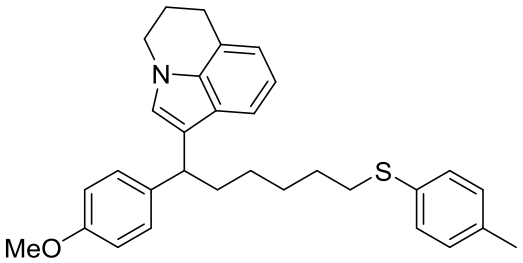
2-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,3-dimethyl-1*H*-indole (4aam), by



silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 48.4 mg, 53%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.54 (d, J = 7.6 Hz, 1H),

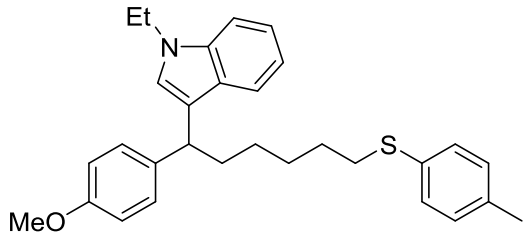
7.21-7.14 (m, 4H), 7.11-7.05 (m, 5H), 6.79 (d, *J* = 8.4 Hz, 2H), 4.35-4.31 (m, 1H), 3.76 (s, 3H), 3.41 (s, 3H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.33 (s, 3H), 2.30 (s, 3H), 2.24-2.18 (m, 1H), 2.16-2.08 (m, 1H), 1.62-1.54 (m, 2H), 1.51-1.41 (m, 2H), 1.36-1.27 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 150.8, 130.6, 129.8, 128.9, 127.9, 125.8, 122.8 (2C), 122.6 (2C), 121.5, 121.4 (2C), 113.8, 111.5, 111.1, 106.7 (2C), 101.5, 100.8, 48.2, 33.5, 27.3, 26.1, 23.4, 22.0, 21.8, 20.6, 14.0, 2.4; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2519.

1-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-5,6-dihydro-4*H*-pyrrolo[3,2,1-*ij*]qui



noline (4aan), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 74.1 mg, 79%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.24-7.19 (m, 5H), 7.06 (d, *J* = 8.0 Hz, 2H), 6.90 (t, *J* = 7.6 Hz, 1H), 6.84 (d, *J* = 7.2 Hz, 1H), 6.80 (d, *J* = 2.4 Hz, 2H), 6.78 (s, 1H), 4.08-4.04 (m, 3H), 3.74 (s, 3H), 2.93 (t, *J* = 6.0 Hz, 2H), 2.81 (t, *J* = 7.6 Hz, 2H), 2.29 (s, 3H), 2.21-2.12 (m, 3H), 1.99-1.90 (m, 1H), 1.61-1.54 (m, 2H), 1.48-1.41 (m, 2H), 1.36-1.26 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.6, 137.8, 135.7, 134.6, 133.0, 129.7 (2C), 129.5 (2C), 128.7 (2C), 124.7, 123.0, 121.5, 119.4, 118.9, 118.3, 117.1, 113.5 (2C), 55.1, 43.8, 42.3, 36.2, 34.2, 29.1, 28.8, 27.6, 24.6, 22.8, 20.9; HRMS (ESI-TOF) *m/z*: $C_{31}H_{36}NOS^+$ $(M + H)^+$ calcd for 470.2512, found 470.2509.

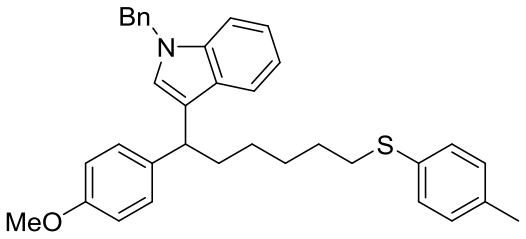
1-Ethyl-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4aao), by silica



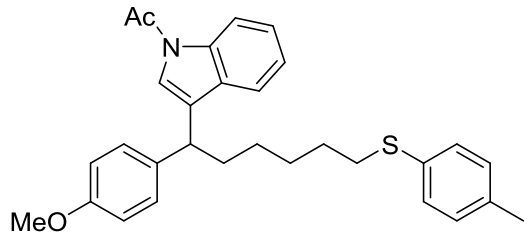
gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 64.0 mg, 70%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.41 (d, *J* = 8.0 Hz, 1H), 7.26 (d, *J* = 8.4 Hz, 1H), 7.22-7.11 (m, 5H), 7.06 (d, *J* = 7.2 Hz, 2H), 6.97 (t, *J* = 7.6 Hz, 1H), 6.87 (s, 1H), 6.79 (d, *J* = 7.2 Hz, 2H), 4.11-4.05 (m, 3H), 3.74 (s, 3H), 2.81 (t, *J* = 7.2 Hz, 2H), 2.29 (s, 3H), 2.16-2.09 (m, 1H), 1.98-1.91 (m, 1H), 1.62-1.55 (m, 2H), 1.49-1.39 (m, 5H), 1.32-1.28 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 157.6, 137.6, 136.2, 135.7, 133.0, 129.7 (2C), 129.5 (2C), 128.7 (2C), 127.5, 123.8, 121.2, 119.6, 119.3,

118.5, 113.5 (2C), 109.1, 55.1, 41.9, 40.7, 36.2, 34.2, 29.1, 28.7, 27.5, 20.9, 15.5; HRMS (ESI-TOF) *m/z*: $C_{30}H_{36}NOS^+$ $(M + H)^+$ calcd for 458.2512, found 458.2519.

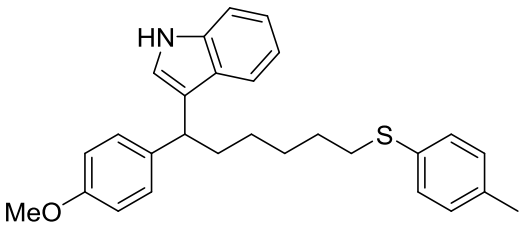
1-Benzyl-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4aap), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 61.2 mg, 59%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 (d, J = 7.6 Hz, 1H), 7.28-7.17 (m, 8H), 7.10-7.08 (m, 4H), 6.99 (t, J = 7.2 Hz, 1H), 6.93 (s, 1H), 6.79 (d, J = 8.8 Hz, 2H), 6.72-6.66 (m, 1H), 5.28 (s, 2H), 4.09 (t, J = 7.2 Hz, 1H), 3.76 (s, 3H), 2.83-2.76 (m, 2H), 2.30 (s, 3H), 2.16-2.08 (m, 1H), 1.98-1.89 (m, 1H), 1.61-1.58 (m, 2H), 1.47-1.27 (m, 4H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.7, 137.8, 137.6, 136.9, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 128.7 (2C), 128.7 (2C), 127.6, 127.4, 126.5 (2C), 125.1, 121.6, 119.9, 119.7, 118.8, 113.6 (2C), 109.5, 55.2, 49.9, 41.9, 36.2, 34.2, 29.1, 28.7, 27.5, 21.0; HRMS (ESI-TOF) *m/z*: $C_{35}H_{38}NOS^+$ $(M + H)^+$ calcd for 520.2669, found 520.2668.



1-(3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1*H*-indol-1-yl)ethan-1-one (4aaq), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 48.0 mg, 51%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34-7.27 (m, 2H), 7.23-7.16 (m, 6H), 7.08 (d, J = 8.0 Hz, 2H), 6.82 (d, J = 8.8 Hz, 2H), 4.00 (t, J = 6.0 Hz, 2H), 3.77 (s, 3H), 2.84 (t, J = 6.8 Hz, 2H), 2.62 (s, 3H), 2.31 (s, 3H), 2.15-2.08 (m, 1H), 1.99-1.89 (m, 1H), 1.64-1.58 (m, 2H), 1.50-1.43 (m, 2H), 1.39-1.30 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 168.4, 158.1, 136.1, 135.9, 135.5, 132.9, 129.8 (2C), 129.6 (2C), 128.7 (2C), 127.0, 125.1, 123.3, 121.3, 119.7, 116.6, 116.5, 113.9 (2C), 55.2, 41.7, 35.4, 34.2, 29.0, 28.6, 27.3, 24.1, 21.0; HRMS (ESI-TOF) *m/z*: $C_{30}H_{34}NO_2S^+$ $(M + H)^+$ calcd for 472.2305, found 472.2309.

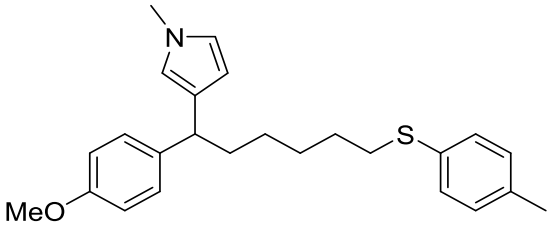


3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4aas), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 57.5 mg, 67%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.89 (s, 1H), 7.41 (d, J = 8.0 Hz, 1H), 7.28 (d, J =



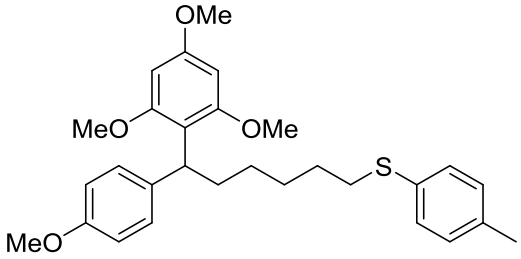
8.4 Hz, 1H), 7.21 (d, *J* = 8.0 Hz, 2H), 7.17 (d, *J* = 8.8 Hz, 2H), 7.12 (t, *J* = 7.6 Hz, 1H), 7.06 (d, *J* = 8.0 Hz, 2H), 6.99 (t, *J* = 7.6 Hz, 1H), 6.94 (s, 1H), 6.79 (d, *J* = 8.8 Hz, 2H), 4.07 (t, *J* = 7.6 Hz, 1H), 3.74 (s, 3H), 2.81 (t, *J* = 7.2 Hz, 2H), 2.29 (s, 3H), 2.17-2.09 (m, 1H), 1.98-1.89 (m, 1H), 1.61-1.54 (m, 2H), 1.49-1.39 (m, 2H), 1.36-1.28 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): *δ* 157.6, 137.5, 136.4, 135.8, 133.0, 129.7 (2C), 129.6 (2C), 128.7 (2C), 126.9, 121.8, 120.8, 120.7, 119.5, 119.1, 113.6 (2C), 111.0, 55.1, 41.9, 36.0, 34.2, 29.1, 28.7, 27.5, 21.0; HRMS (ESI-TOF) *m/z*: $C_{28}H_{32}NOS^+$ $(M + H)^+$ calcd for 430.2199, found 430.2198.

3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-pyrrole (4aat), by



silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 37.7 mg, 48%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: ^{1}H NMR (400 MHz, $CDCl_3$): *δ* 7.22 (d, *J* = 8.0 Hz, 2H), 7.08 (d, *J* = 8.0 Hz, 2H), 6.98 (d, *J* = 8.0 Hz, 2H), 6.78 (d, *J* = 8.0 Hz, 2H), 6.49 (s, 1H), 6.08 (s, 2H), 3.80 (s, 0.2H), 3.76 (s, 3H), 3.72 (d, *J* = 7.5 Hz, 0.8H), 3.26 (s, 3H), 2.83 (t, *J* = 7.2 Hz, 2H), 2.31 (s, 3H), 2.05-1.97 (m, 1H), 1.83-1.76 (m, 1H), 1.62-1.56 (m, 2H), 1.46-1.33 (m, 3H), 1.29-1.22 (m, 1H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): *δ* 157.8, 136.2, 135.8, 133.0, 129.8, 129.6 (2C), 129.5 (2C), 128.7 (2C), 121.5, 113.7 (2C), 106.1, 105.3, 55.2, 42.5, 36.4, 34.2, 33.8, 29.0, 28.7, 27.3, 21.0; HRMS (ESI-TOF) *m/z*: $C_{25}H_{32}NOS^+$ $(M + H)^+$ calcd for 394.2199, found 394.2196.

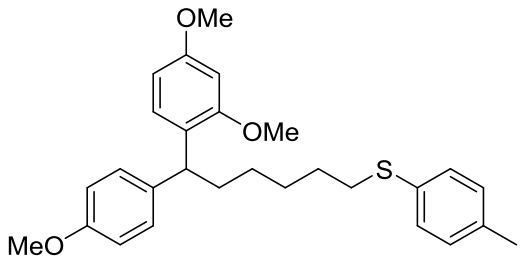
(6-(4-Methoxyphenyl)-6-(2,4,6-trimethoxyphenyl)hexyl)(*p*-tolyl)sulfane (4aau),



by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 53.8 mg, 56%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): *δ* 7.23-7.20 (m, 4H), 7.07 (d, *J* = 8.0 Hz, 2H), 6.75 (d, *J* = 8.4 Hz, 2H), 6.10 (s, 2H), 4.49 (t, *J* = 6.8 Hz, 2H), 3.77 (s, 3H), 3.74 (s, 3H), 3.71 (s, 6H), 2.81 (t, *J* =

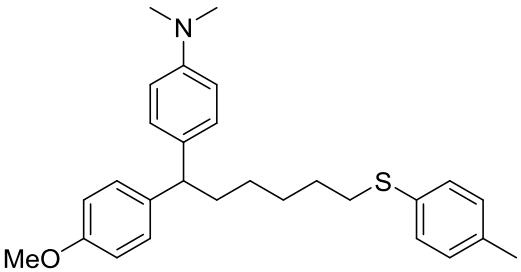
7.2 Hz, 2H), 2.30 (s, 3H), 2.22-2.14 (m, 1H), 2.08-2.00 (m, 1H), 1.60-1.54 (m, 2H), 1.47-1.37 (m, 2H), 1.26-1.16(m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 159.2, 159.1, 157.1, 138.1, 135.7, 133.2, 129.7 (2C), 129.5 (2C), 128.8 (2C), 114.2, 113.6, 112.9 (2C), 91.2 (2C), 55.7 (2C), 55.2, 55.1, 38.5, 34.3, 32.1, 29.1, 28.9, 27.9, 21.0; HRMS (ESI-TOF) m/z: $C_{29}H_{37}O_4S^+$ $(M + H)^+$ calcd for 481.2407, found 481.2415.

(6-(2,4-Dimethoxyphenyl)-6-(4-methoxyphenyl)hexyl)(*p*-tolyl)sulfane (4aav), by



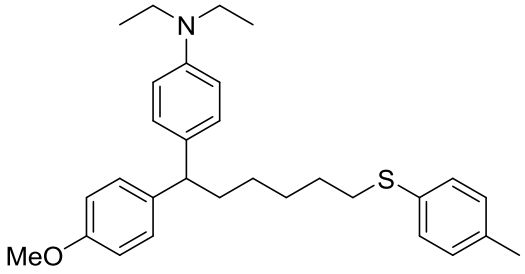
silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 31.5 mg, 35%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.21 (d, *J* = 8.0 Hz, 2H), 7.13 (d, *J* = 8.8 Hz, 2H), 7.08-7.05 (m, 4H), 6.78 (d, *J* = 8.4 Hz, 2H), 6.41 (t, *J* = 3.2 Hz, 1H), 4.20 (t, *J* = 7.6 Hz, 1H), 3.77 (s, 3H), 3.76 (s, 3H), 3.74 (s, 3H), 2.82 (d, *J* = 7.2 Hz, 2H), 2.31 (s, 3H), 1.94-1.88 (m, 2H), 1.63-1.56 (m, 2H), 1.46-1.38 (m, 2H), 1.28-1.22 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$): δ 158.8, 157.8, 157.5, 137.6, 135.8, 133.0, 129.8 (2C), 129.6 (2C), 128.8 (2C), 127.7, 126.5, 113.4 (2C), 104.0, 98.6, 55.4, 55.2, 55.1, 41.7, 35.1, 34.3, 29.1, 28.7, 27.5, 21.0; HRMS (ESI-TOF) m/z: $C_{28}H_{35}O_3S^+$ $(M + H)^+$ calcd for 451.2301, found 451.2302.

4-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-*N*,*N*-dimethylaniline (4aaw), by

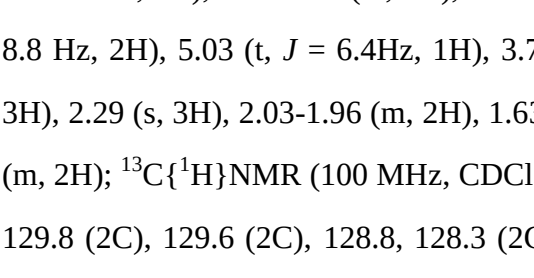


silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 54.6 mg, 63%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.21 (d, *J* = 8.0 Hz, 2H), 7.11 (d, *J* = 8.4 Hz, 2H), 7.08-7.04 (m, 4H), 6.79 (d, *J* = 8.4 Hz, 2H), 6.65 (d, *J* = 8.4 Hz, 2H), 3.75 (s, 3H), 3.71 (d, *J* = 8.0 Hz, 1H), 2.88 (s, 6H), 2.81 (t, *J* = 7.6 Hz, 2H), 2.30 (s, 3H), 1.96-1.91 (m, 2H), 1.61-1.53 (m, 2H), 1.46-1.38 (m, 2H), 1.28-1.21 (m, 2H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ: 157.6, 148.9, 138.2, 135.8, 133.7, 133.0, 129.8 (2C), 129.5 (2C), 128.6 (2C), 128.2 (2C), 113.6 (2C), 112.7 (2C), 55.2, 49.3, 40.7 (2C), 35.9, 34.3, 29.1, 28.7, 27.6, 21.0; HRMS (ESI-TOF) *m/z*: $C_{28}H_{36}NOS^+$ $(M + H)^+$ calcd for 434.2512, found 434.2516.

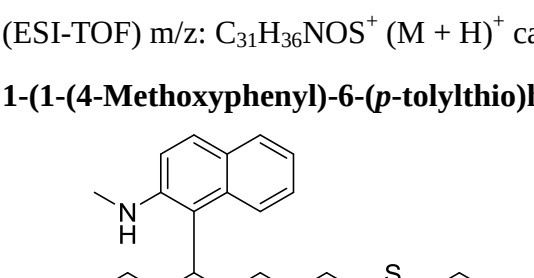
***N*,*N*-Diethyl-4-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)aniline (4aax),** by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 62.8 mg, 67%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.68 (t, J = 8.8 Hz, 2H), 7.61 (d, J = 8.4 Hz, 1H), 7.35 (t, J = 8.0 Hz, 1H), 7.28 (d, J = 9.2 Hz, 1H), 7.21-7.15 (m, 5H), 7.05 (d, J = 8.0 Hz, 2H), 6.93 (s, 1H), 6.82 (d, J = 8.8 Hz, 2H), 5.03 (t, J = 6.4Hz, 1H), 3.78 (s, 3H), 2.82 (t, J = 7.2 Hz, 2H), 2.70 (s, 3H), 2.29 (s, 3H), 2.03-1.96 (m, 2H), 1.63-1.58 (m, 2H), 1.50-1.45 (m, 2H), 1.41-1.33 (m, 2H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 158.5, 148.7, 135.9, 135.1, 133.2, 132.9, 129.8 (2C), 129.6 (2C), 128.8, 128.3 (2C), 127.4, 126.9, 126.2, 126.1, 122.0, 116.9, 113.6 (2C), 106.9, 61.1, 55.2, 34.2, 31.6, 31.5, 29.1, 28.7, 26.5, 21.0; HRMS (ESI-TOF) m/z: $C_{31}H_{36}NOS^+$ $(M + H)^+$ calcd for 470.2512, found 470.2513.



1-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-*N*-methylnaphthalen-2-amine (4aay), by silica gel column chromatography (hexane/ethyl acetate = 15 : 1), yield: 50.7 mg, 55%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.21 (d, J = 7.6 Hz, 2H), 7.12 (d, J = 8.4 Hz, 2H), 7.07 (d, J = 8.0 Hz, 2H), 7.02 (d, J = 8.4 Hz, 2H), 6.79 (d, J = 8.4 Hz, 2H), 6.58 (d, J = 8.8 Hz, 2H), 3.75 (s, 3H), 3.70 (t, J = 8.0 Hz, 1H), 3.13-3.26 (m, 4H), 2.82 (t, J = 7.6 Hz, 2H), 2.30 (s, 3H), 1.96-1.90 (m, 2H), 1.61-1.54 (m, 2H), 1.46-1.38 (m, 2H), 1.28-1.24 (m, 2H), 1.11 (t, J = 7.2 Hz, 6H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 157.5, 146.1, 138.3, 135.8, 133.0, 132.4, 129.8 (2C), 129.5 (2C), 128.6 (2C), 128.4 (2C), 113.6 (2C), 111.8 (2C), 55.2, 49.3, 44.3 (2C), 36.0, 34.3, 29.1, 28.7, 27.6, 21.0, 12.6 (2C); HRMS (ESI-TOF) m/z: $C_{30}H_{40}NOS^+$ $(M + H)^+$ calcd for 462.2825, found 462.2822.



1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexan-1-ol, by silica gel column chromatography (hexane/ethyl acetate = 5 :



1), yield: 34.2 mg, 52%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.24-7.21 (m, 4H), 7.07 (d, J = 8.0 Hz, 2H), 6.86 (d, J = 8.4 Hz, 2H), 4.57 (t, J = 6.8 Hz, 1H), 3.79 (s, 3H), 2.83 (t, J = 7.2 Hz, 2H), 2.30 (s, 3H), 1.84-1.82 (m, 1H), 1.77-1.74 (m, 1H), 1.67-1.55 (m, 3H), 1.43-1.39 (m, 2H), 1.27-1.23 (m, 1H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$): δ 158.9, 136.9, 135.8, 132.9, 129.7 (2C), 129.5 (2C), 127.1 (2C), 113.7 (2C), 74.0, 55.2, 38.7, 34.2, 29.1, 28.5, 25.3, 20.9; HRMS (ESI-TOF) m/z: $C_{20}H_{27}O_2S^+$ (M + H)$^+$ calcd for 331.1726, found 331.1722.

4. Reference

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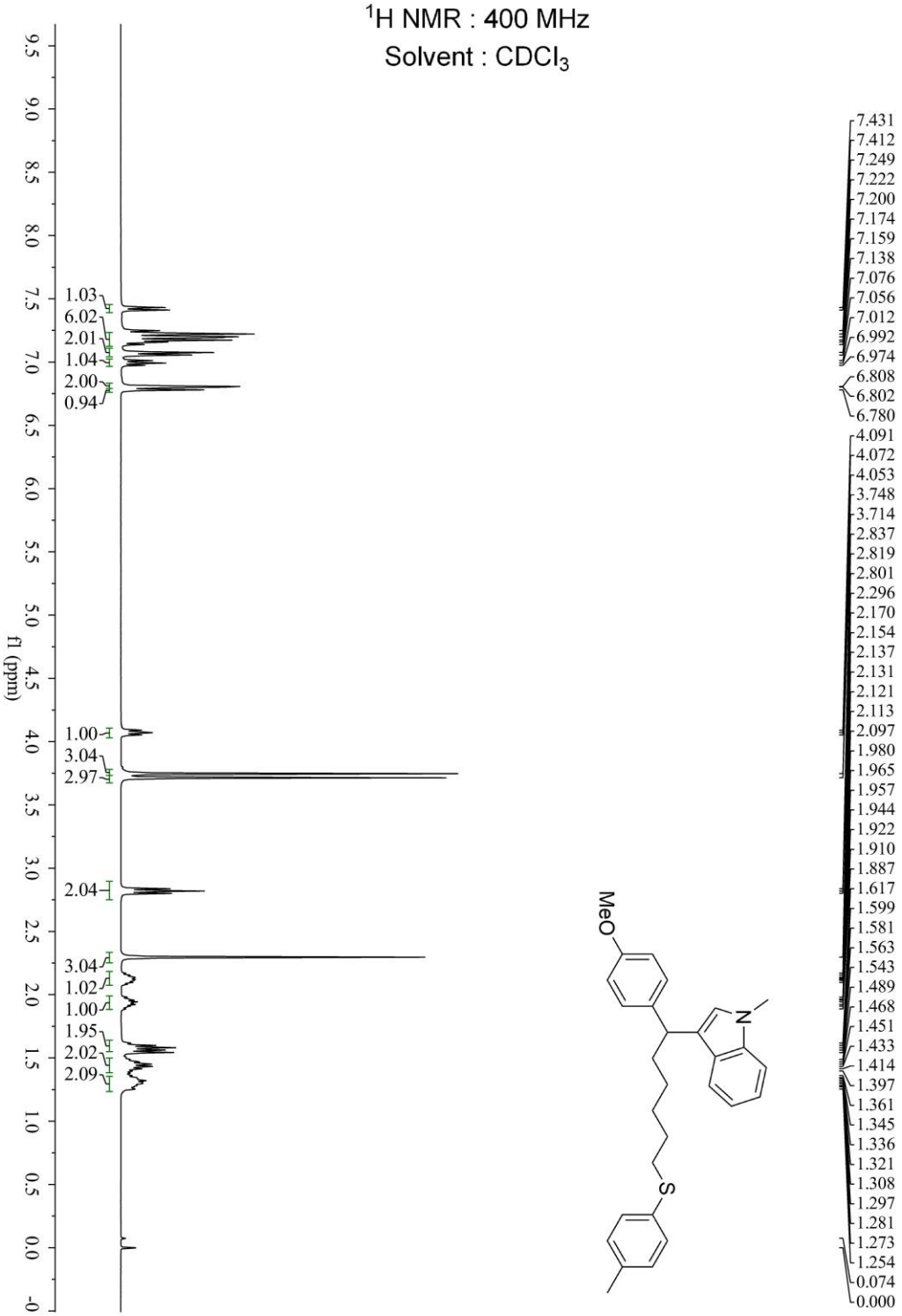
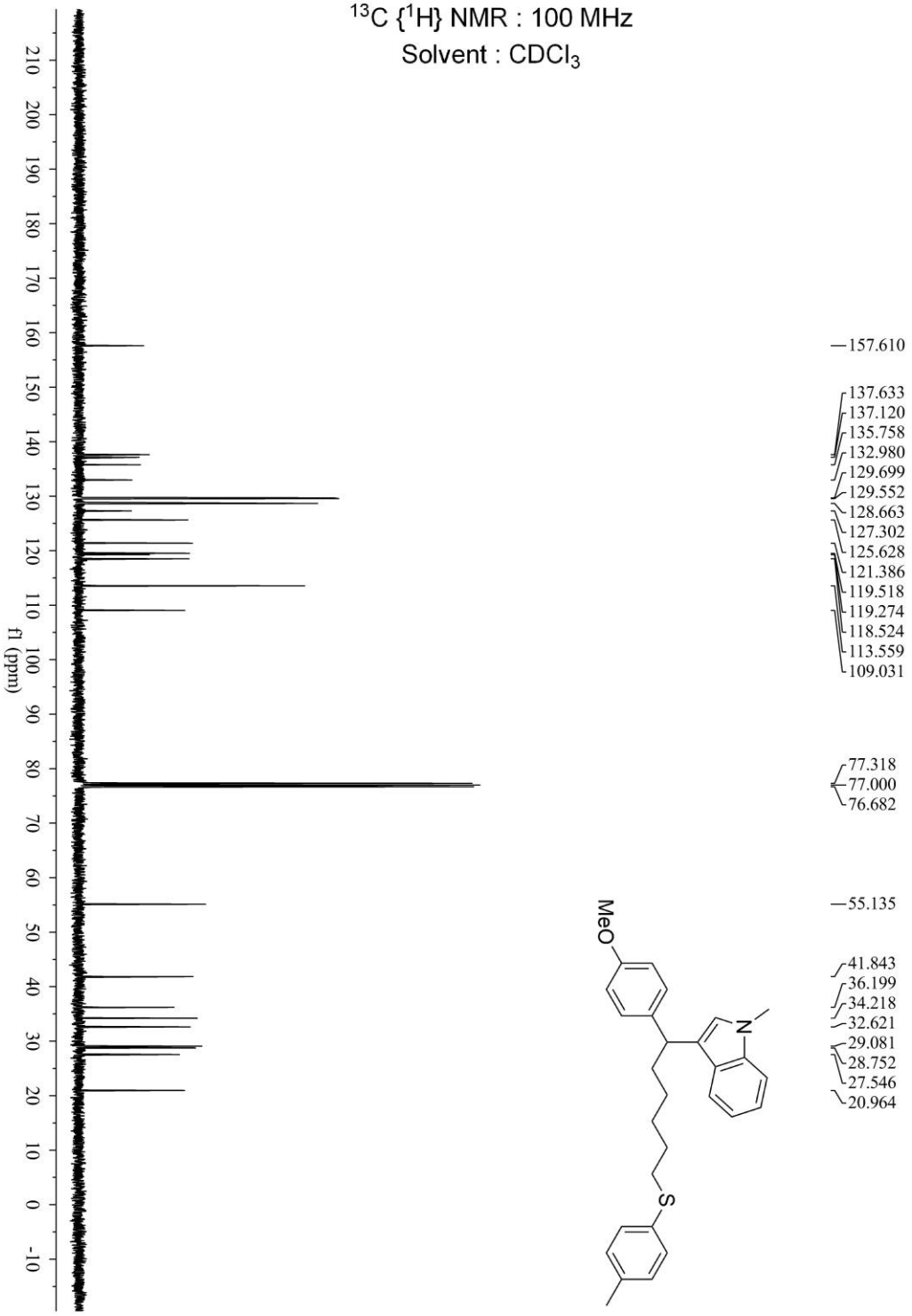
2. X.-Q. Liu, X.-F. Li, L.-Y.Wang, Y.-J. Shi, J. Lv, D.-S. Yang, Visible Light/Copper Catalysis Enabled Heck-Like Coupling between Alkenes and Cyclic Sulfonium Salts via Selective C-S Bond Cleavage, *Org. Chem. Front*. **2024**,11, 2195-2200.
3. P.-F. Yuan, Z. Yang, S.-S. Zhang, C.-M. Zhu, X.-L. Yang, Q.-Y. Meng, Deconstructive Carboxylation of Activated Alkenes with Carbon Dioxide, *Angew. Chem. Int. Ed.* **2024**, *63*, *e202313030.*
4. L.-J. Zhong, H. Chen, X. Shang, J.-H. Fan, K.-W. Tang, Y. Liu, J.-H. Li, Photoredox Ring Opening 1,2-Alkylarylation of Alkenes with Sulfonium Salts Toward Thioether-Substituted Oxindoles, *J. Org. Chem.* **2024**, 89, 12, 8721-8733.

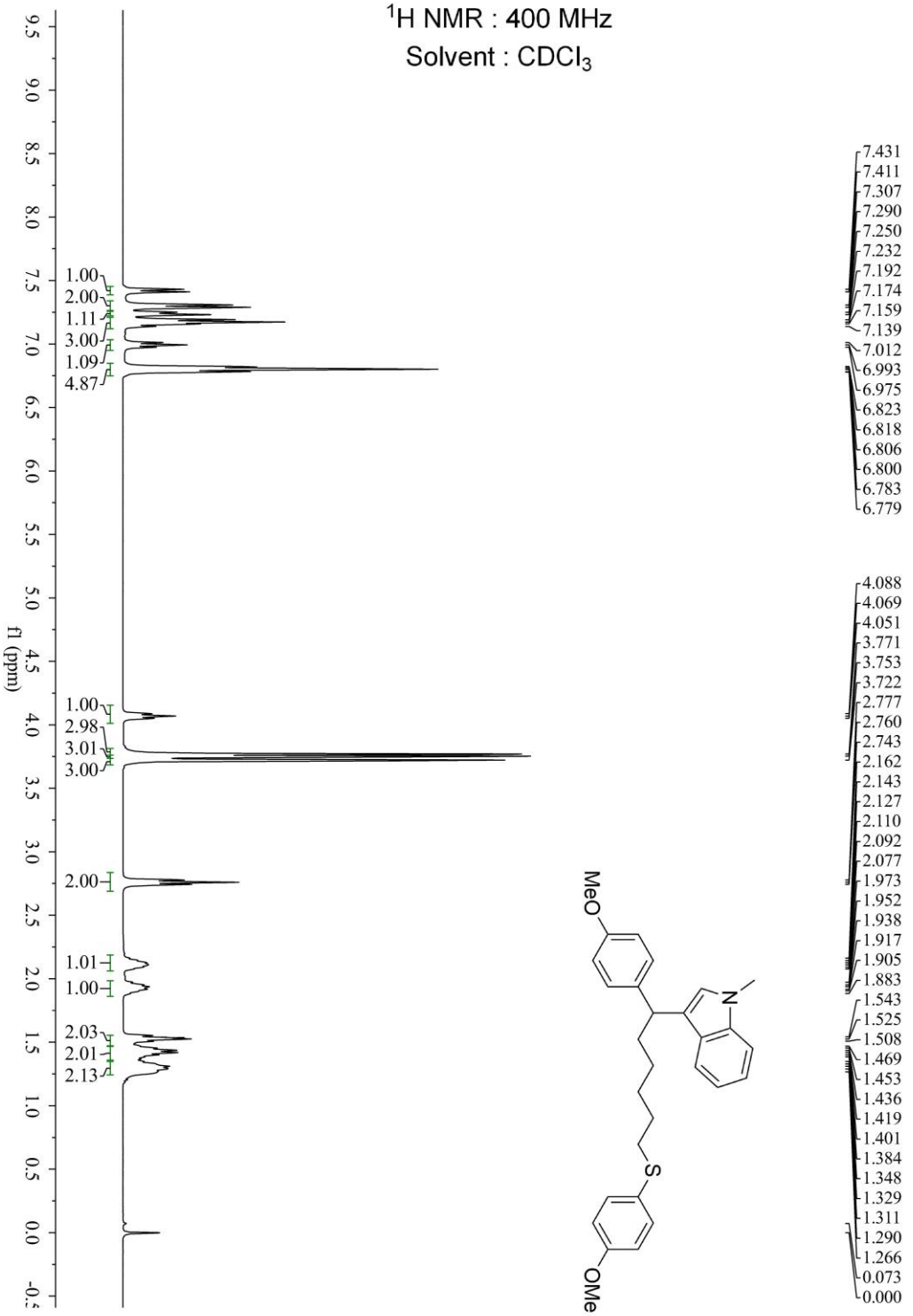
4.Spectra

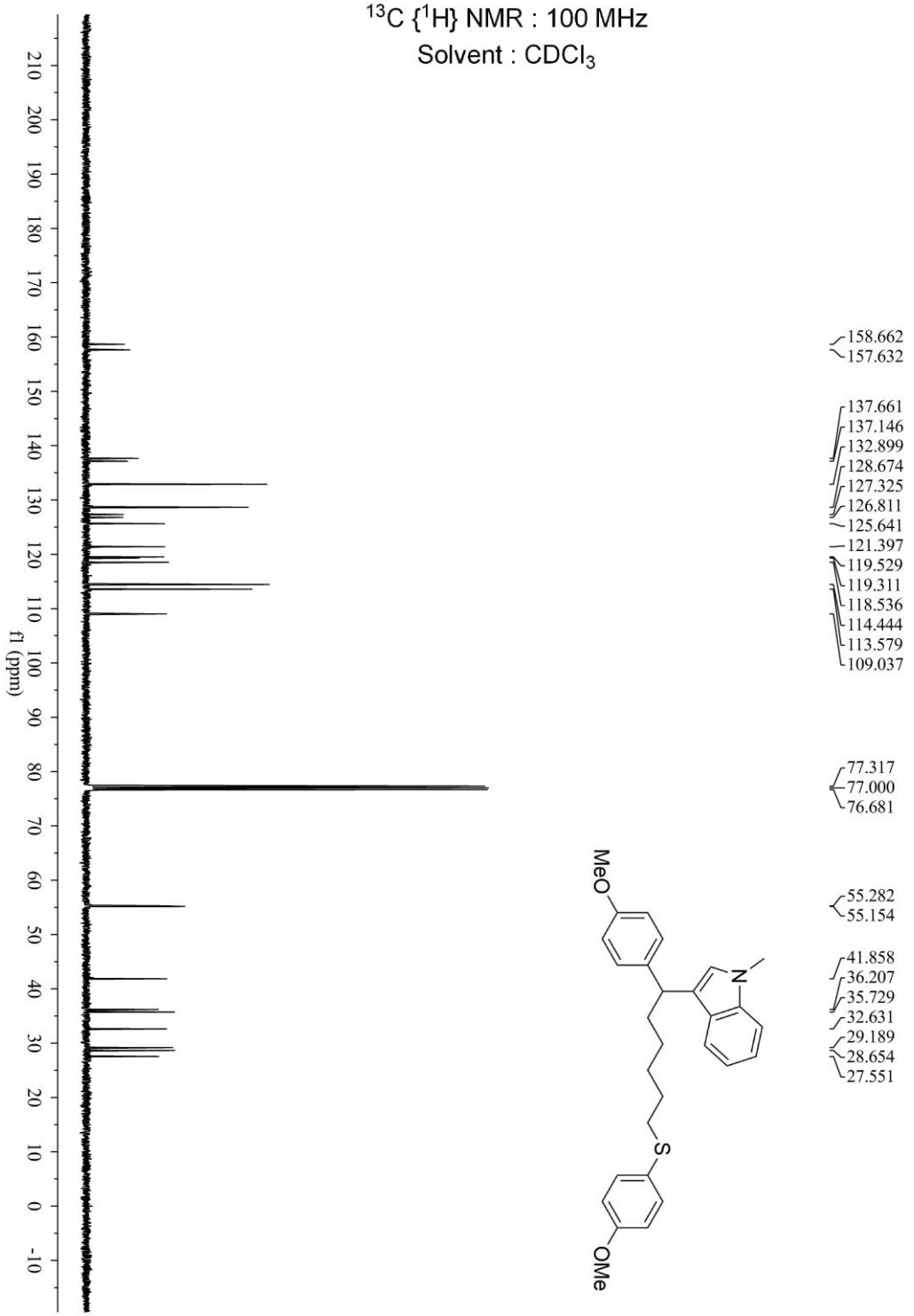
1,3-Dimethyl-3-(5-(*p*-tolylthio)pentyl)indolin-2-one (4aaa)



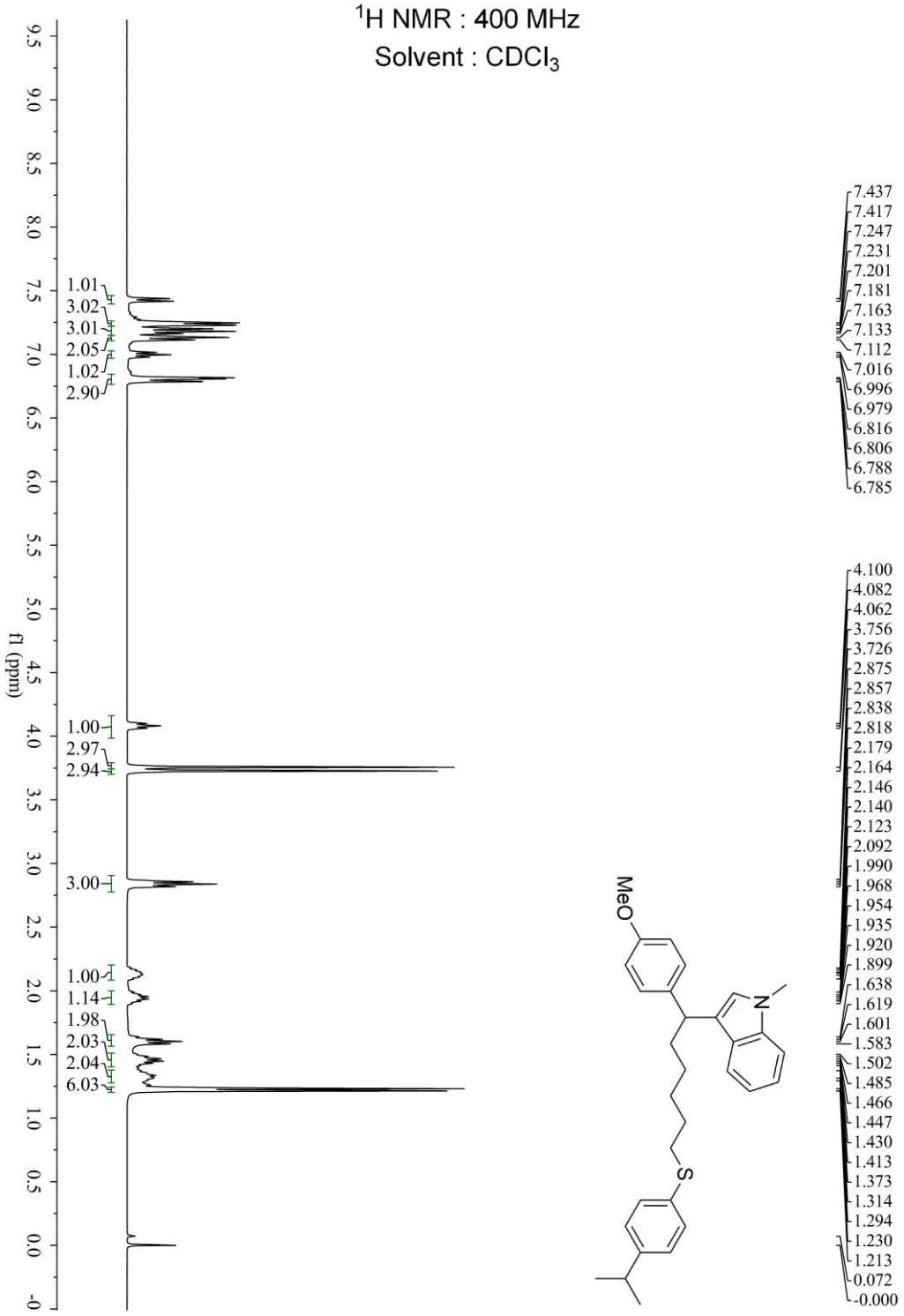

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.610
137.633
137.120
135.758
132.980
129.699
129.552
128.663
127.302
125.628
121.386
119.518
119.274
118.524
113.559
109.031
77.318
77.000
76.682
55.135
41.843
36.199
34.218
32.621
29.081
28.752
27.546
20.964
MeO
N
S

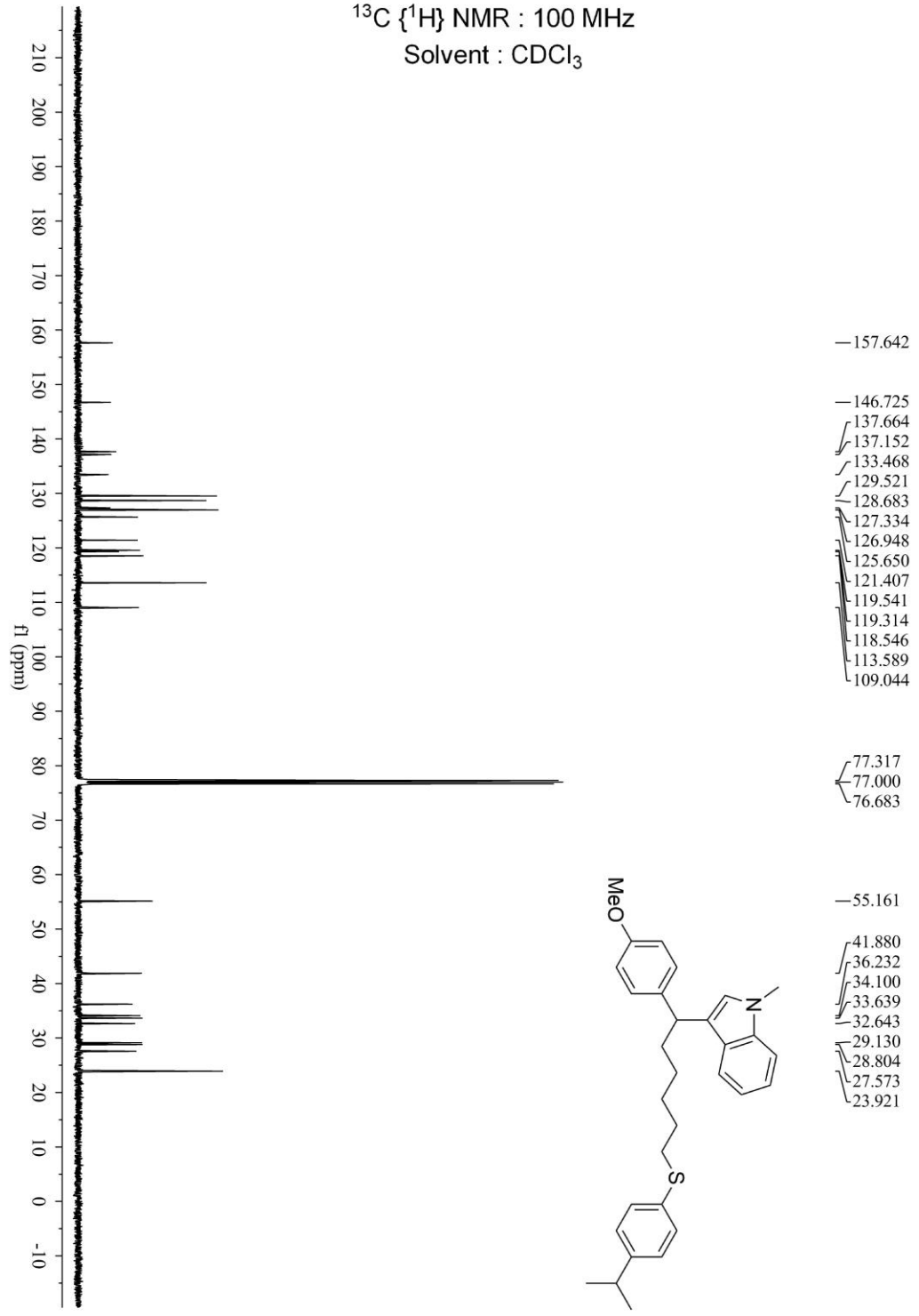
3-(1-(4-Methoxyphenyl)-6-((4-methoxyphenyl)thio)hexyl)-1-methyl-1*H*-indole (4aba)



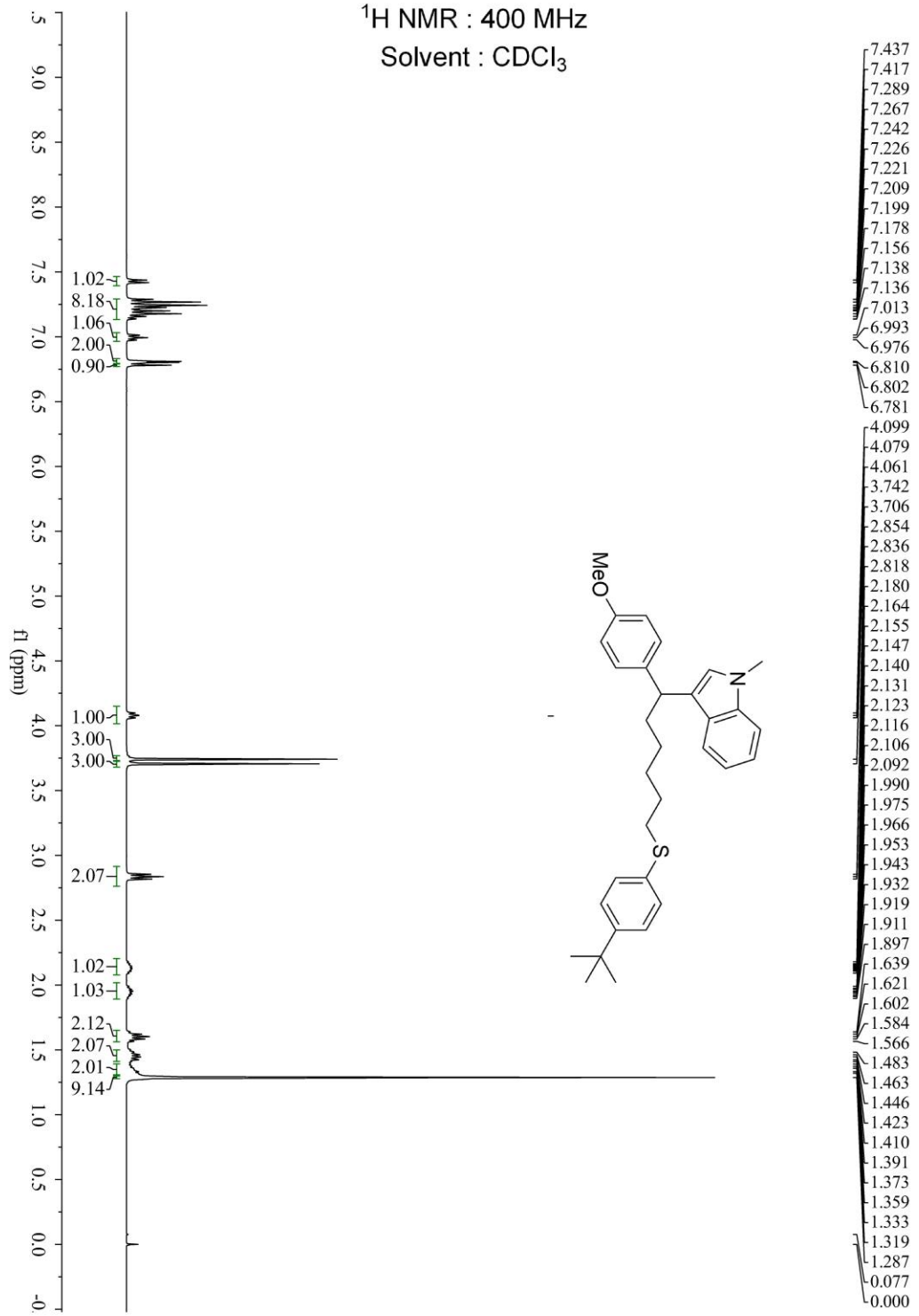

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
158.662
157.632
137.661
137.146
132.899
128.674
127.325
126.811
125.641
121.397
119.529
119.311
118.536
114.444
113.579
109.037
77.317
77.000
76.681
55.282
55.154
41.858
36.207
35.729
32.631
29.189
28.654
27.551
MeO
N
S
OMe

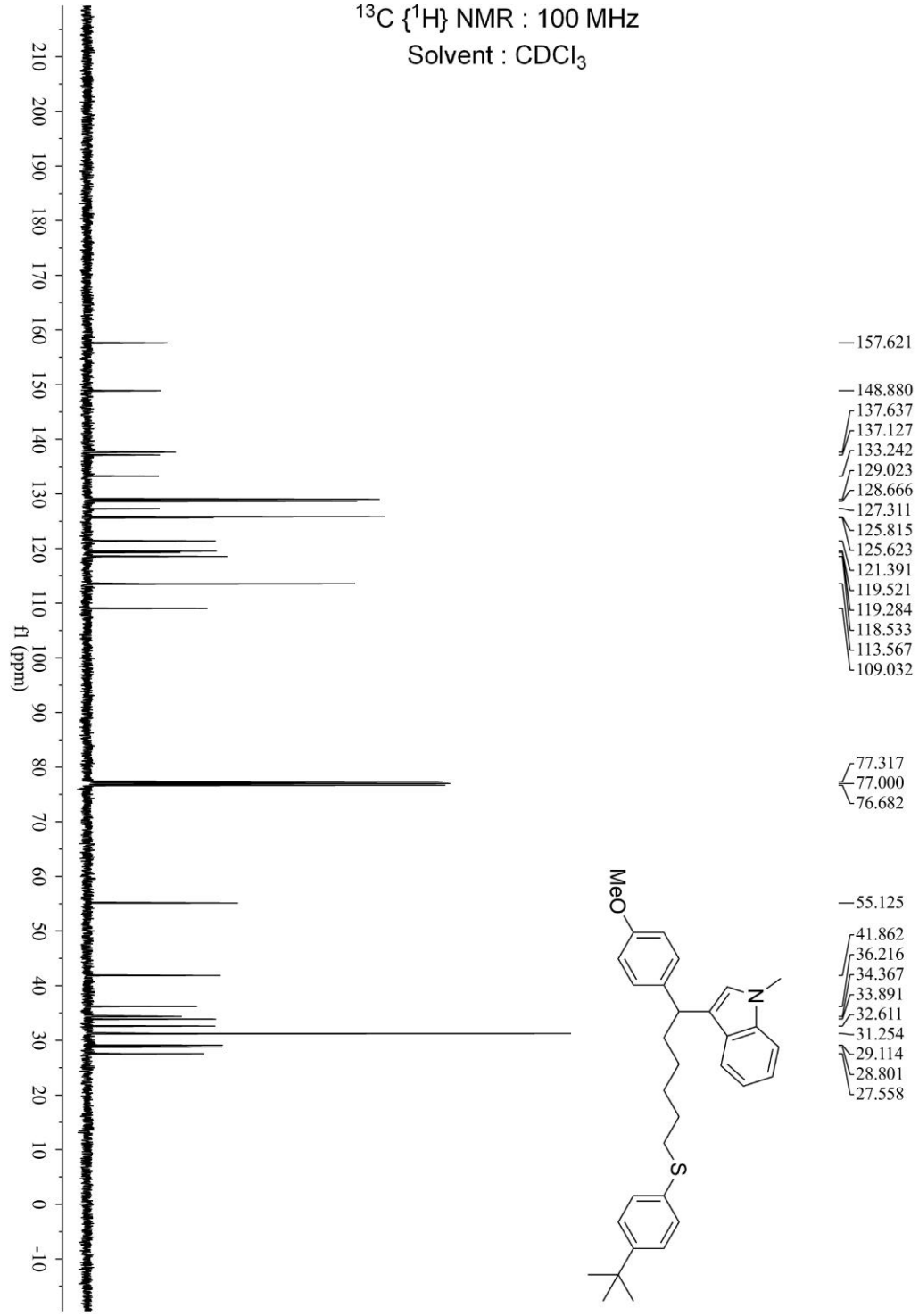
3-(6-((4-Isopropylphenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4aca)



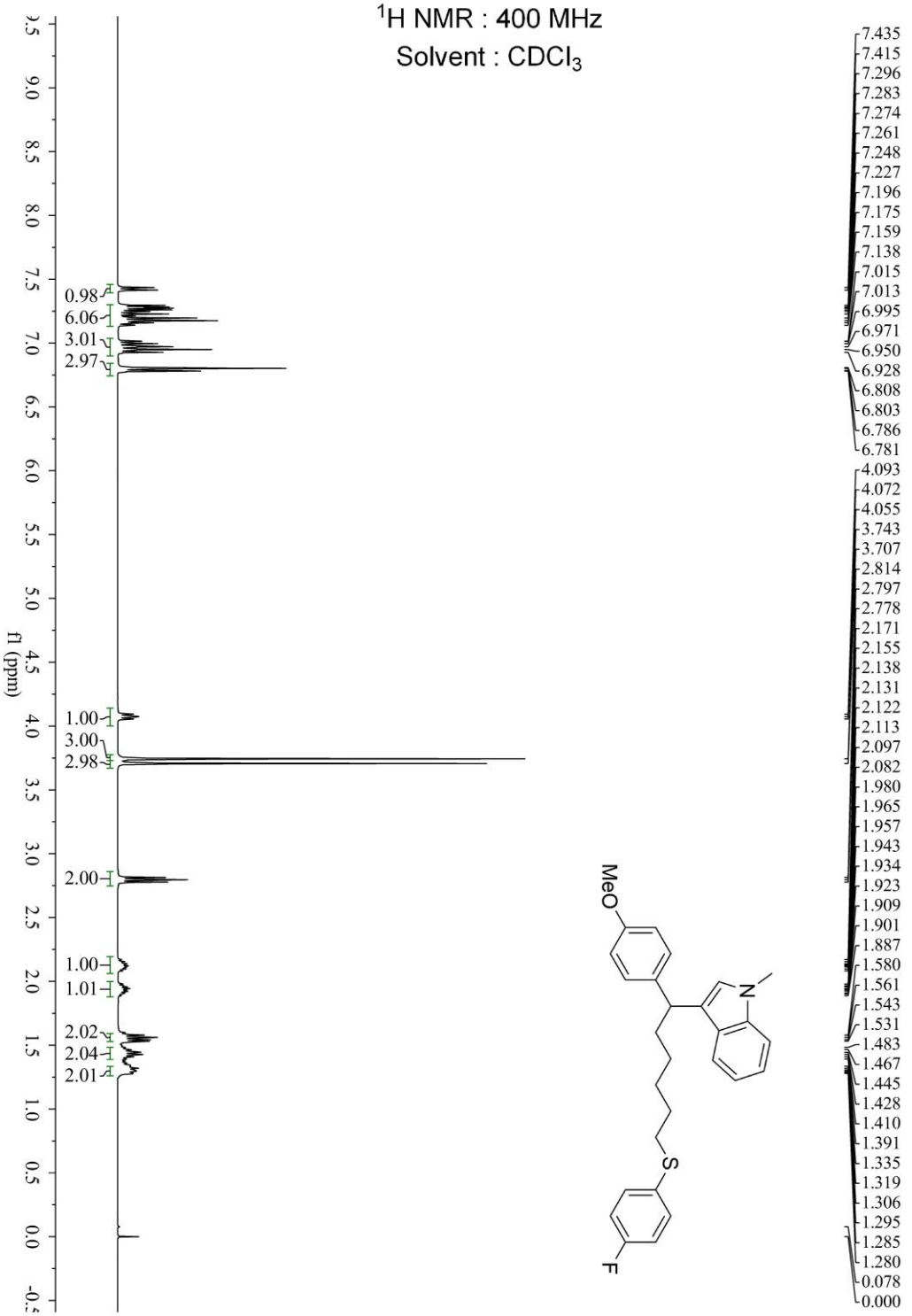

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.642
146.725
137.664
137.152
133.468
129.521
128.683
127.334
126.948
125.650
121.407
119.541
119.314
118.546
113.589
109.044
77.317
77.000
76.683
55.161
41.880
36.232
34.100
33.639
32.643
29.130
28.804
27.573
23.921
MeO
N
S

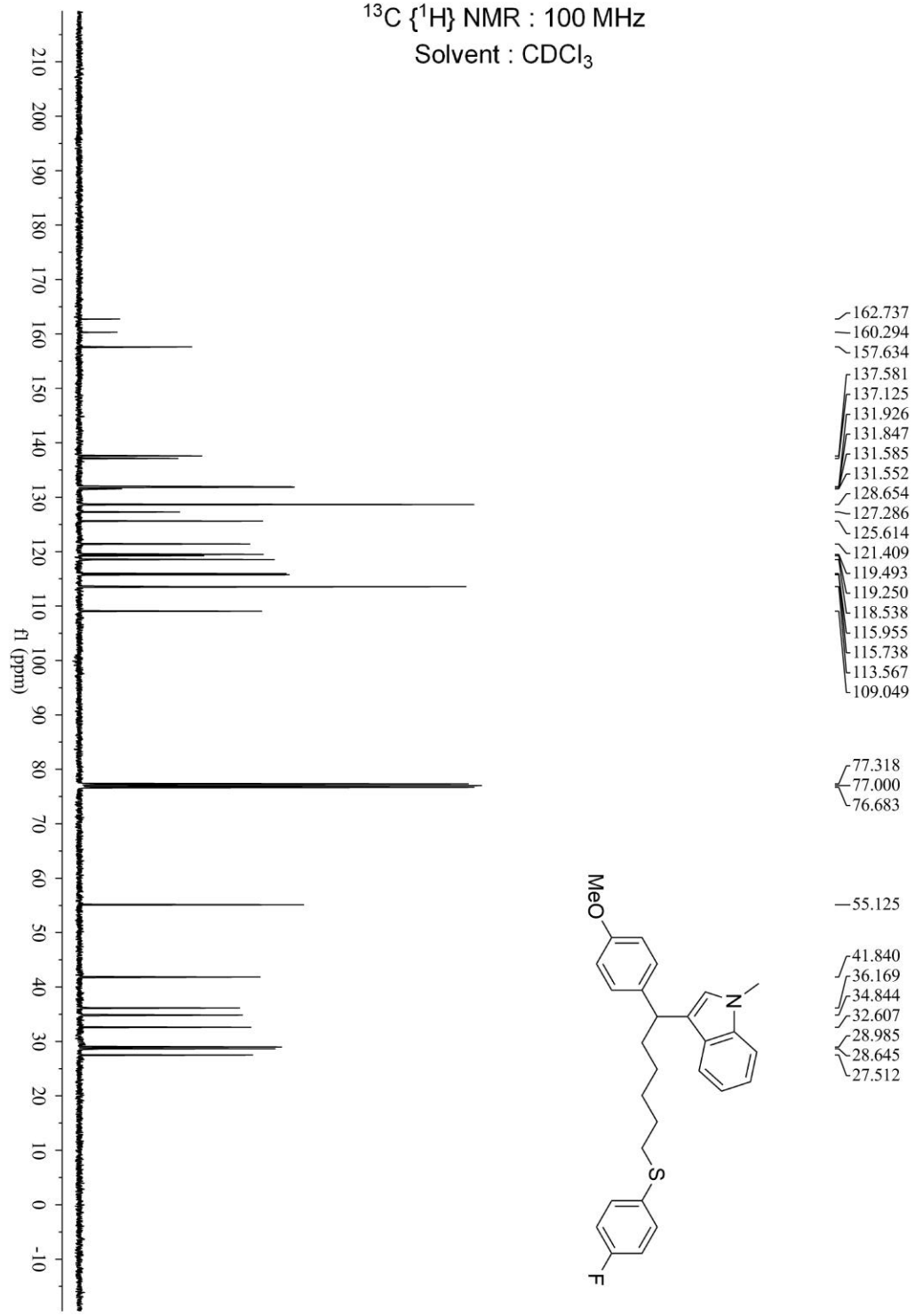
3-(6-((4-(*Tert*-butyl)phenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4ada)

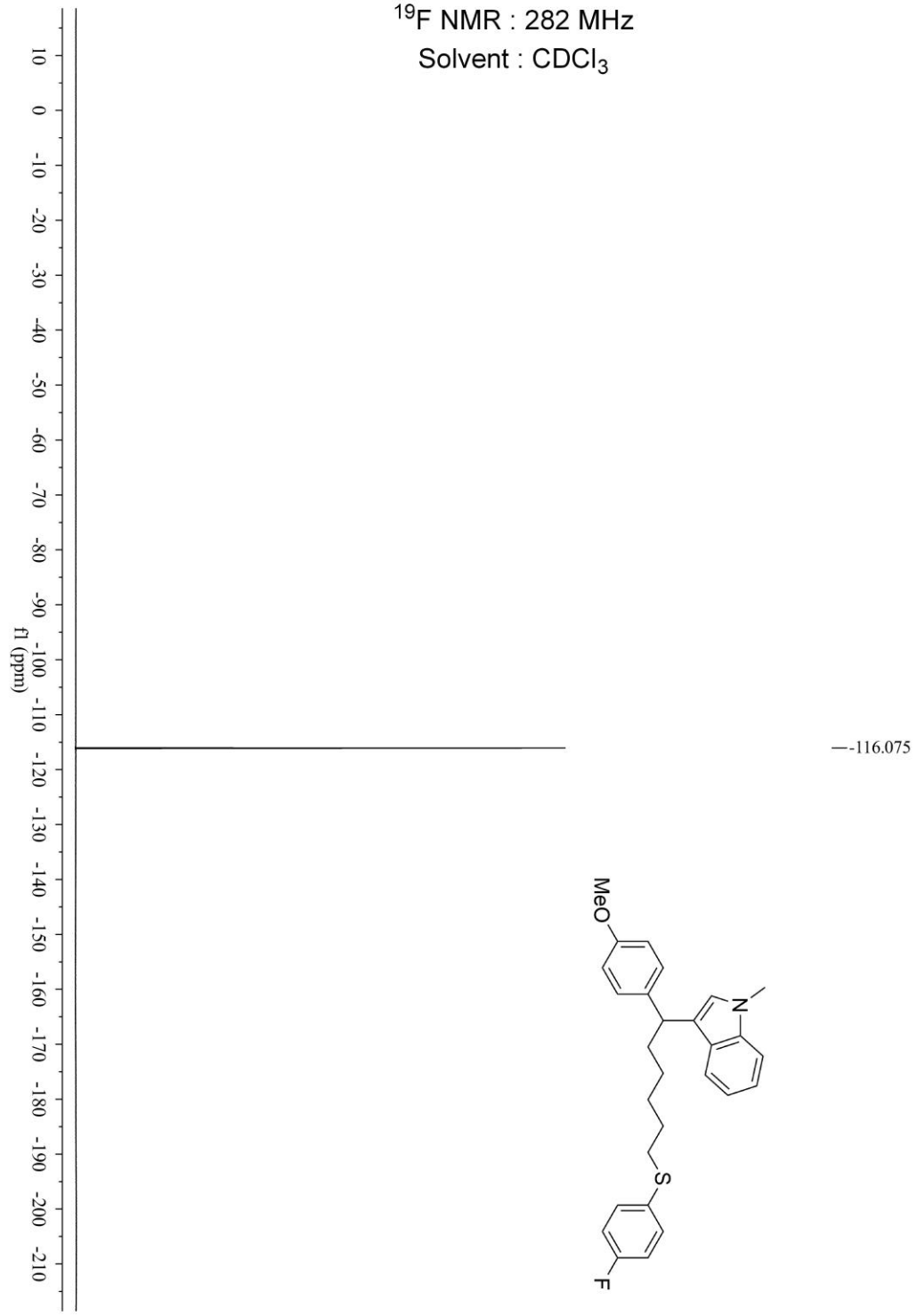



^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.621
148.880
137.637
137.127
133.242
129.023
128.666
127.311
125.815
125.623
121.391
119.521
119.284
118.533
113.567
109.032
77.317
77.000
76.682
55.125
41.862
36.216
34.367
33.891
32.611
31.254
29.114
28.801
27.558
MeO
N
S

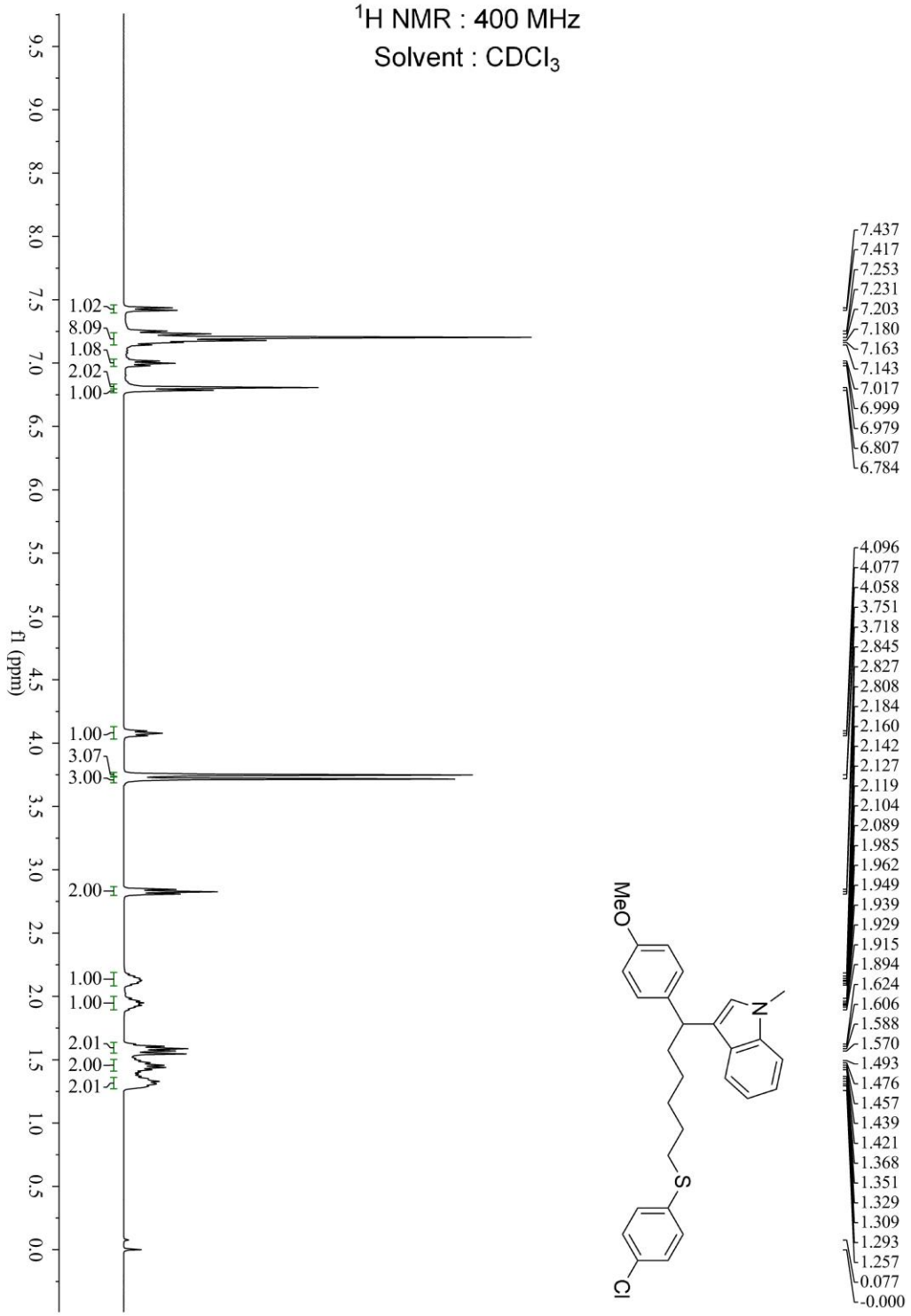
3-(6-((4-Fluorophenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4aea)

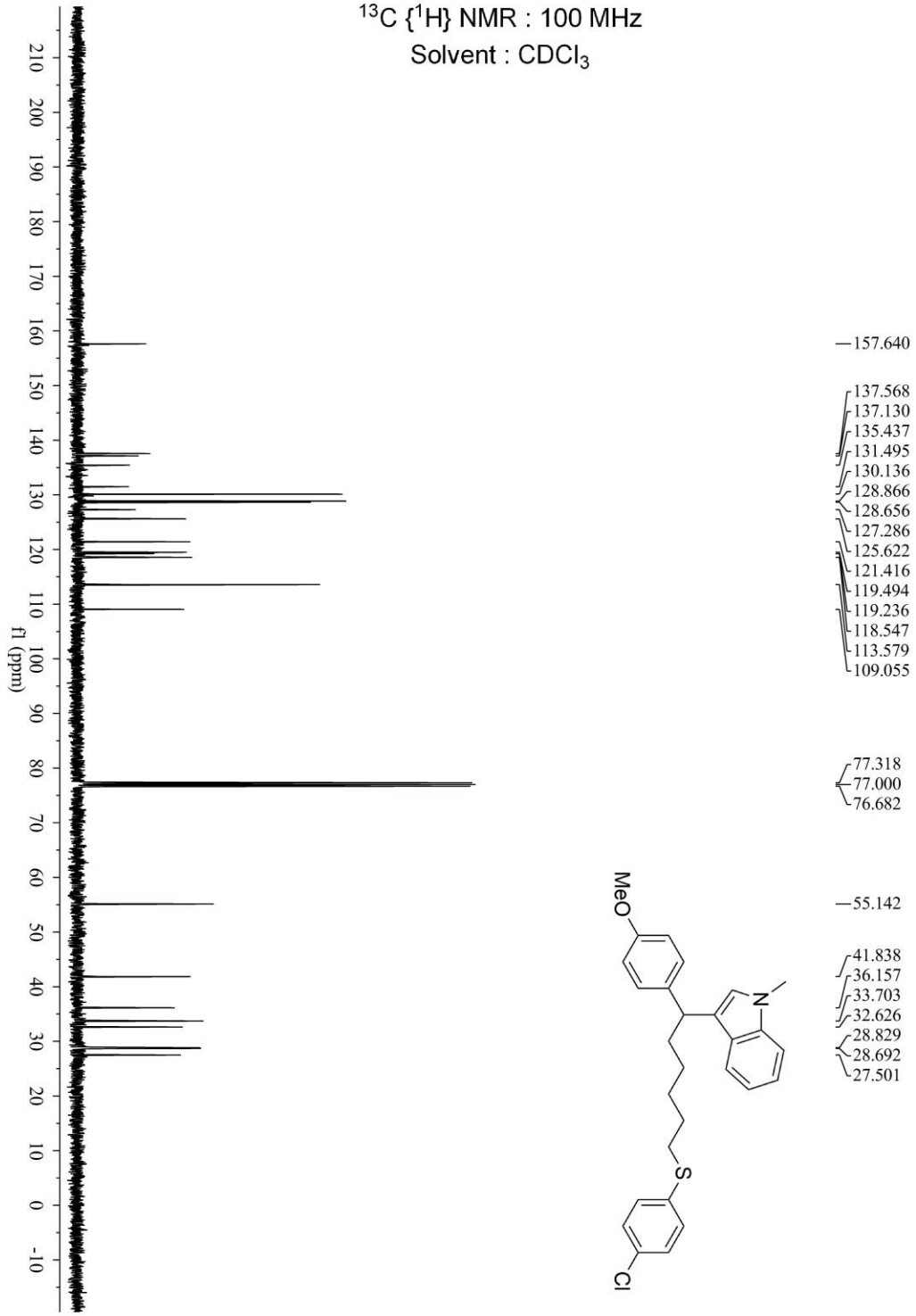



^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
162.737
160.294
157.634
137.581
137.125
131.926
131.847
131.585
131.552
128.654
127.286
125.614
121.409
119.493
119.250
118.538
115.955
115.738
113.567
109.049
77.318
77.000
76.683
55.125
41.840
36.169
34.844
32.607
28.985
28.645
27.512
MeO
N
S
F

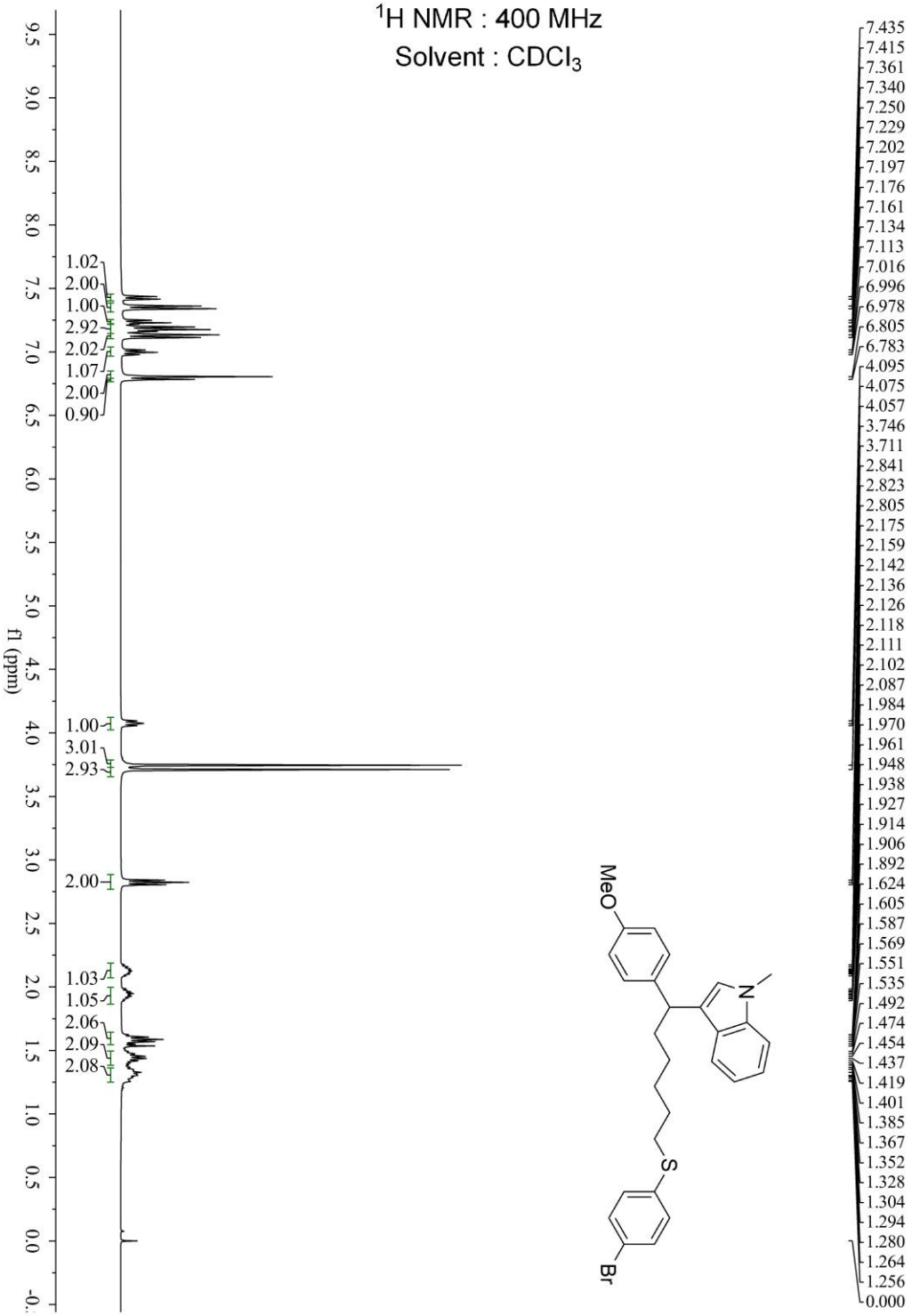

^{19}F NMR : 282 MHz
Solvent : $CDCl_3$
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)
-116.075
MeO
N
S
F

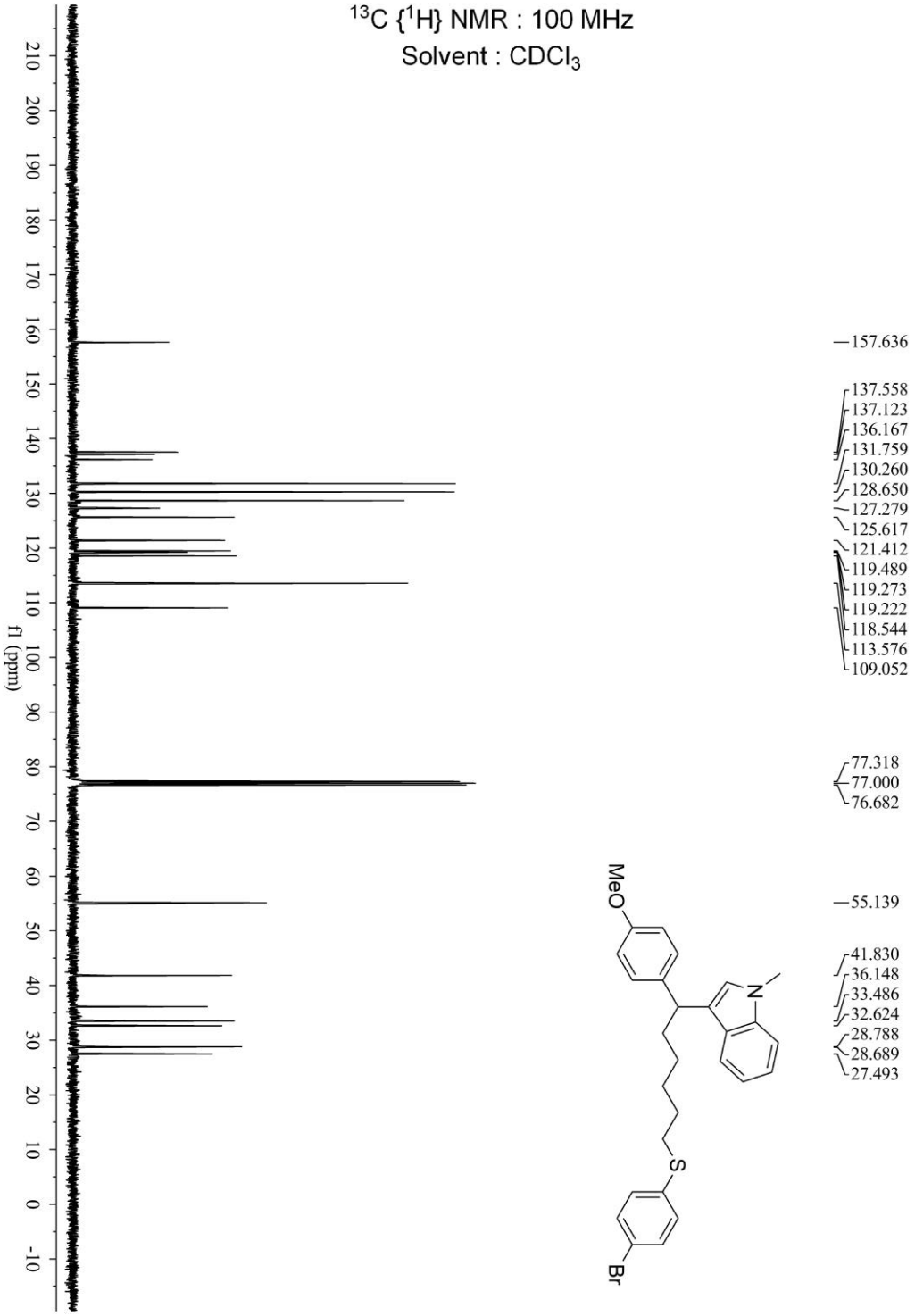
3-(6-((4-Chlorophenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4afa)



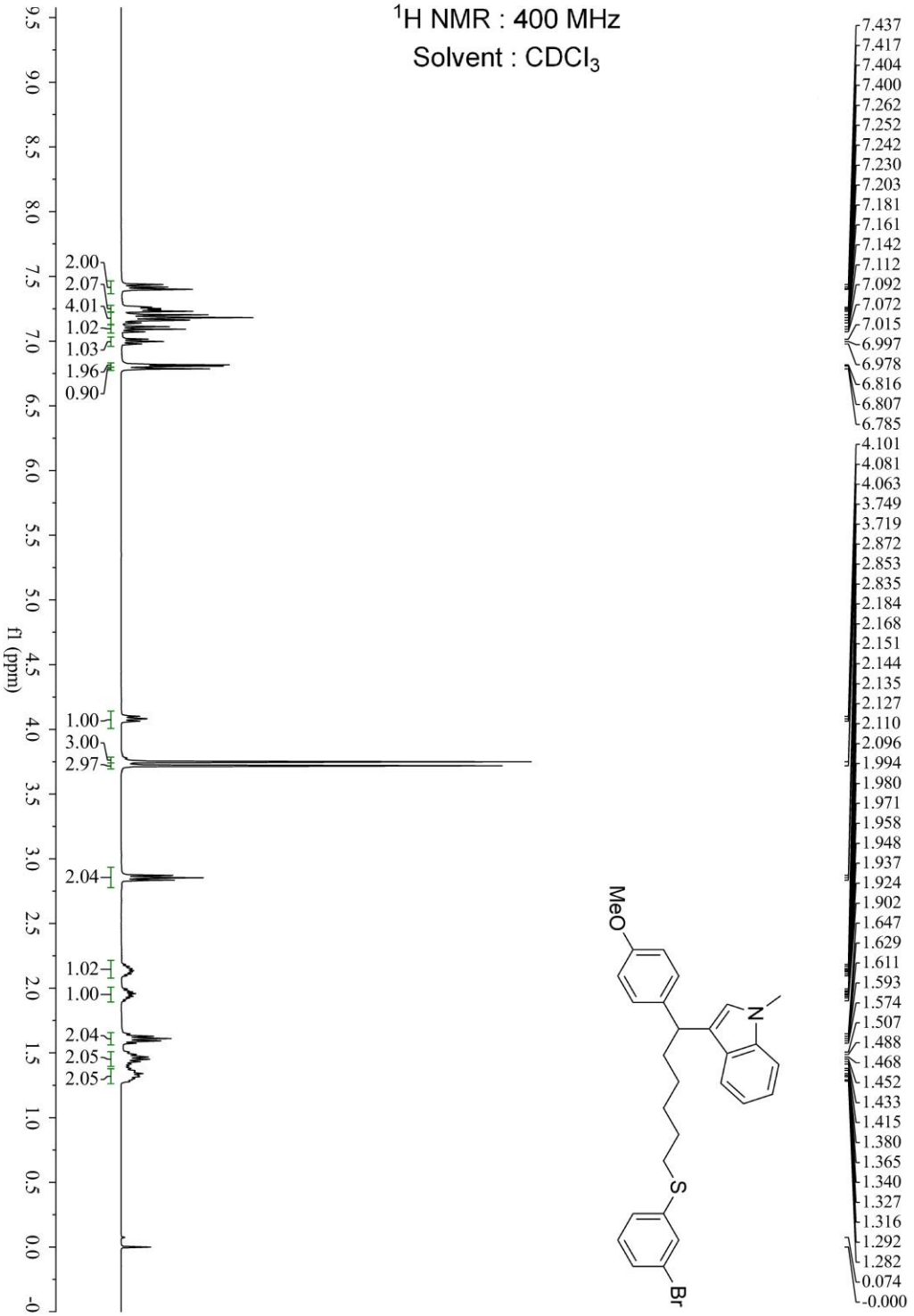

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.640
137.568
137.130
135.437
131.495
130.136
128.866
128.656
127.286
125.622
121.416
119.494
119.236
118.547
113.579
109.055
77.318
77.000
76.682
55.142
41.838
36.157
33.703
32.626
28.829
28.692
27.501
MeO
N
S
Cl

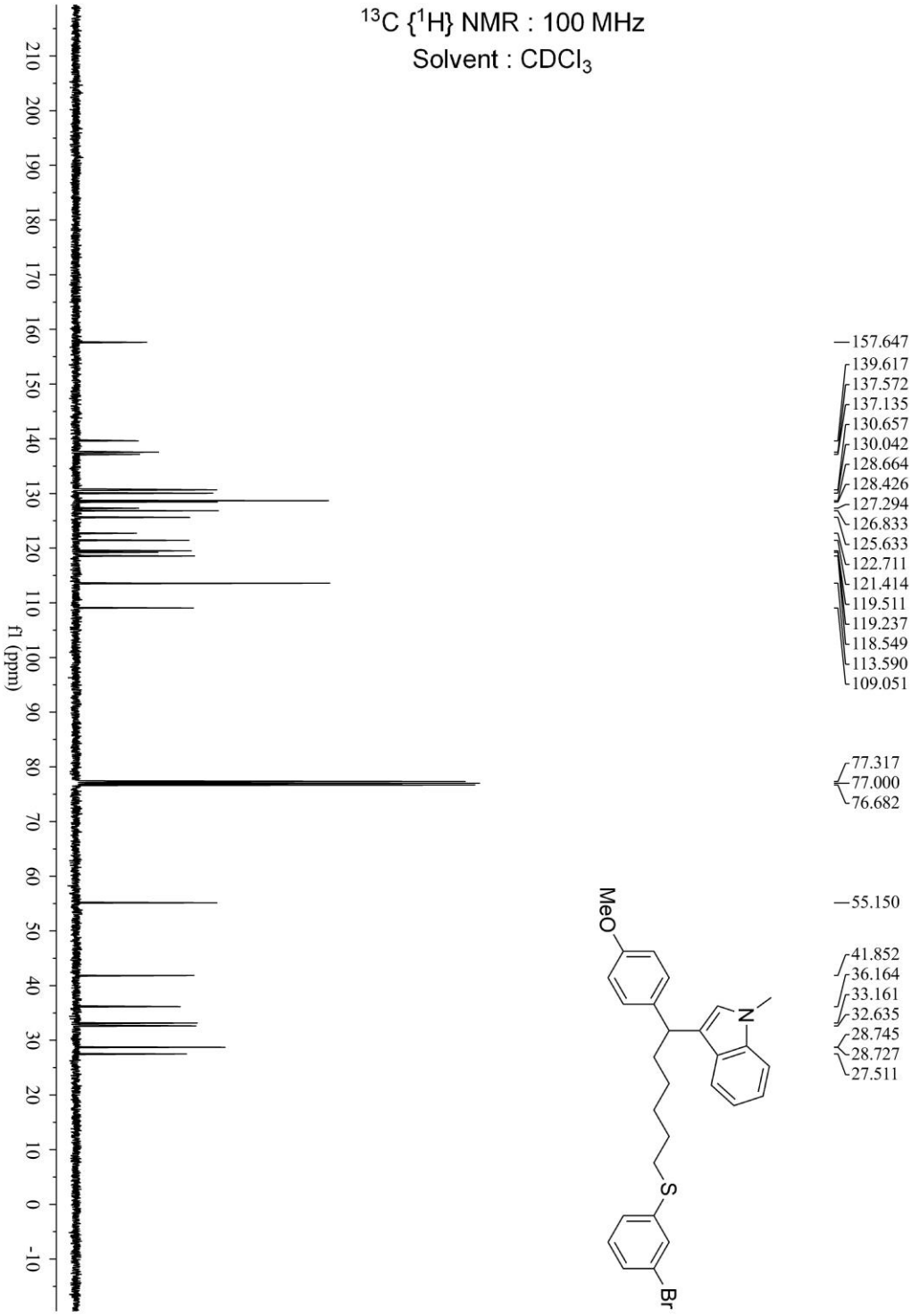
3-(6-((4-Bromophenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4aga)



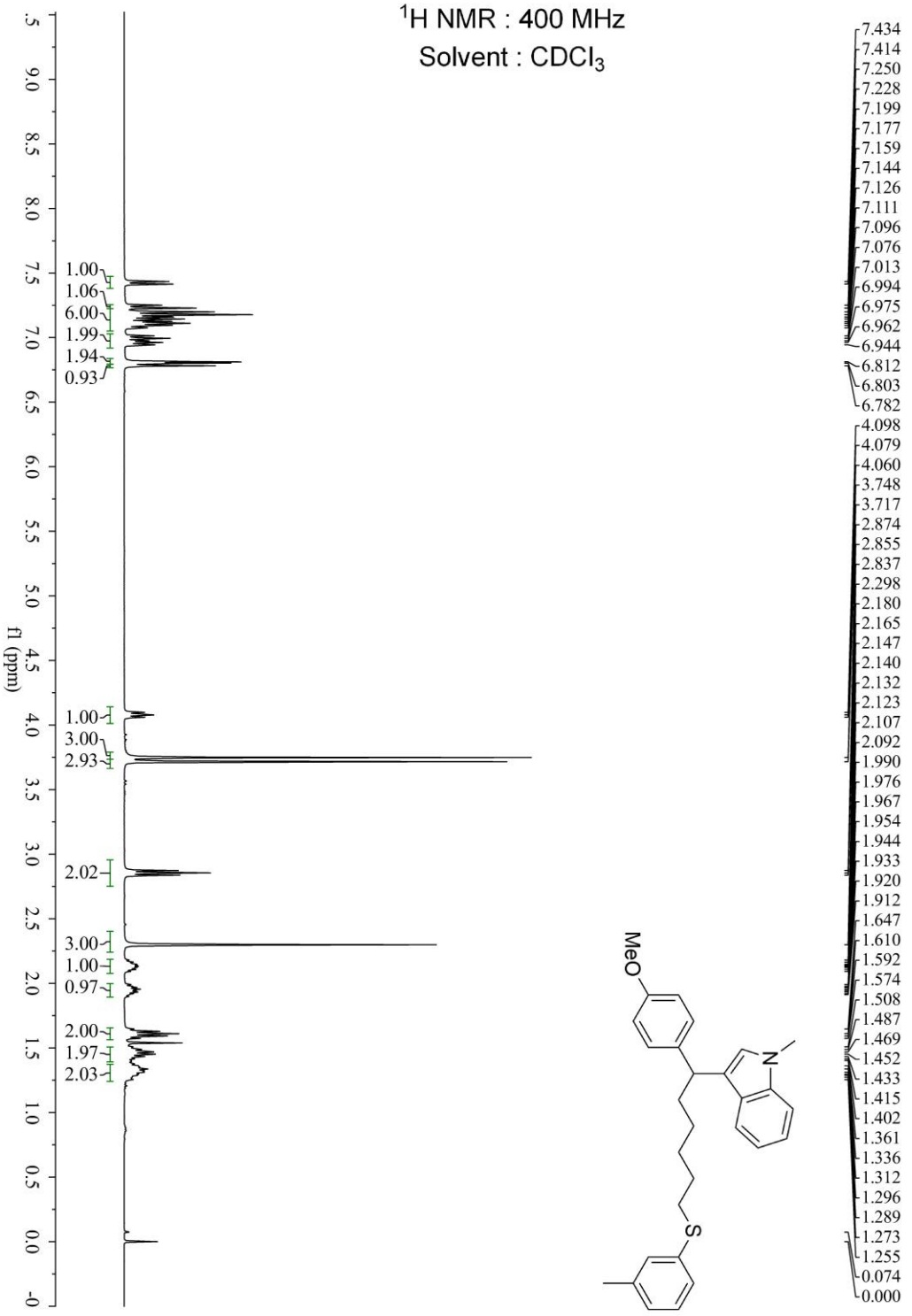

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
157.636
137.558
137.123
136.167
131.759
130.260
128.650
127.279
125.617
121.412
119.489
119.273
119.222
118.544
113.576
109.052
77.318
77.000
76.682
55.139
41.830
36.148
33.486
32.624
28.788
28.689
27.493
MeO
N
S
Br

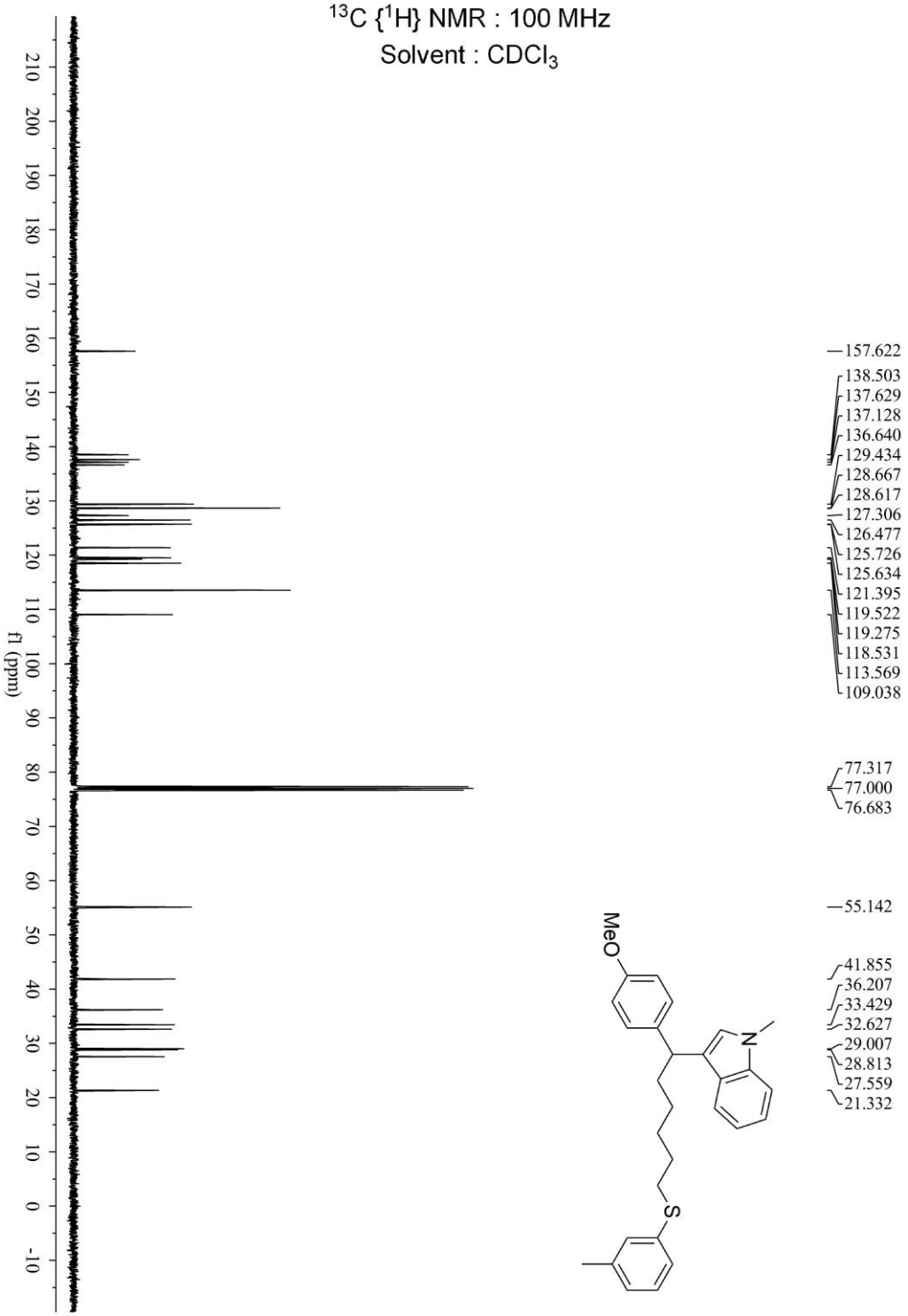
3-(6-((3-Bromophenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4aha)



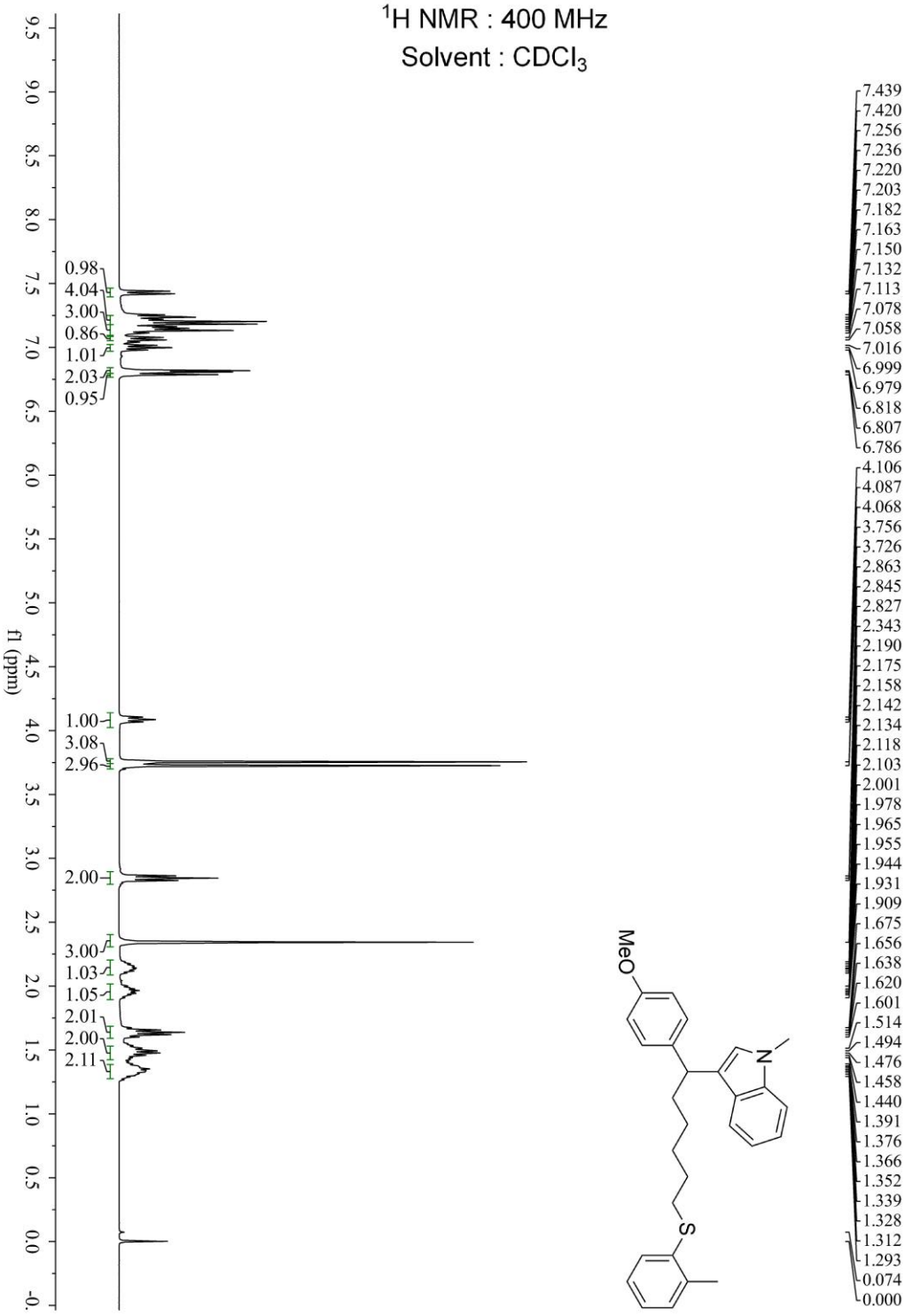

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
157.647
139.617
137.572
137.135
130.657
130.042
128.664
128.426
127.294
126.833
125.633
122.711
121.414
119.511
119.237
118.549
113.590
109.051
77.317
77.000
76.682
55.150
41.852
36.164
33.161
32.635
28.745
28.727
27.511
MeO
N
S
Br

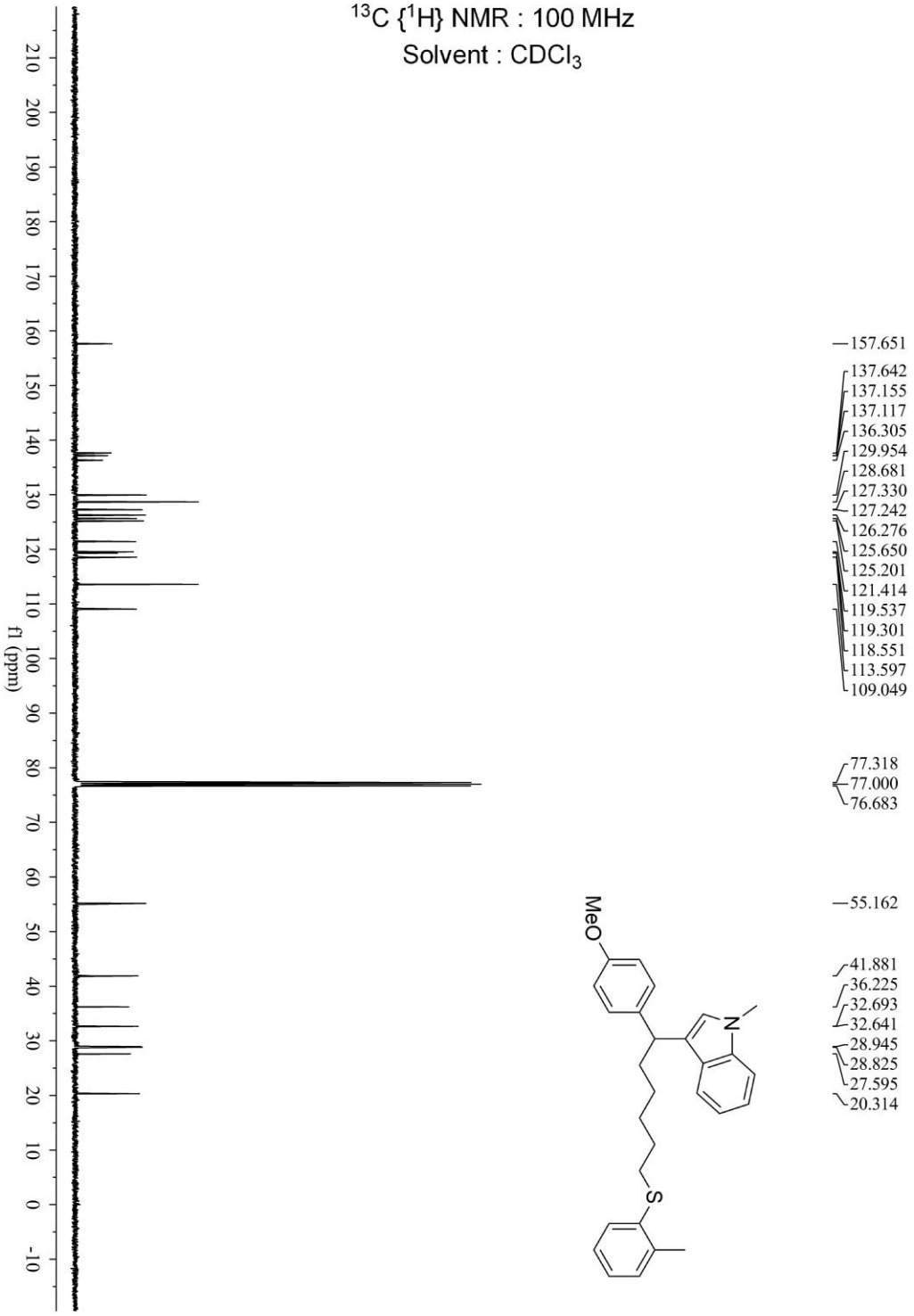
3-(1-(4-Methoxyphenyl)-6-(*m*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aia)



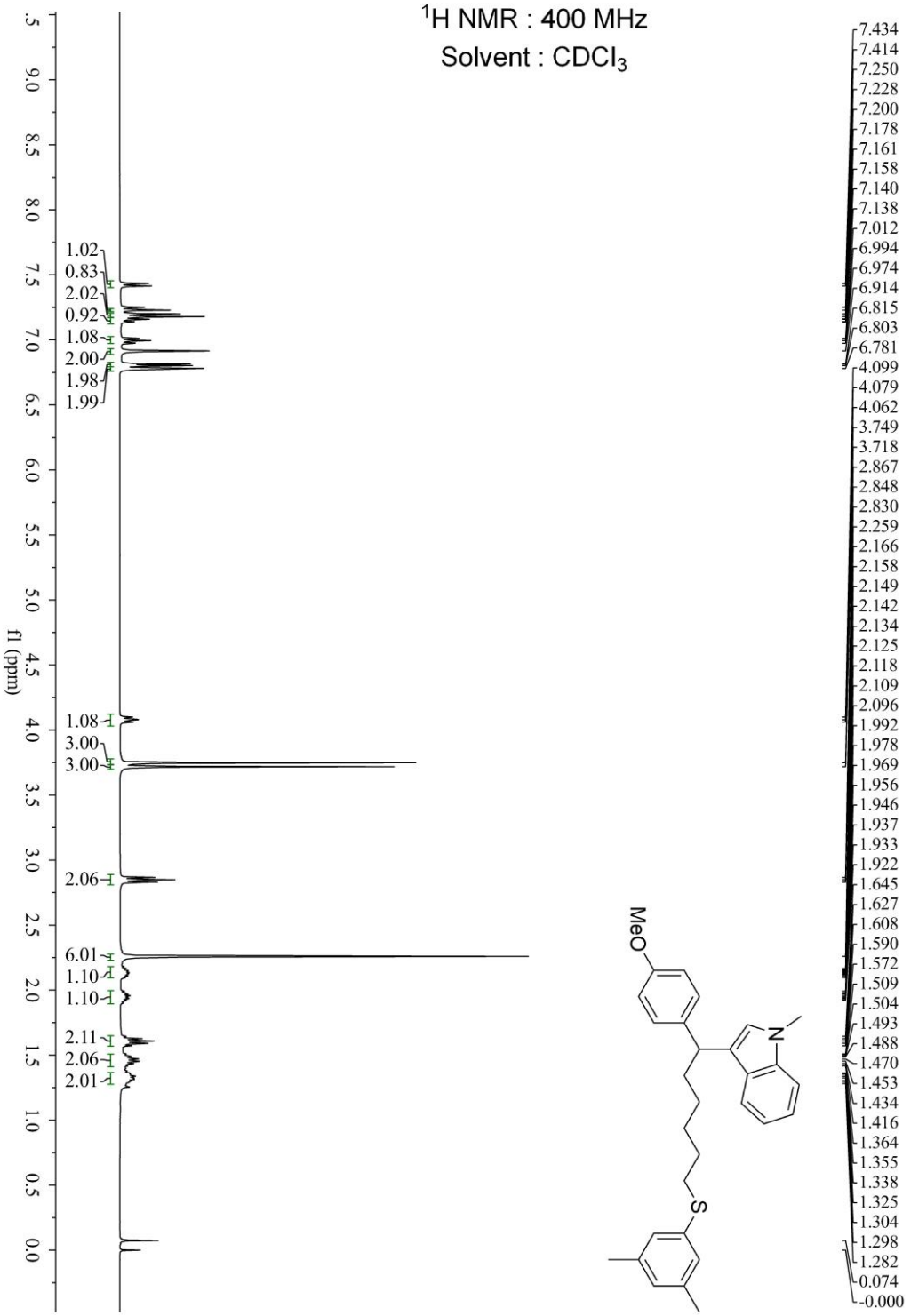

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.622
138.503
137.629
137.128
136.640
129.434
128.667
128.617
127.306
126.477
125.726
125.634
121.395
119.522
119.275
118.531
113.569
109.038
77.317
77.000
76.683
55.142
41.855
36.207
33.429
32.627
29.007
28.813
27.559
21.332
MeO
N
S

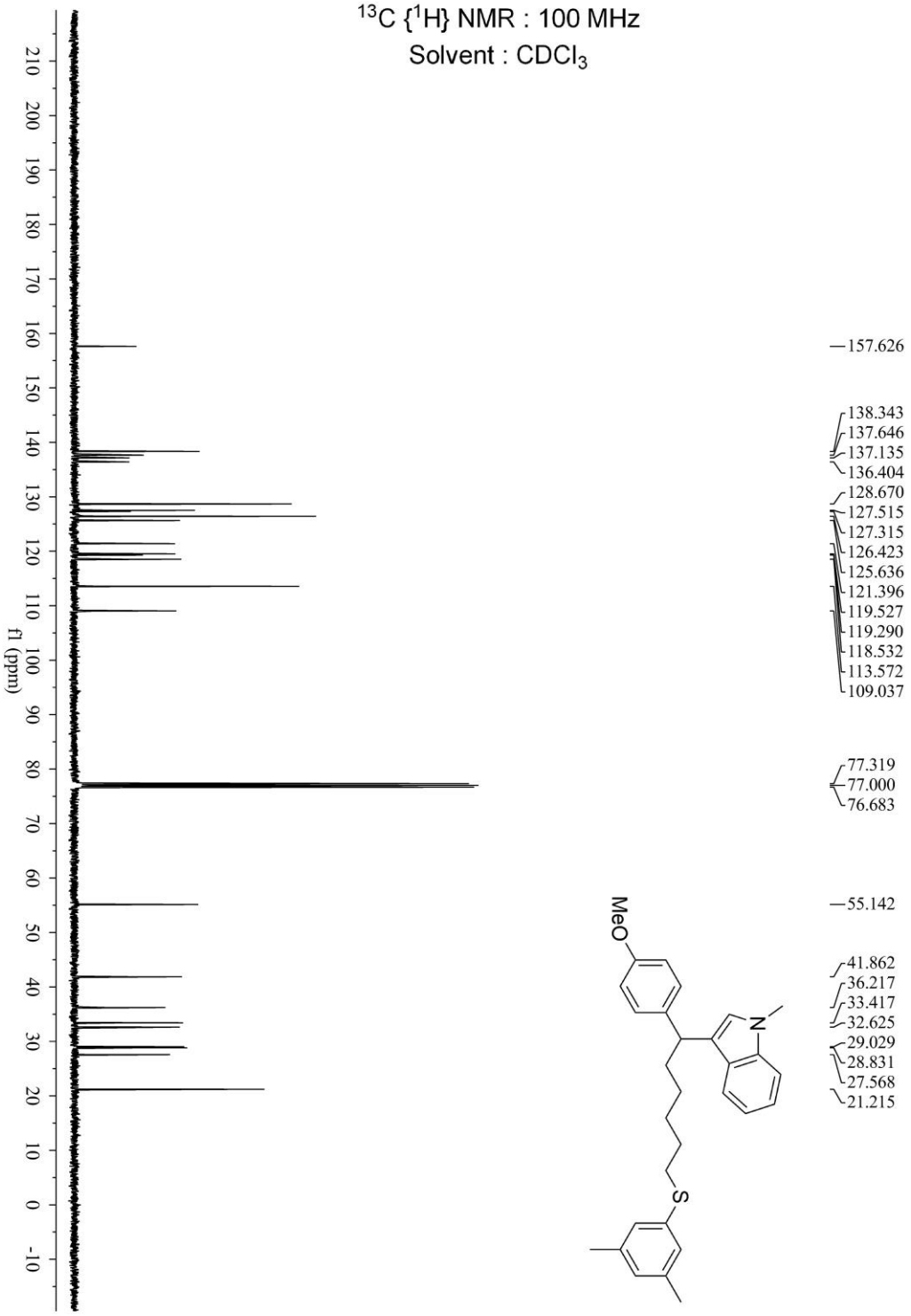
3-(1-(4-Methoxyphenyl)-6-(*o*-tolylthio)hexyl)-1-methyl-1*H*-indole(4aja)



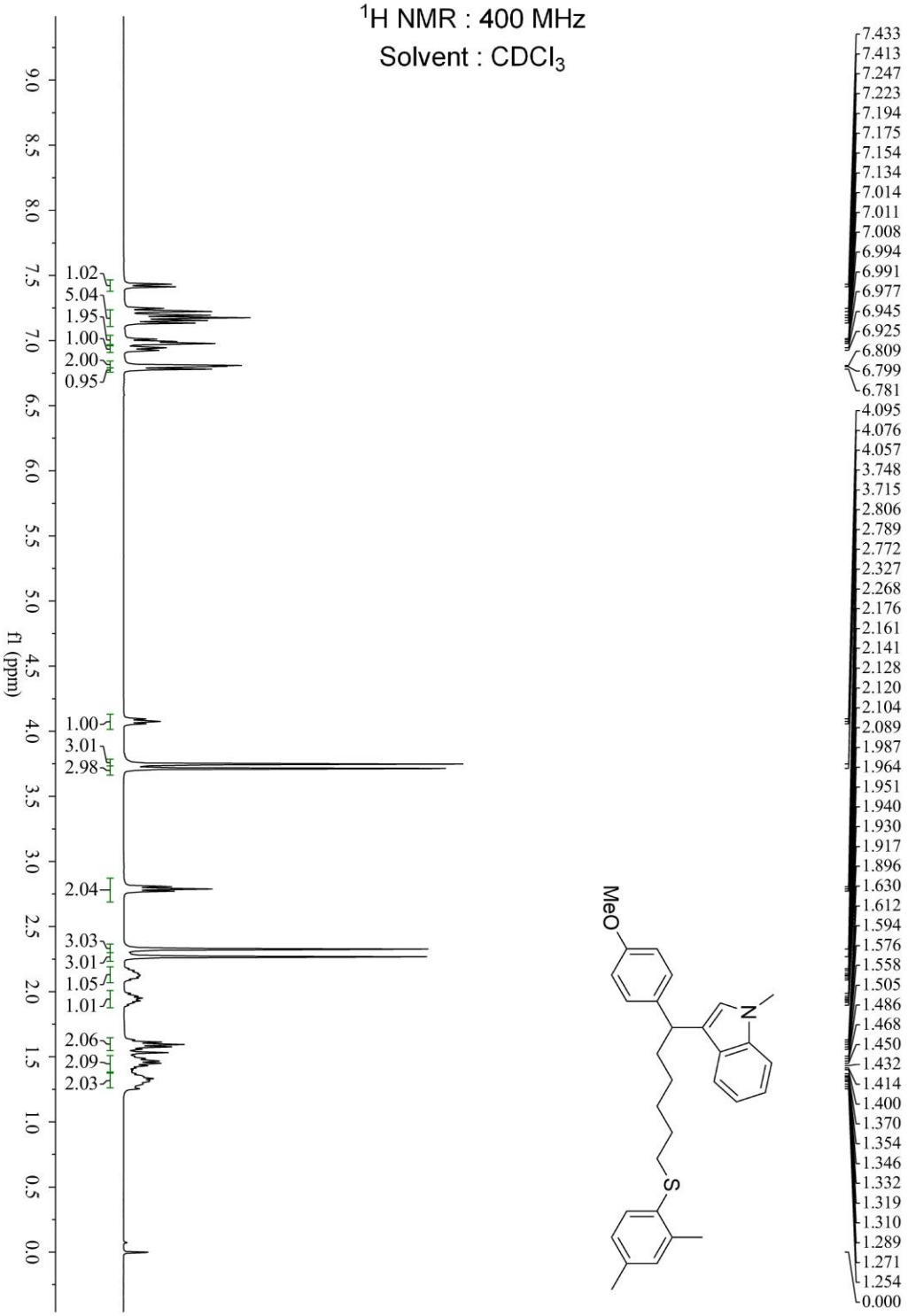

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.651
137.642
137.155
137.117
136.305
129.954
128.681
127.330
127.242
126.276
125.650
125.201
121.414
119.537
119.301
118.551
113.597
109.049
77.318
77.000
76.683
55.162
41.881
36.225
32.693
32.641
28.945
28.825
27.595
20.314
MeO
N
S

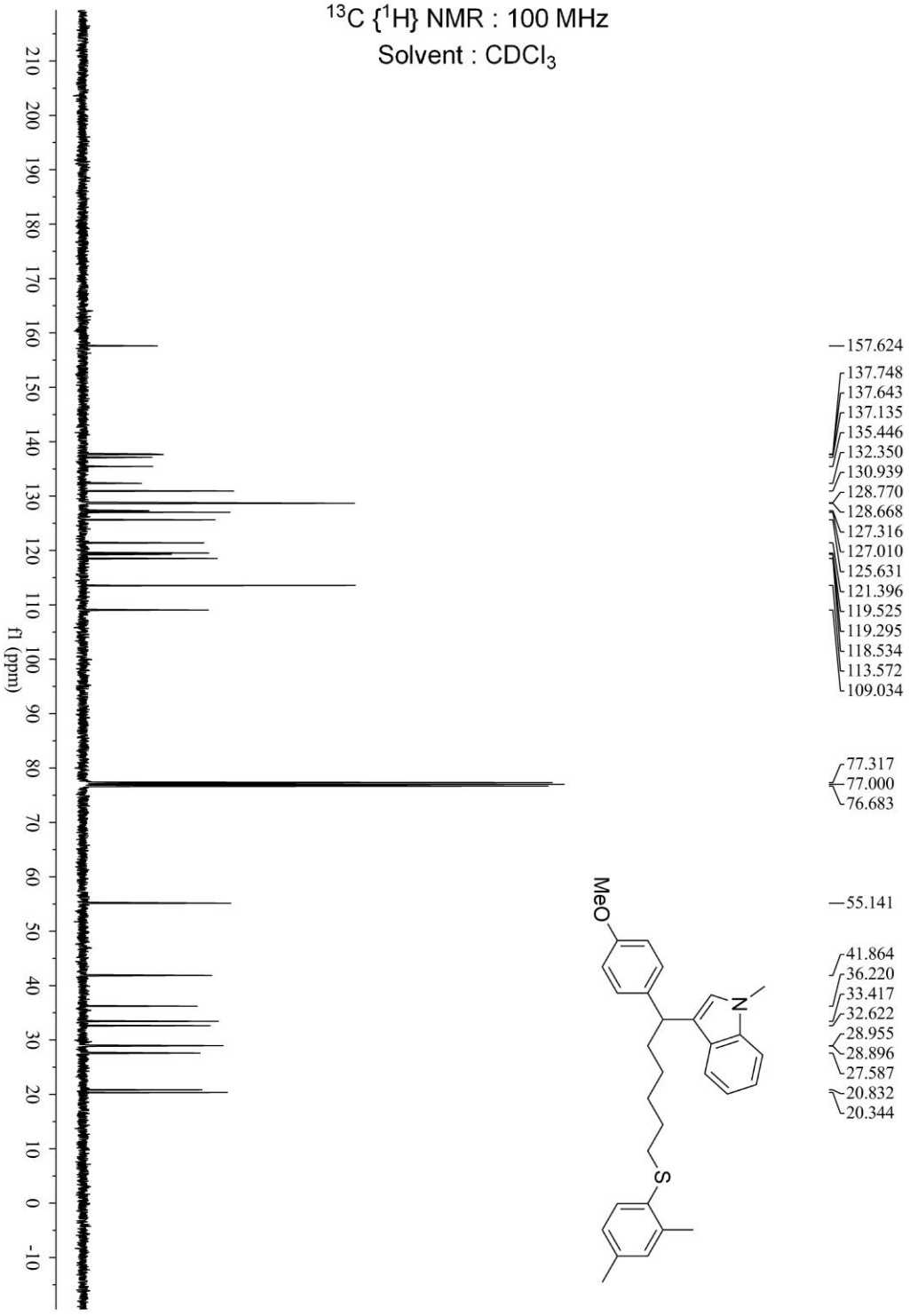
3-(6-((3,5-Dimethylphenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4aka)



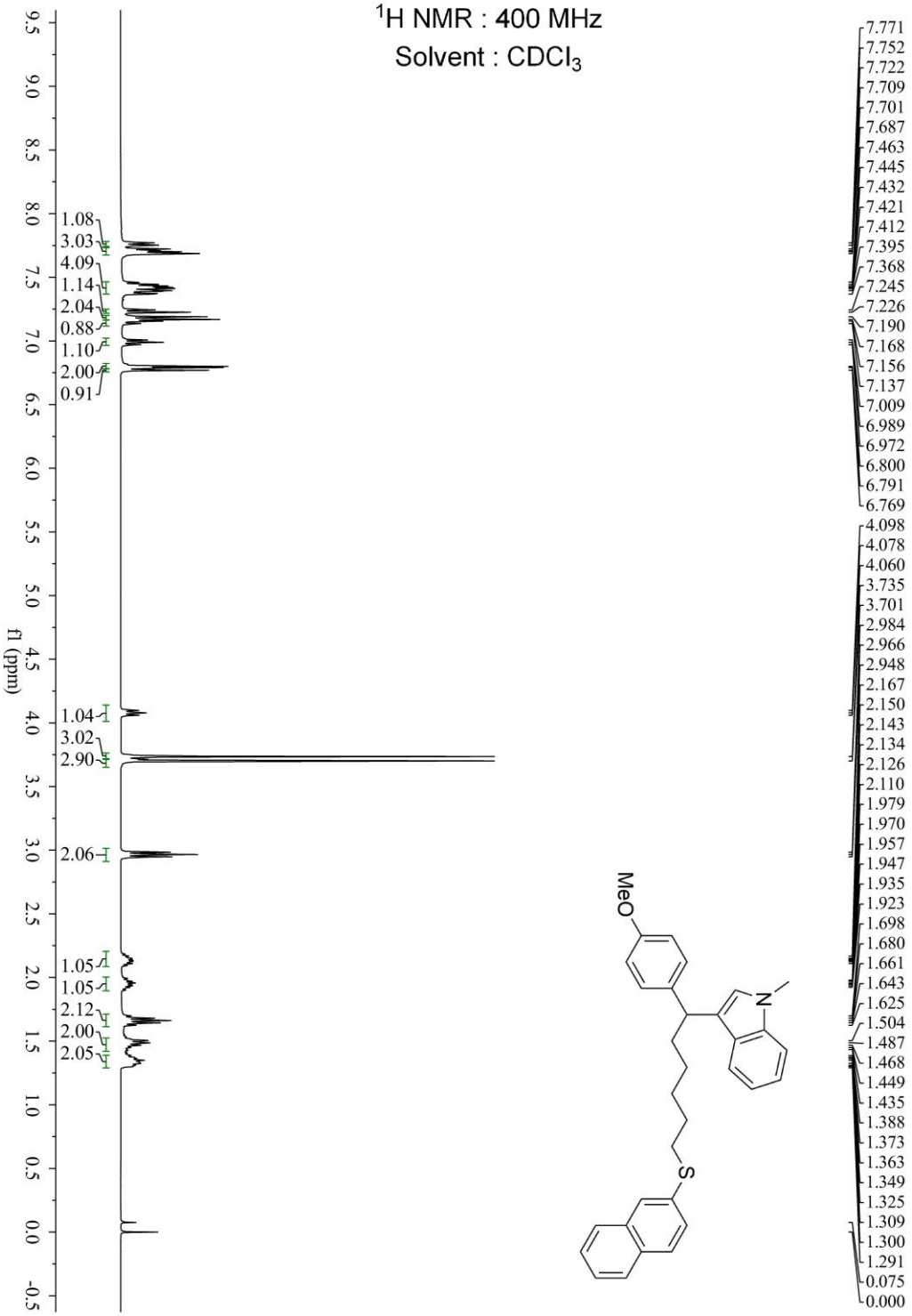

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.626
138.343
137.646
137.135
136.404
128.670
127.515
127.315
126.423
125.636
121.396
119.527
119.290
118.532
113.572
109.037
77.319
77.000
76.683
55.142
41.862
36.217
33.417
32.625
29.029
28.831
27.568
21.215
MeO
N
S

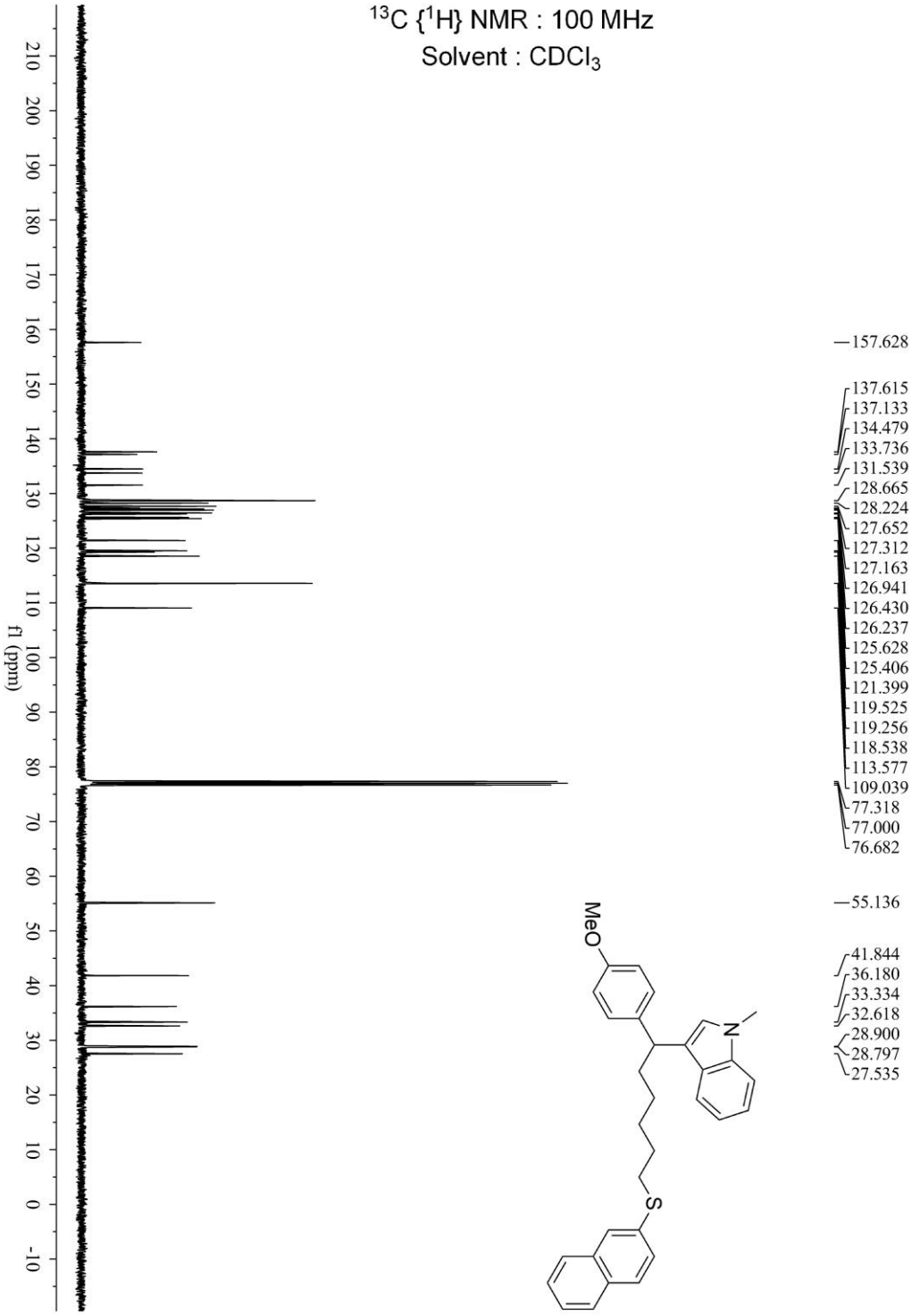
3-(6-((2,4-Dimethylphenyl)thio)-1-(4-methoxyphenyl)hexyl)-1-methyl-1*H*-indole (4ala)



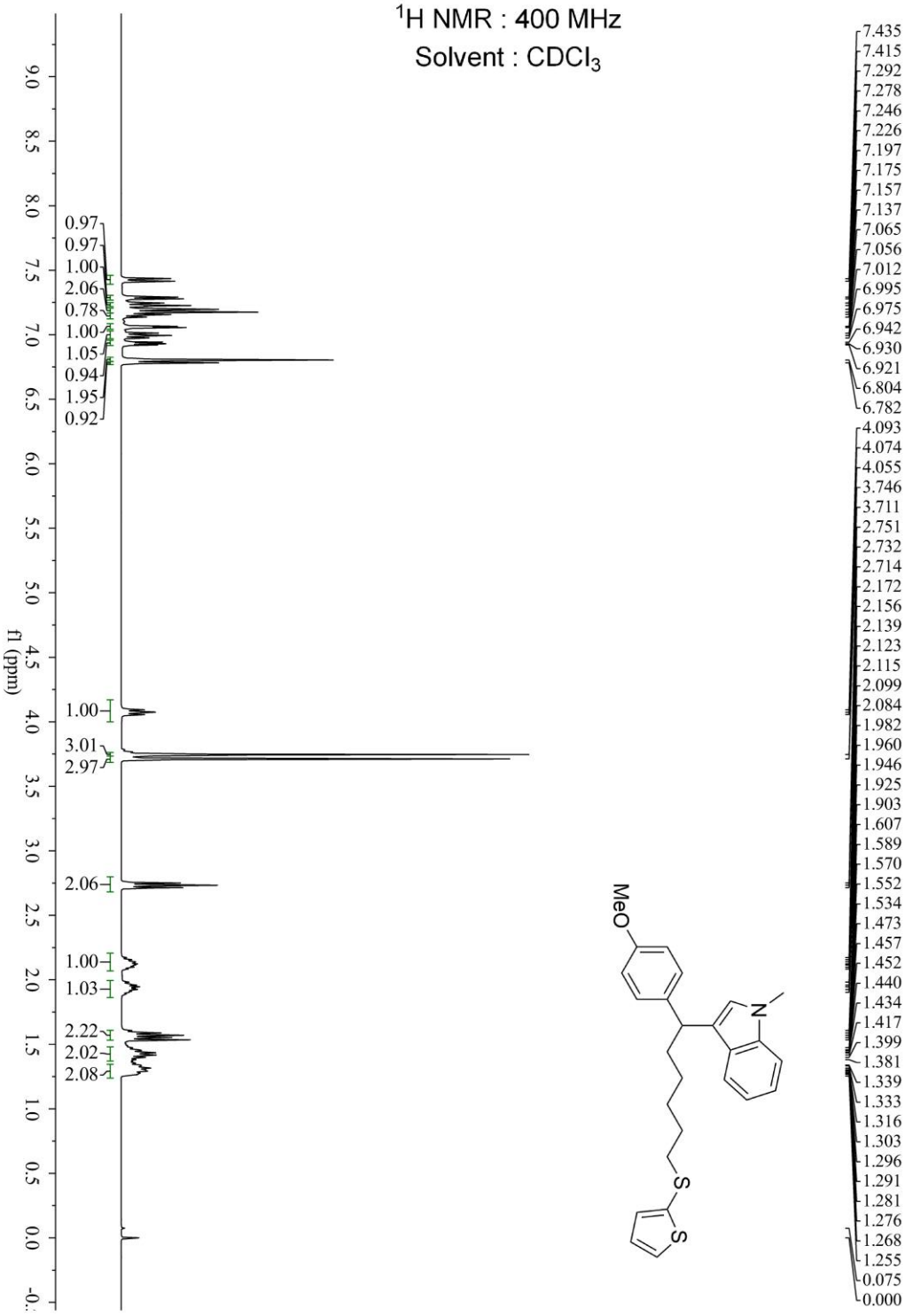

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.624
137.748
137.643
137.135
135.446
132.350
130.939
128.770
128.668
127.316
127.010
125.631
121.396
119.525
119.295
118.534
113.572
109.034
77.317
77.000
76.683
55.141
41.864
36.220
33.417
32.622
28.955
28.896
27.587
20.832
20.344
MeO
N
S

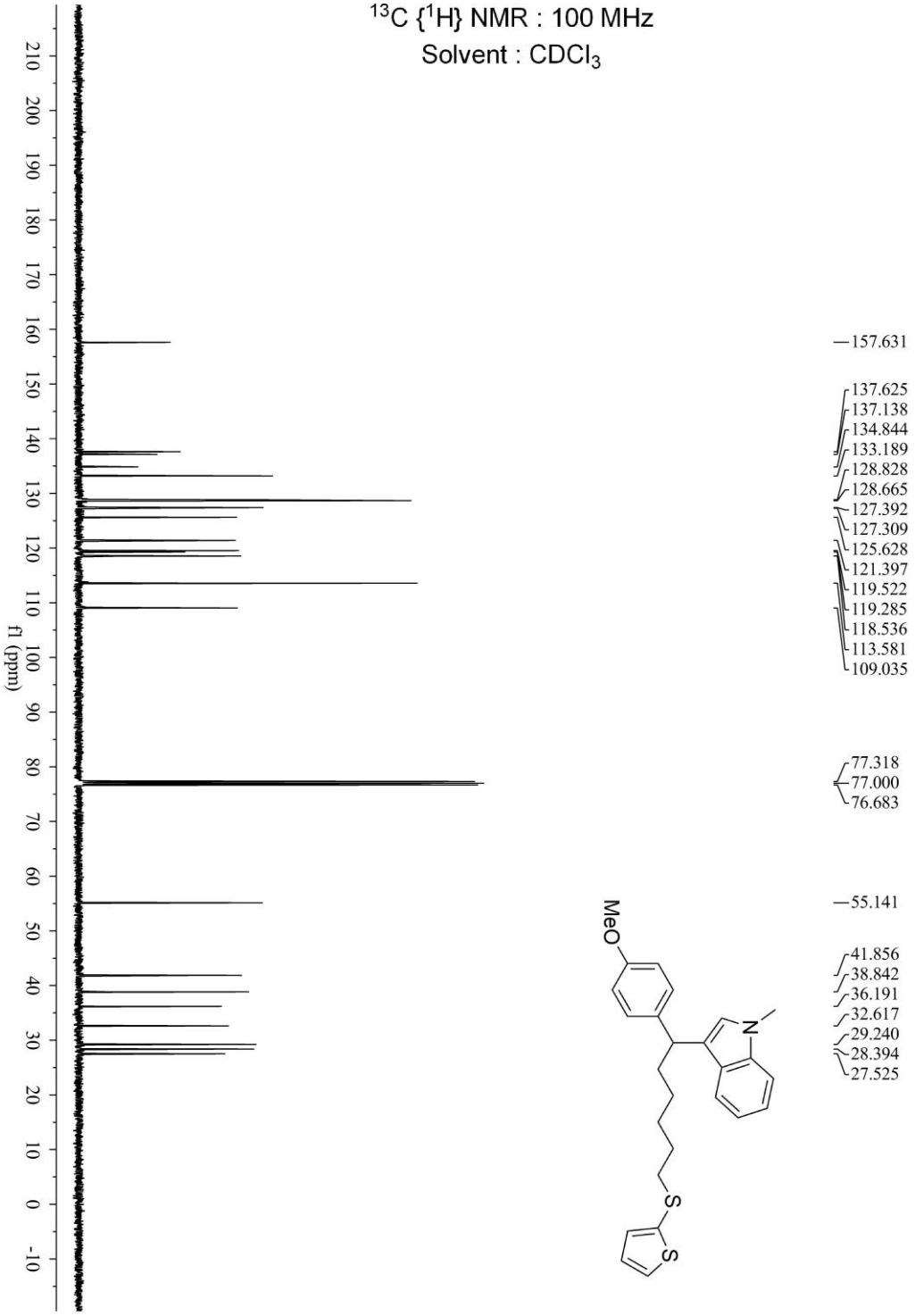
3-(1-(4-Methoxyphenyl)-6-(naphthalen-2-ylthio)hexyl)-1-methyl-1*H*-indole (4ama)



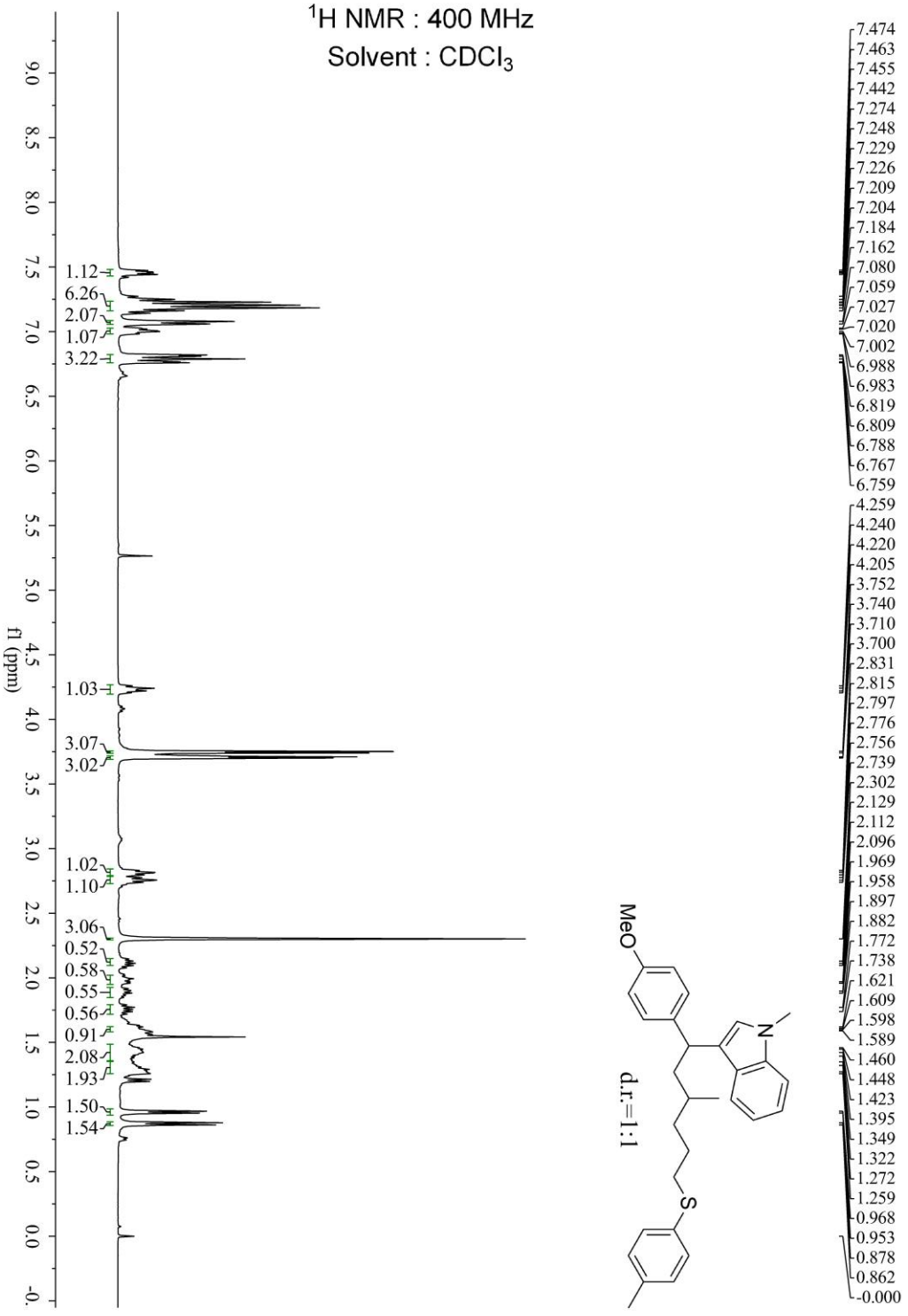

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.628
137.615
137.133
134.479
133.736
131.539
128.665
128.224
127.652
127.312
127.163
126.941
126.430
126.237
125.628
125.406
121.399
119.525
119.256
118.538
113.577
109.039
77.318
77.000
76.682
55.136
41.844
36.180
33.334
32.618
28.900
28.797
27.535
MeO
N
S

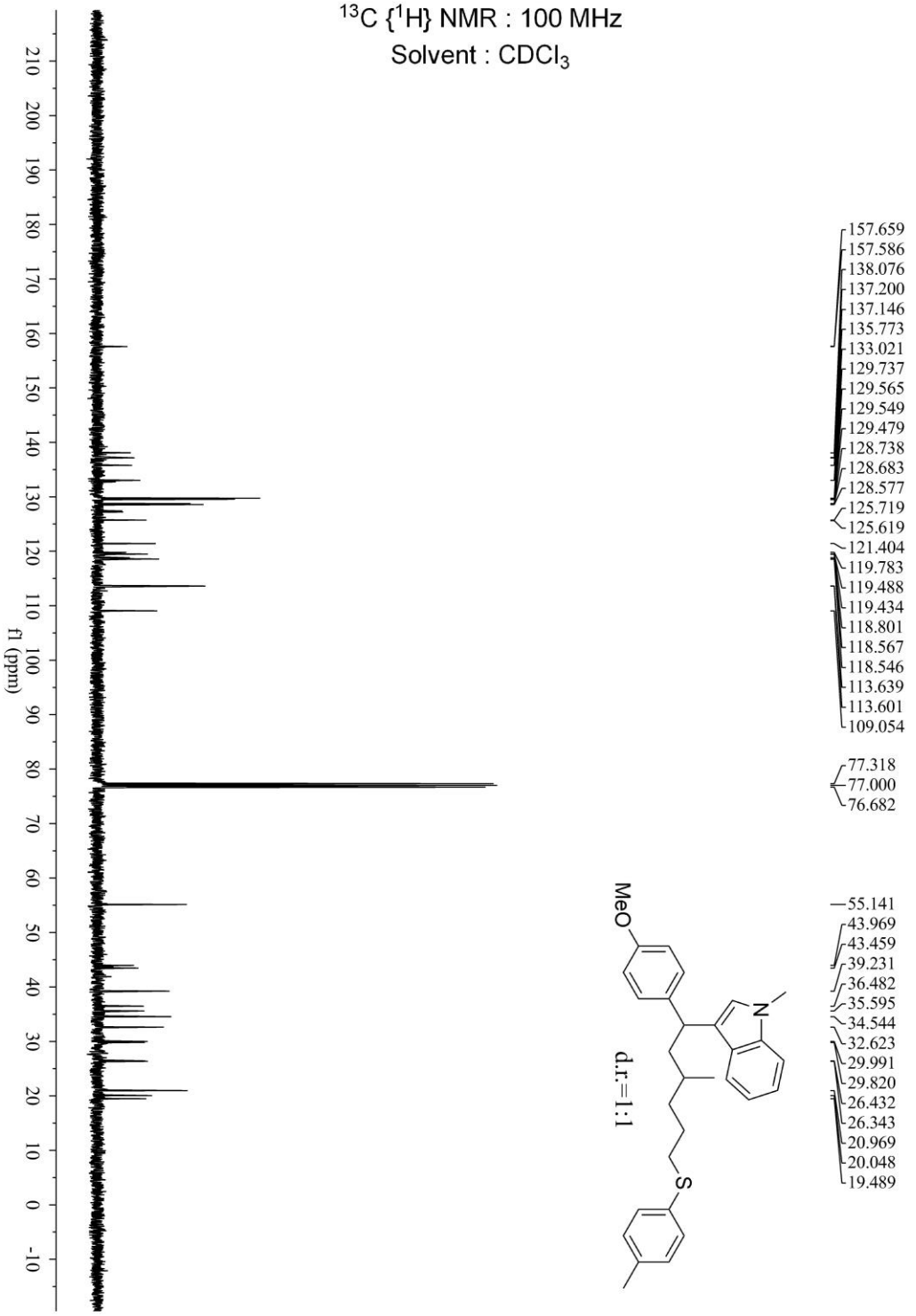
3-(1-(4-Methoxyphenyl)-6-(thiophen-2-ylthio)hexyl)-1-methyl-1*H*-indole (4ana)



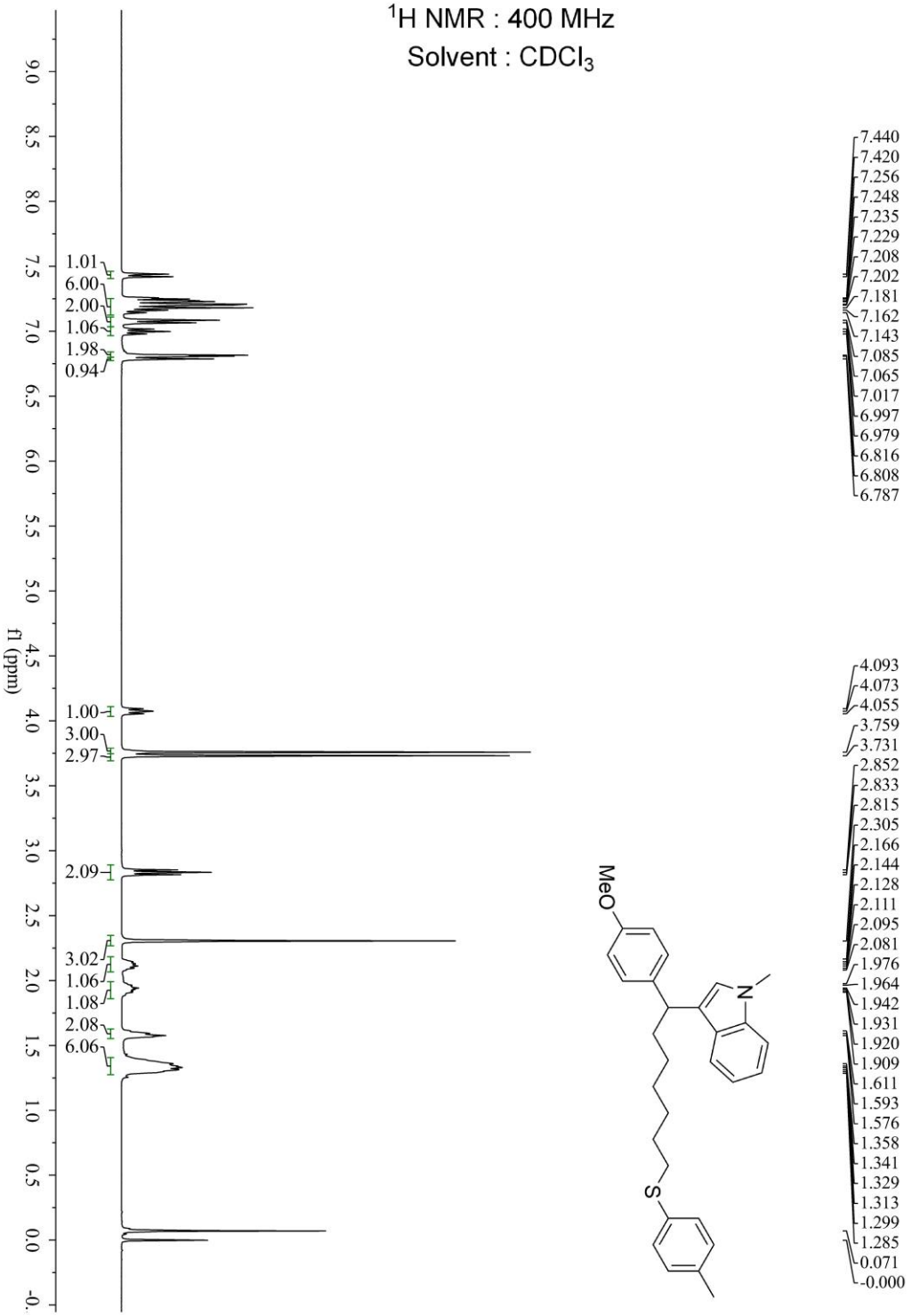

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.631
137.625
137.138
134.844
133.189
128.828
128.665
127.392
127.309
125.628
121.397
119.522
119.285
118.536
113.581
109.035
77.318
77.000
76.683
55.141
41.856
38.842
36.191
32.617
29.240
28.394
27.525
MeO
N
S
S

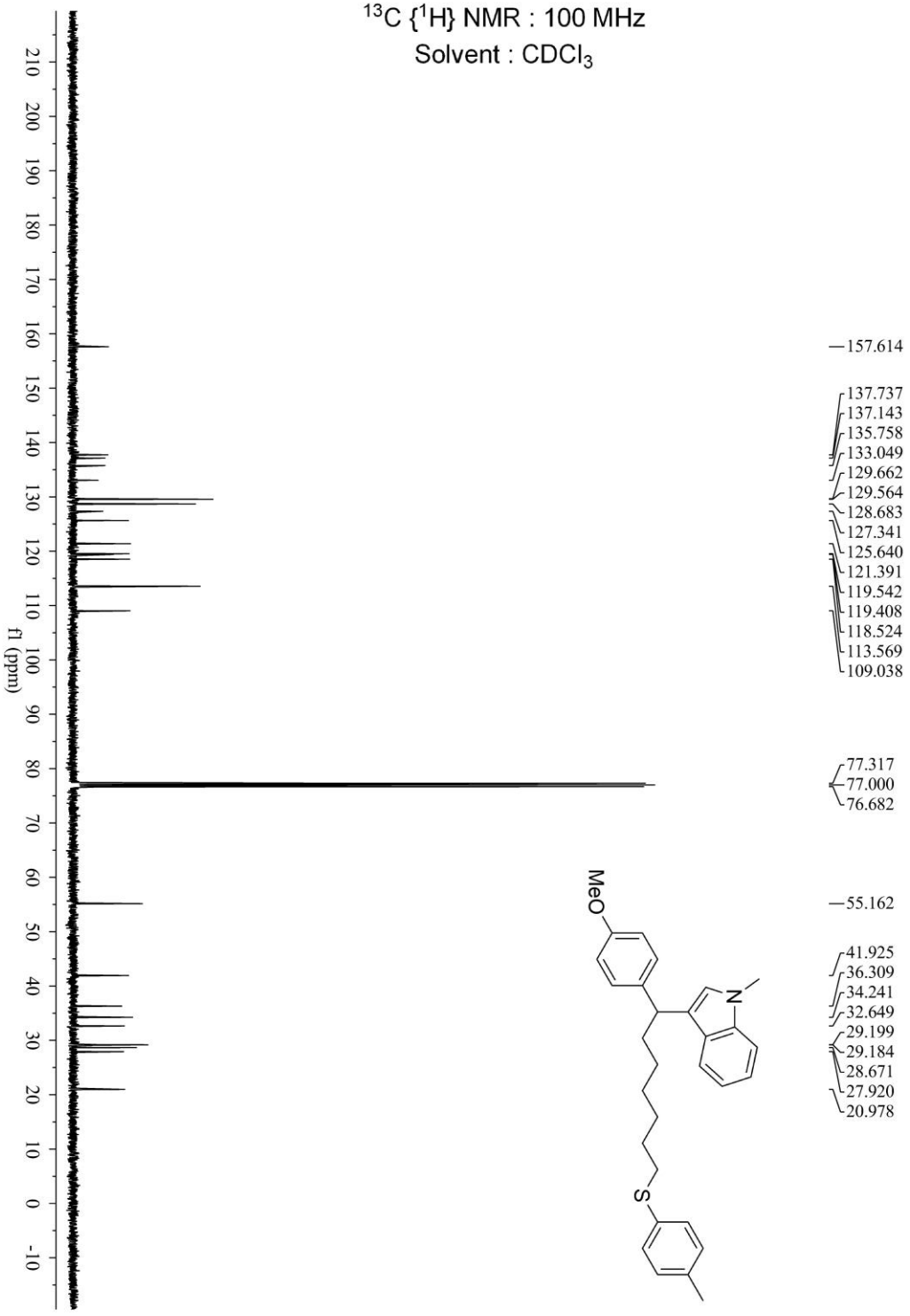
3-(1-(4-Methoxyphenyl)-3-methyl-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aoa)



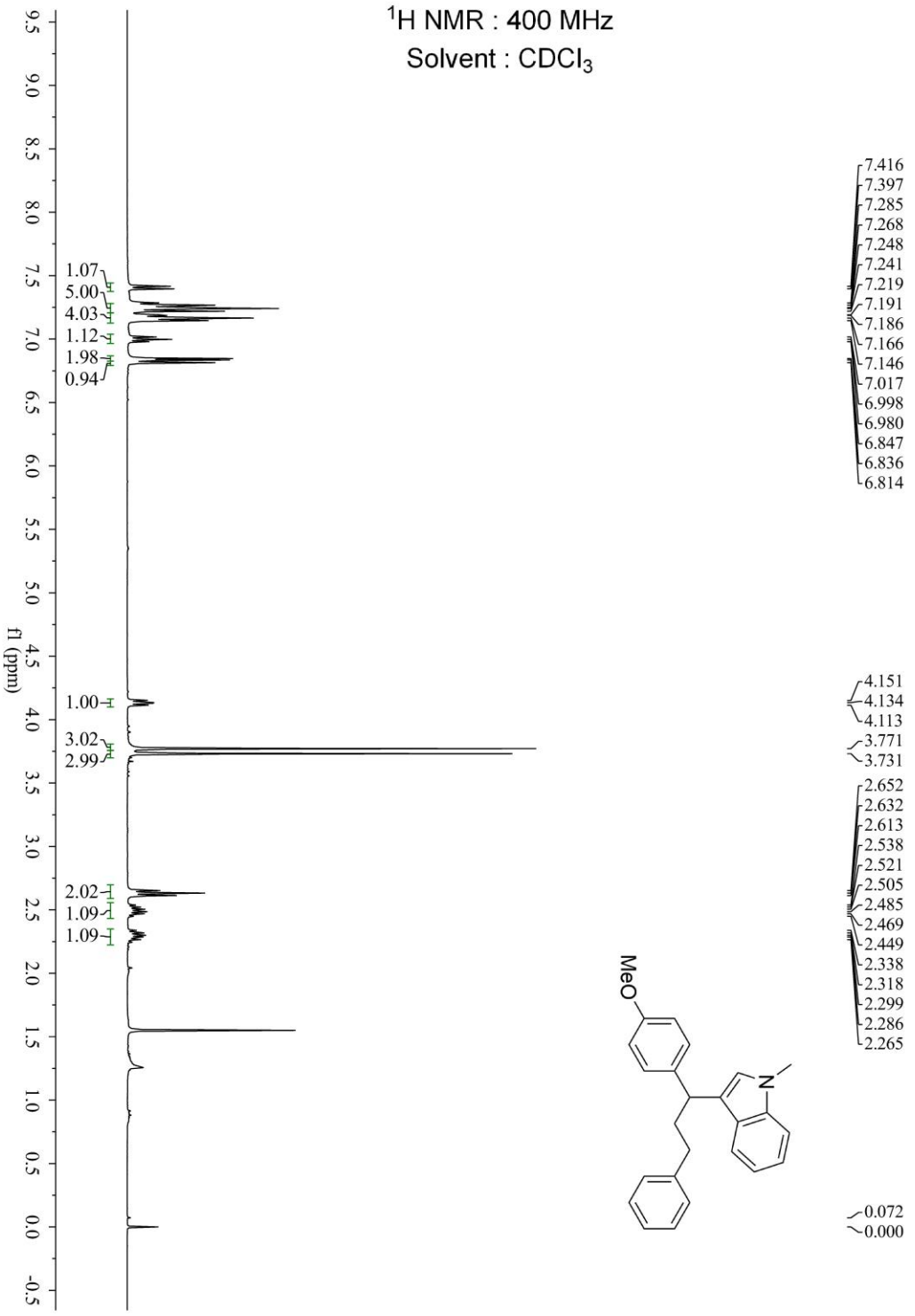

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.659
157.586
138.076
137.200
137.146
135.773
133.021
129.737
129.565
129.549
129.479
128.738
128.683
128.577
125.719
125.619
121.404
119.783
119.488
119.434
118.801
118.567
118.546
113.639
113.601
109.054
77.318
77.000
76.682
55.141
43.969
43.459
39.231
36.482
35.595
34.544
32.623
29.991
29.820
26.432
26.343
20.969
20.048
19.489
MeO
N
S
d.r.=1:1

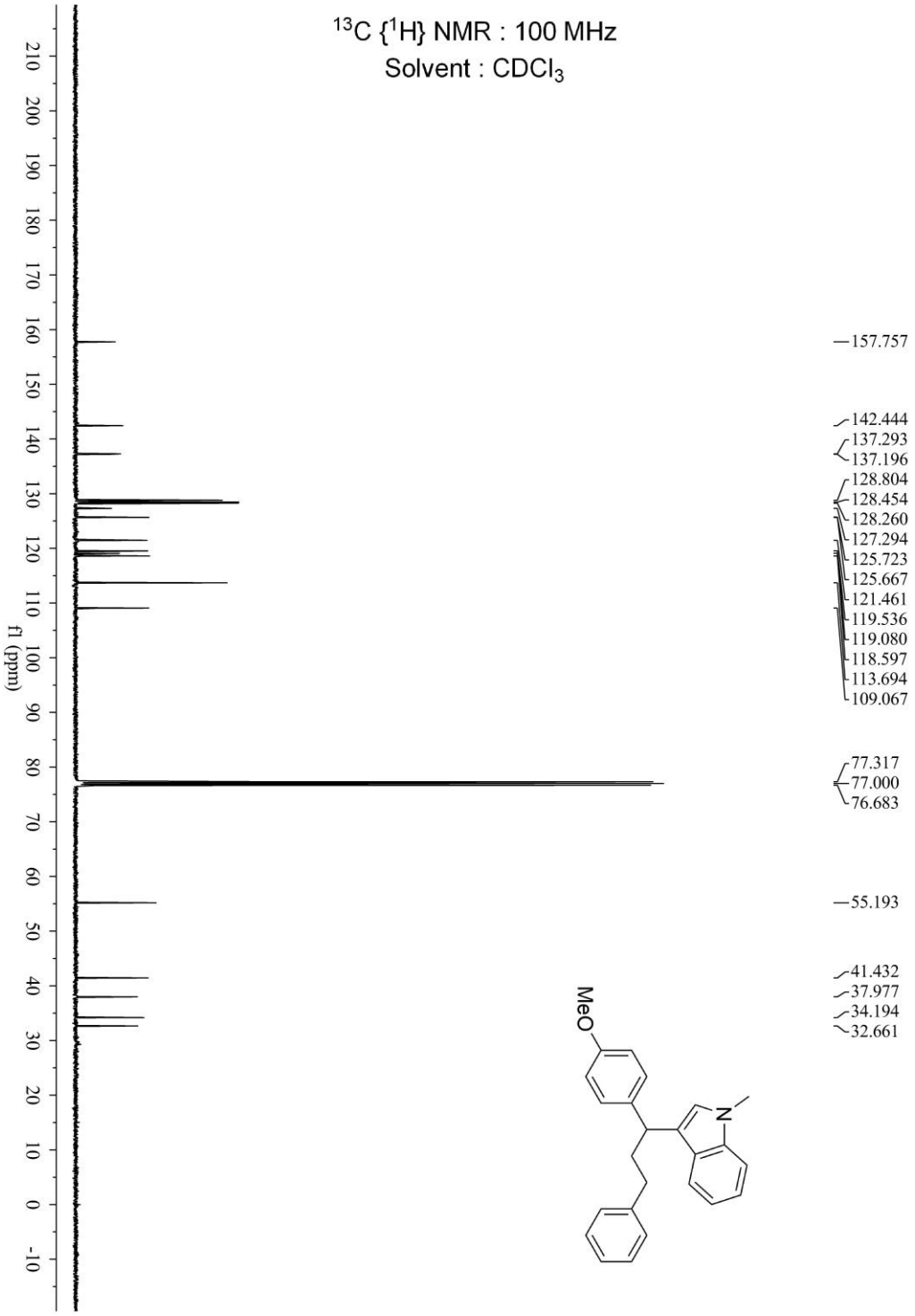
3-(1-(4-Methoxyphenyl)-7-(*p*-tolylthio)heptyl)-1-methyl-1*H*-indole (4apa)



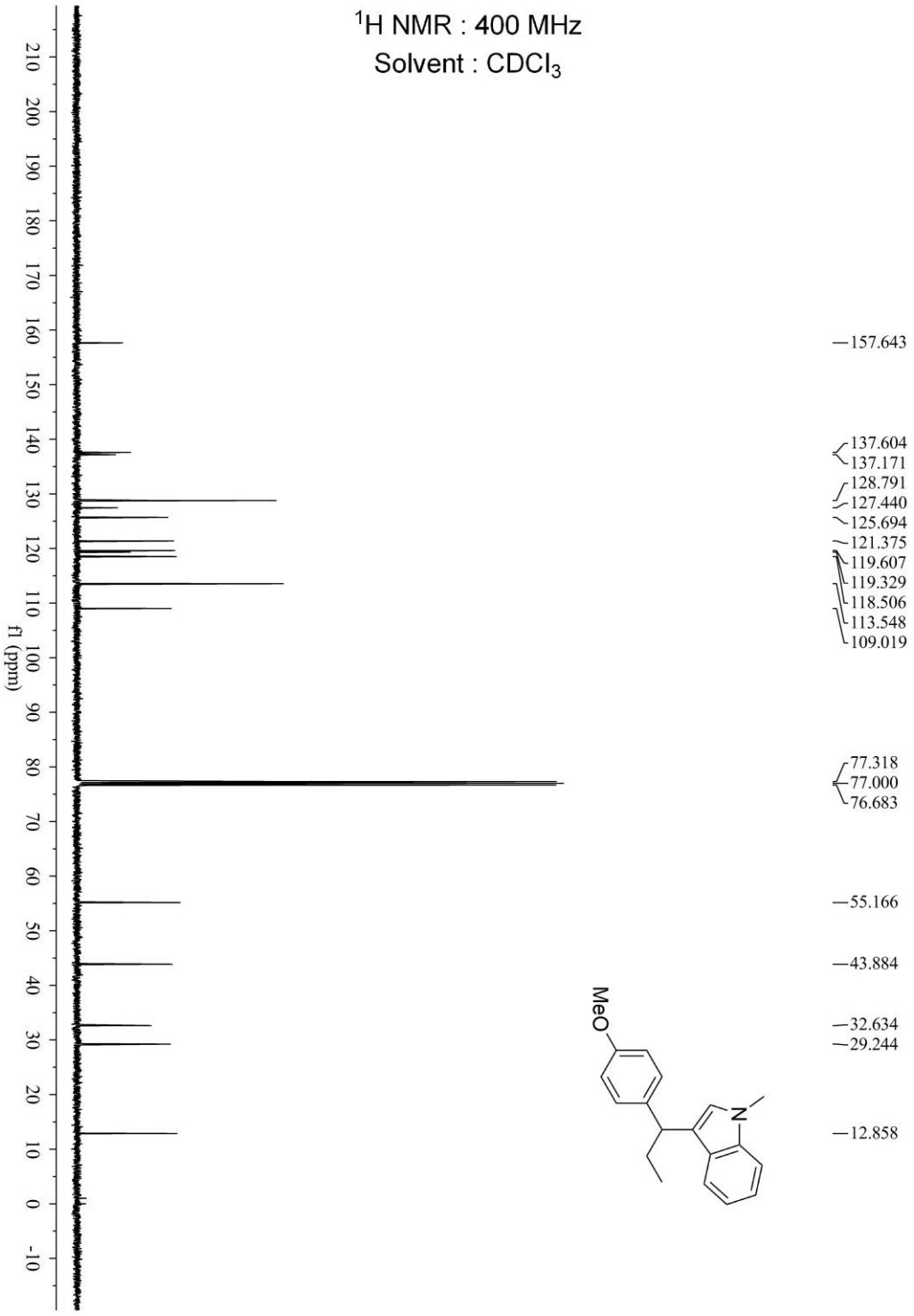

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.614
137.737
137.143
135.758
133.049
129.662
129.564
128.683
127.341
125.640
121.391
119.542
119.408
118.524
113.569
109.038
77.317
77.000
76.682
55.162
41.925
36.309
34.241
32.649
29.199
29.184
28.671
27.920
20.978
MeO
N
S

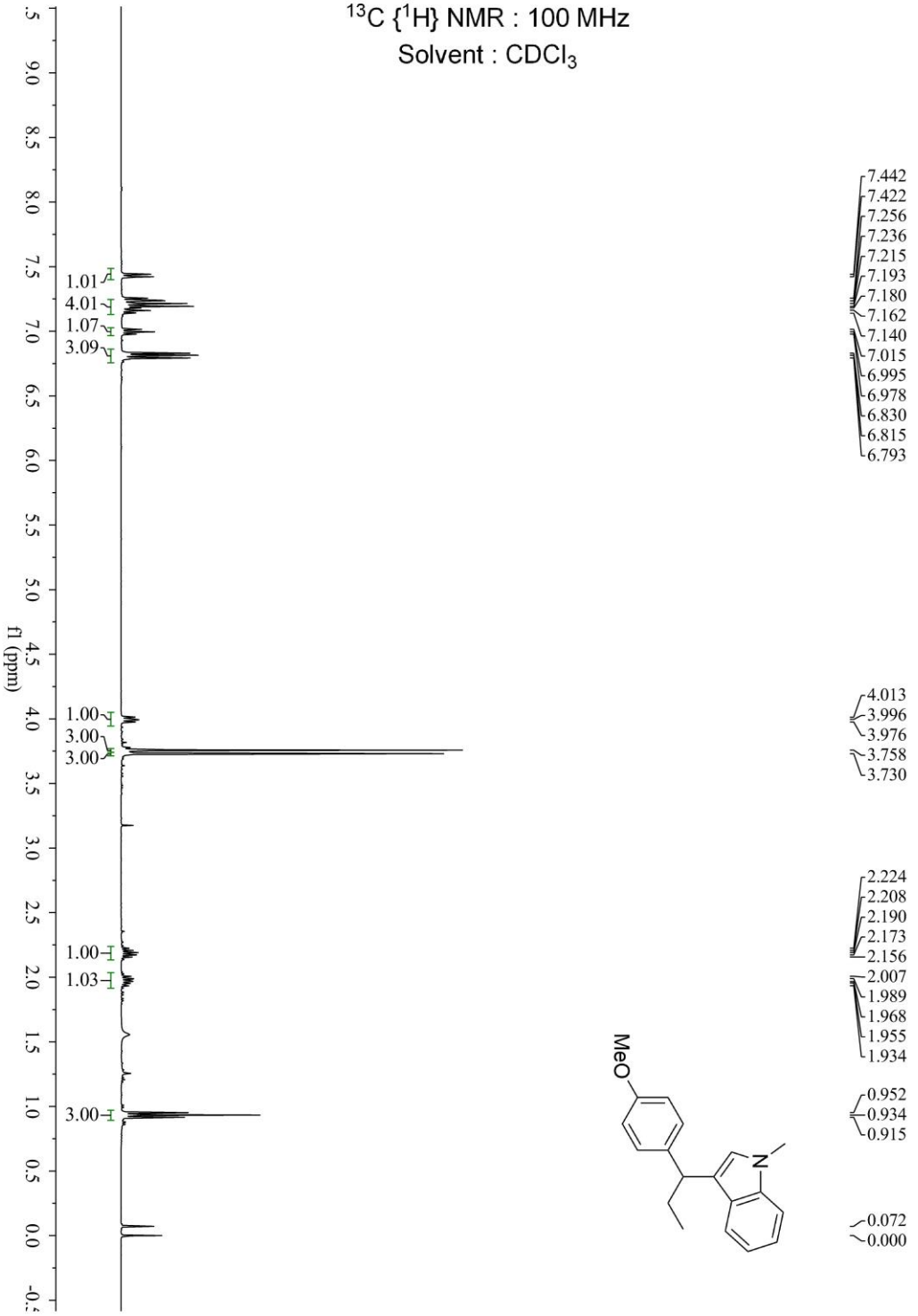
3-(1-(4-Methoxyphenyl)-3-phenylpropyl)-1-methyl-1*H*-indole (4aqa)



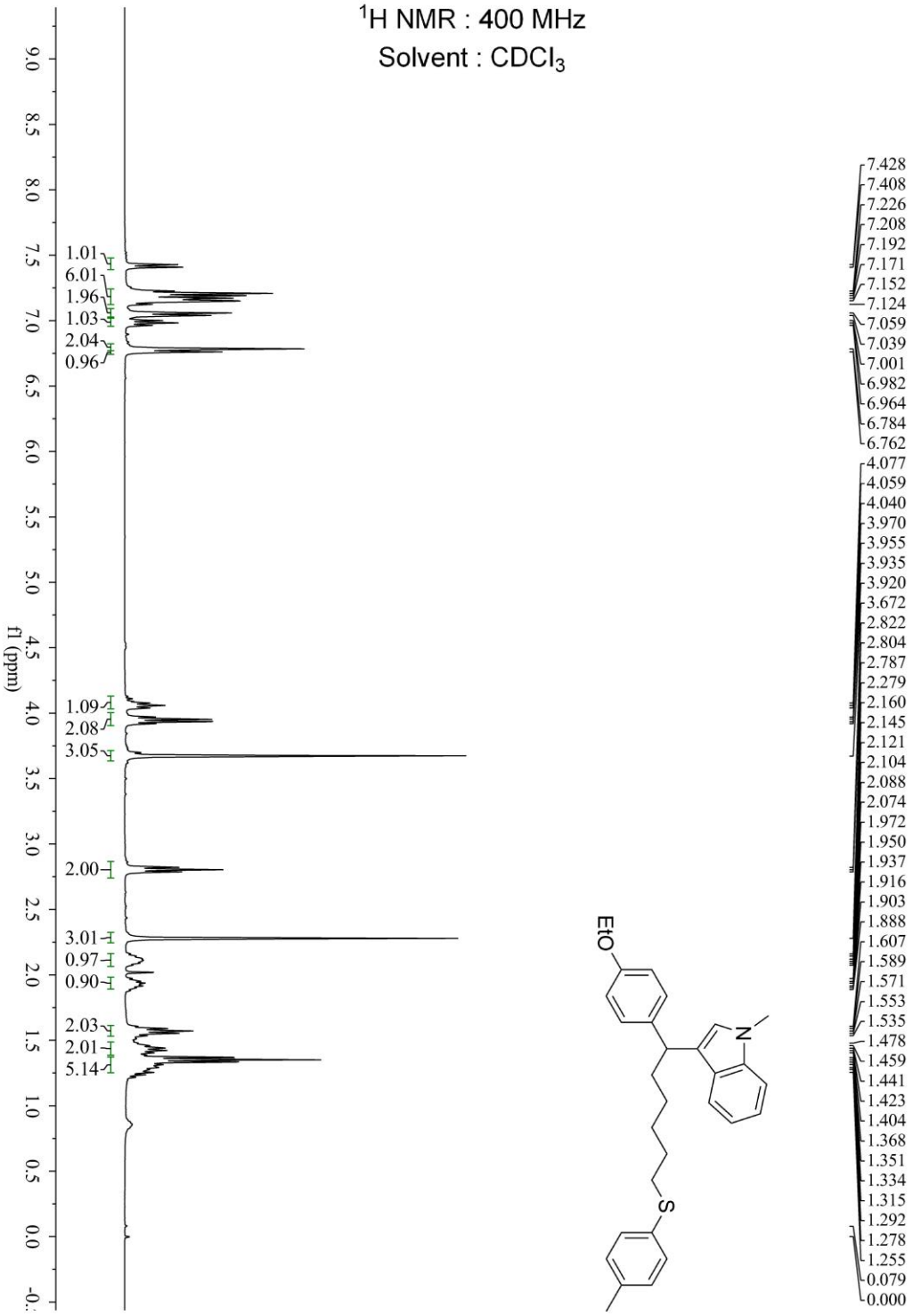

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.757
142.444
137.293
137.196
128.804
128.454
128.260
127.294
125.723
125.667
121.461
119.536
119.080
118.597
113.694
109.067
77.317
77.000
76.683
55.193
41.432
37.977
34.194
32.661
MeO
N

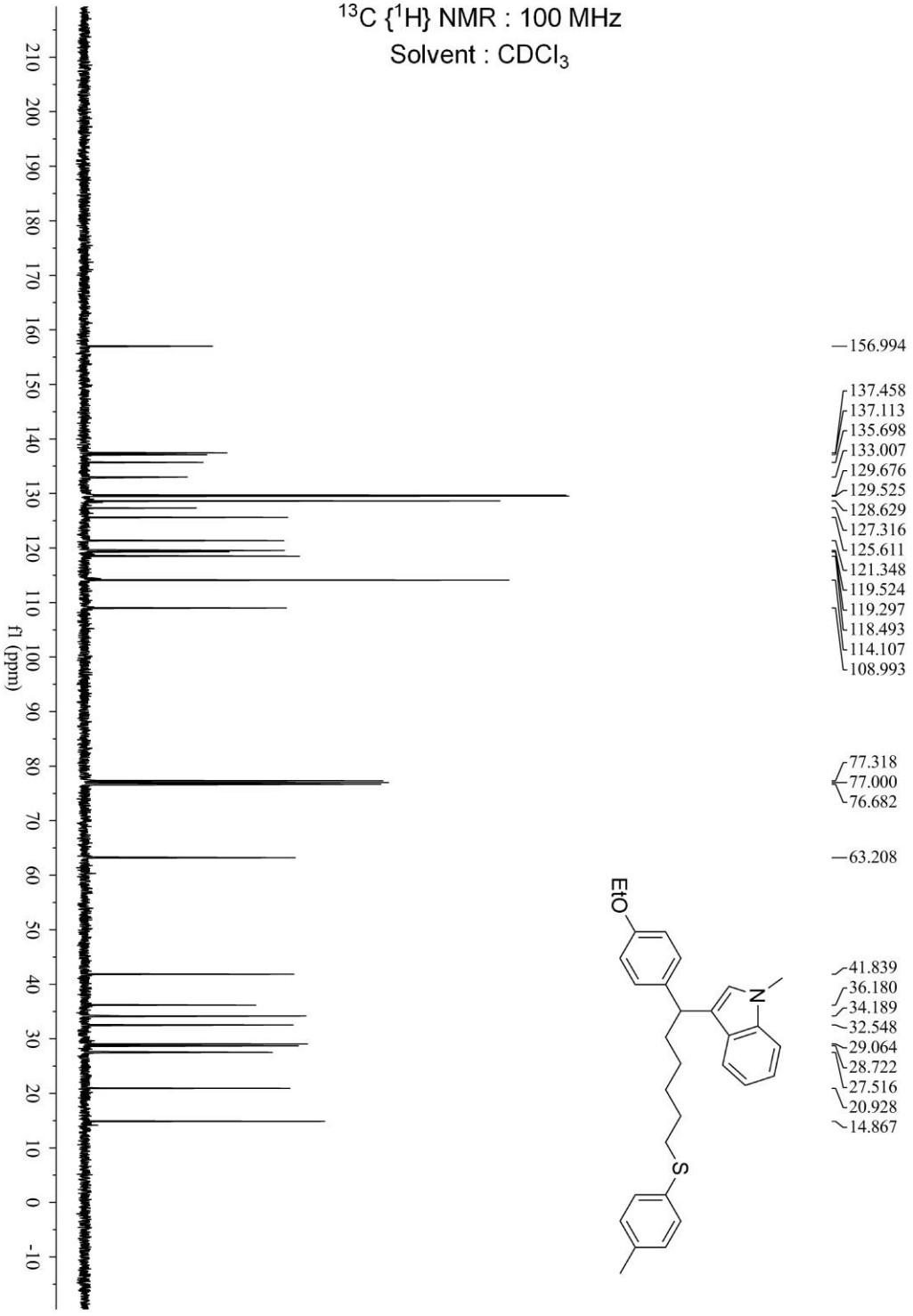
3-(1-(4-Methoxyphenyl)propyl)-1-methyl-1*H*-indole (4ara)



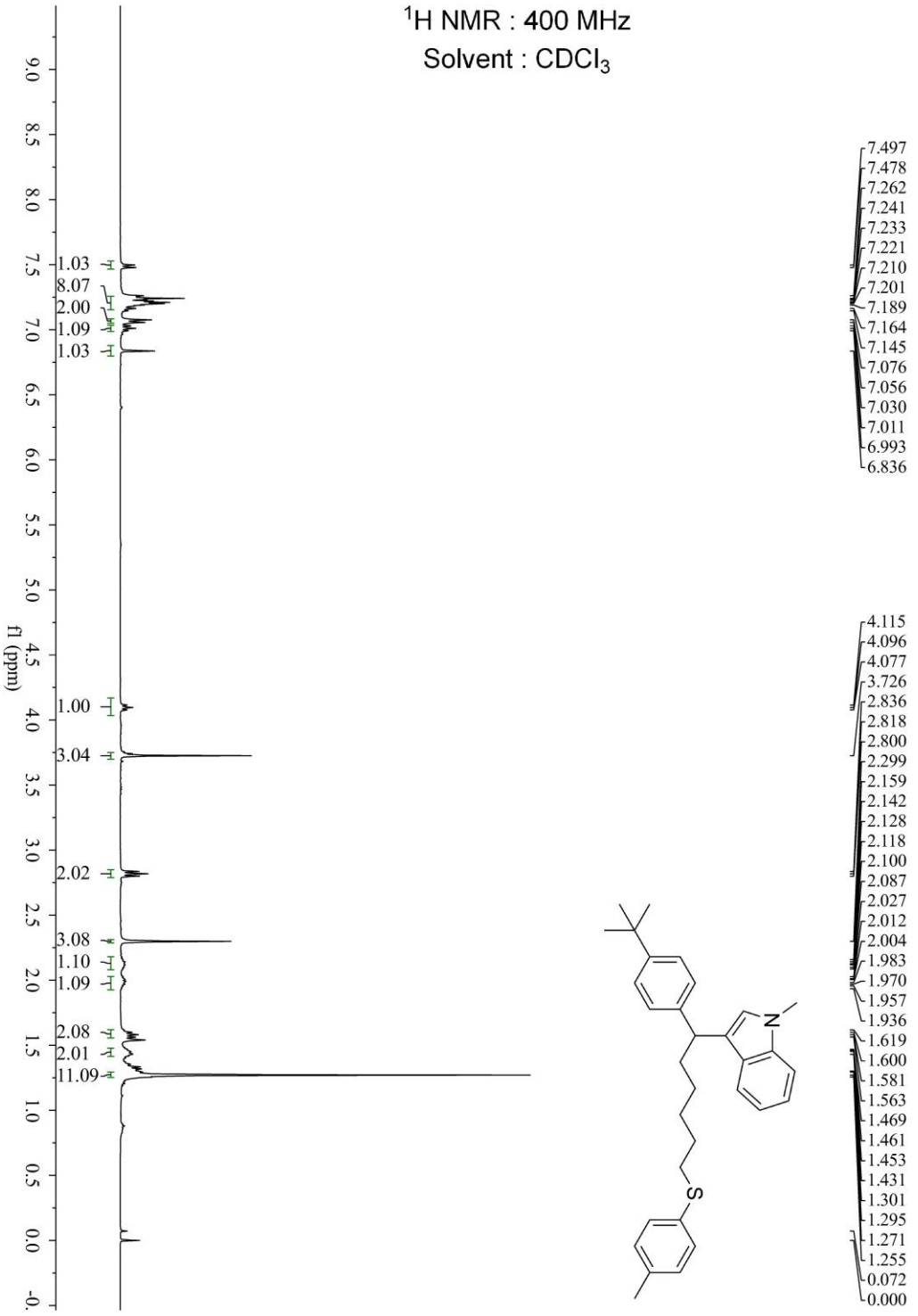

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
1.01
4.01
1.07
3.09
1.00
3.00
3.00
1.00
1.03
3.00
7.442
7.422
7.256
7.236
7.215
7.193
7.180
7.162
7.140
7.015
6.995
6.978
6.830
6.815
6.793
4.013
3.996
3.976
3.758
3.730
2.224
2.208
2.190
2.173
2.156
2.007
1.989
1.968
1.955
1.934
0.952
0.934
0.915
0.072
0.000
MeO
N

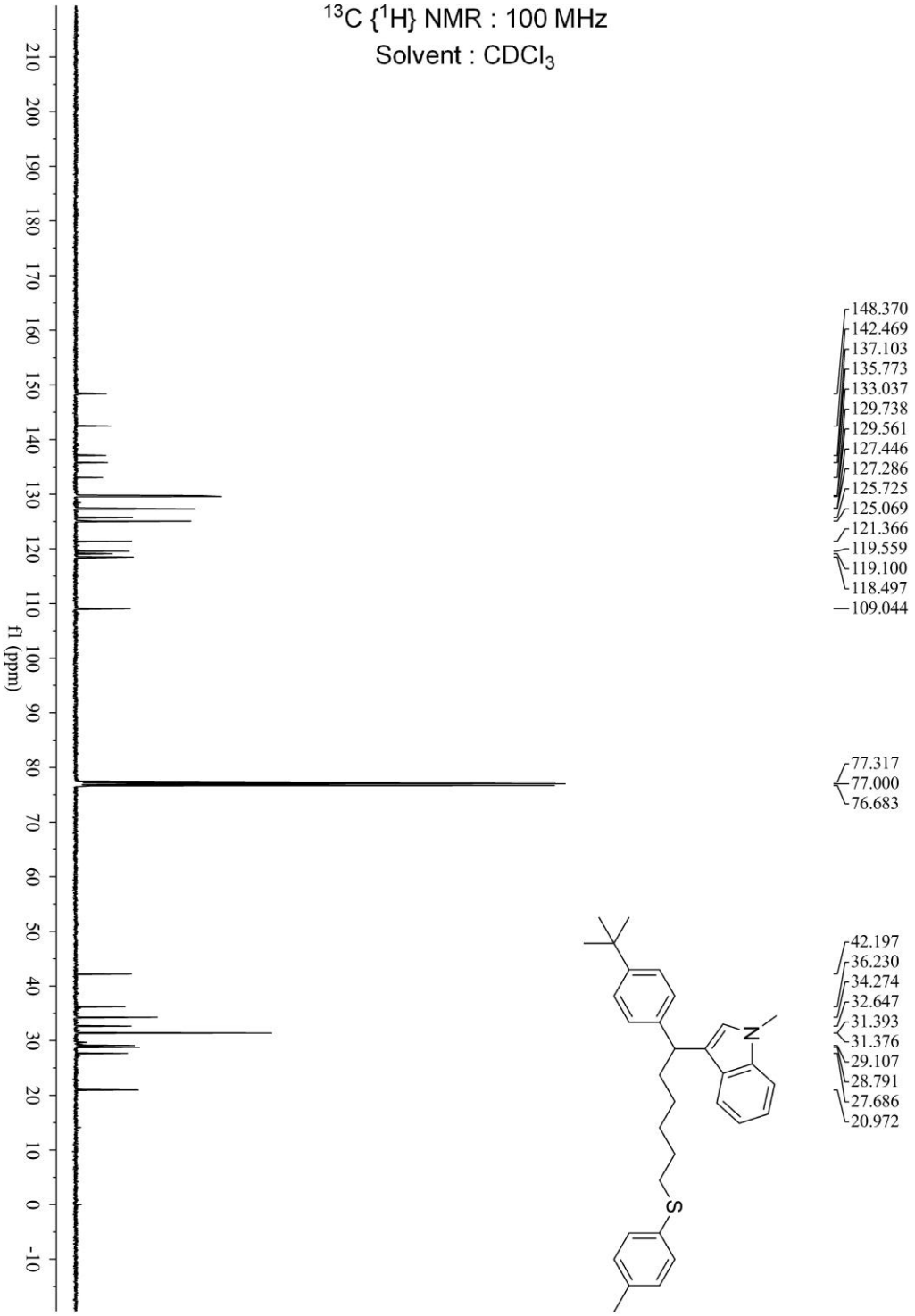
3-(1-(4-Ethoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4baa)



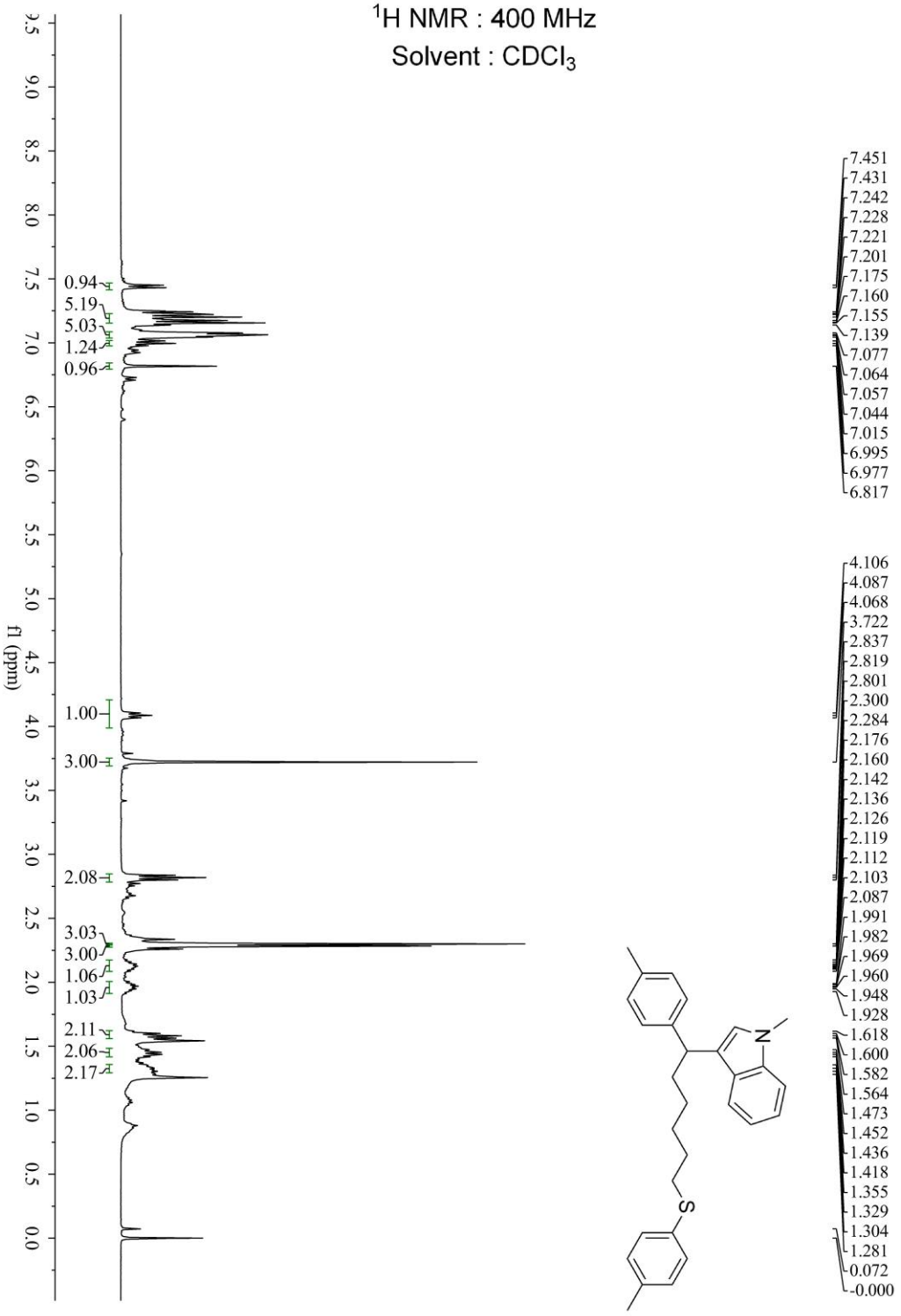

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
156.994
137.458
137.113
135.698
133.007
129.676
129.525
128.629
127.316
125.611
121.348
119.524
119.297
118.493
114.107
108.993
77.318
77.000
76.682
63.208
41.839
36.180
34.189
32.548
29.064
28.722
27.516
20.928
14.867
EtO
N
S

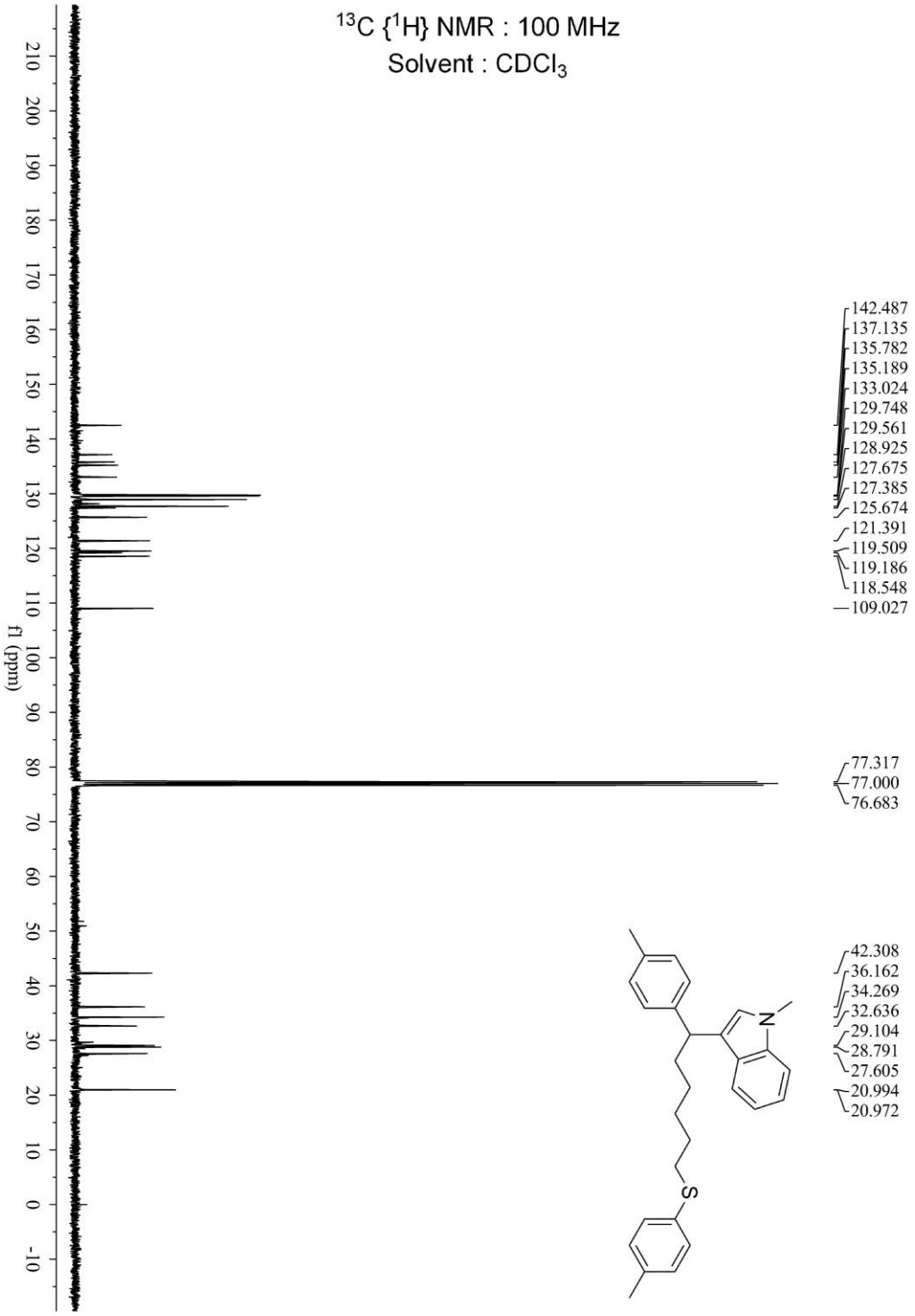
3-(1-(4-(Tert-butyl)phenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4caa)



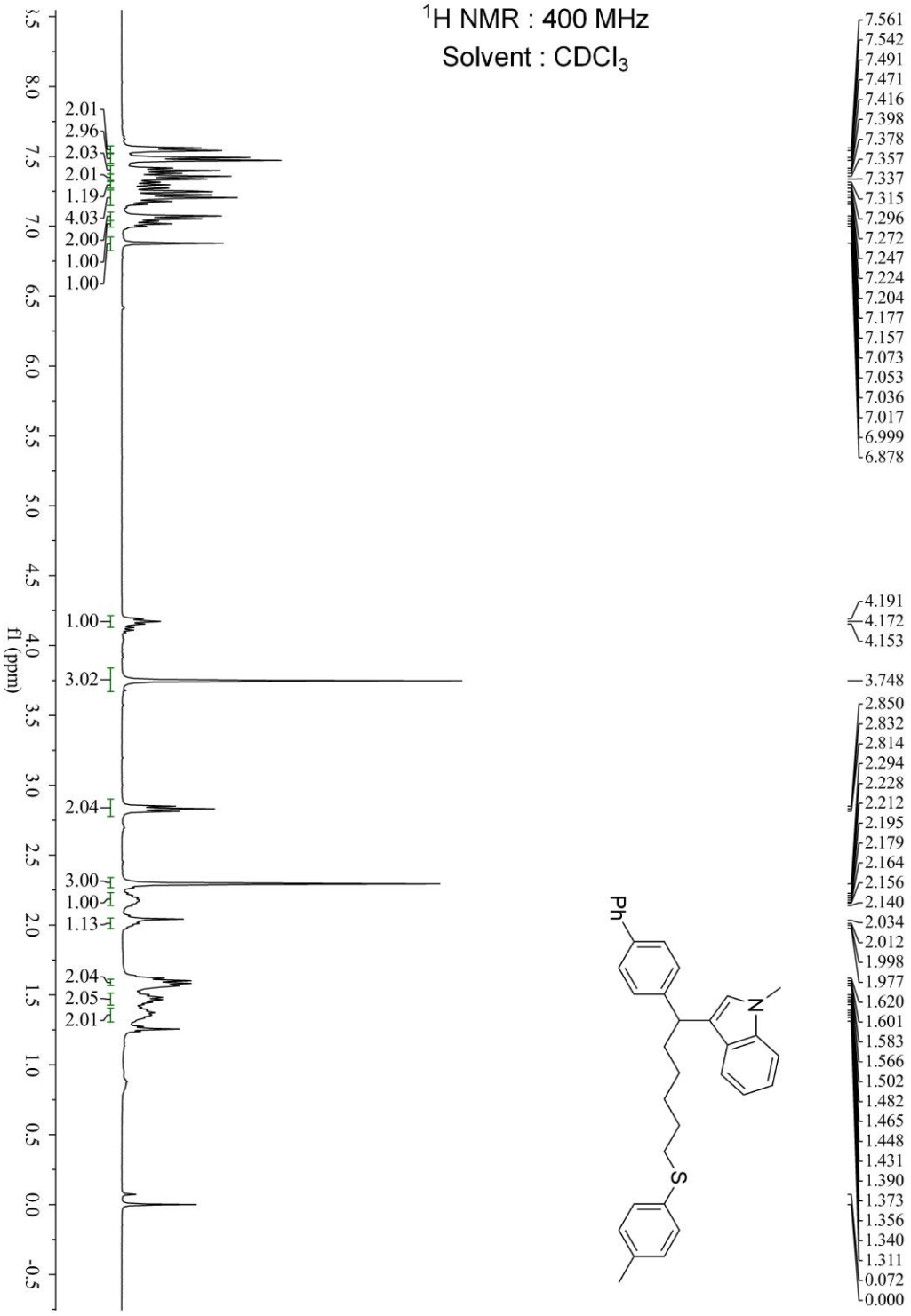

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
148.370
142.469
137.103
135.773
133.037
129.738
129.561
127.446
127.286
125.725
125.069
121.366
119.559
119.100
118.497
109.044
77.317
77.000
76.683
42.197
36.230
34.274
32.647
31.393
31.376
29.107
28.791
27.686
20.972
N
S

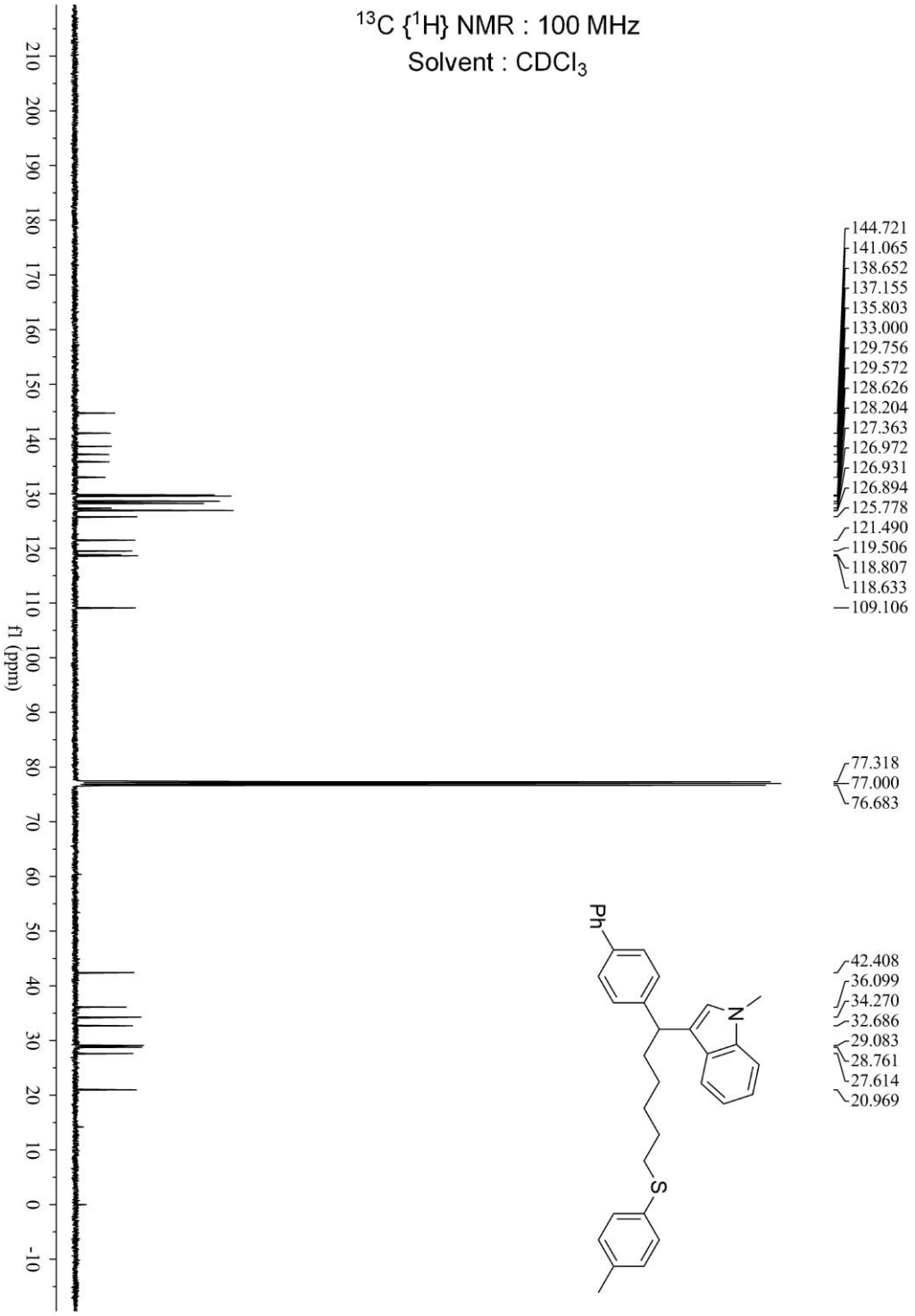
1-Methyl-3-(1-(*p*-tolyl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4daa)



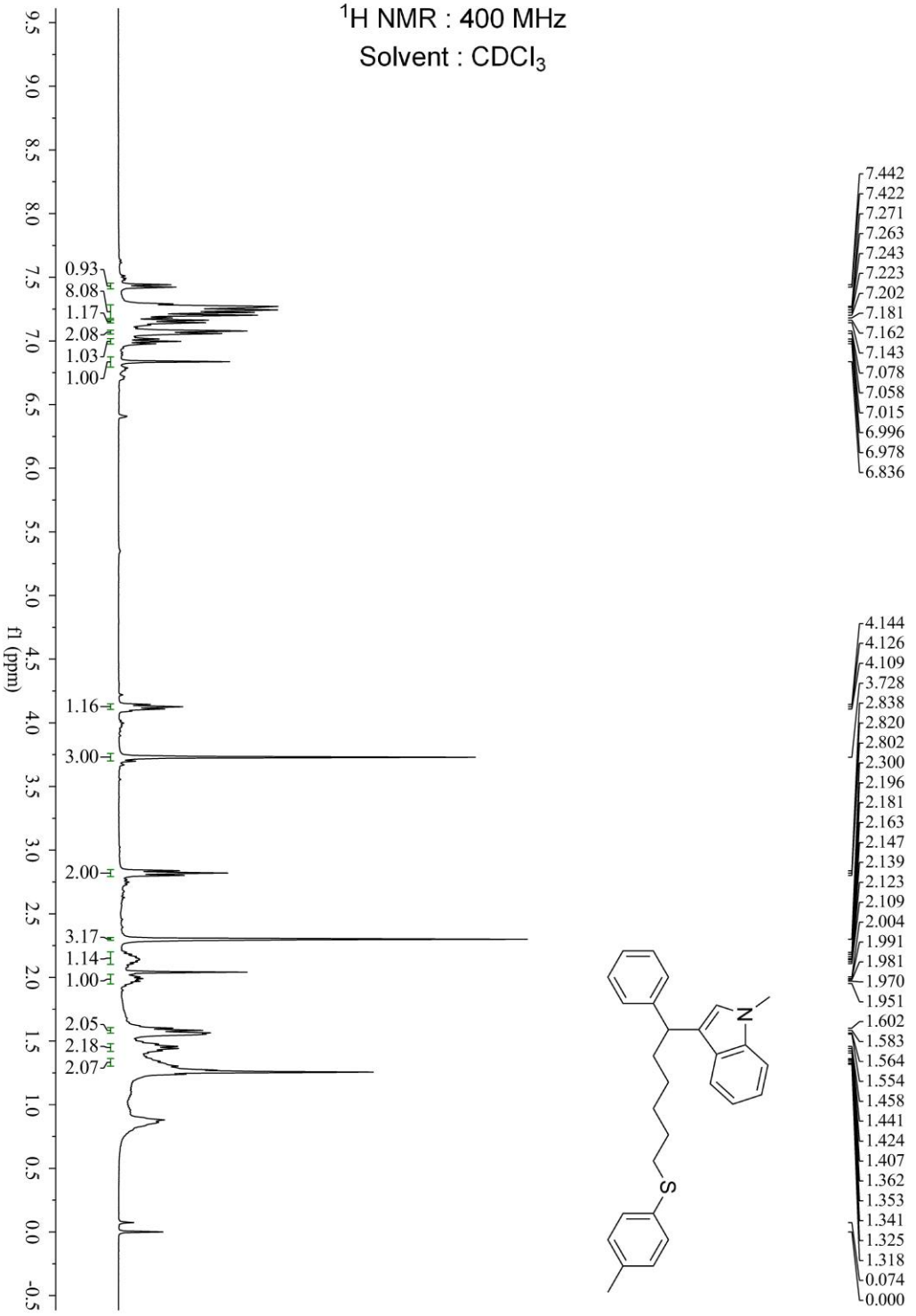

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
142.487
137.135
135.782
135.189
133.024
129.748
129.561
128.925
127.675
127.385
125.674
121.391
119.509
119.186
118.548
109.027
77.317
77.000
76.683
42.308
36.162
34.269
32.636
29.104
28.791
27.605
20.994
20.972
N
S

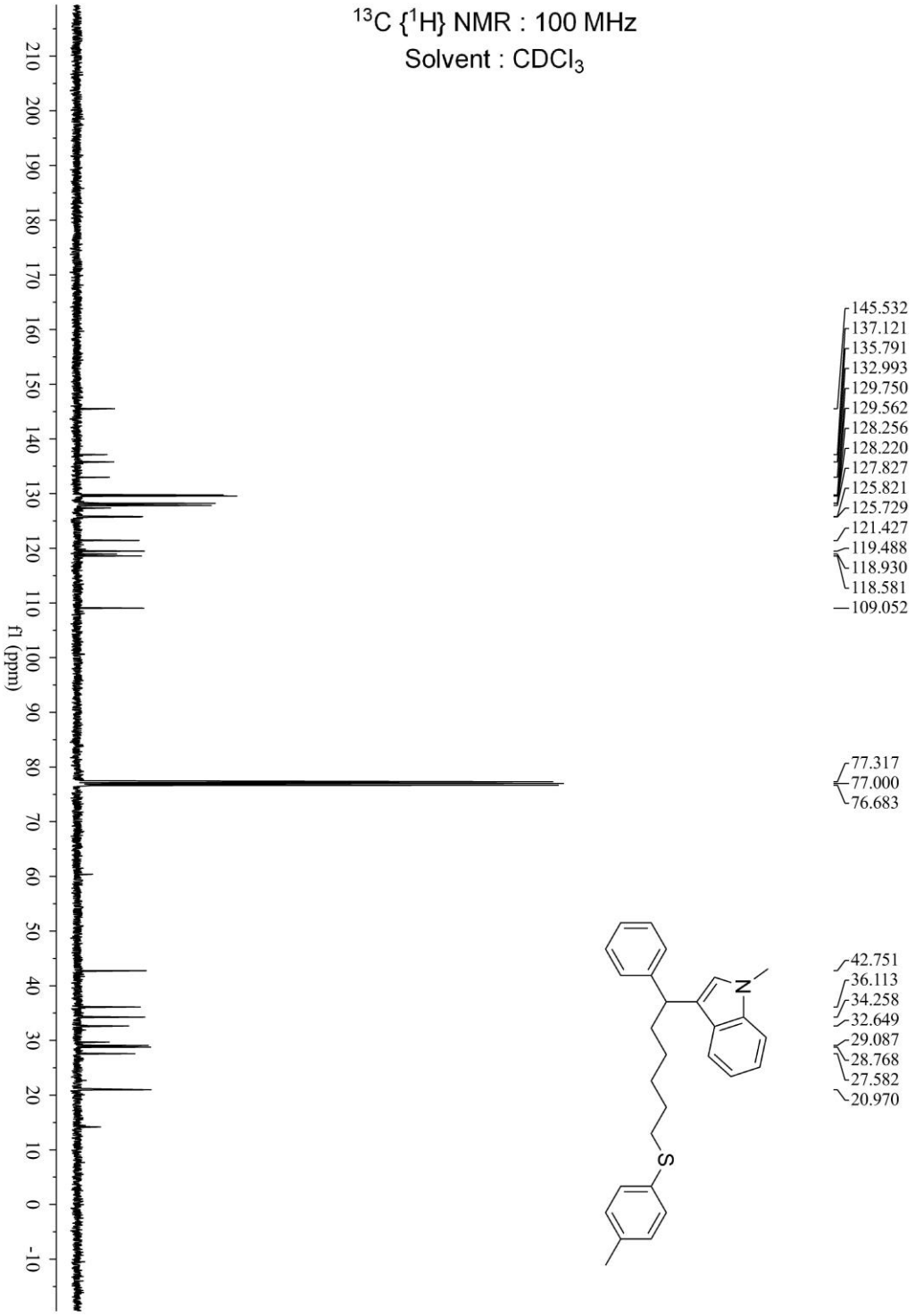
3-(1-([1,1'-Biphenyl]-4-yl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4eaa)



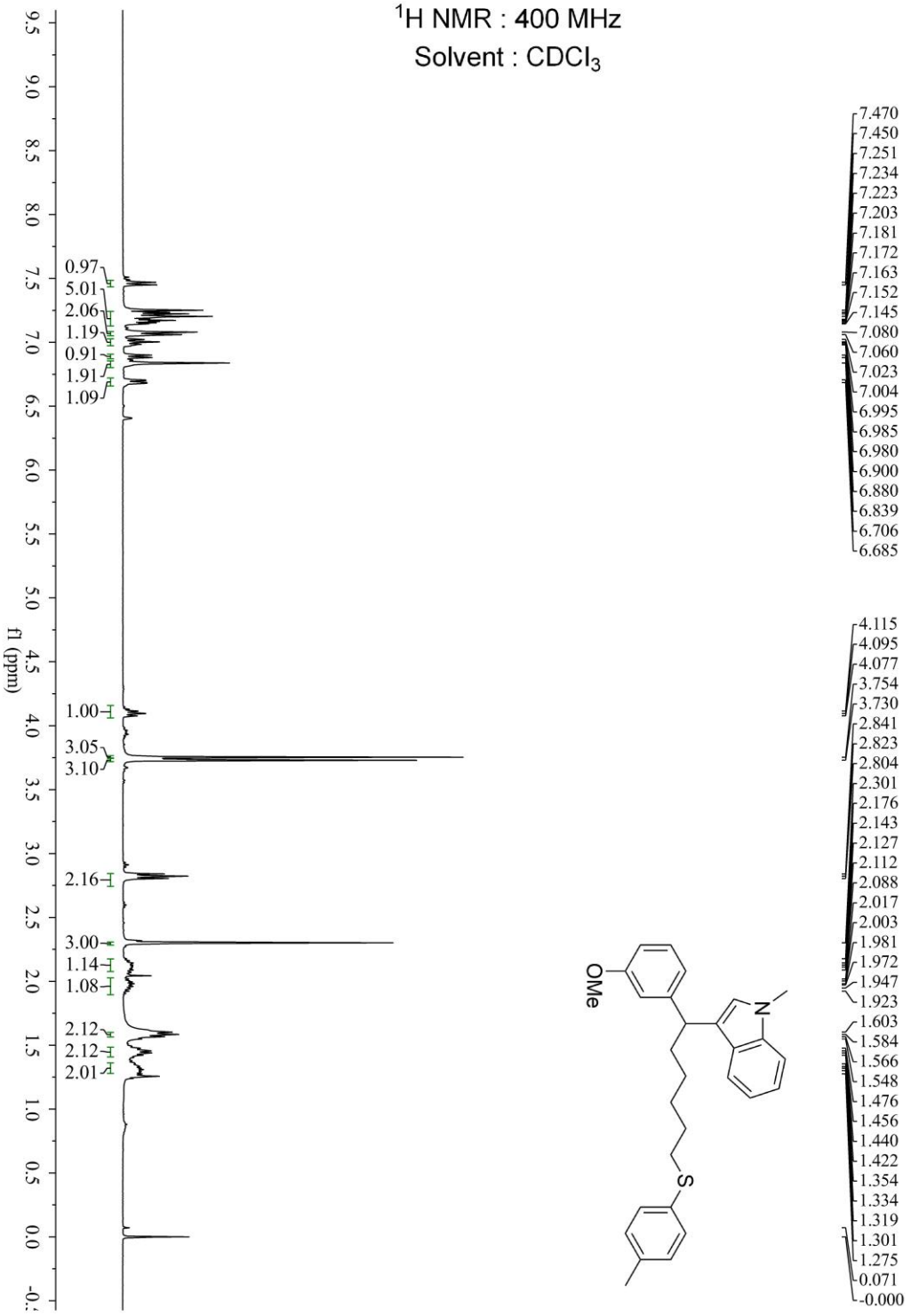

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
144.721
141.065
138.652
137.155
135.803
133.000
129.756
129.572
128.626
128.204
127.363
126.972
126.931
126.894
125.778
121.490
119.506
118.807
118.633
109.106
77.318
77.000
76.683
42.408
36.099
34.270
32.686
29.083
28.761
27.614
20.969
Ph
N
S

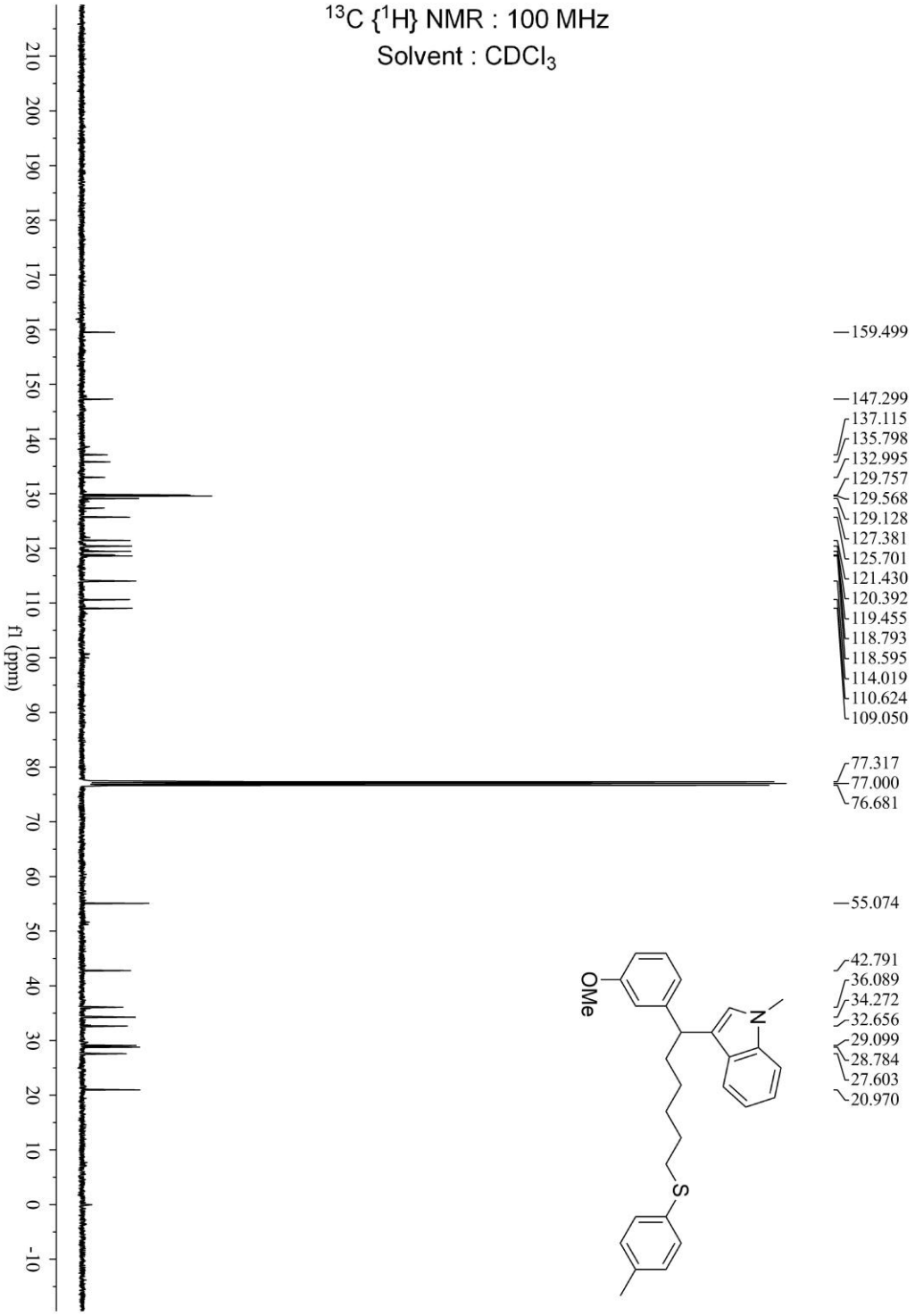
1-Methyl-3-(1-phenyl-6-(*p*-tolylthio)hexyl)-1*H*-indole (4faa)



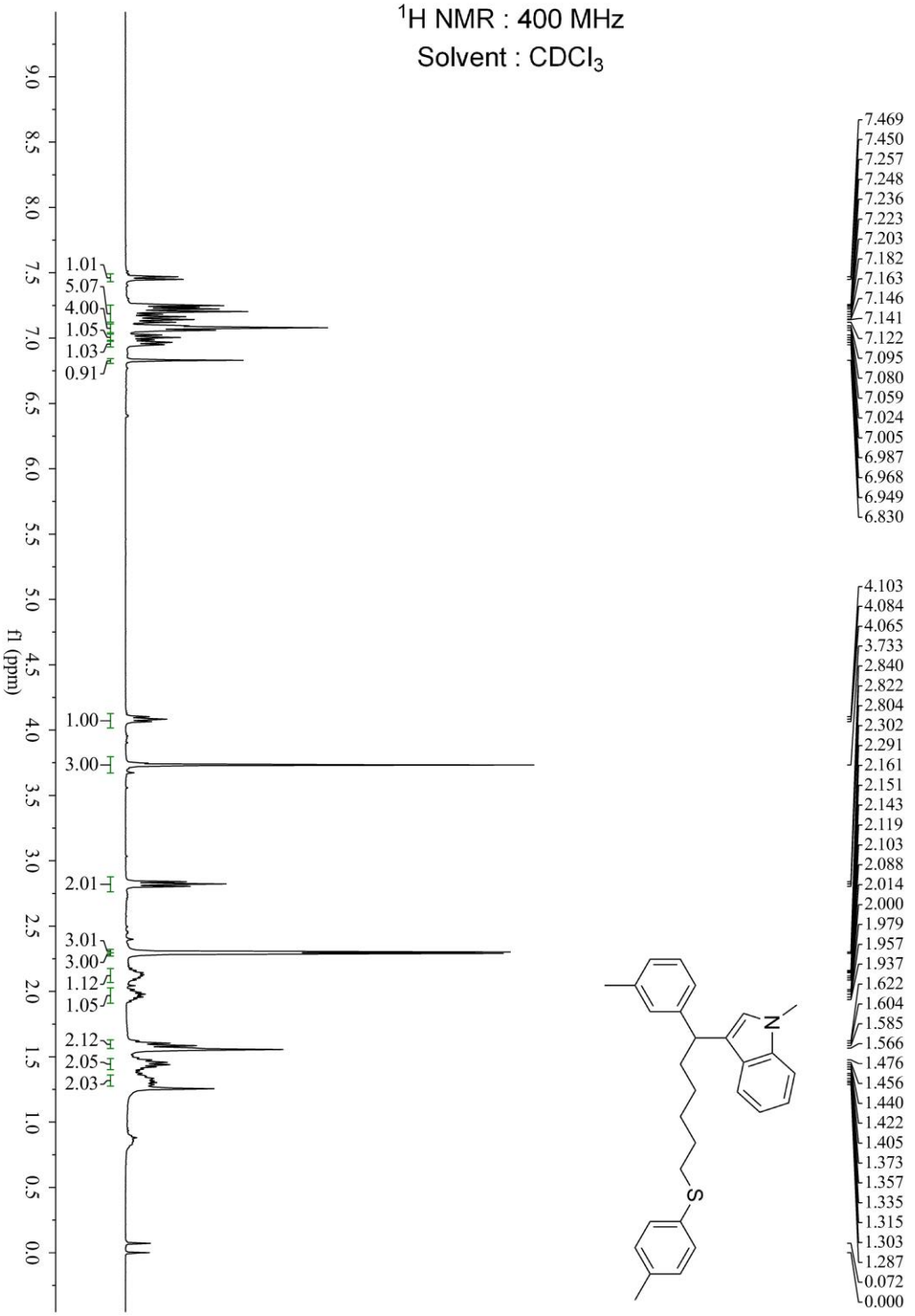

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
145.532
137.121
135.791
132.993
129.750
129.562
128.256
128.220
127.827
125.821
125.729
121.427
119.488
118.930
118.581
109.052
77.317
77.000
76.683
42.751
36.113
34.258
32.649
29.087
28.768
27.582
20.970
N
S

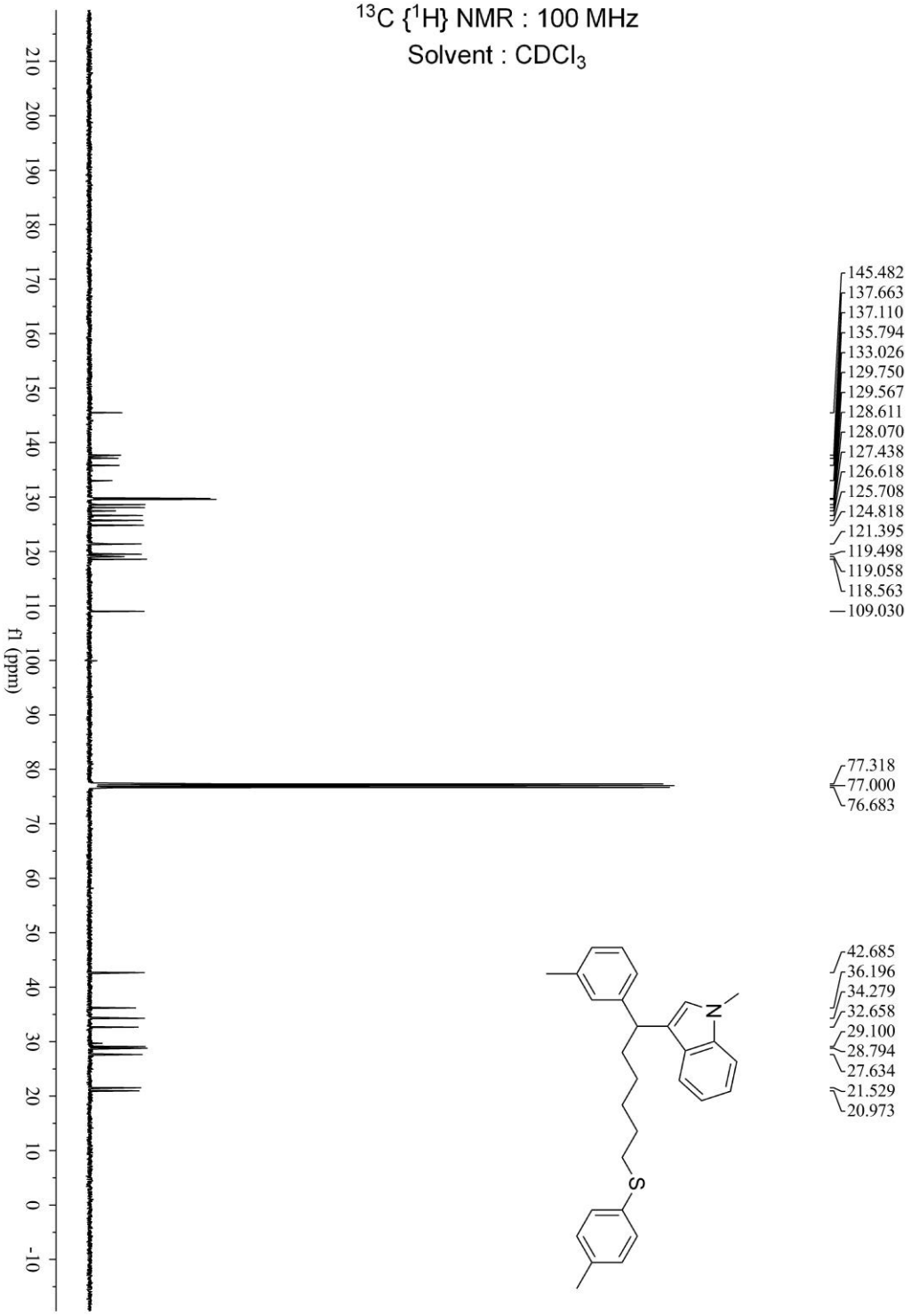
3-(1-(3-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4haa)



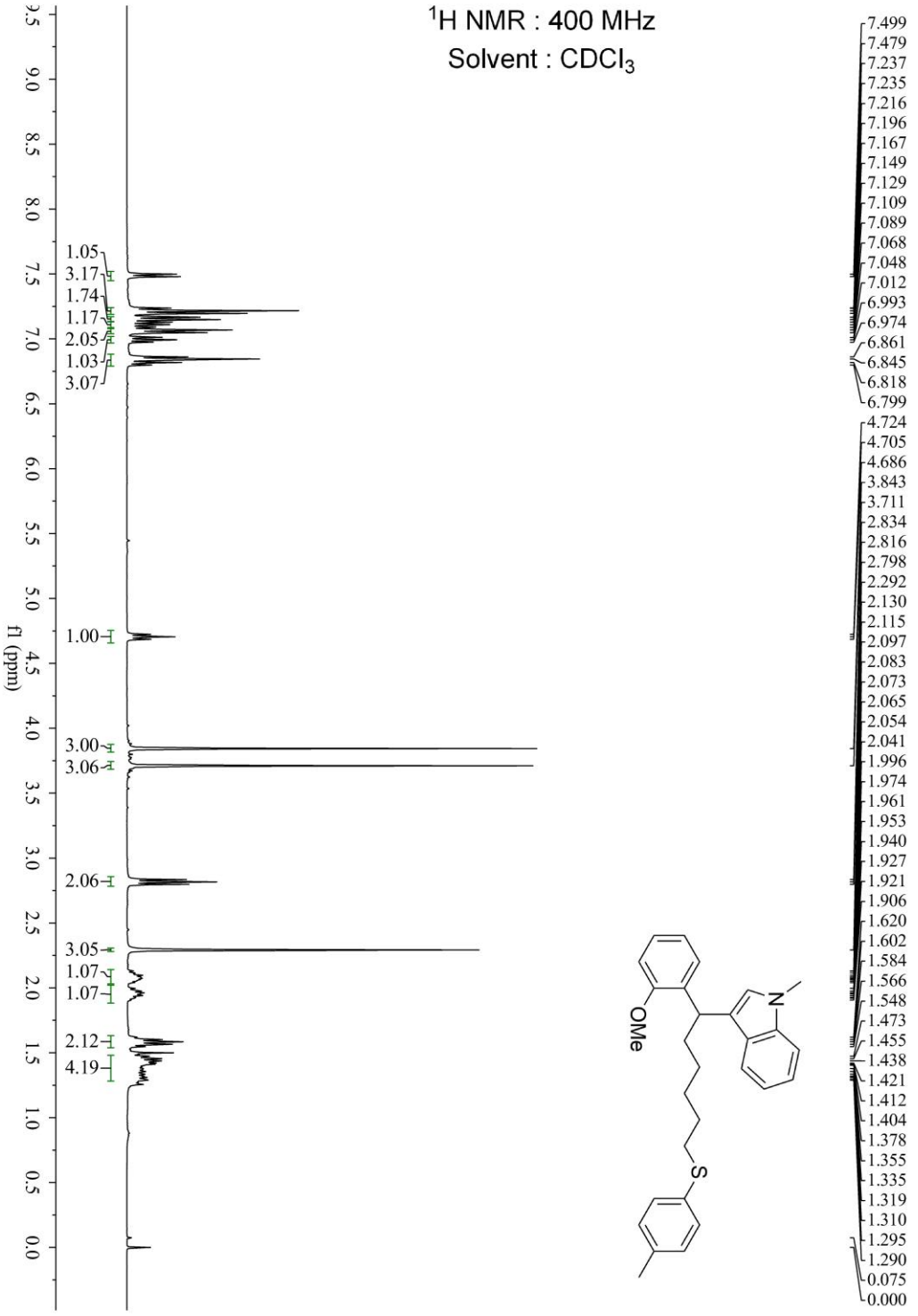

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
159.499
147.299
137.115
135.798
132.995
129.757
129.568
129.128
127.381
125.701
121.430
120.392
119.455
118.793
118.595
114.019
110.624
109.050
77.317
77.000
76.681
55.074
42.791
36.089
34.272
32.656
29.099
28.784
27.603
20.970
OMe
N
S

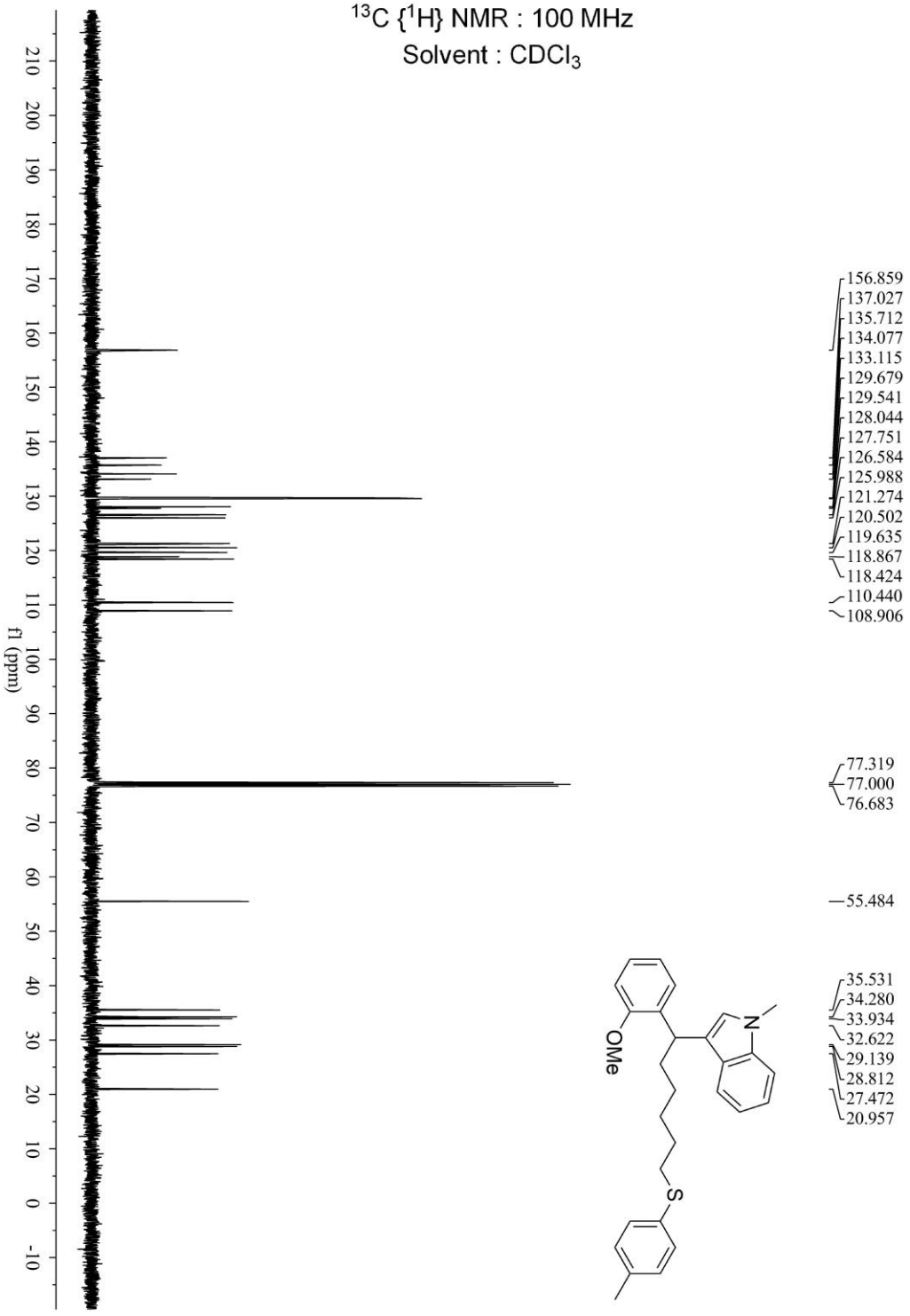
1-Methyl-3-(1-(*m*-tolyl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4iaa)



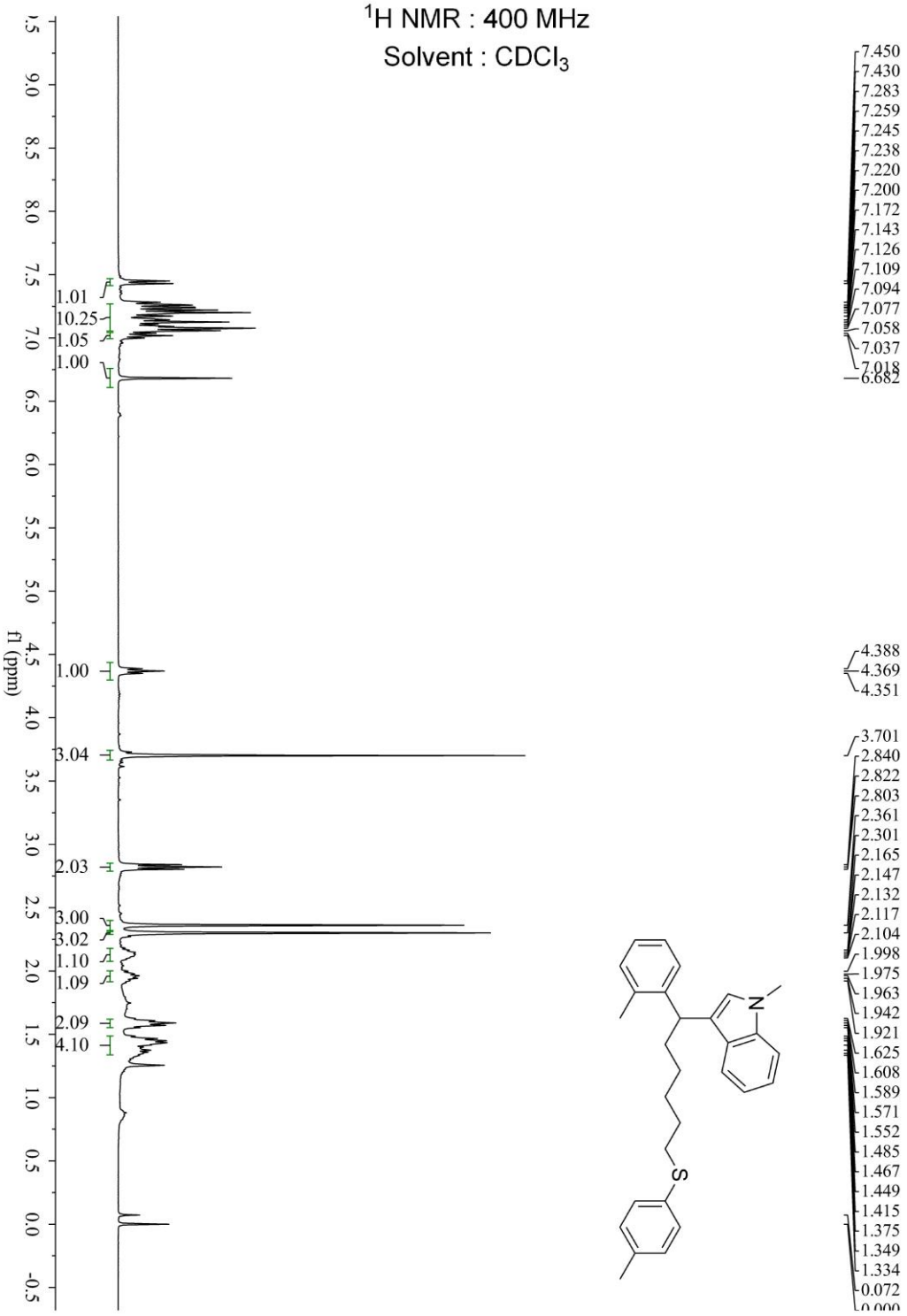

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
145.482
137.663
137.110
135.794
133.026
129.750
129.567
128.611
128.070
127.438
126.618
125.708
124.818
121.395
119.498
119.058
118.563
109.030
77.318
77.000
76.683
42.685
36.196
34.279
32.658
29.100
28.794
27.634
21.529
20.973
N
S

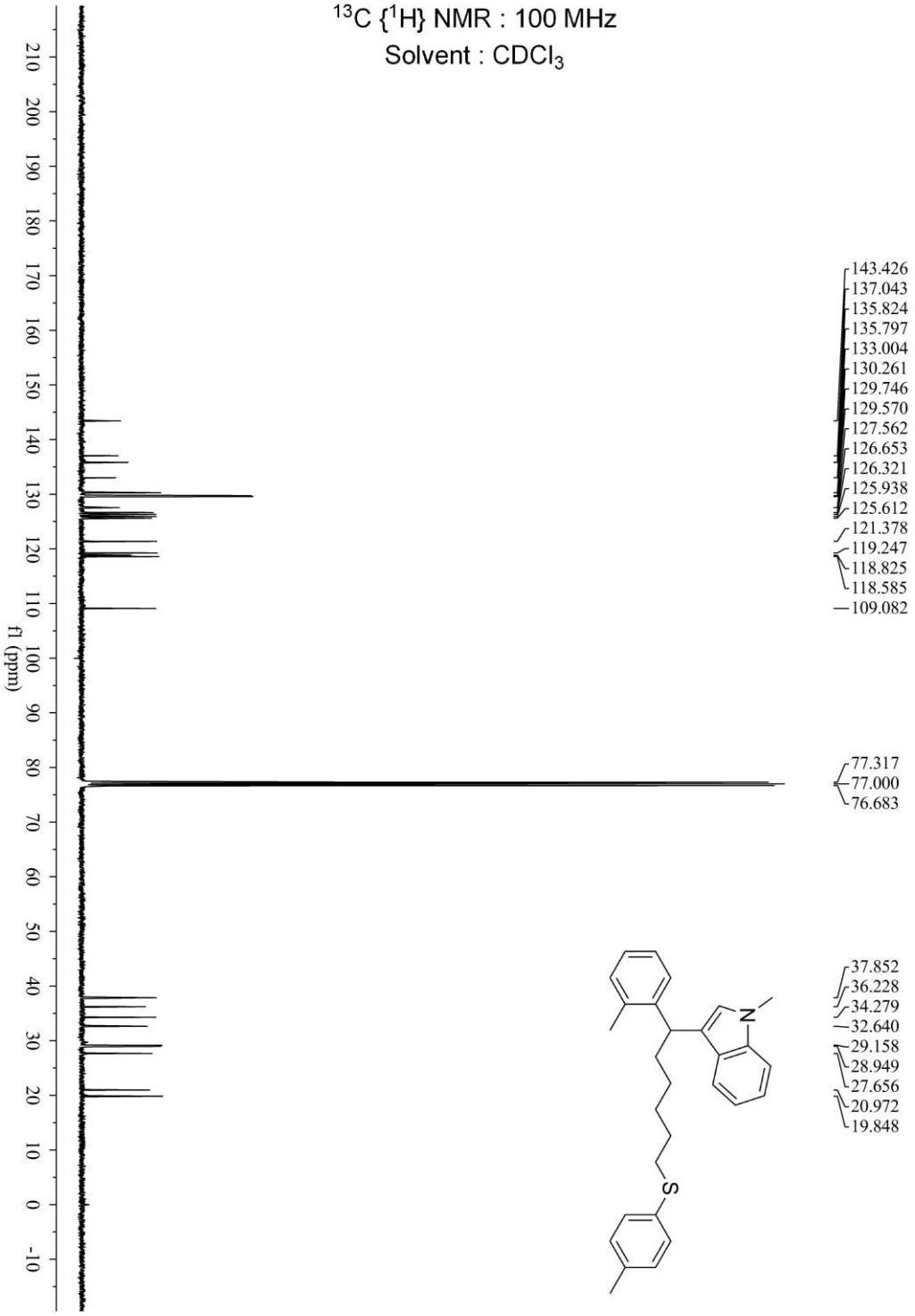
3-(1-(2-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4jaa)



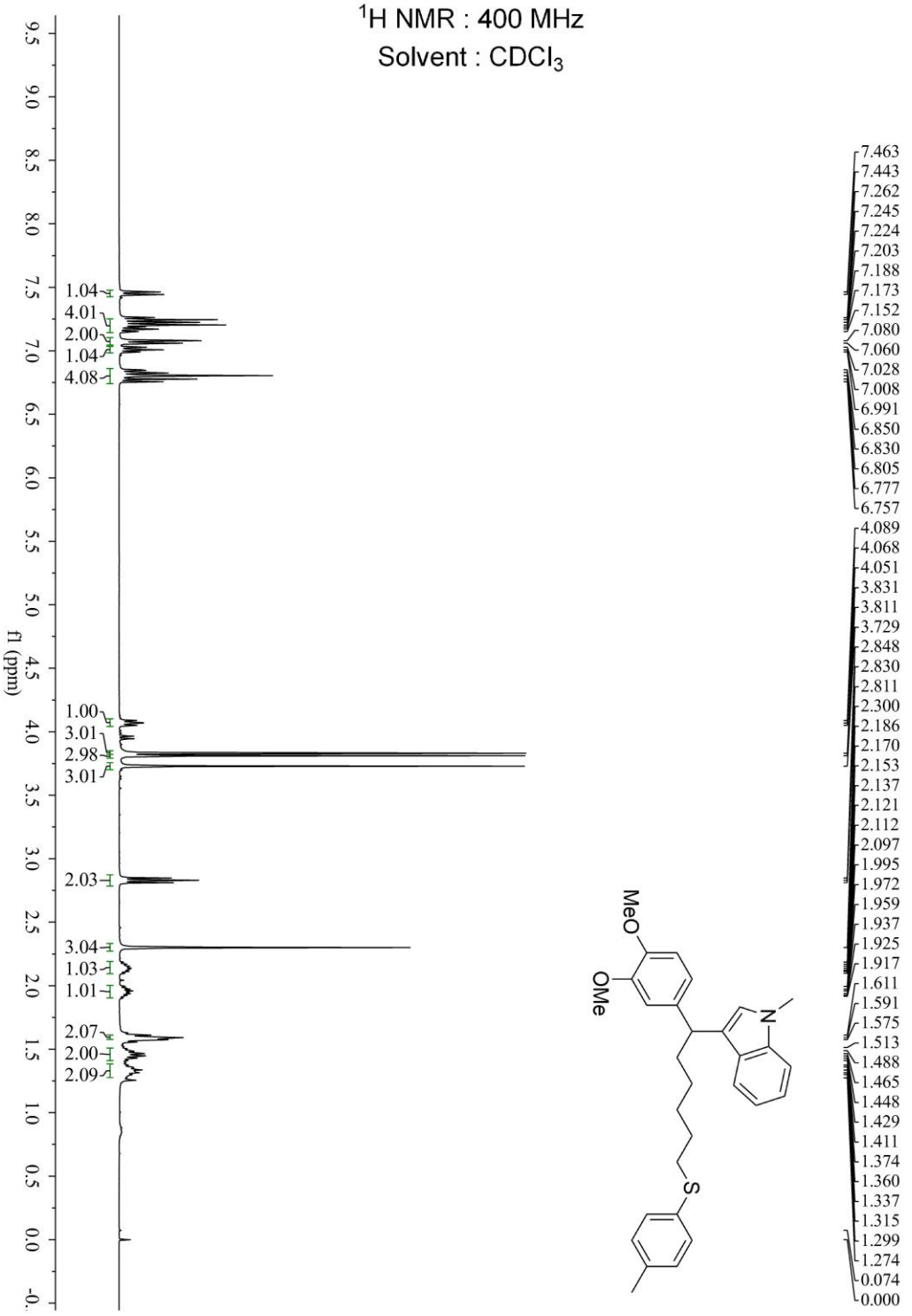

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
156.859
137.027
135.712
134.077
133.115
129.679
129.541
128.044
127.751
126.584
125.988
121.274
120.502
119.635
118.867
118.424
110.440
108.906
77.319
77.000
76.683
55.484
35.531
34.280
33.934
32.622
29.139
28.812
27.472
20.957
OMe
N
S

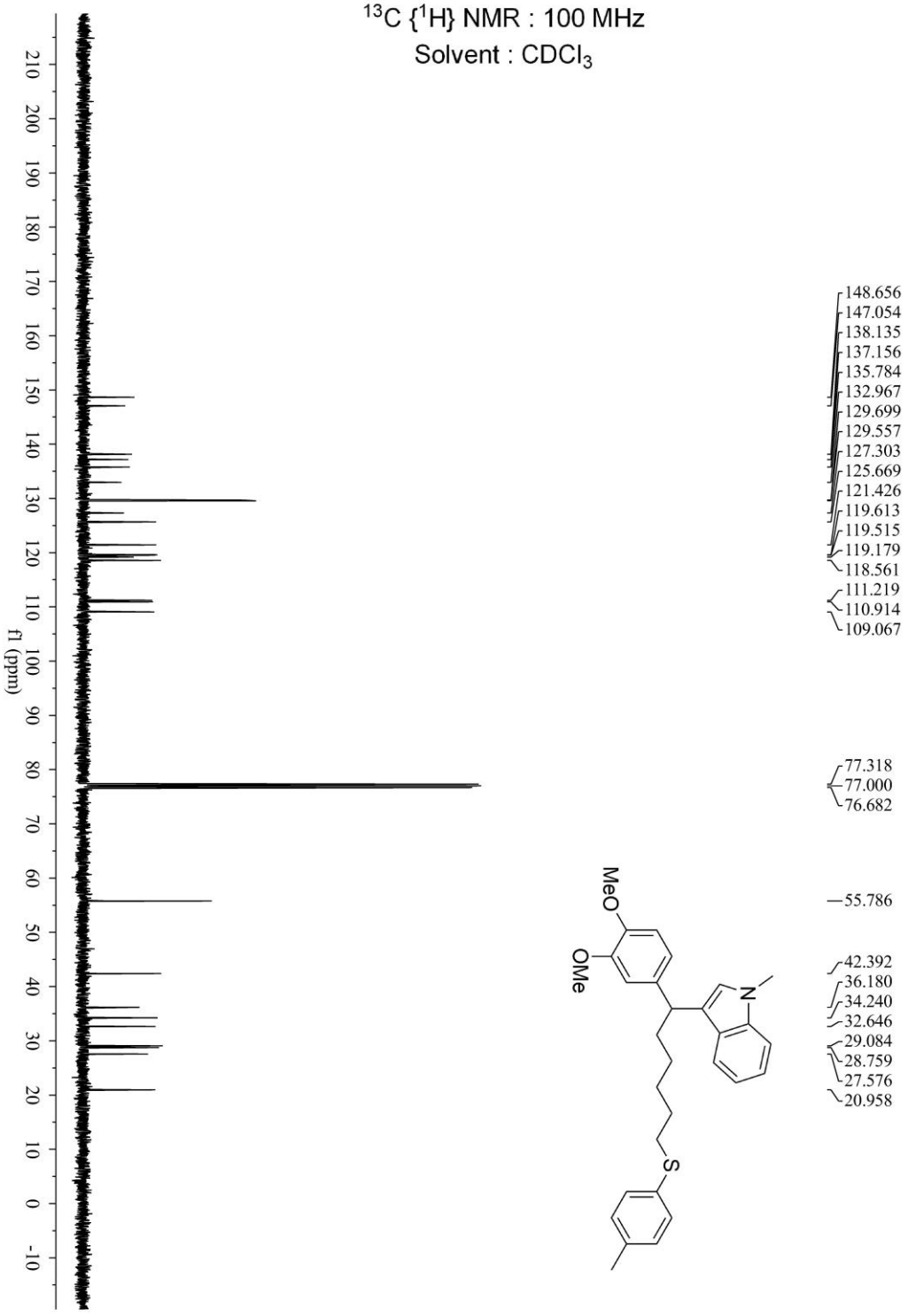
1-Methyl-3-(1-(*o*-tolyl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4kaa)



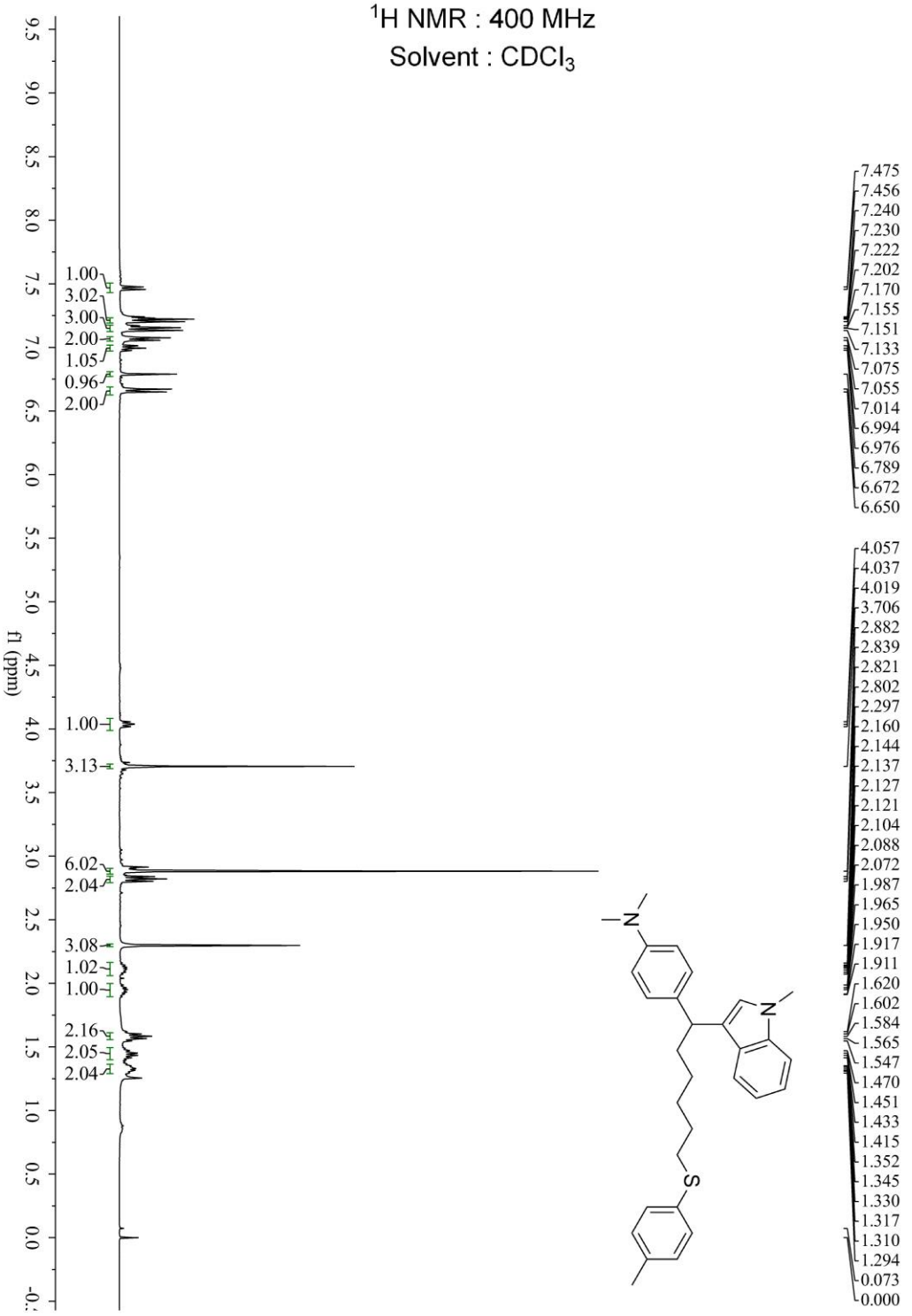

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
143.426
137.043
135.824
135.797
133.004
130.261
129.746
129.570
127.562
126.653
126.321
125.938
125.612
121.378
119.247
118.825
118.585
109.082
77.317
77.000
76.683
37.852
36.228
34.279
32.640
29.158
28.949
27.656
20.972
19.848
N
S

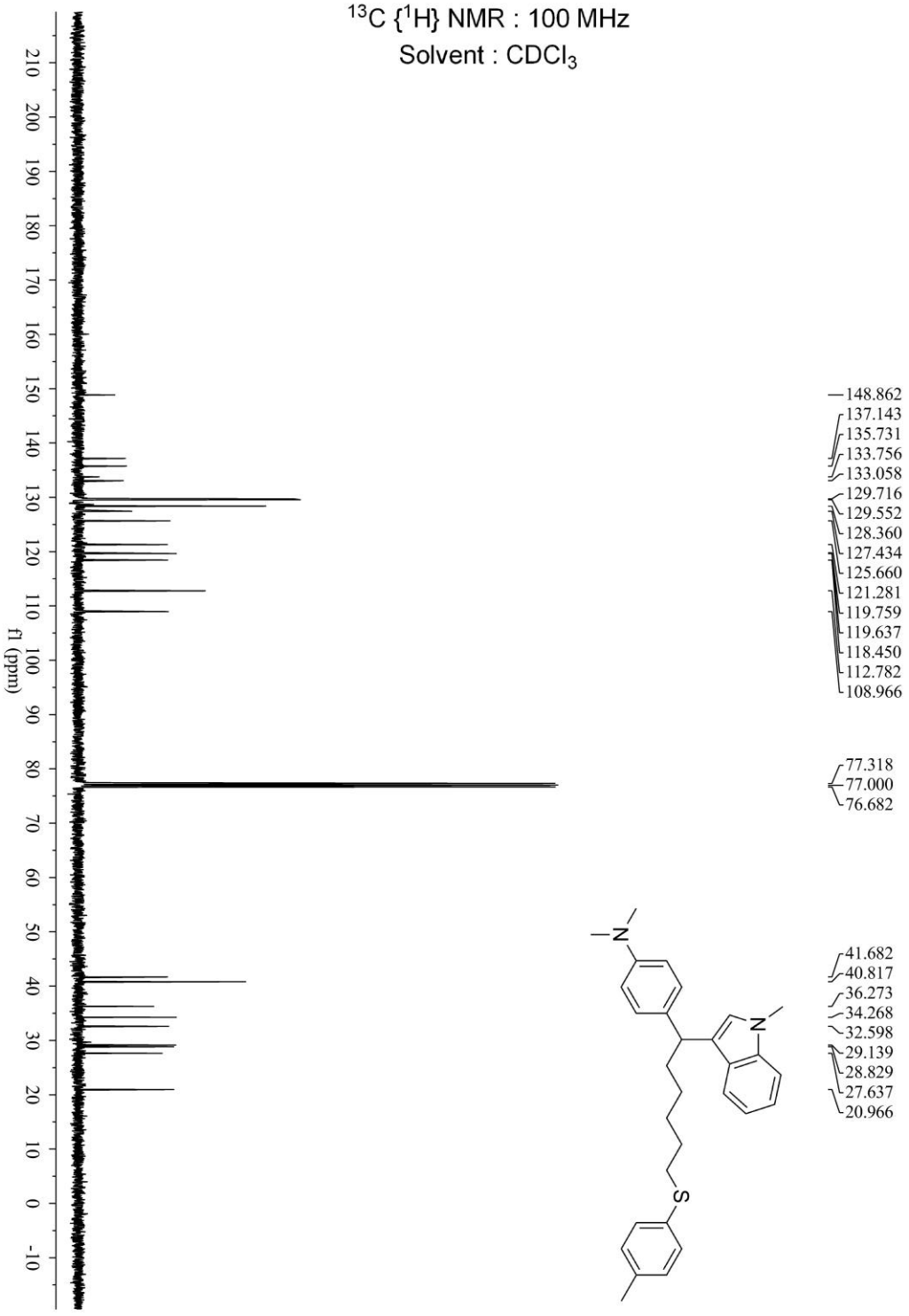
3-(1-(3,4-Dimethoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4laa)



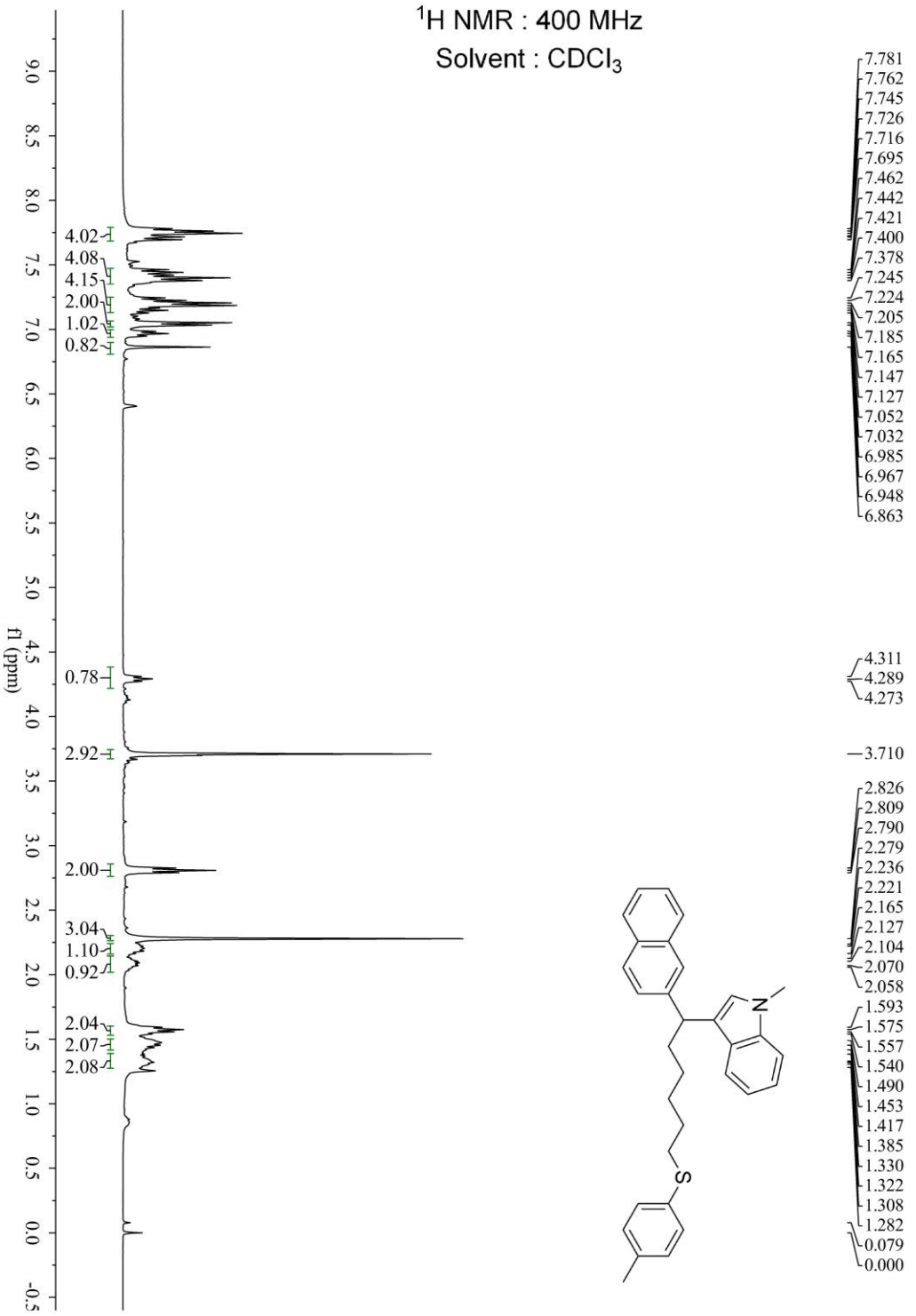

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
148.656
147.054
138.135
137.156
135.784
132.967
129.699
129.557
127.303
125.669
121.426
119.613
119.515
119.179
118.561
111.219
110.914
109.067
77.318
77.000
76.682
55.786
42.392
36.180
34.240
32.646
29.084
28.759
27.576
20.958
MeO
OMe
N
S

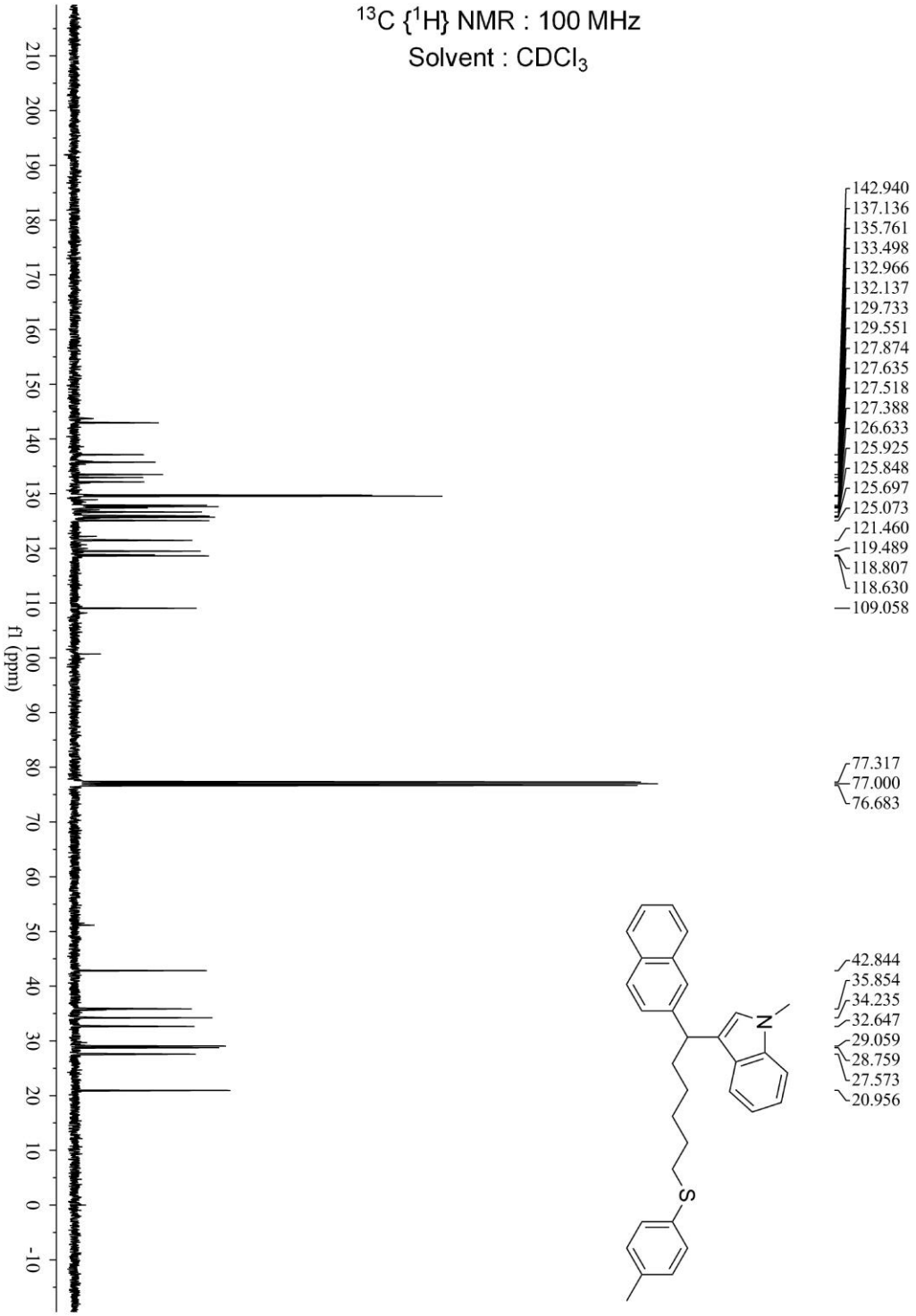
_N_,_N_-Dimethyl-4-(1-(1-methyl-1_H_-indol-3-yl)-6-(_p_-tolylthio)hexyl)aniline (4maa)



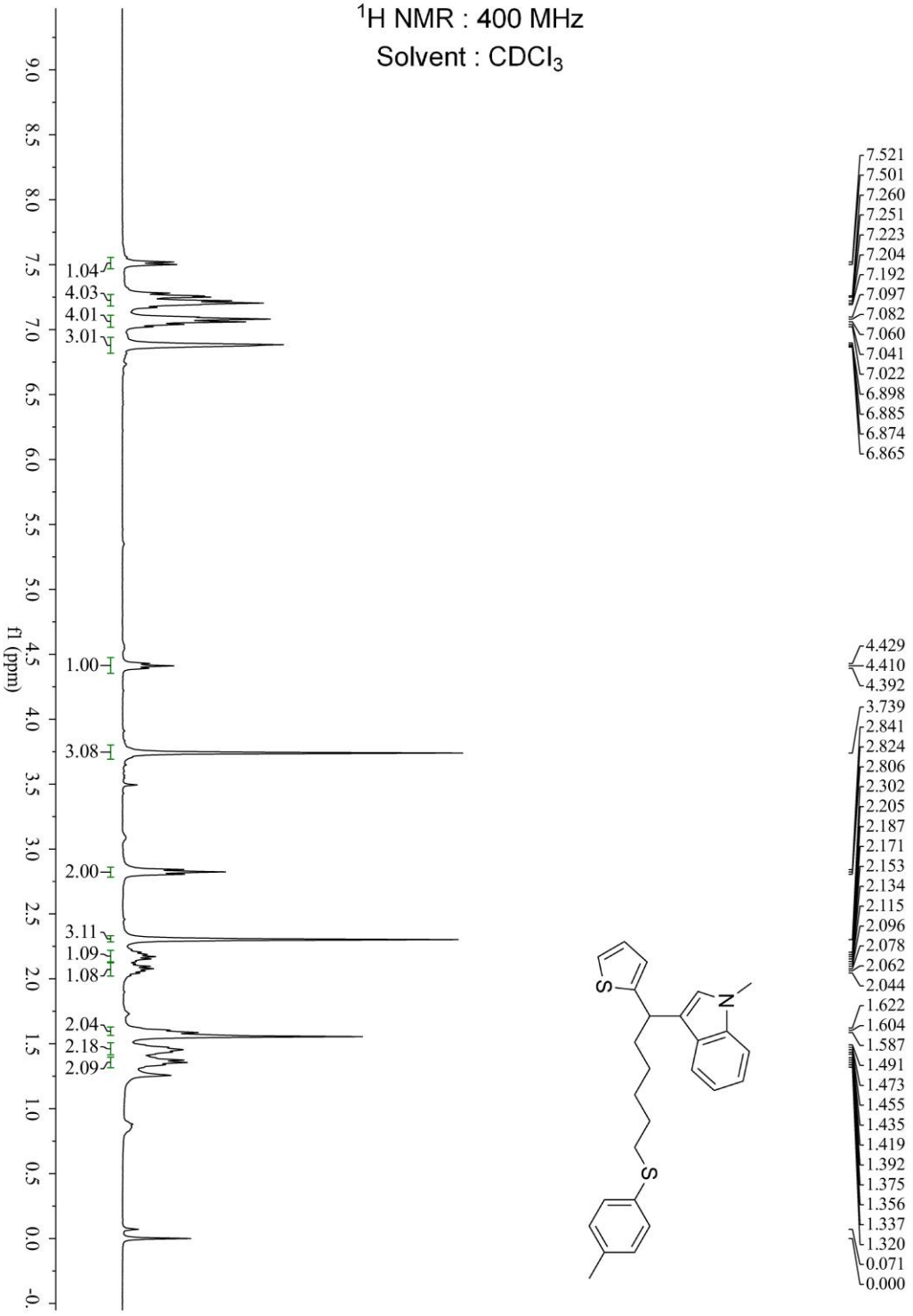

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
148.862
137.143
135.731
133.756
133.058
129.716
129.552
128.360
127.434
125.660
121.281
119.759
119.637
118.450
112.782
108.966
77.318
77.000
76.682
41.682
40.817
36.273
34.268
32.598
29.139
28.829
27.637
20.966
N
N
S

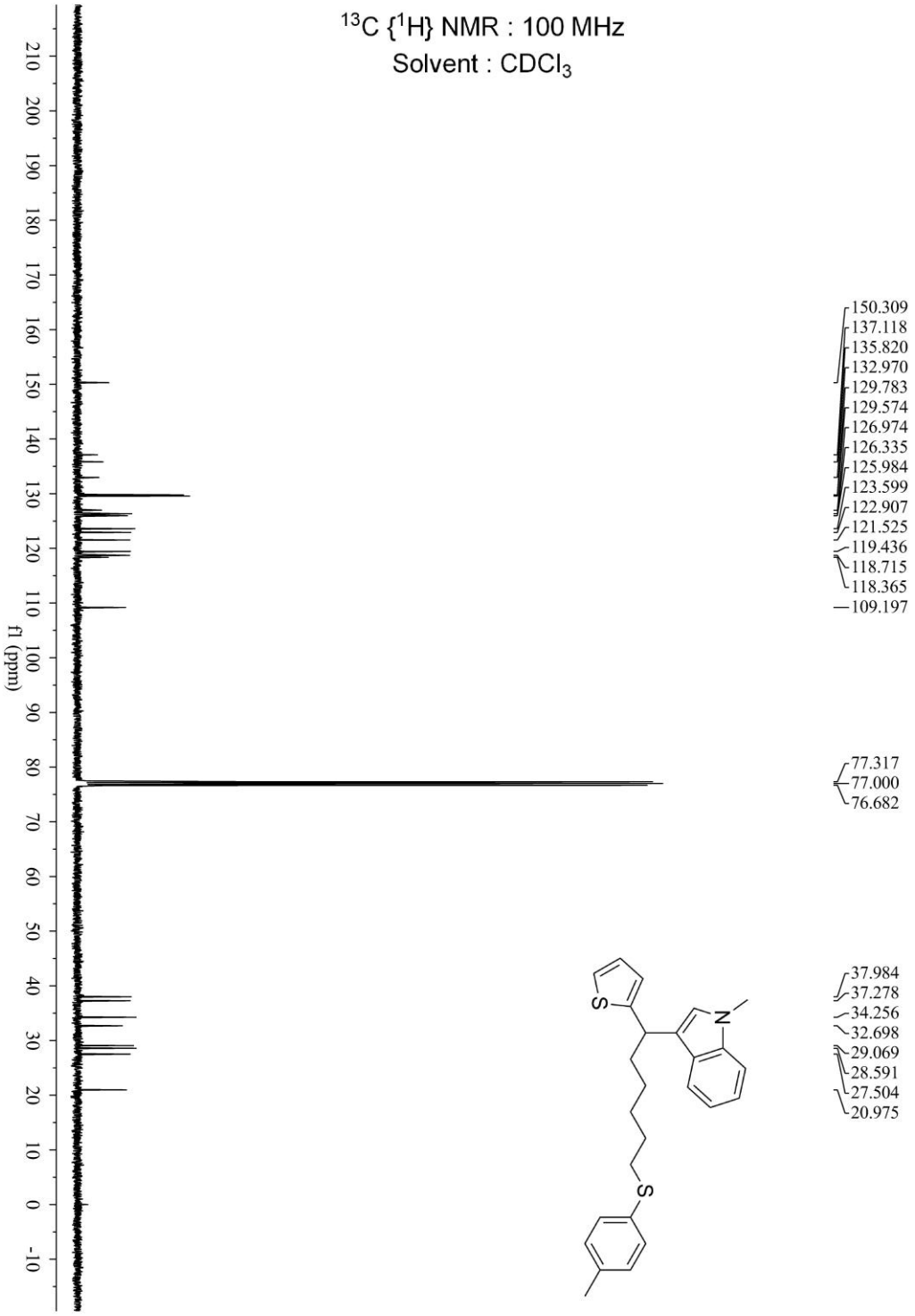
1-Methyl-3-(1-(naphthalen-2-yl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4naa)



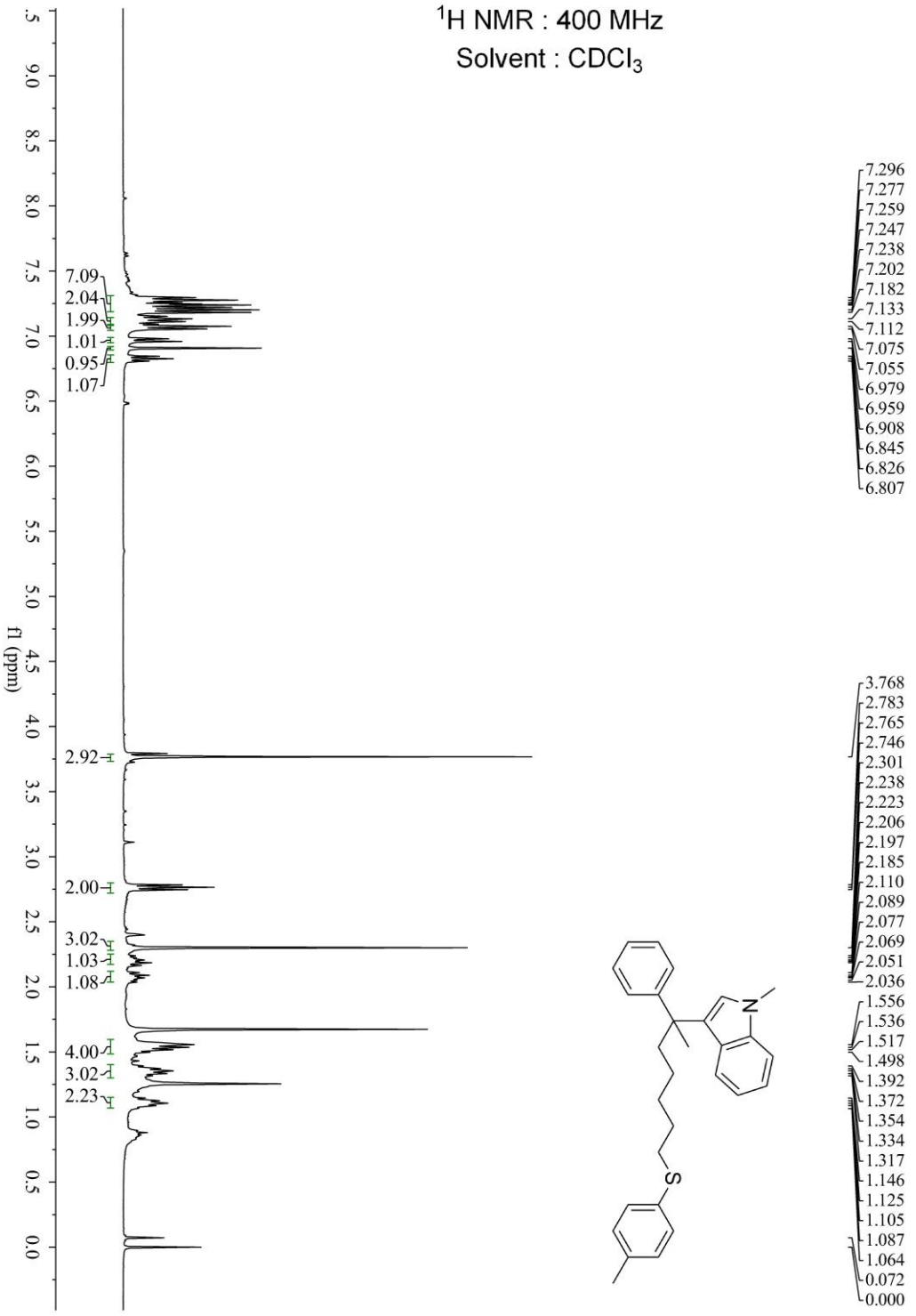

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
142.940
137.136
135.761
133.498
132.966
132.137
129.733
129.551
127.874
127.635
127.518
127.388
126.633
125.925
125.848
125.697
125.073
121.460
119.489
118.807
118.630
109.058
77.317
77.000
76.683
42.844
35.854
34.235
32.647
29.059
28.759
27.573
20.956
N
S

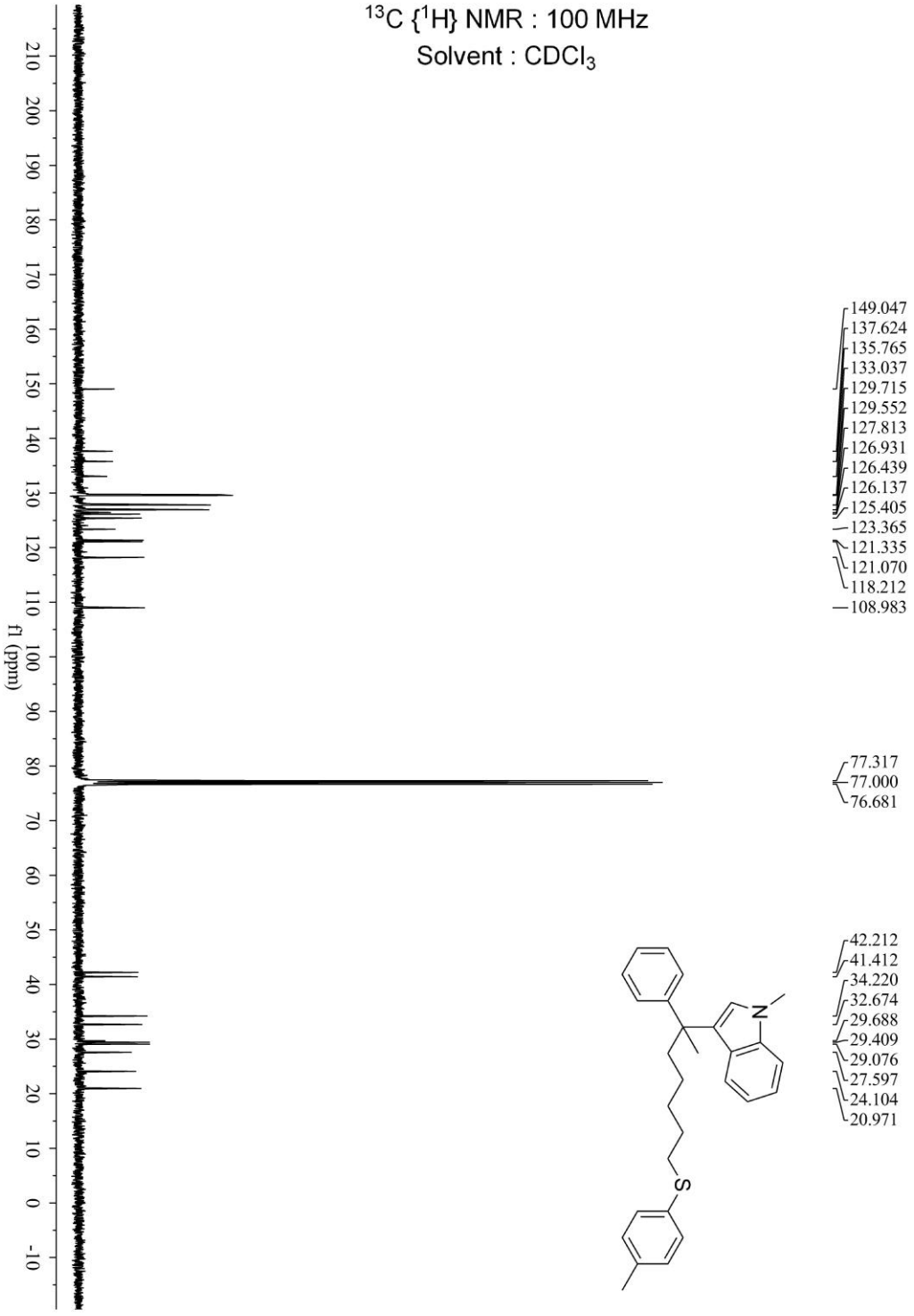
1-Methyl-3-(1-(thiophen-2-yl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4oaa)



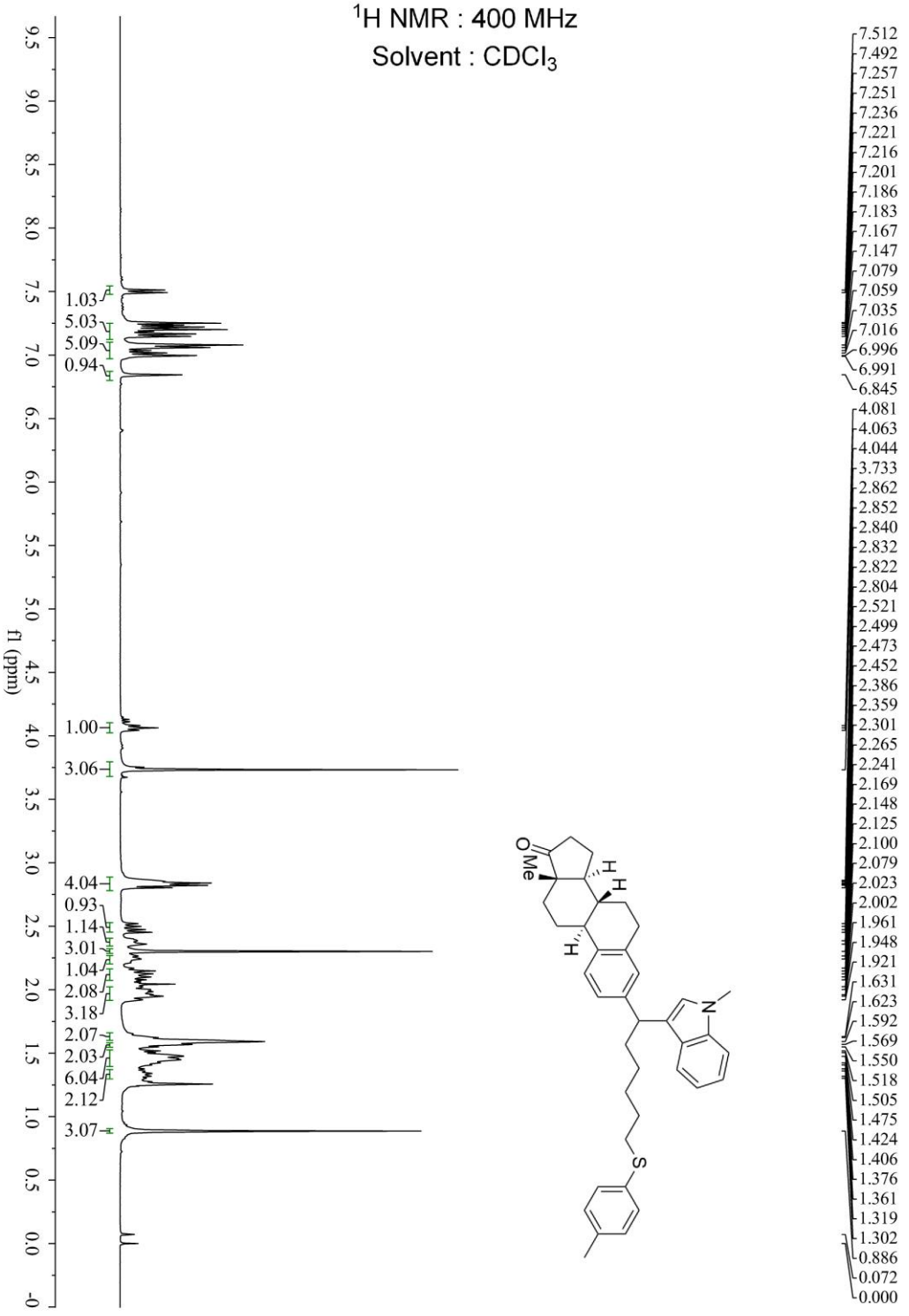

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
150.309
137.118
135.820
132.970
129.783
129.574
126.974
126.335
125.984
123.599
122.907
121.525
119.436
118.715
118.365
109.197
77.317
77.000
76.682
37.984
37.278
34.256
32.698
29.069
28.591
27.504
20.975
S
N
S

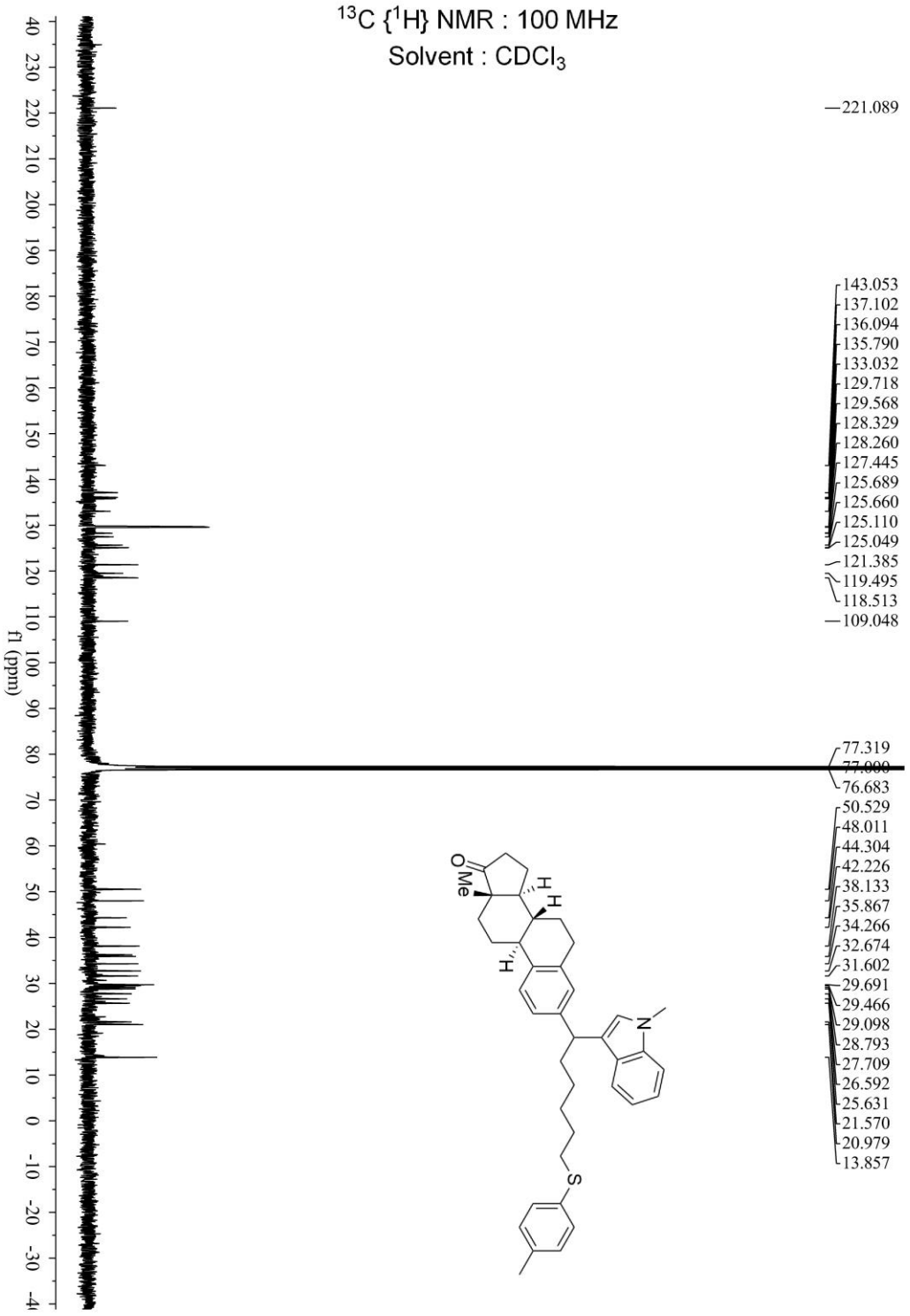
1-Methyl-3-(2-phenyl-7-(*p*-tolylthio)heptan-2-yl)-1*H*-indole (4paa)



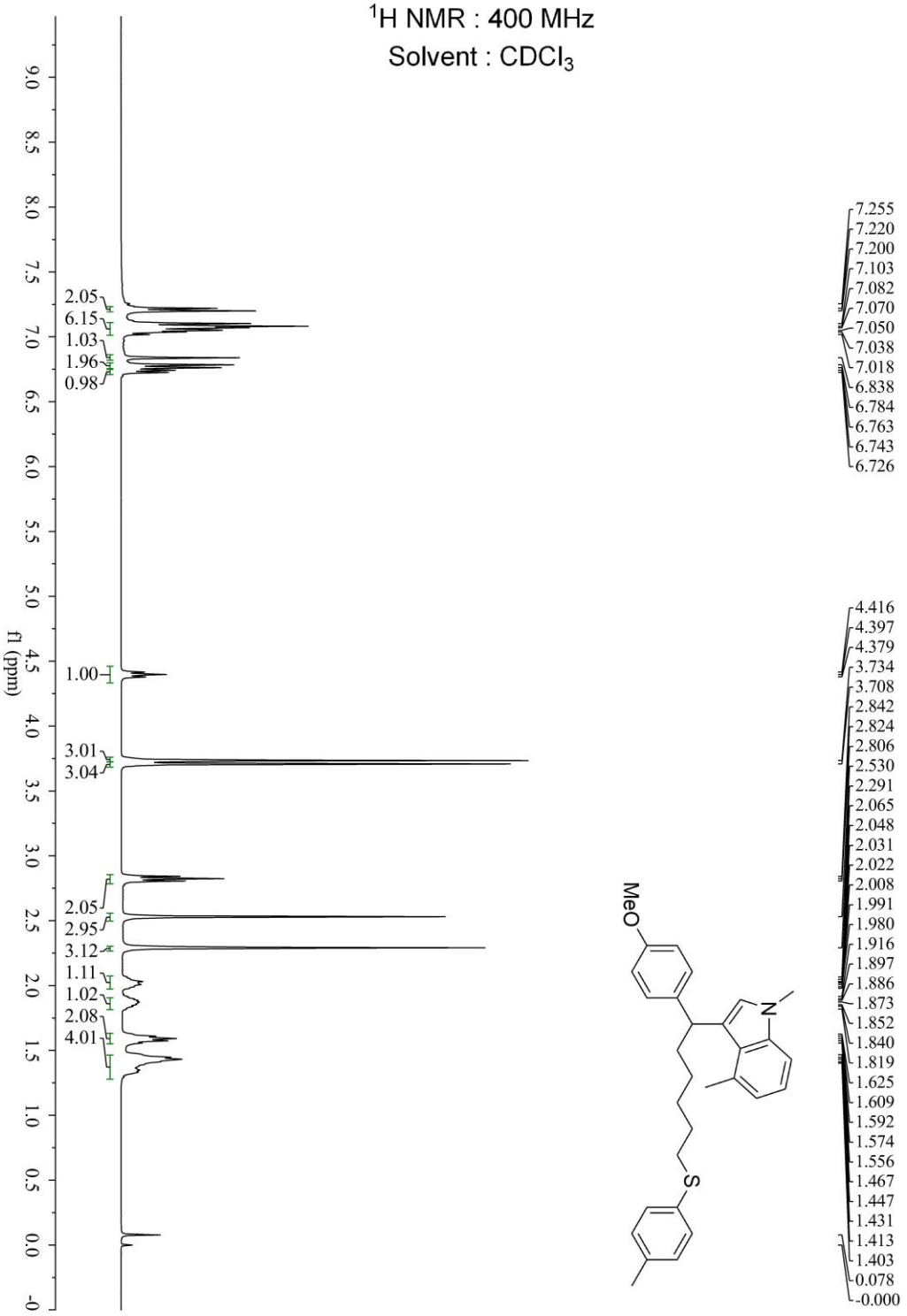

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
149.047
137.624
135.765
133.037
129.715
129.552
127.813
126.931
126.439
126.137
125.405
123.365
121.335
121.070
118.212
108.983
77.317
77.000
76.681
42.212
41.412
34.220
32.674
29.688
29.409
29.076
27.597
24.104
20.971
N
S

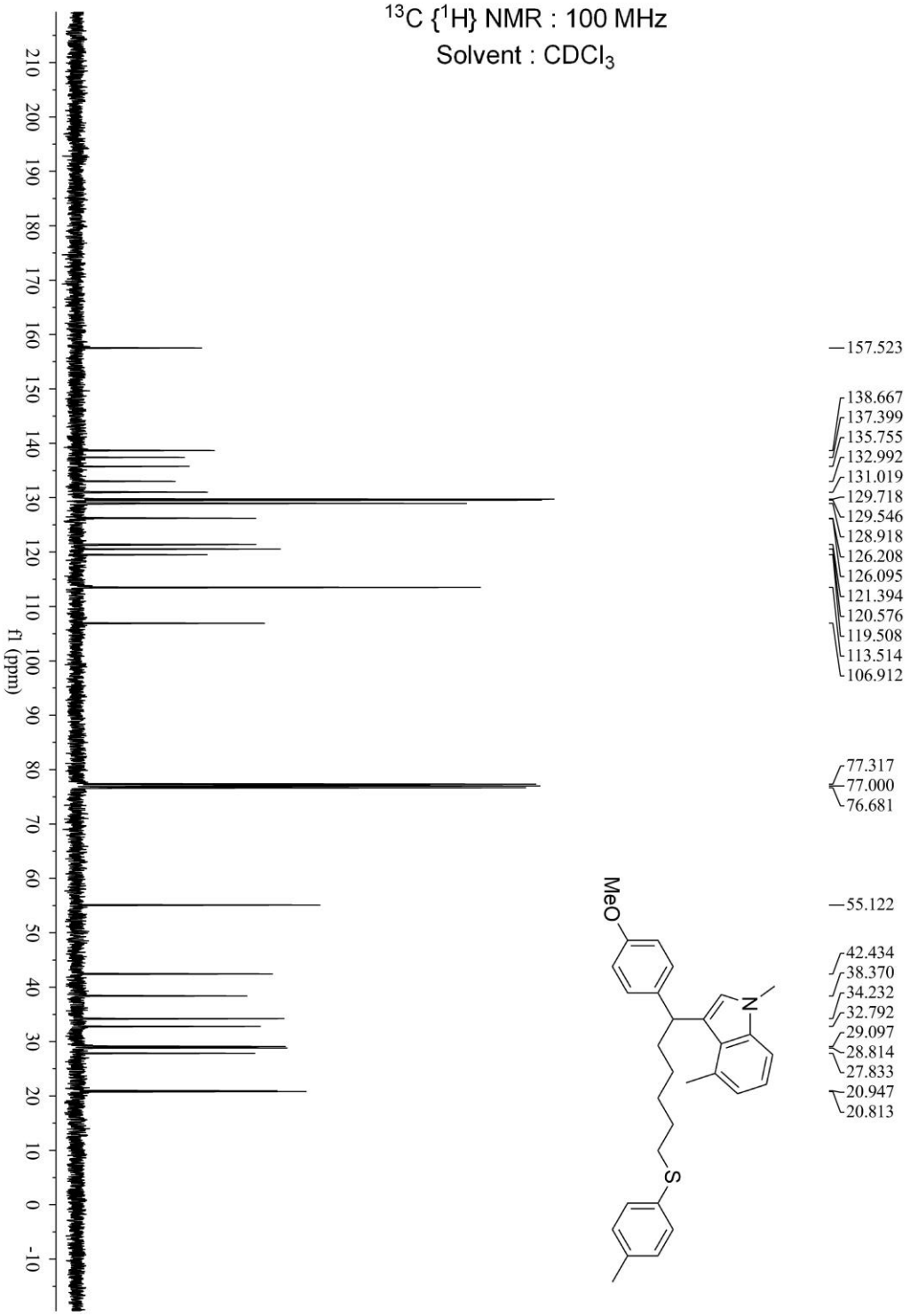
(8*R*,9*S*,13*S*,14*S*)-13-Methyl-3-(1-(1-methyl-1*H*-indol-3-yl)-6-(*p*-tolylthio)hexyl)-6,7,8,9,11,12,13,14,15,16-decahydro-17*H*-cyclopenta*[a]*phenanthren-17-one (4raa)



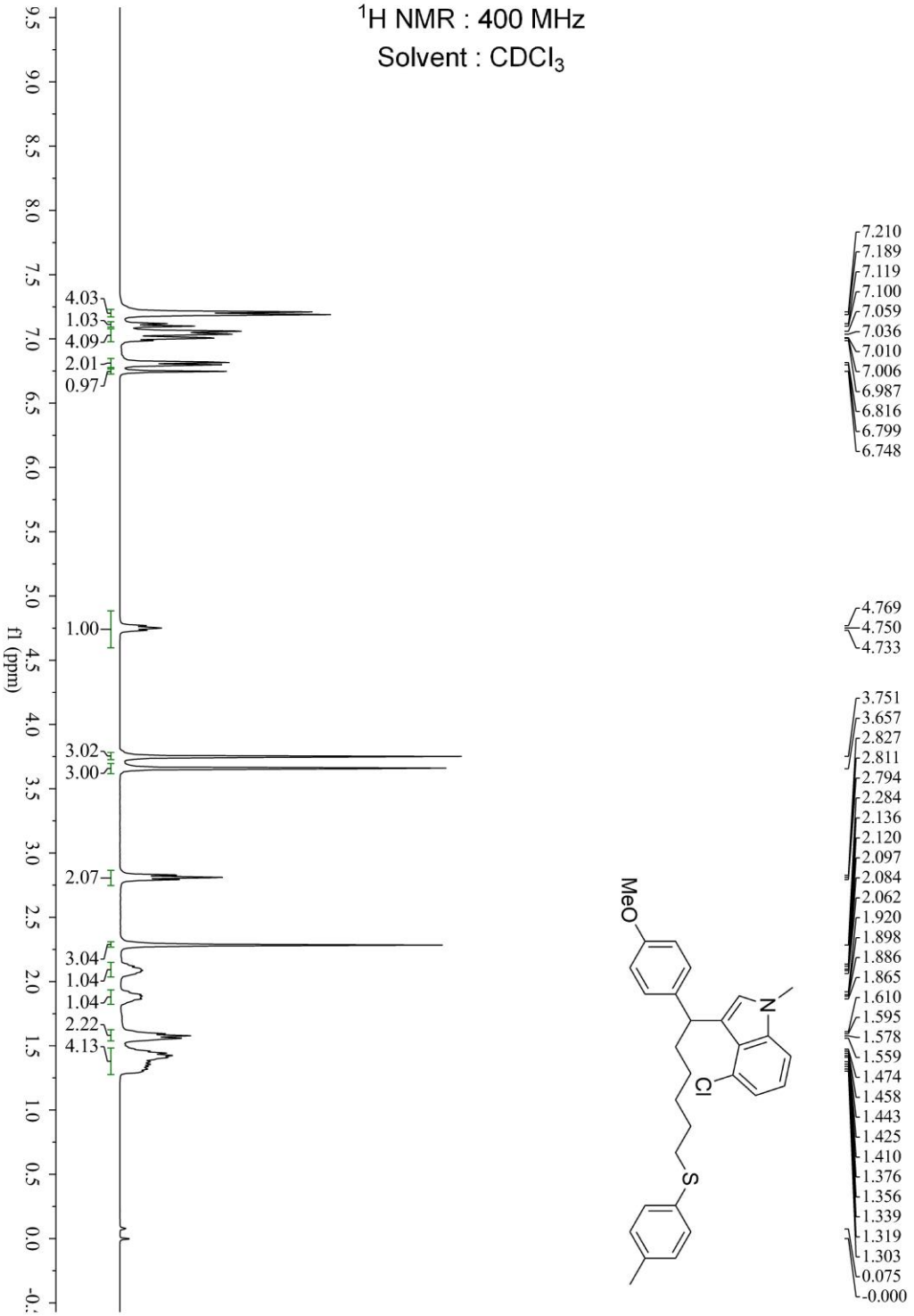

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
221.089
143.053
137.102
136.094
135.790
133.032
129.718
129.568
128.329
128.260
127.445
125.689
125.660
125.110
125.049
121.385
119.495
118.513
109.048
77.319
77.000
76.683
50.529
48.011
44.304
42.226
38.133
35.867
34.266
32.674
31.602
29.691
29.466
29.098
28.793
27.709
26.592
25.631
21.570
20.979
13.857
O
Me
H
H
H
N
S

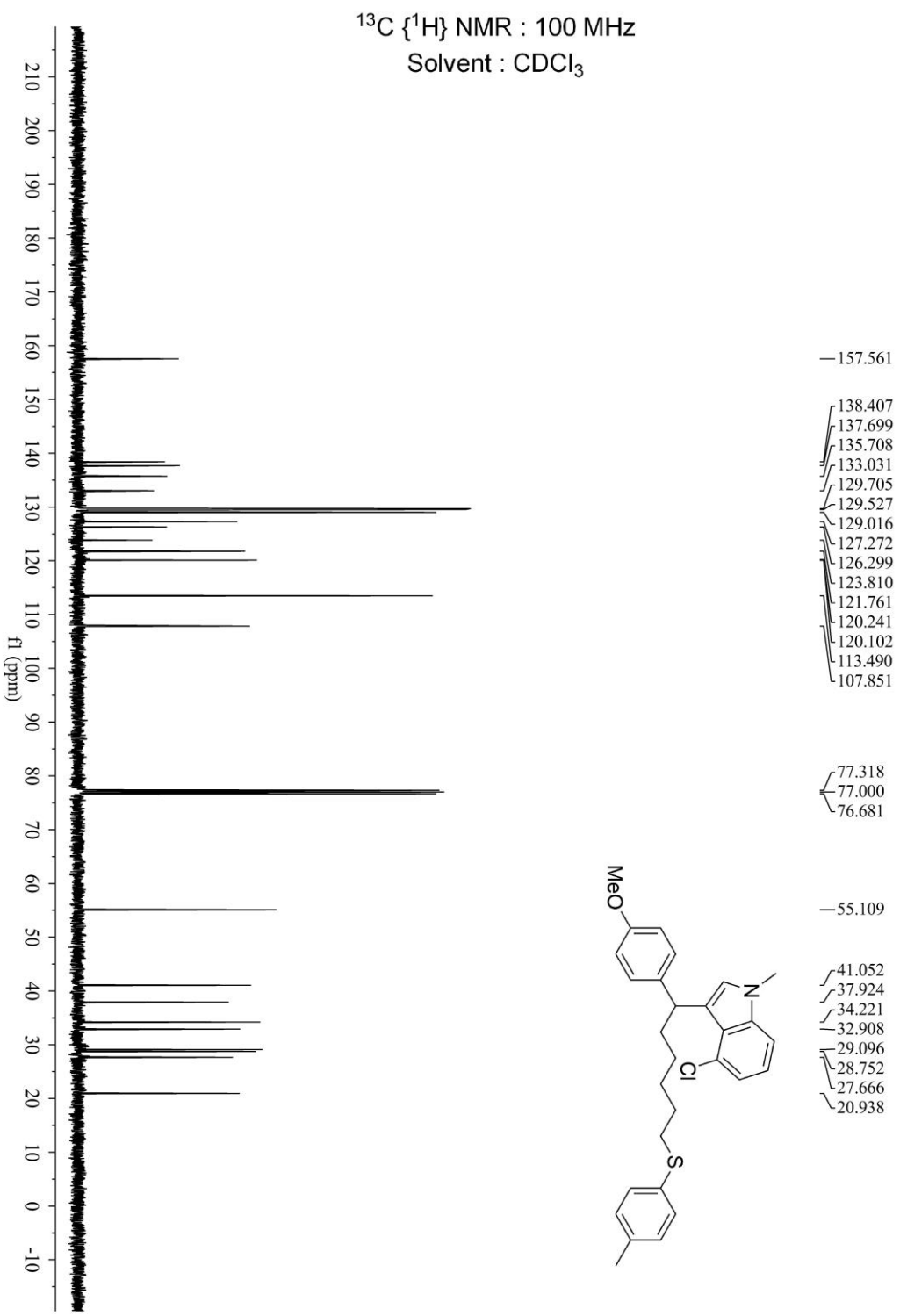
3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,4-dimethyl-1*H*-indole (4aab)



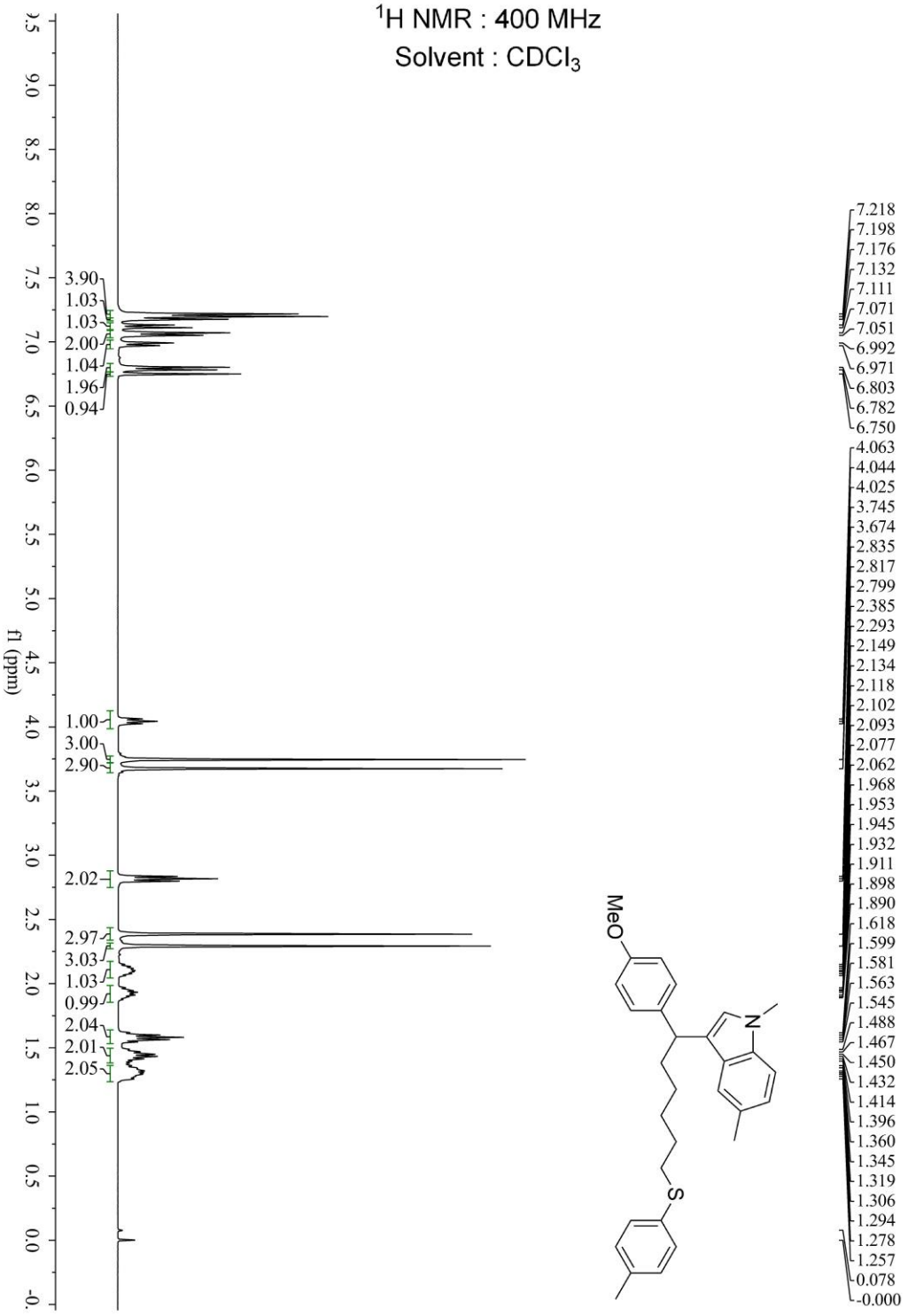

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.523
138.667
137.399
135.755
132.992
131.019
129.718
129.546
128.918
126.208
126.095
121.394
120.576
119.508
113.514
106.912
77.317
77.000
76.681
55.122
42.434
38.370
34.232
32.792
29.097
28.814
27.833
20.947
20.813
MeO
N
S

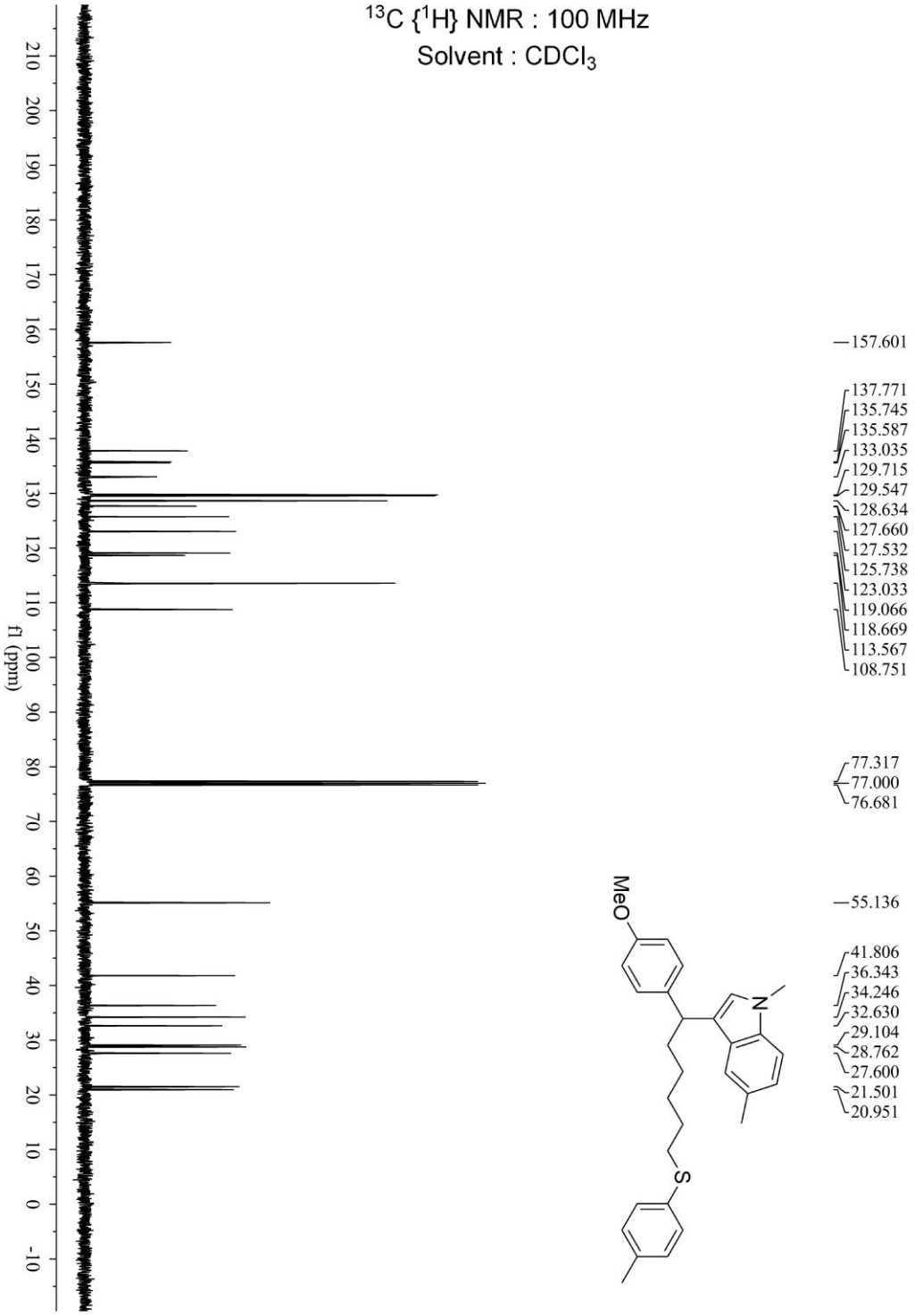
4-Chloro-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aac)



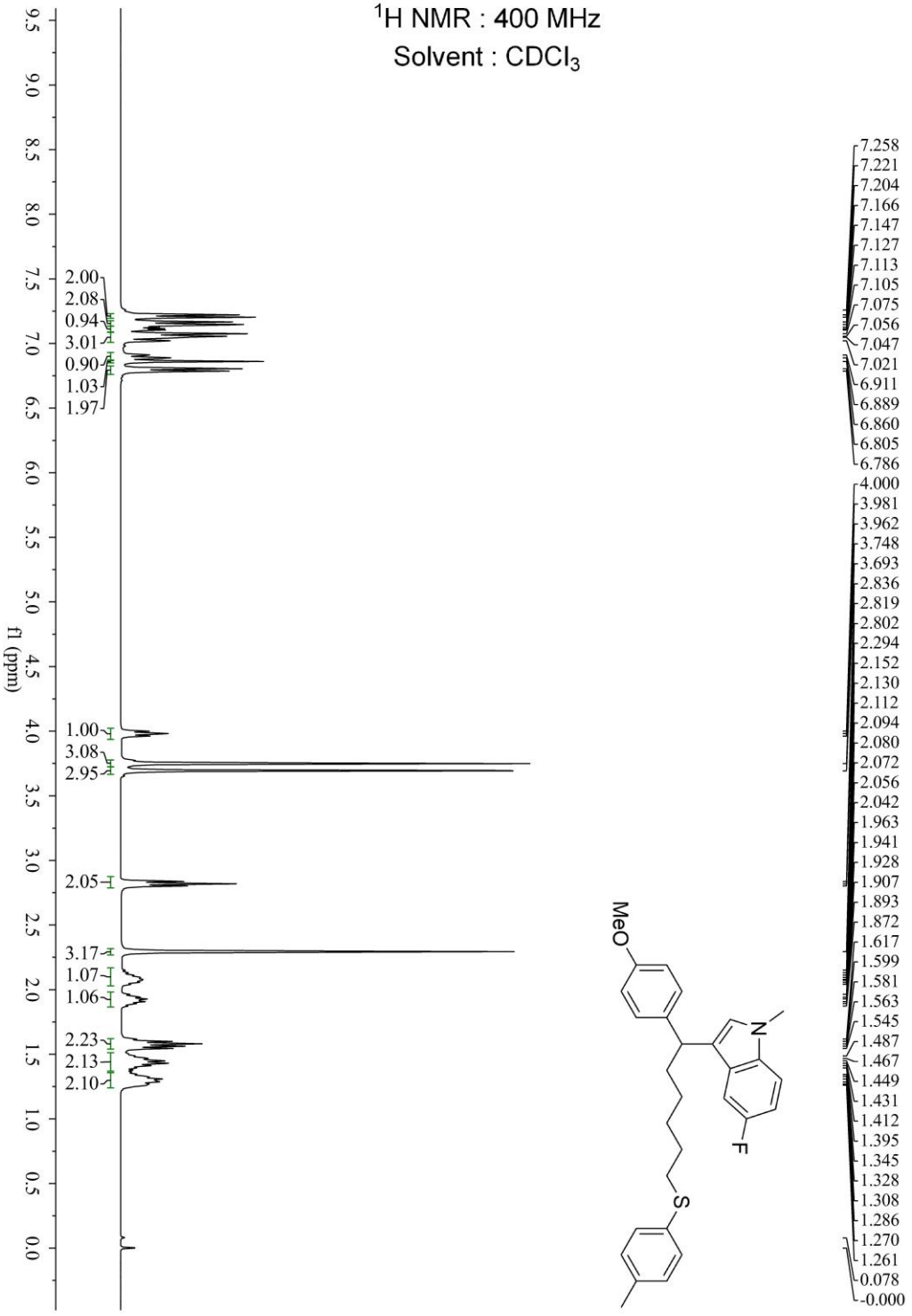

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.561
138.407
137.699
135.708
133.031
129.705
129.527
129.016
127.272
126.299
123.810
121.761
120.241
120.102
113.490
107.851
77.318
77.000
76.681
55.109
41.052
37.924
34.221
32.908
29.096
28.752
27.666
20.938
MeO
N
Cl
S

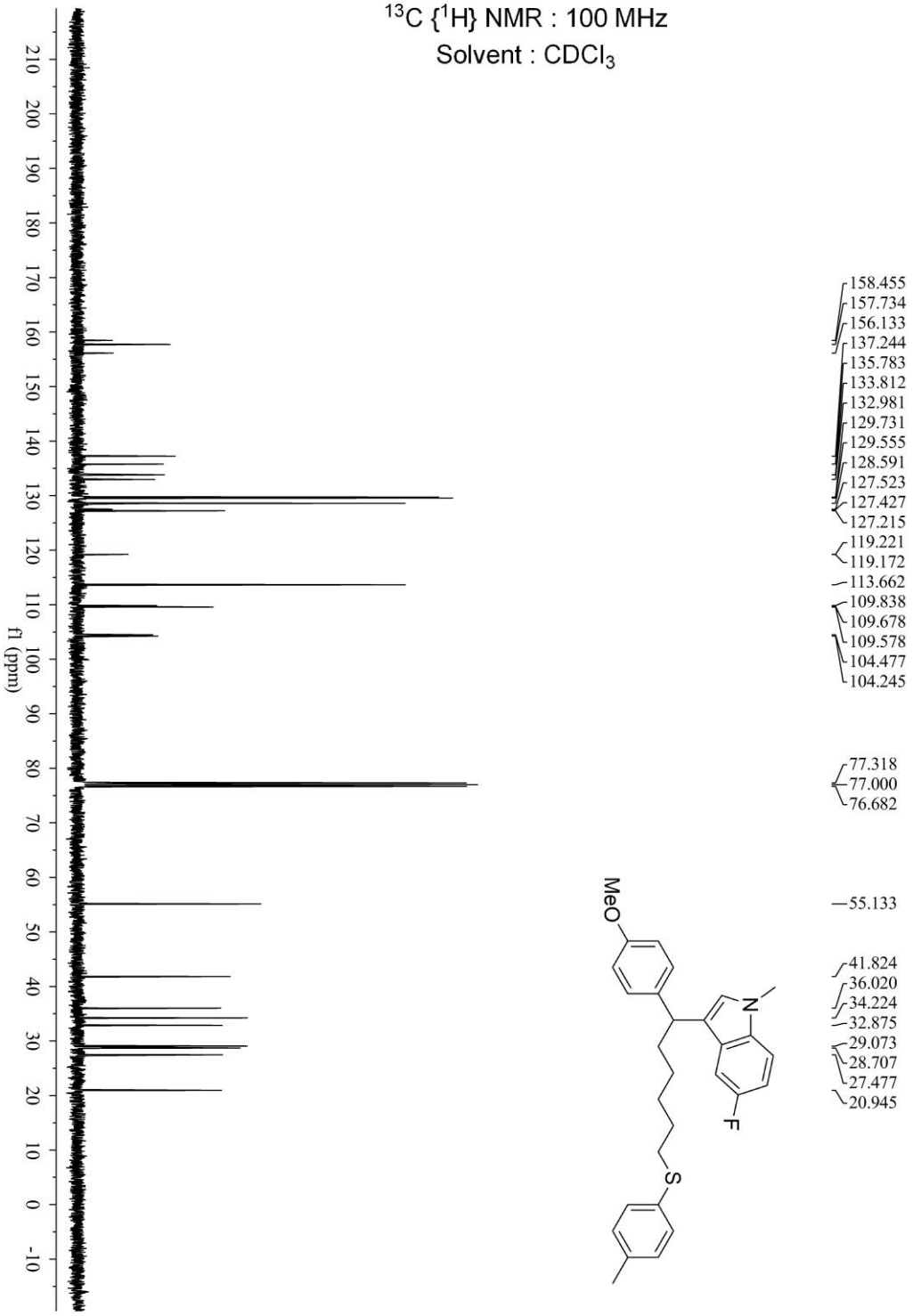
3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,5-dimethyl-1*H*-indole (4aad)

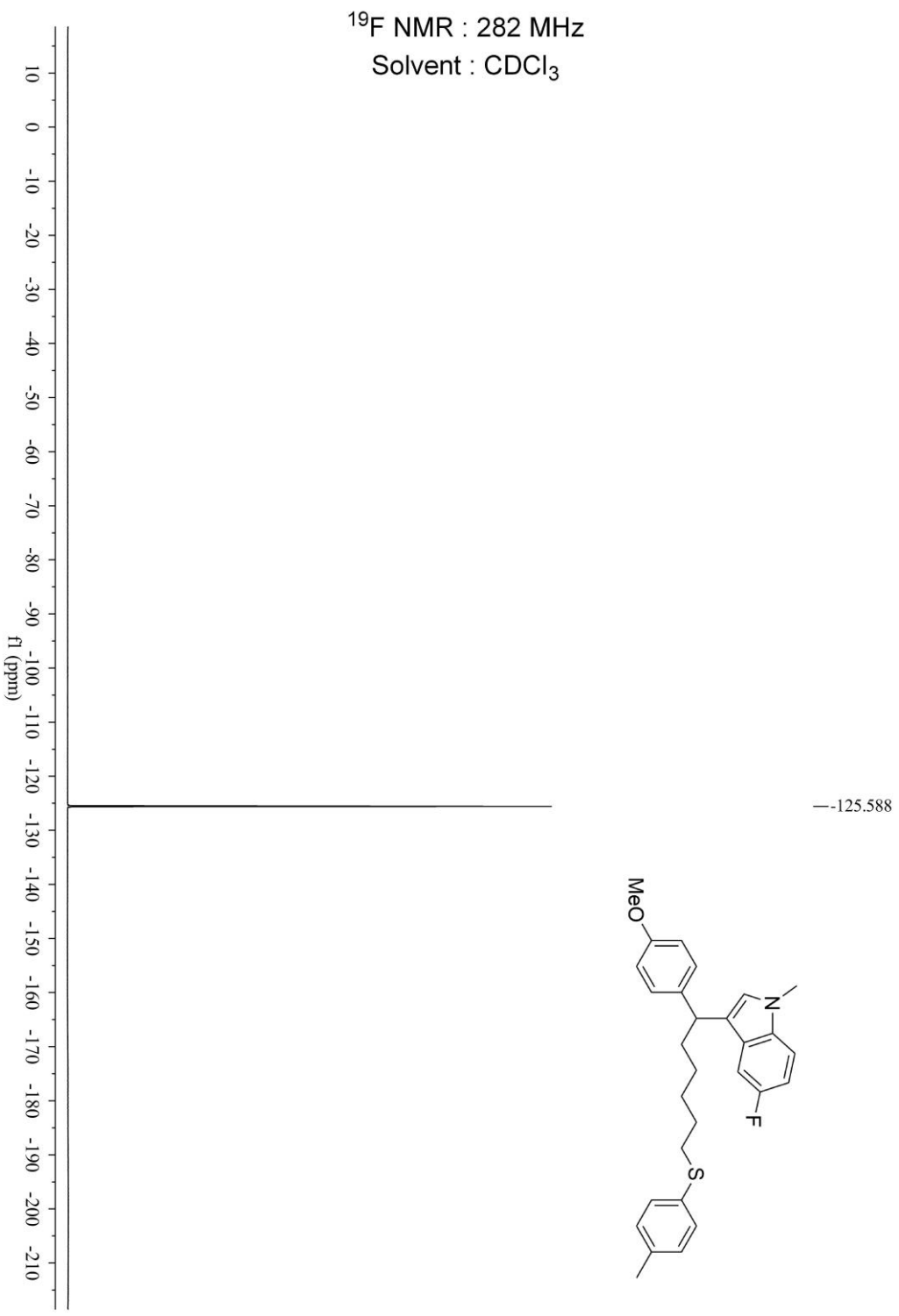



^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.601
137.771
135.745
135.587
133.035
129.715
129.547
128.634
127.660
127.532
125.738
123.033
119.066
118.669
113.567
108.751
77.317
77.000
76.681
55.136
41.806
36.343
34.246
32.630
29.104
28.762
27.600
21.501
20.951
MeO
N
S

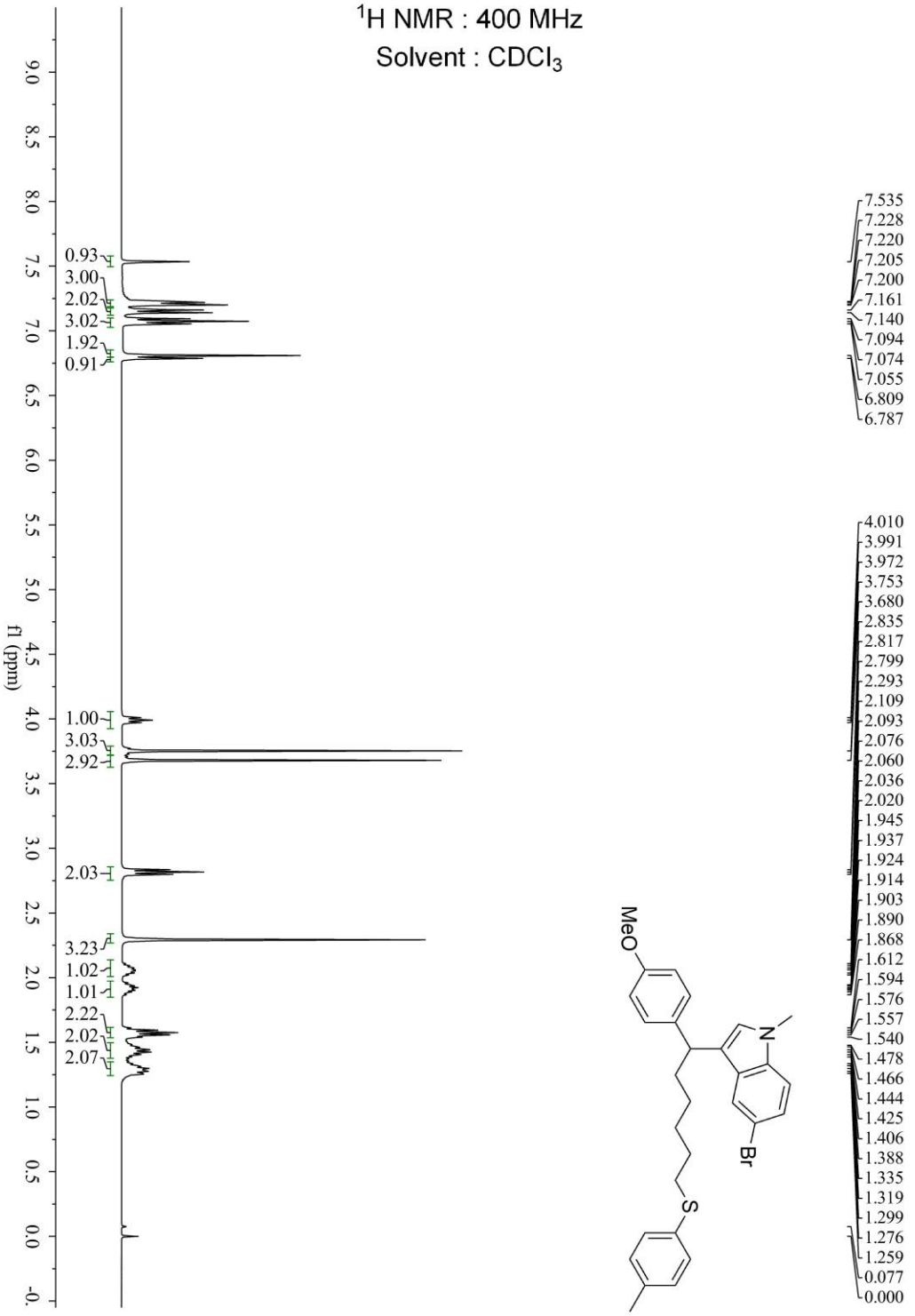
5-Fluoro-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aae)

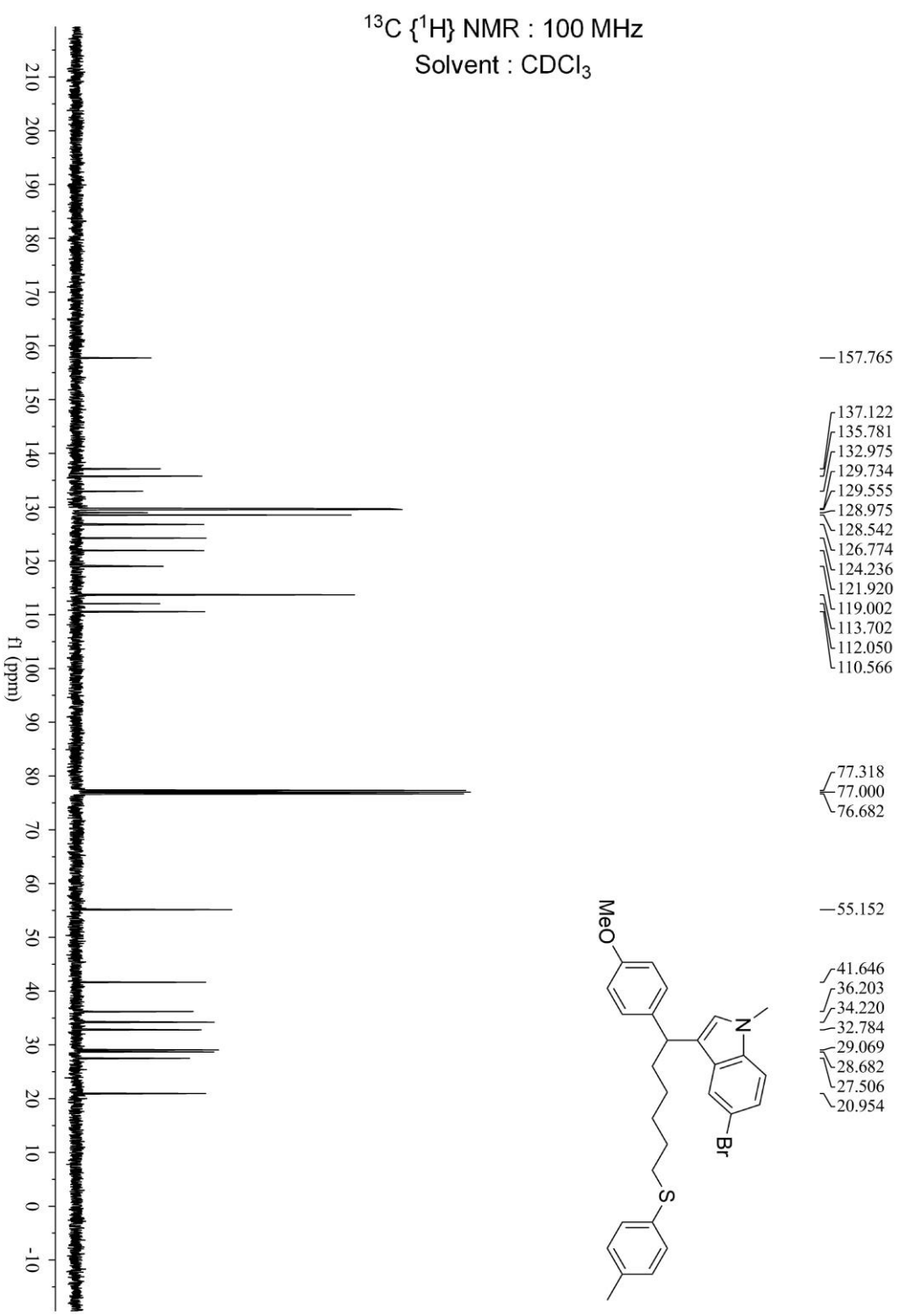



^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
158.455
157.734
156.133
137.244
135.783
133.812
132.981
129.731
129.555
128.591
127.523
127.427
127.215
119.221
119.172
113.662
109.838
109.678
109.578
104.477
104.245
77.318
77.000
76.682
55.133
41.824
36.020
34.224
32.875
29.073
28.707
27.477
20.945
MeO
N
F
S

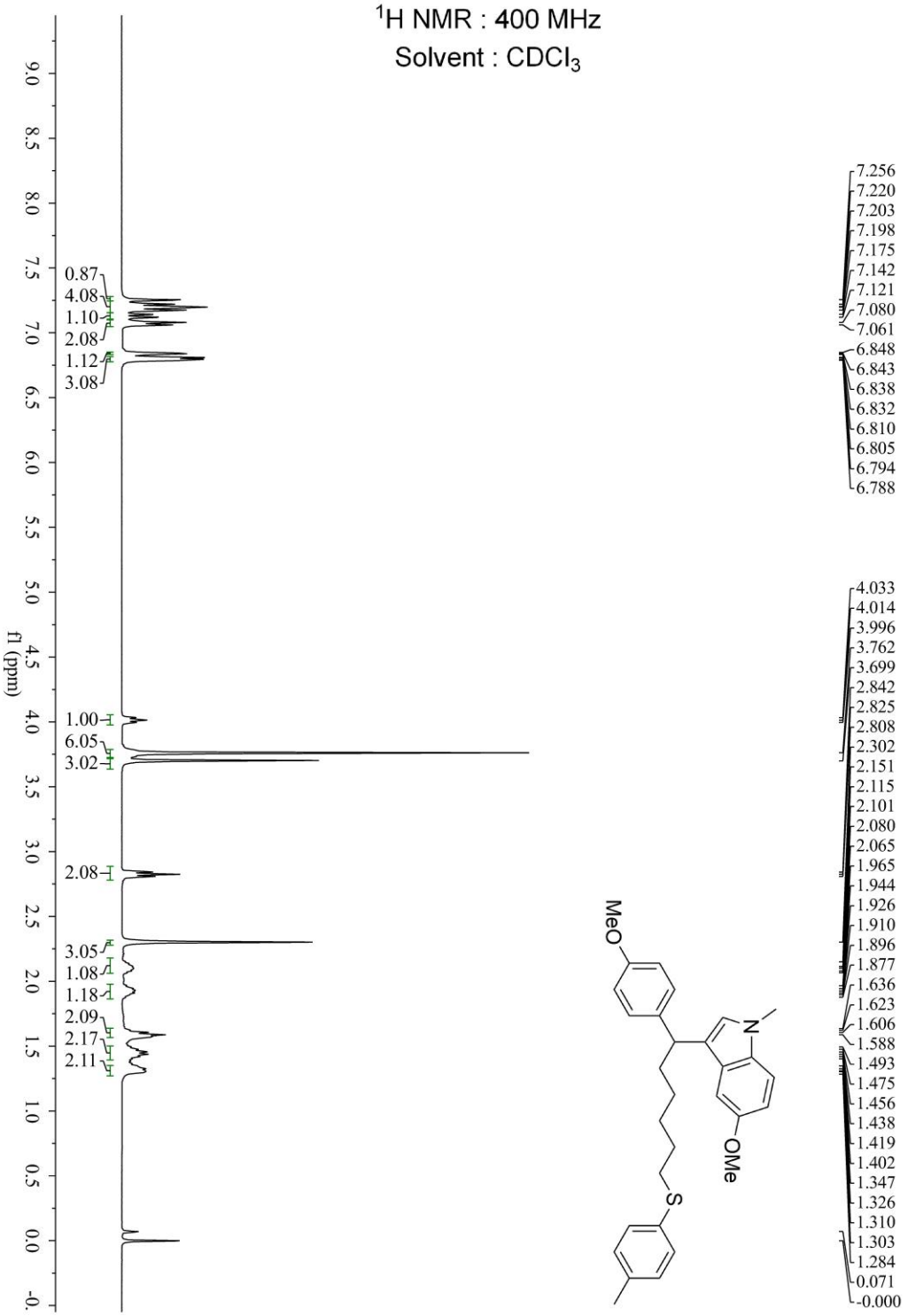

^{19}F NMR : 282 MHz
Solvent : $CDCl_3$
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)
-125.588
MeO
N
F
S

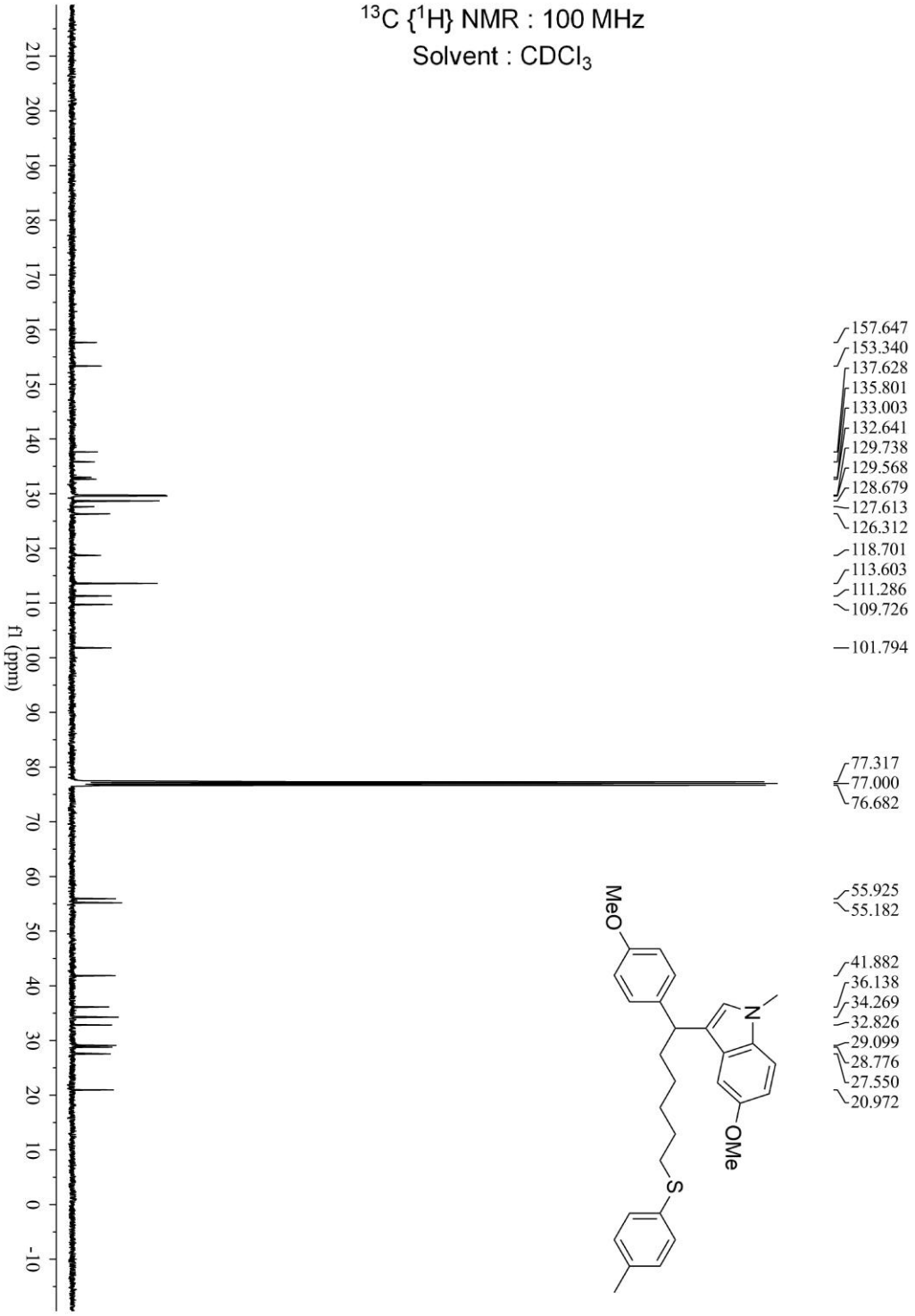
5-Bromo-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aaf)



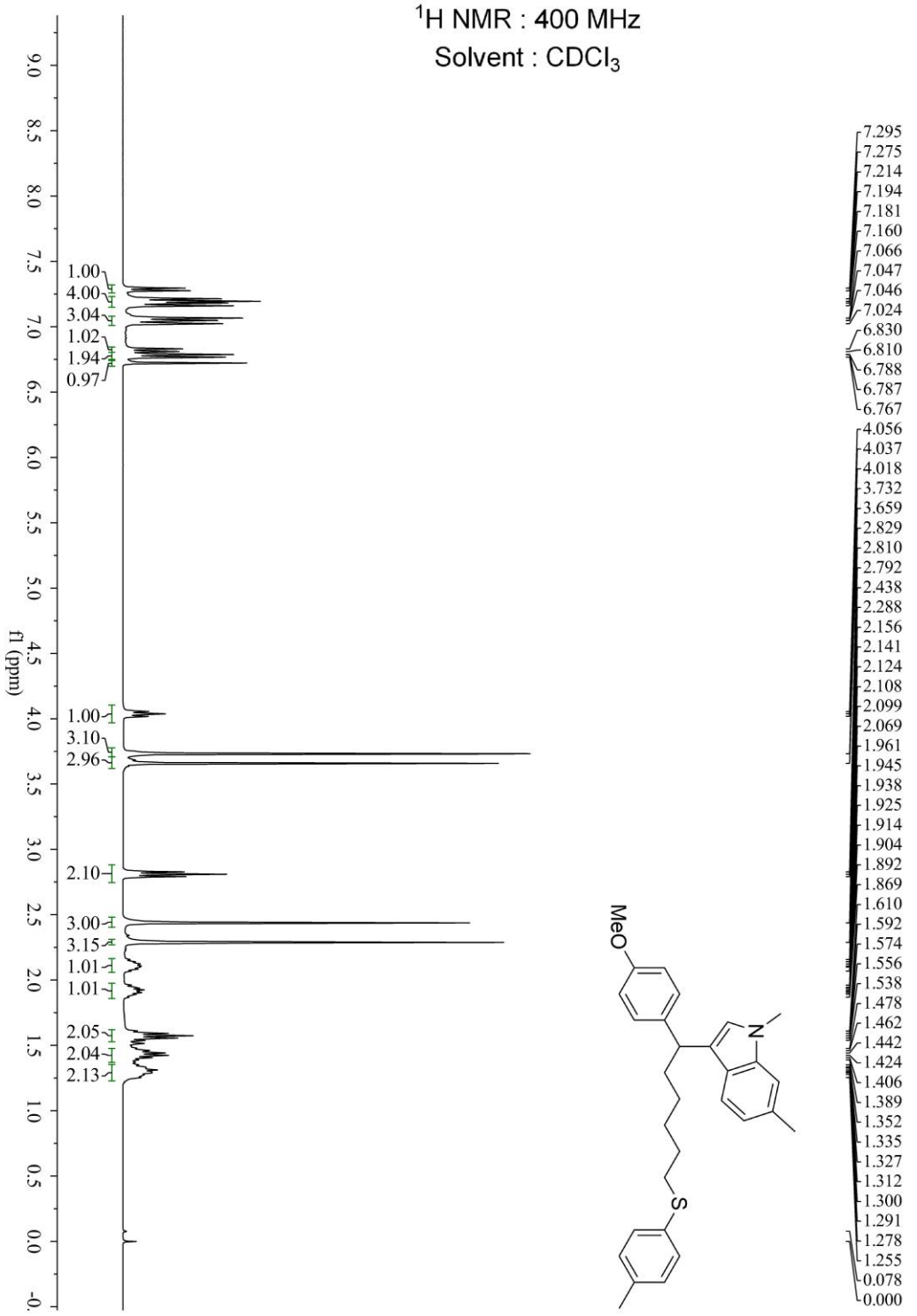

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.765
137.122
135.781
132.975
129.734
129.555
128.975
128.542
126.774
124.236
121.920
119.002
113.702
112.050
110.566
77.318
77.000
76.682
55.152
41.646
36.203
34.220
32.784
29.069
28.682
27.506
20.954
MeO
N
Br
S

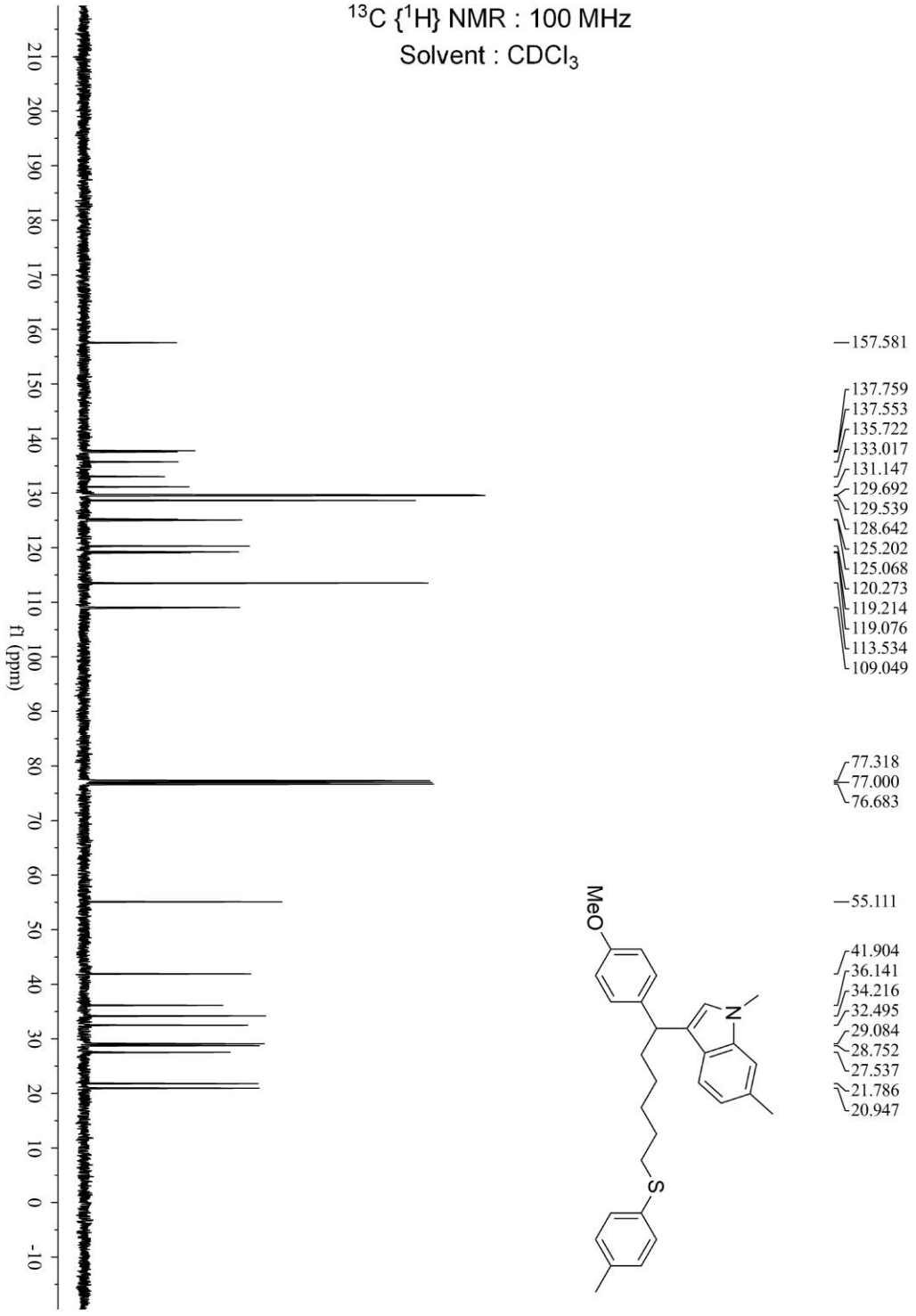
5-Methoxy-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aag)



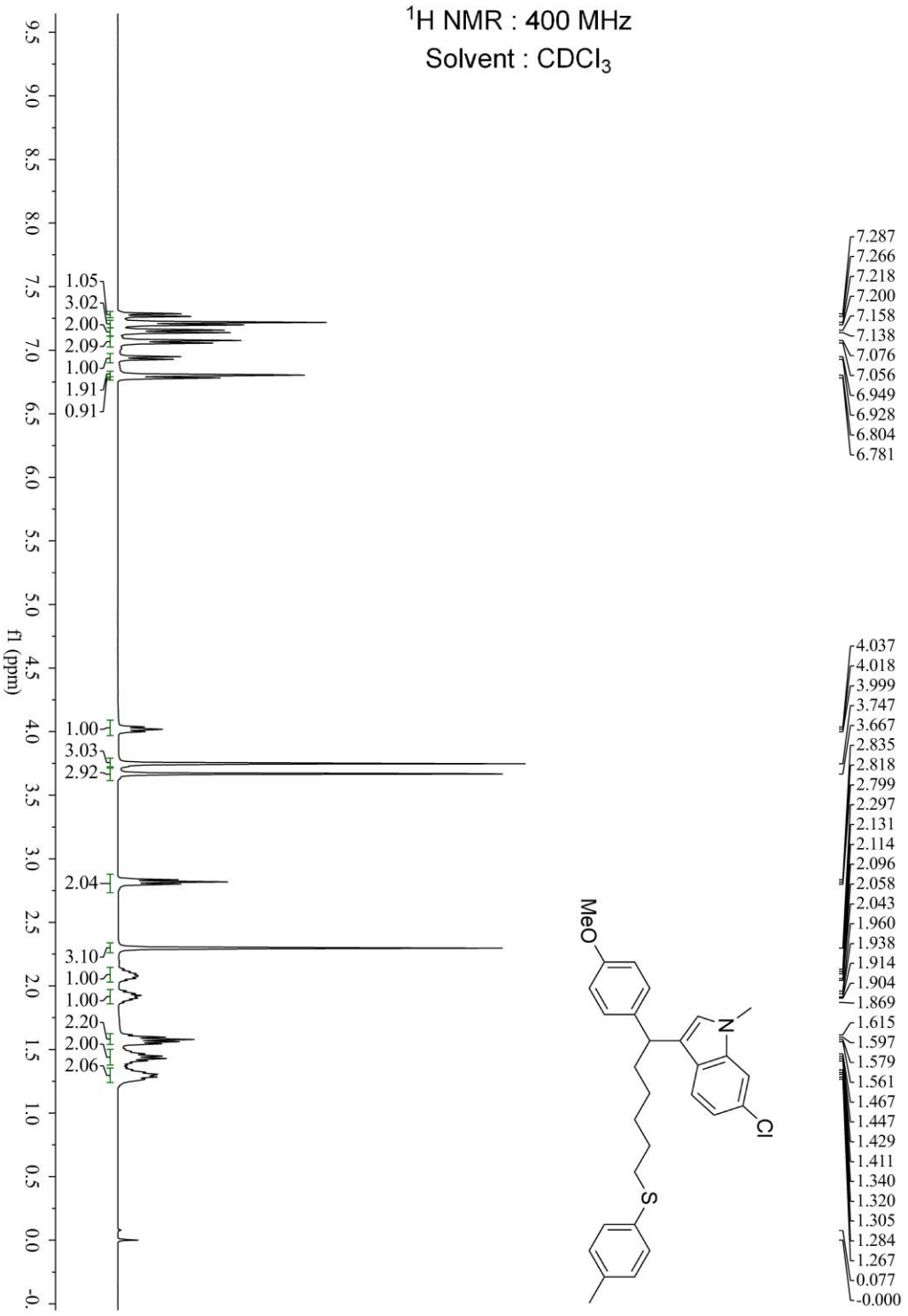

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
157.647
153.340
137.628
135.801
133.003
132.641
129.738
129.568
128.679
127.613
126.312
118.701
113.603
111.286
109.726
101.794
77.317
77.000
76.682
55.925
55.182
41.882
36.138
34.269
32.826
29.099
28.776
27.550
20.972
MeO
N
OMe
S

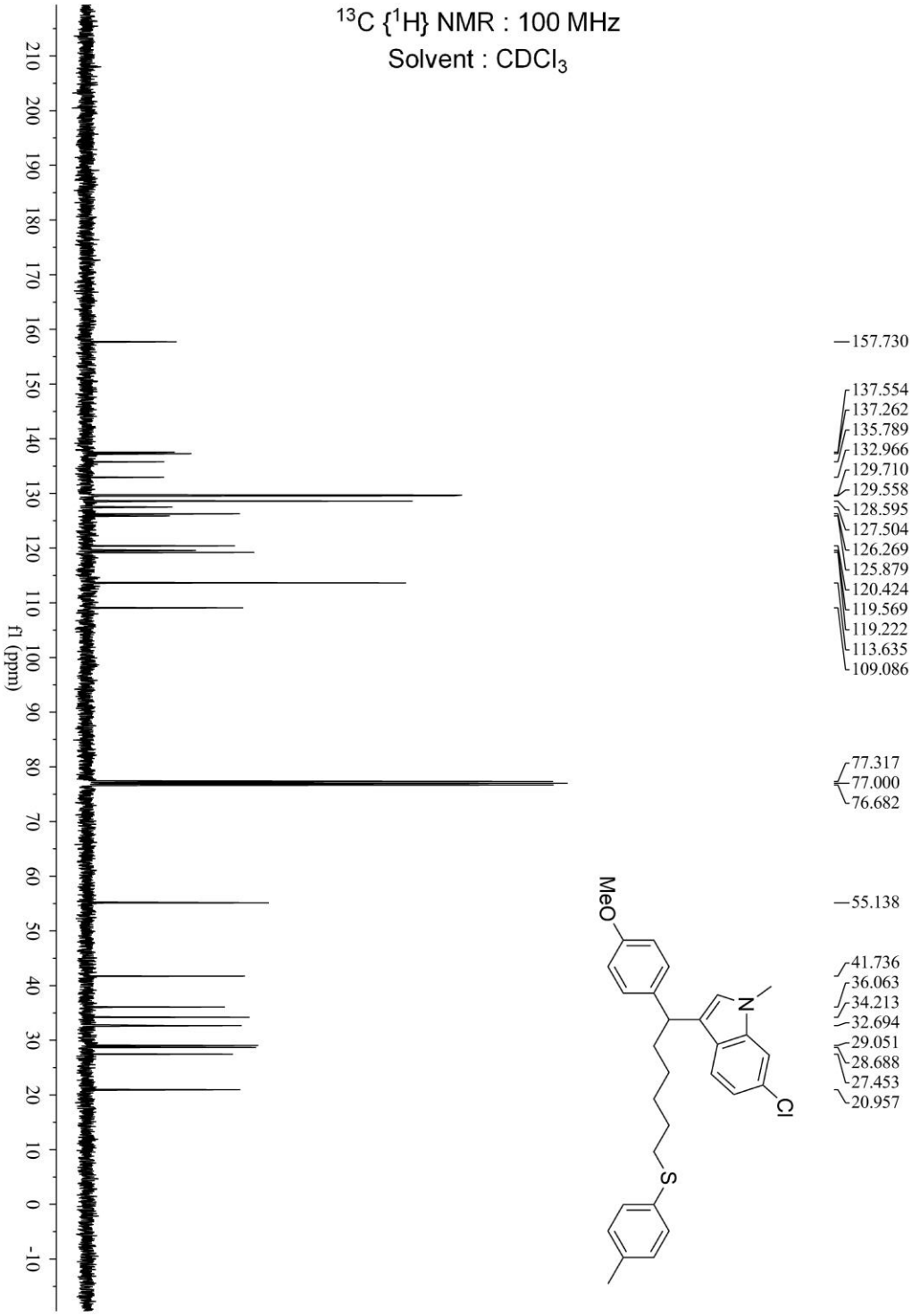
3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,6-dimethyl-1*H*-indole (4aah)



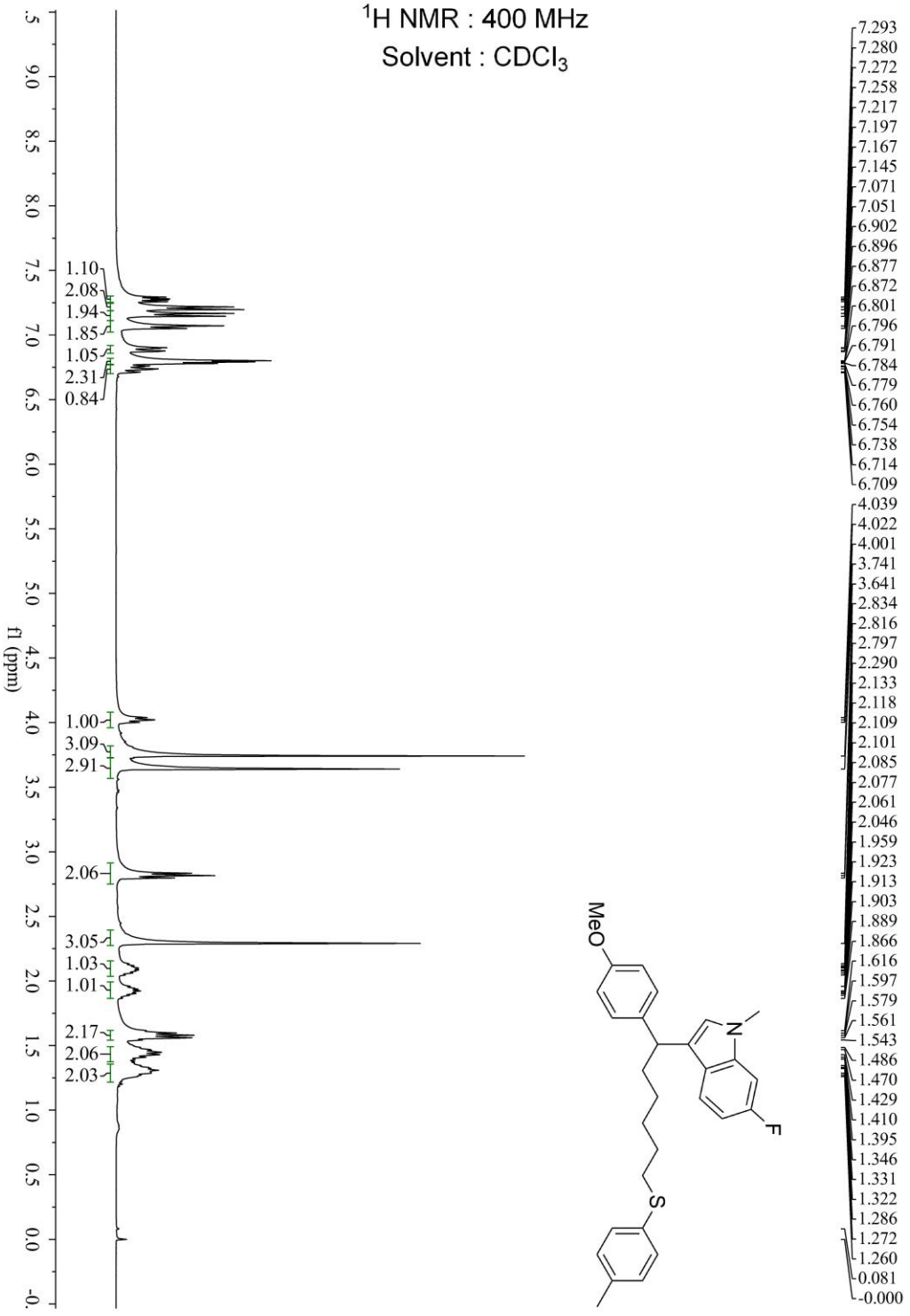

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.581
137.759
137.553
135.722
133.017
131.147
129.692
129.539
128.642
125.202
125.068
120.273
119.214
119.076
113.534
109.049
77.318
77.000
76.683
55.111
41.904
36.141
34.216
32.495
29.084
28.752
27.537
21.786
20.947
MeO
N
S

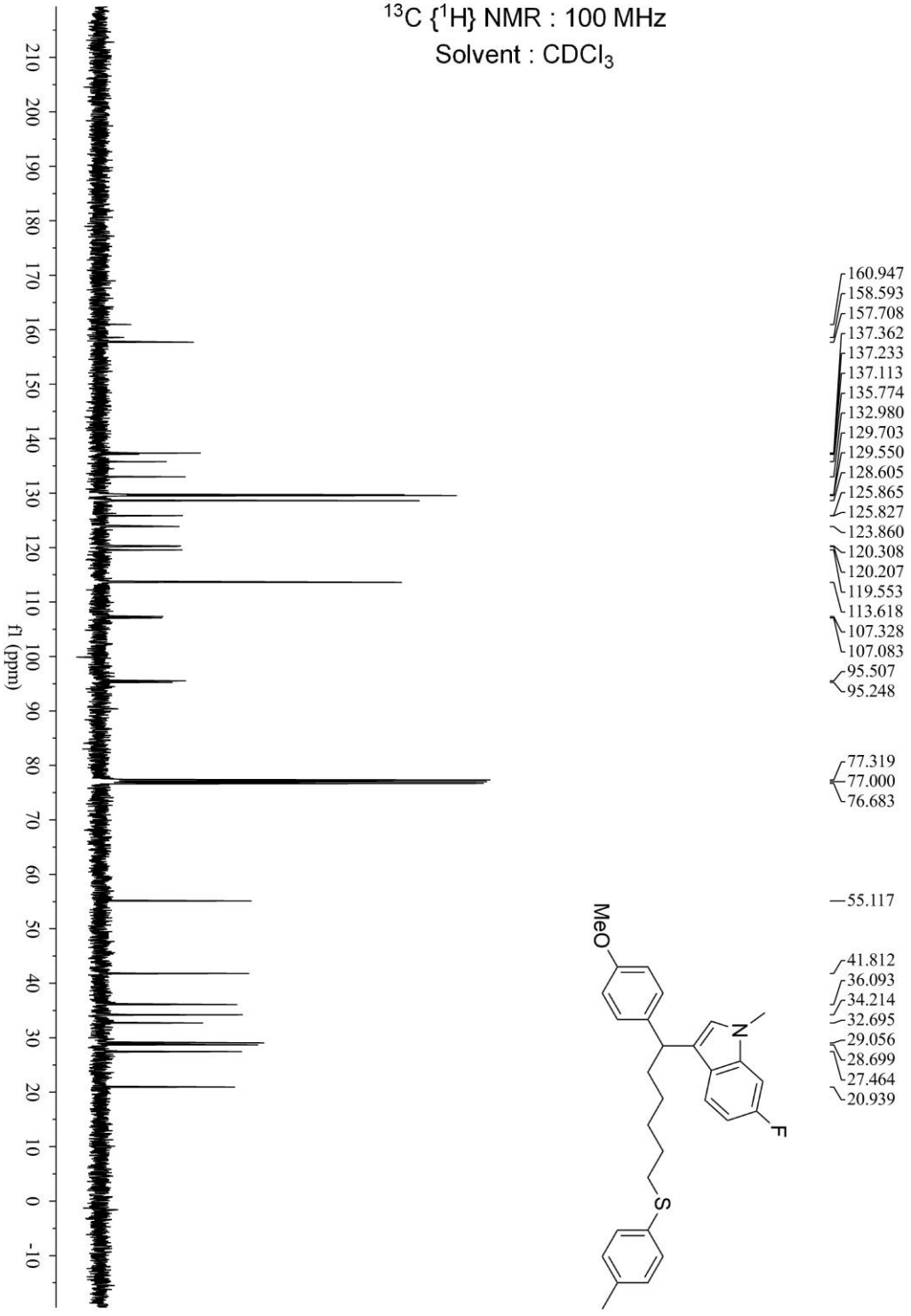
6-Chloro-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aai)

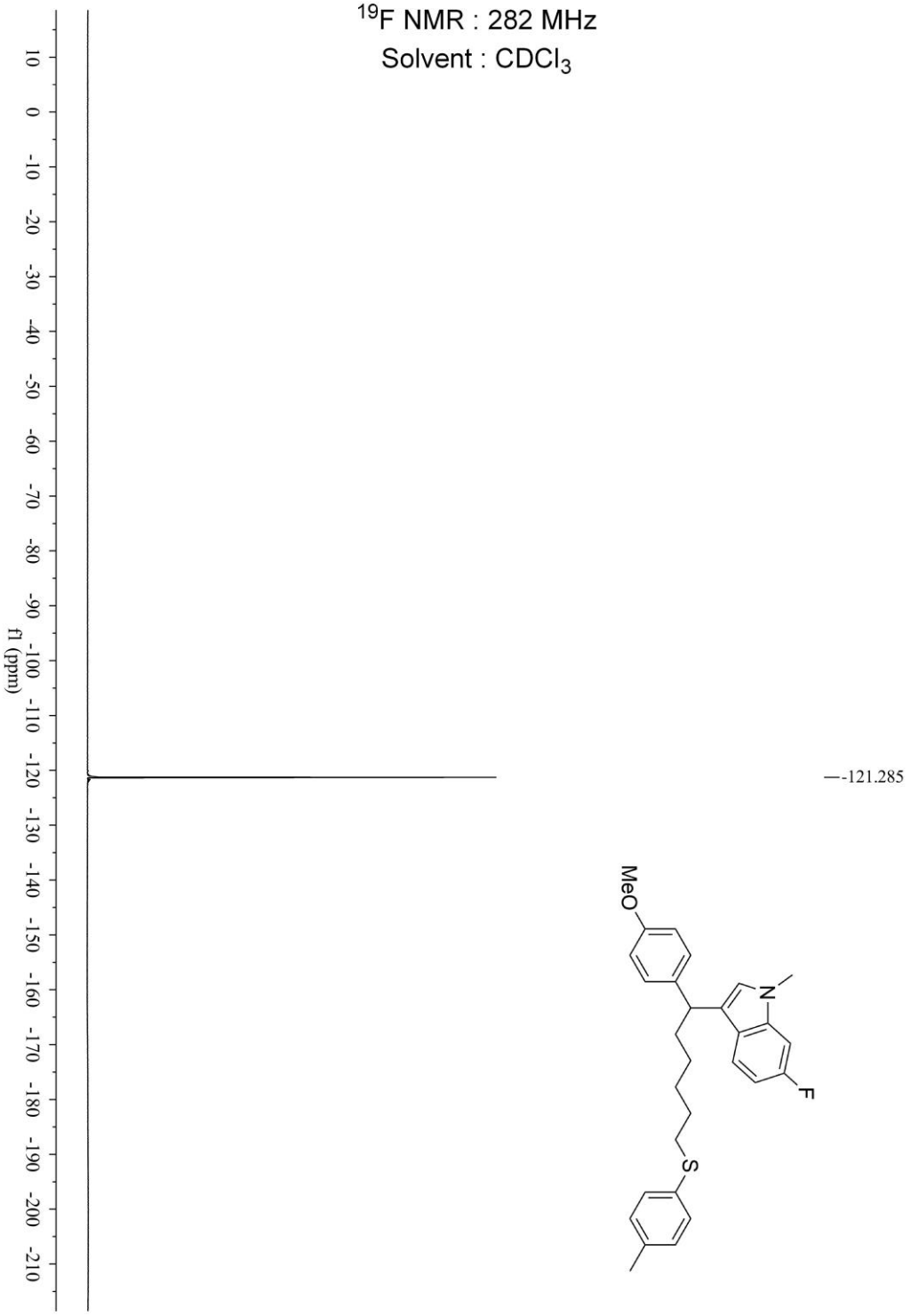



^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.730
137.554
137.262
135.789
132.966
129.710
129.558
128.595
127.504
126.269
125.879
120.424
119.569
119.222
113.635
109.086
77.317
77.000
76.682
55.138
41.736
36.063
34.213
32.694
29.051
28.688
27.453
20.957
MeO
N
Cl
S

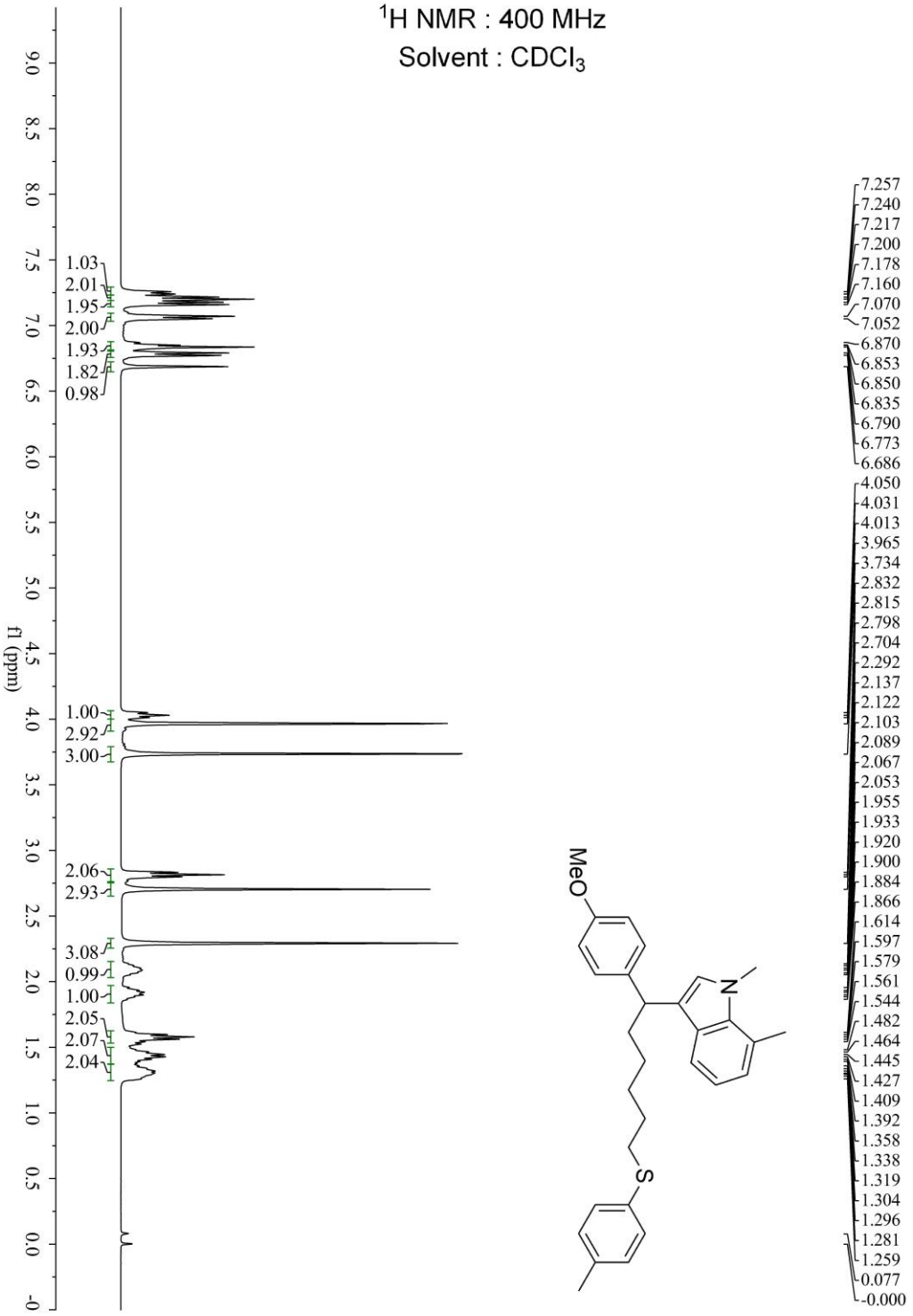
6-Fluoro-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-indole (4aaj)

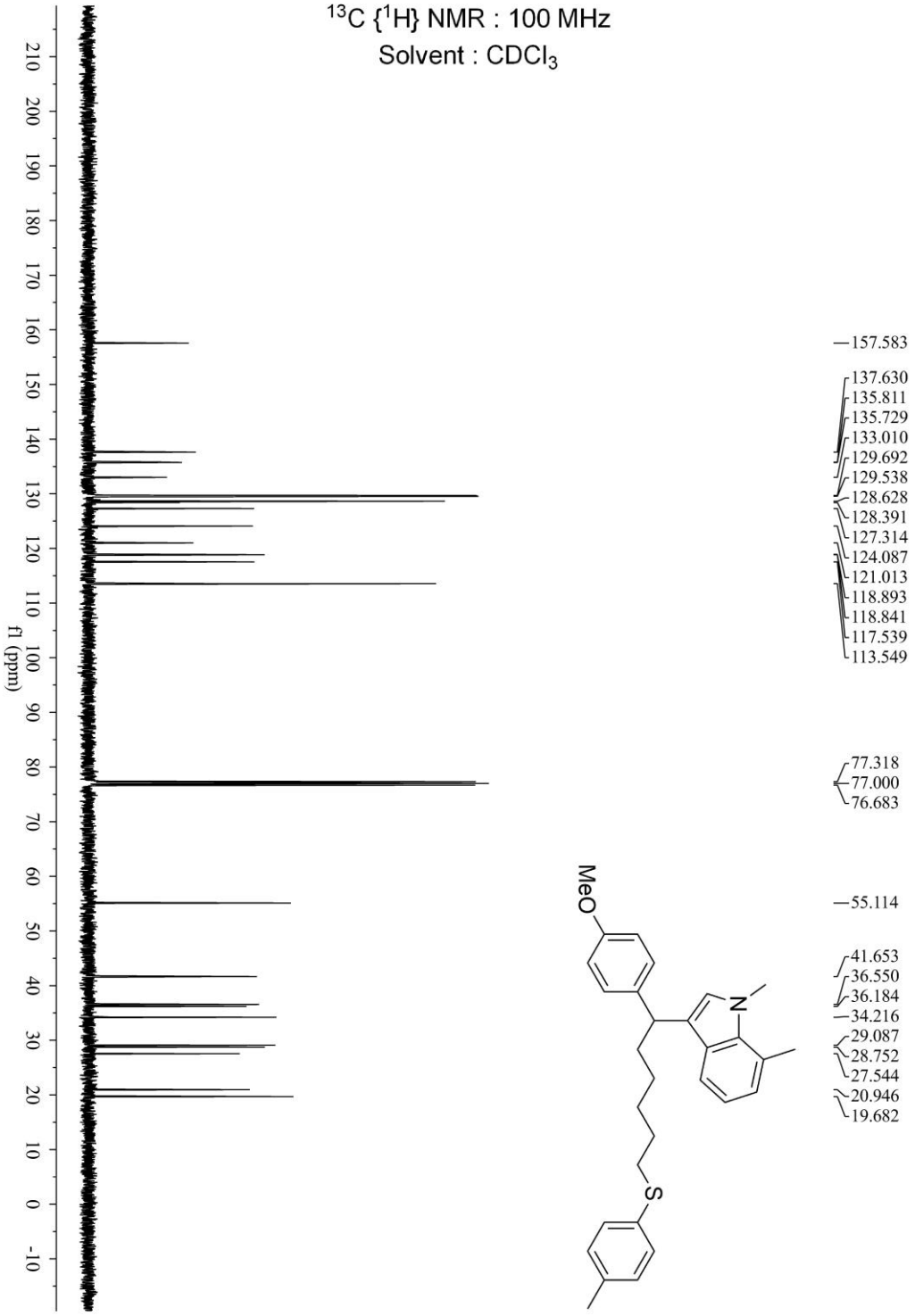



^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
160.947
158.593
157.708
137.362
137.233
137.113
135.774
132.980
129.703
129.550
128.605
125.865
125.827
123.860
120.308
120.207
119.553
113.618
107.328
107.083
95.507
95.248
77.319
77.000
76.683
55.117
41.812
36.093
34.214
32.695
29.056
28.699
27.464
20.939
MeO
N
F
S

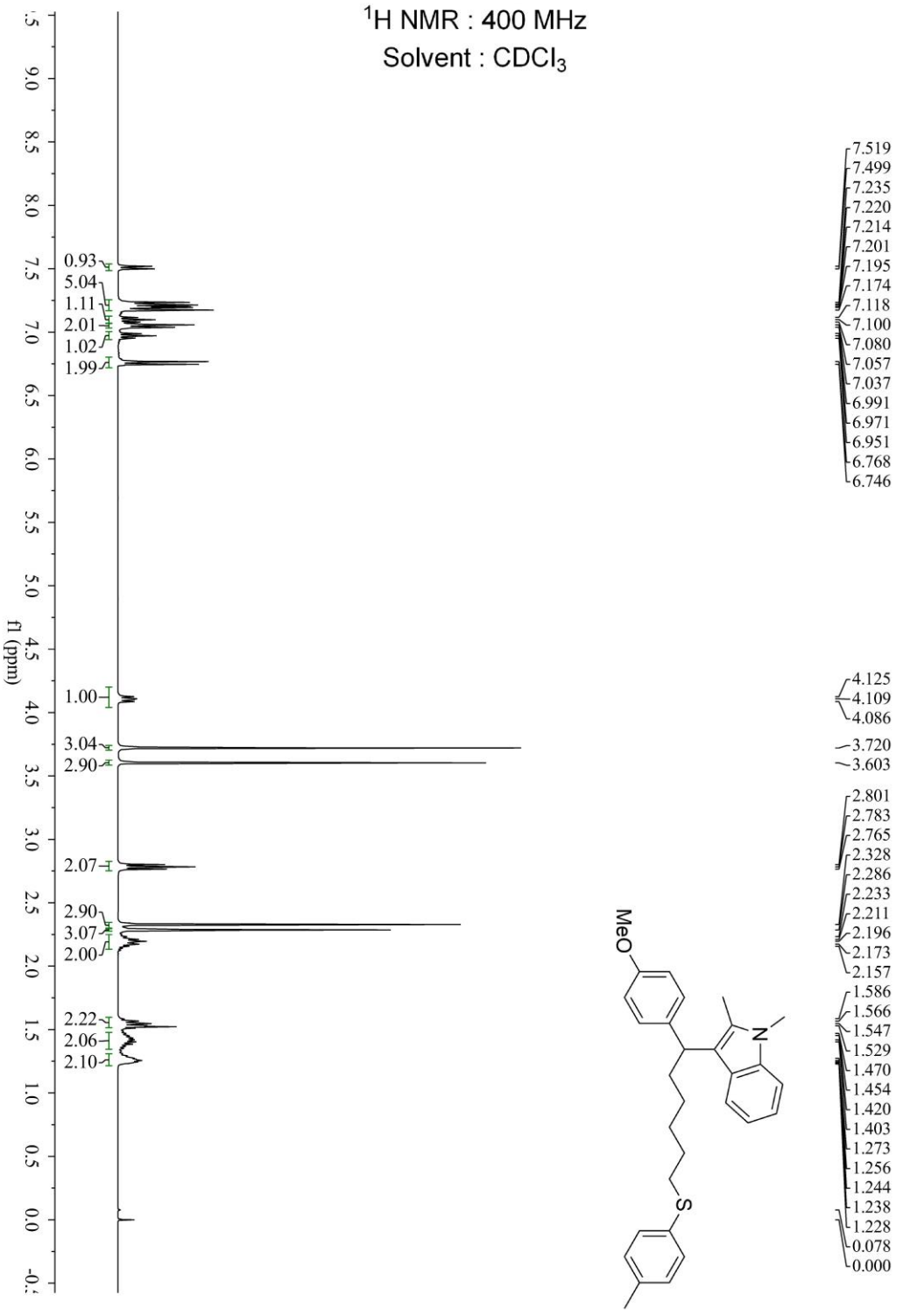

^{19}F NMR : 282 MHz
Solvent : $CDCl_3$
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)
—-121.285
MeO
N
F
S

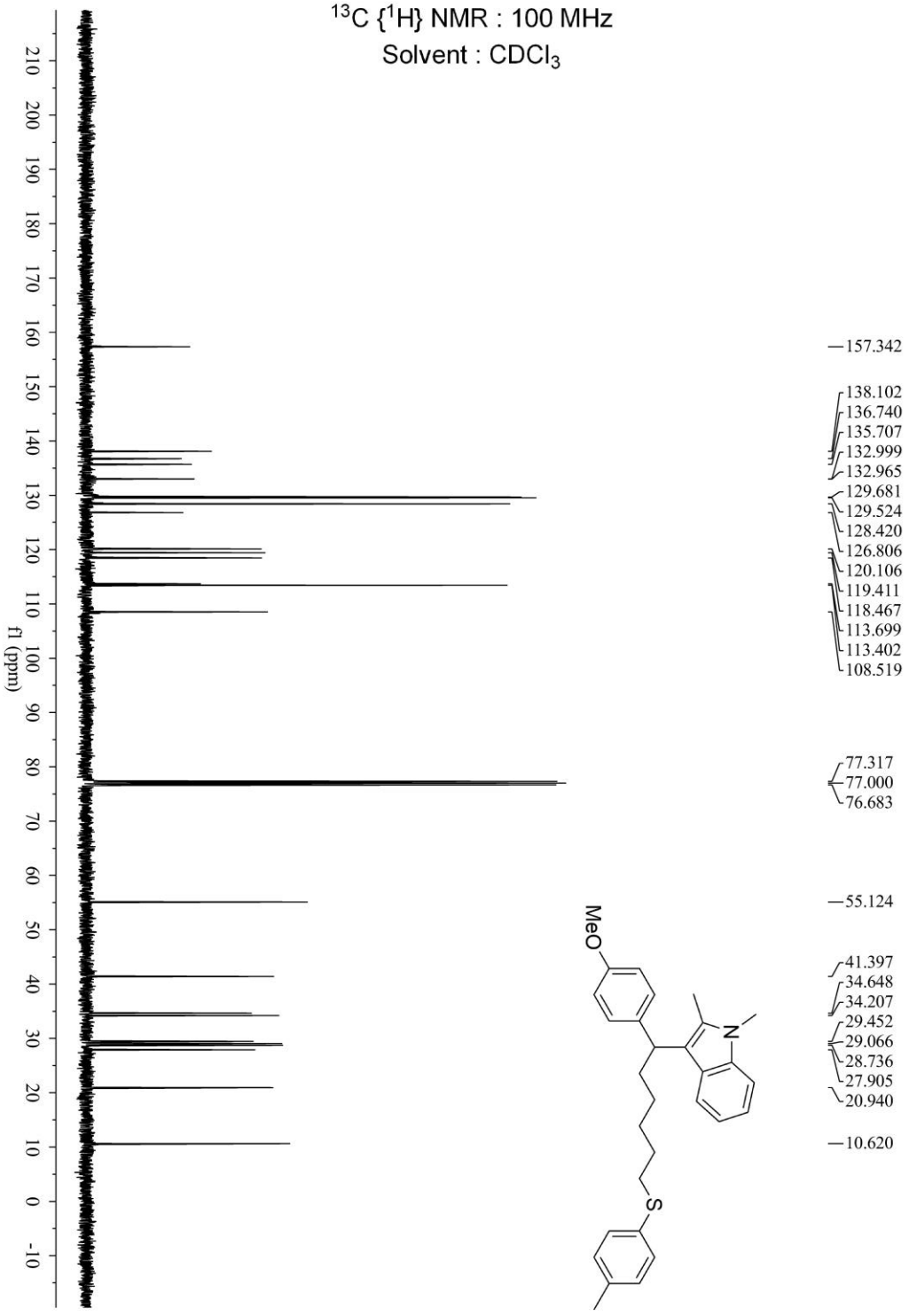
3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,7-dimethyl-1*H*-indole (4aak)



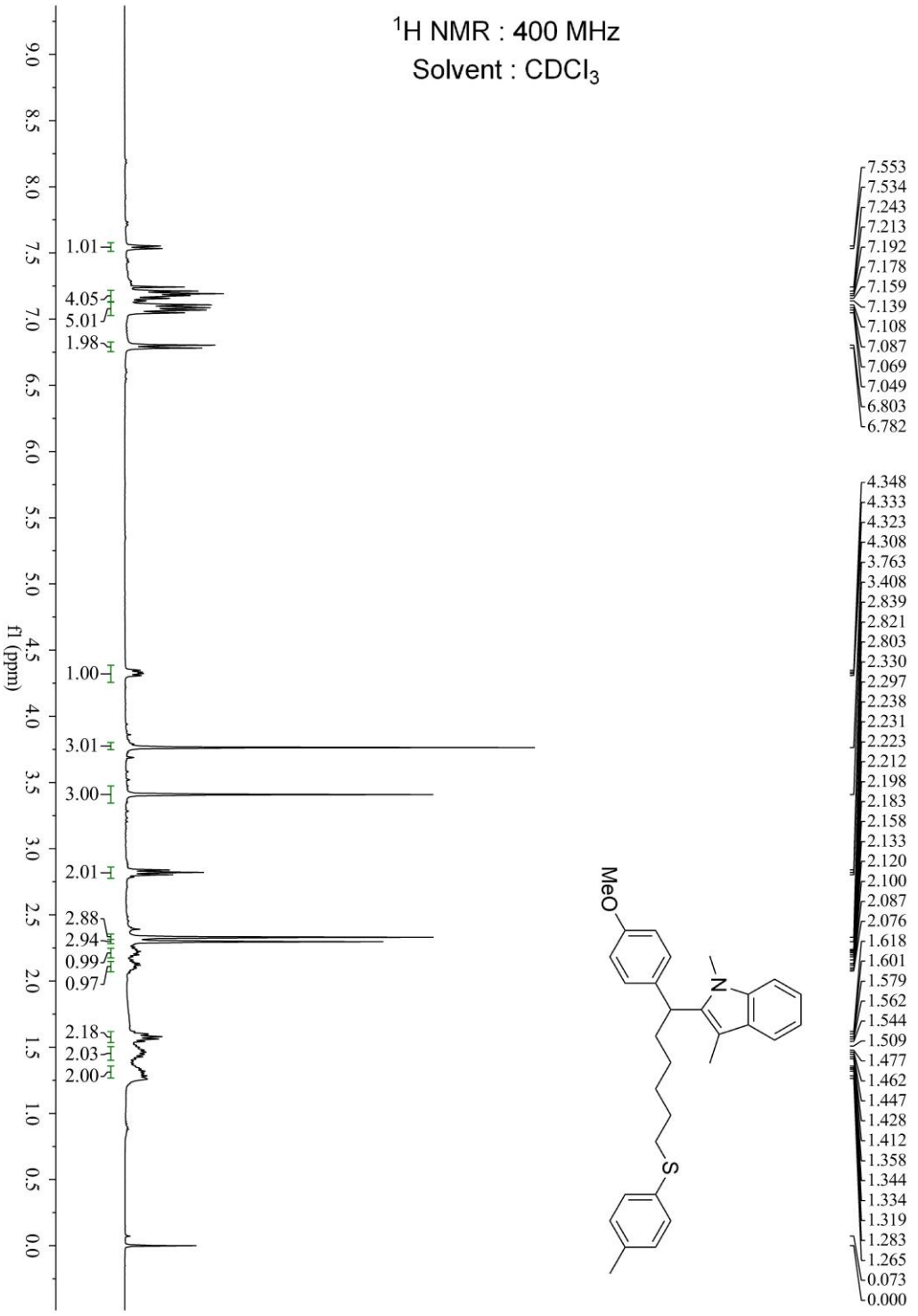

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.583
137.630
135.811
135.729
133.010
129.692
129.538
128.628
128.391
127.314
124.087
121.013
118.893
118.841
117.539
113.549
77.318
77.000
76.683
55.114
41.653
36.550
36.184
34.216
29.087
28.752
27.544
20.946
19.682
MeO
N
S

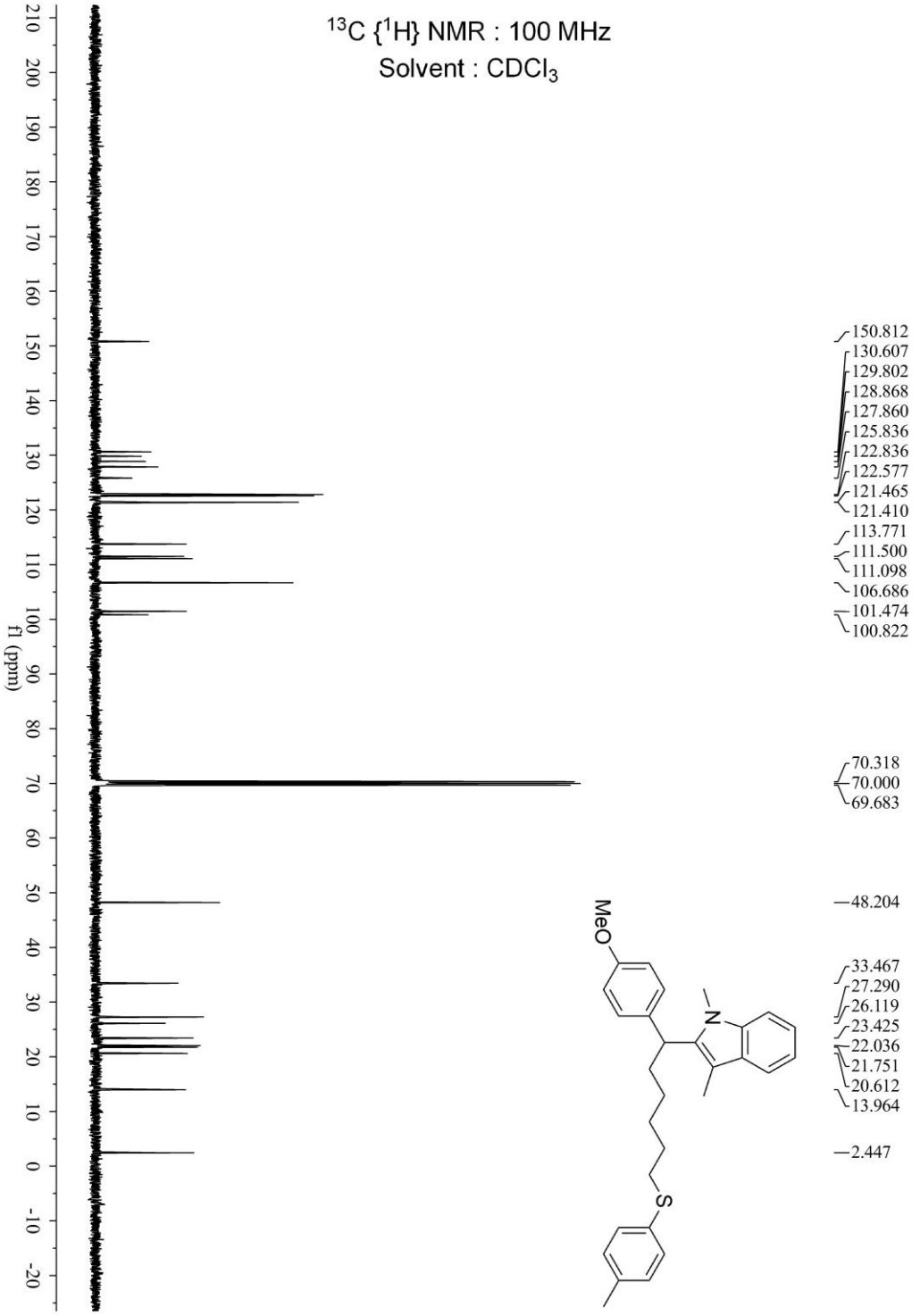
3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,2-dimethyl-1*H*-indole (4aal)



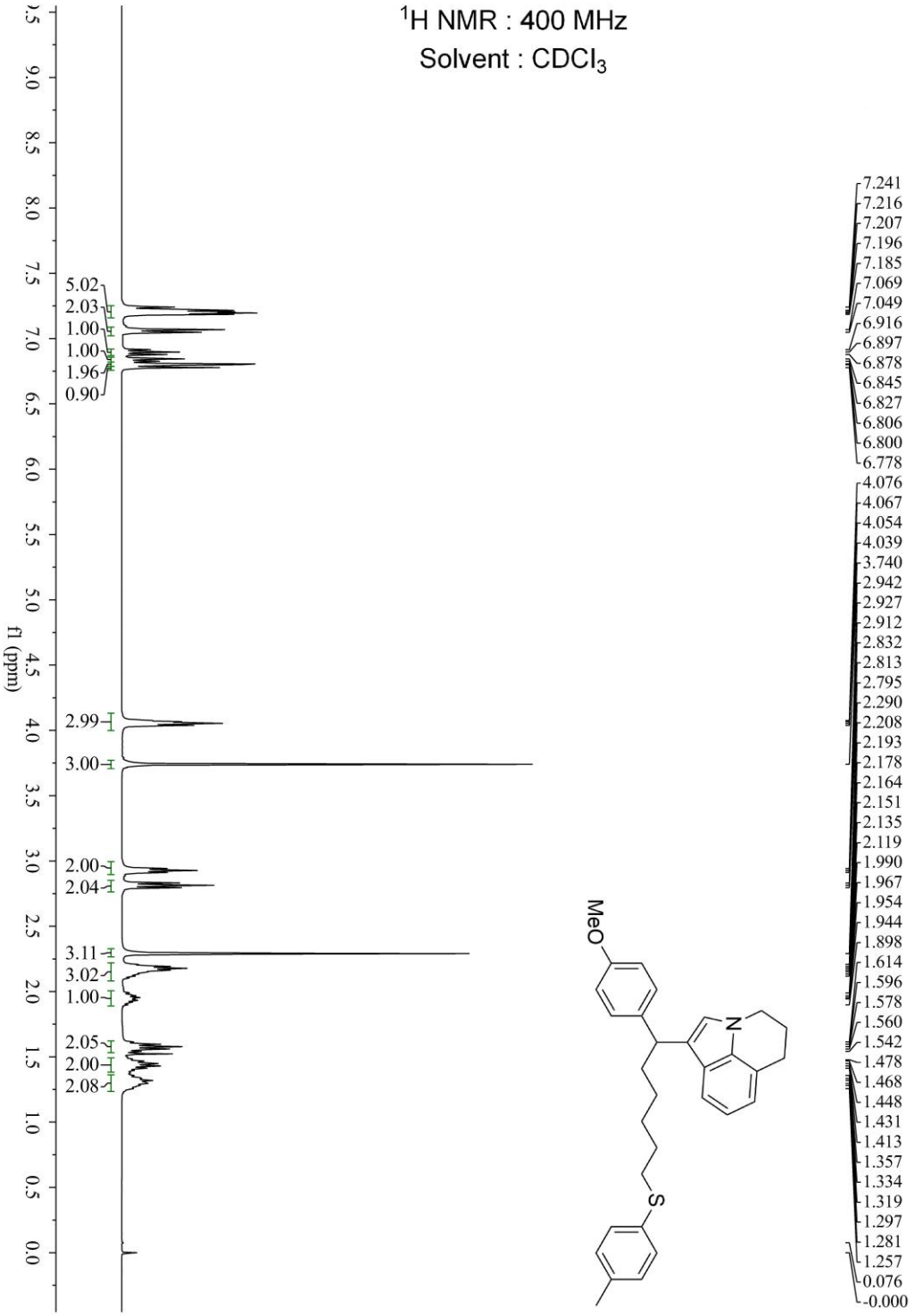

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
157.342
138.102
136.740
135.707
132.999
132.965
129.681
129.524
128.420
126.806
120.106
119.411
118.467
113.699
113.402
108.519
77.317
77.000
76.683
55.124
41.397
34.648
34.207
29.452
29.066
28.736
27.905
20.940
10.620
MeO
N
S

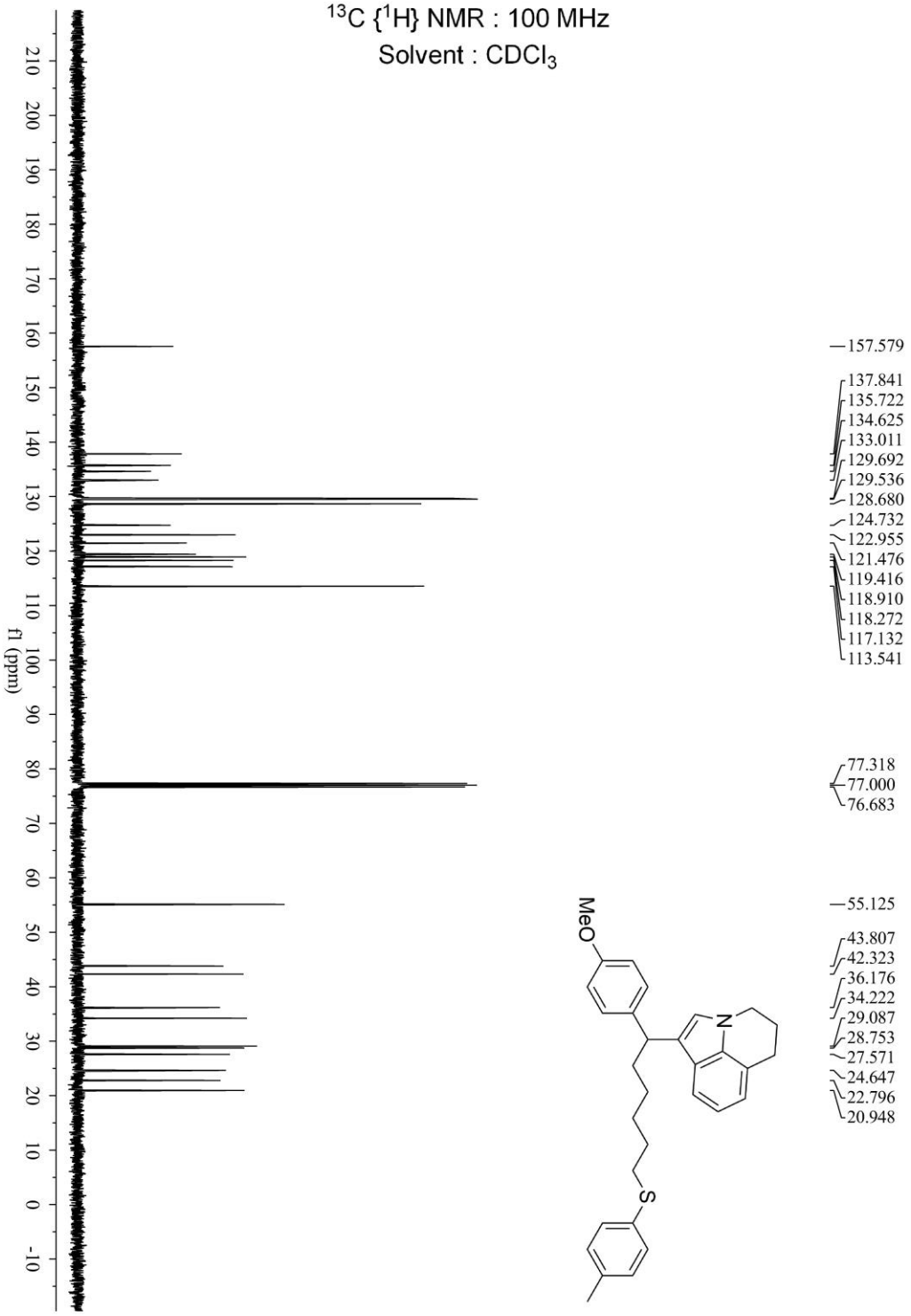
2-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1,3-dimethyl-1*H*-indole (4aam)



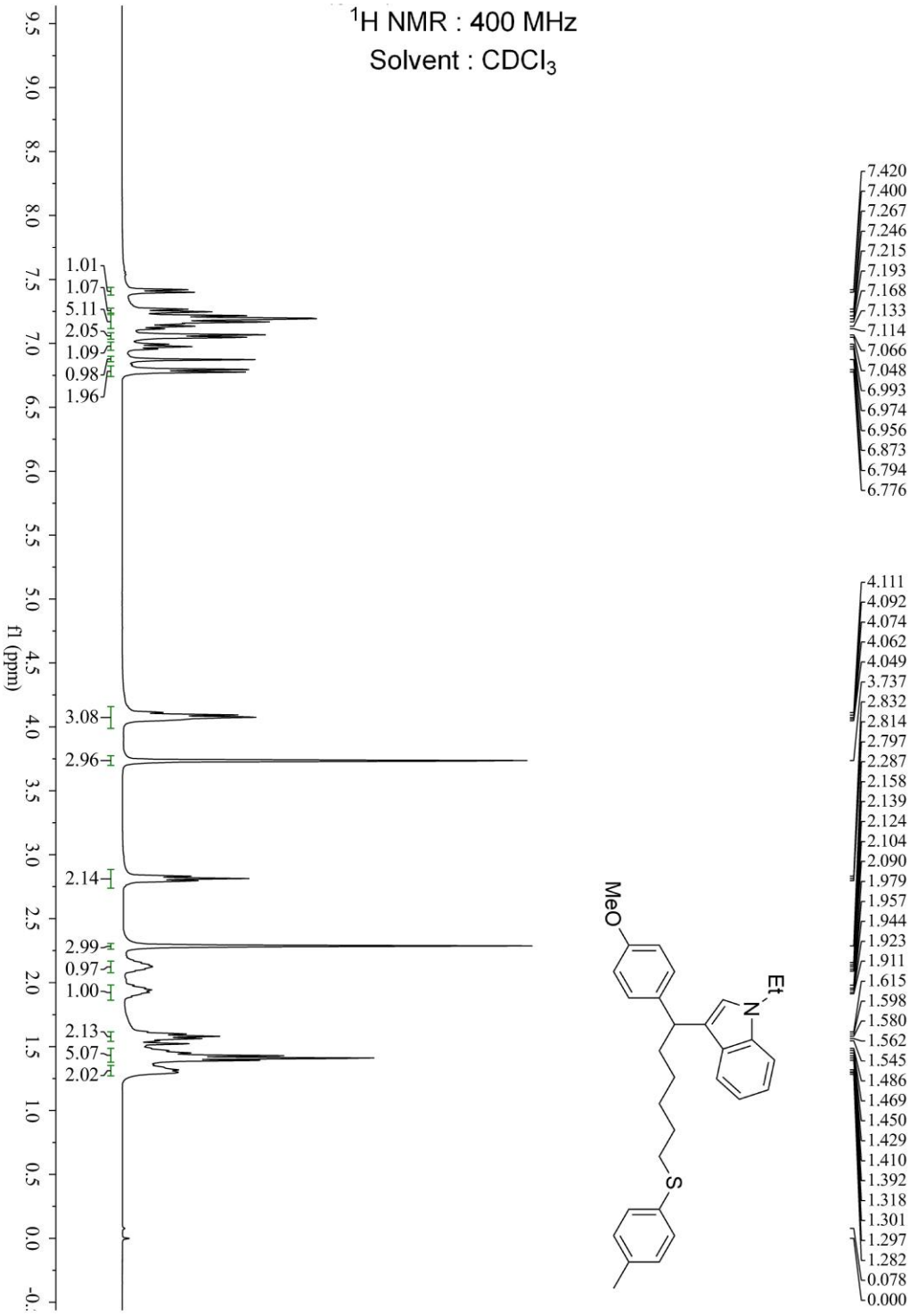

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
150.812
130.607
129.802
128.868
127.860
125.836
122.836
122.577
121.465
121.410
113.771
111.500
111.098
106.686
101.474
100.822
70.318
70.000
69.683
48.204
33.467
27.290
26.119
23.425
22.036
21.751
20.612
13.964
2.447
MeO
N
S

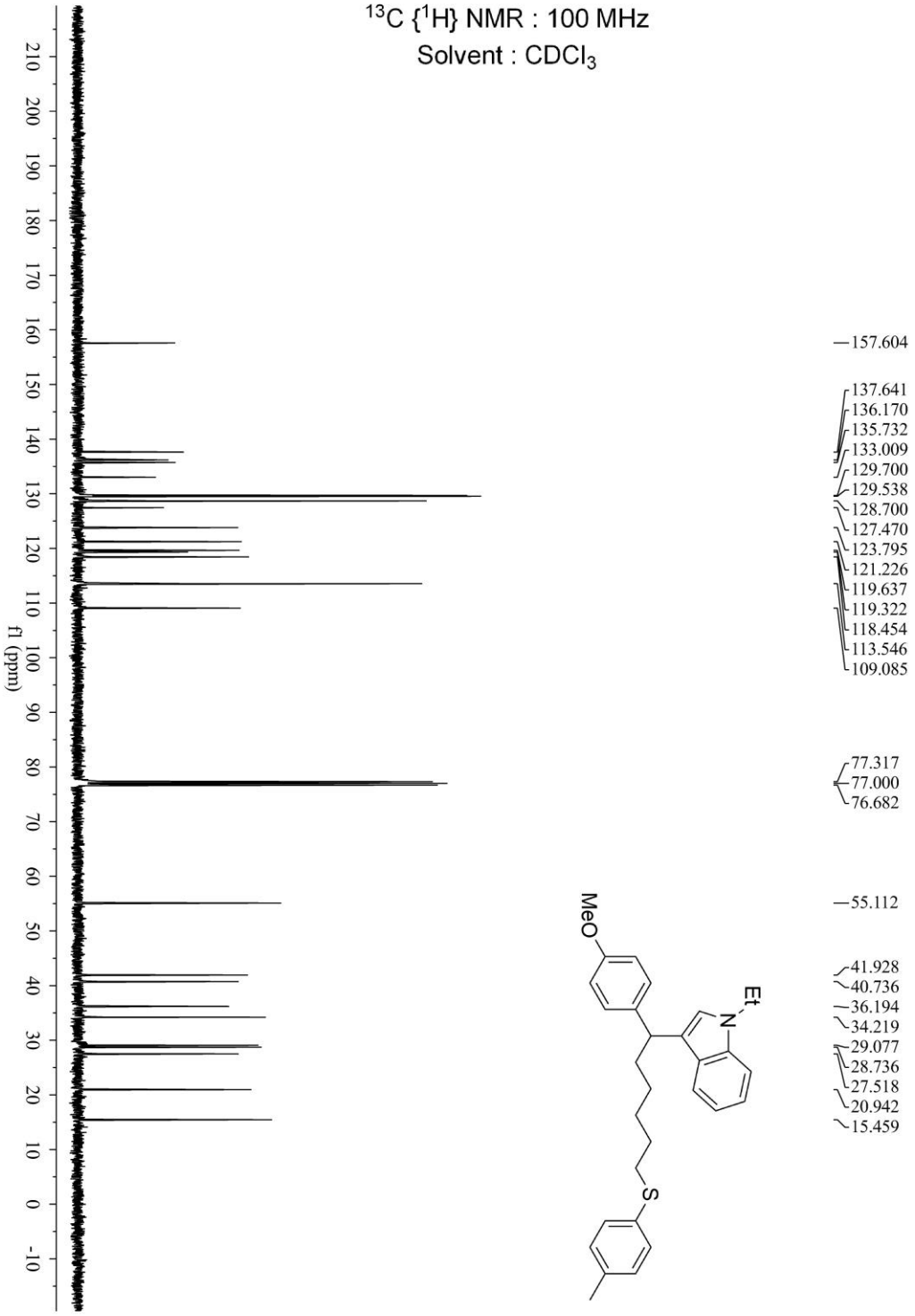
1-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-5,6-dihydro-4*H*-pyrrolo[3,2,1-*ij*]quinoline (4aan)



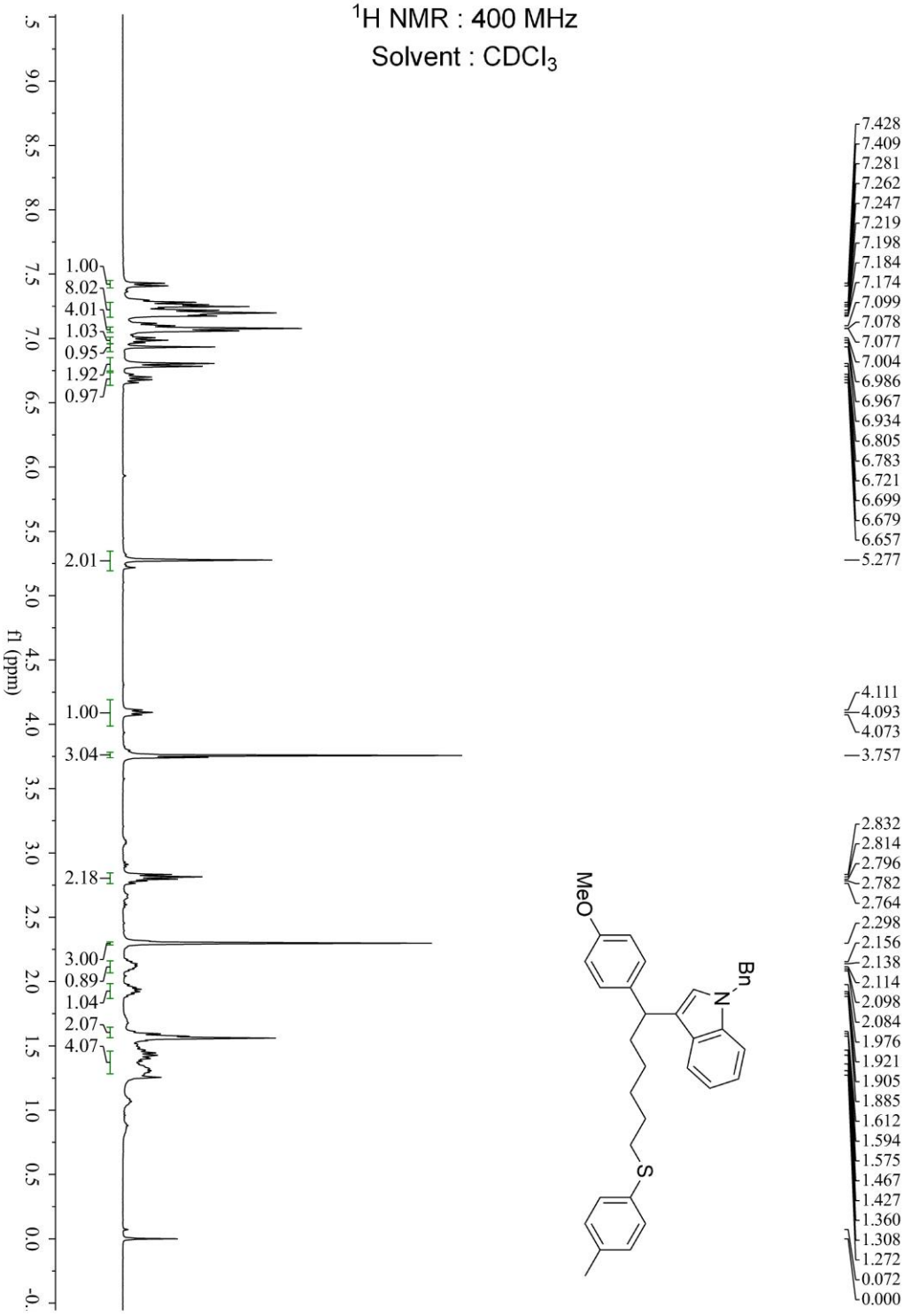

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
157.579
137.841
135.722
134.625
133.011
129.692
129.536
128.680
124.732
122.955
121.476
119.416
118.910
118.272
117.132
113.541
77.318
77.000
76.683
55.125
43.807
42.323
36.176
34.222
29.087
28.753
27.571
24.647
22.796
20.948
MeO
N
S

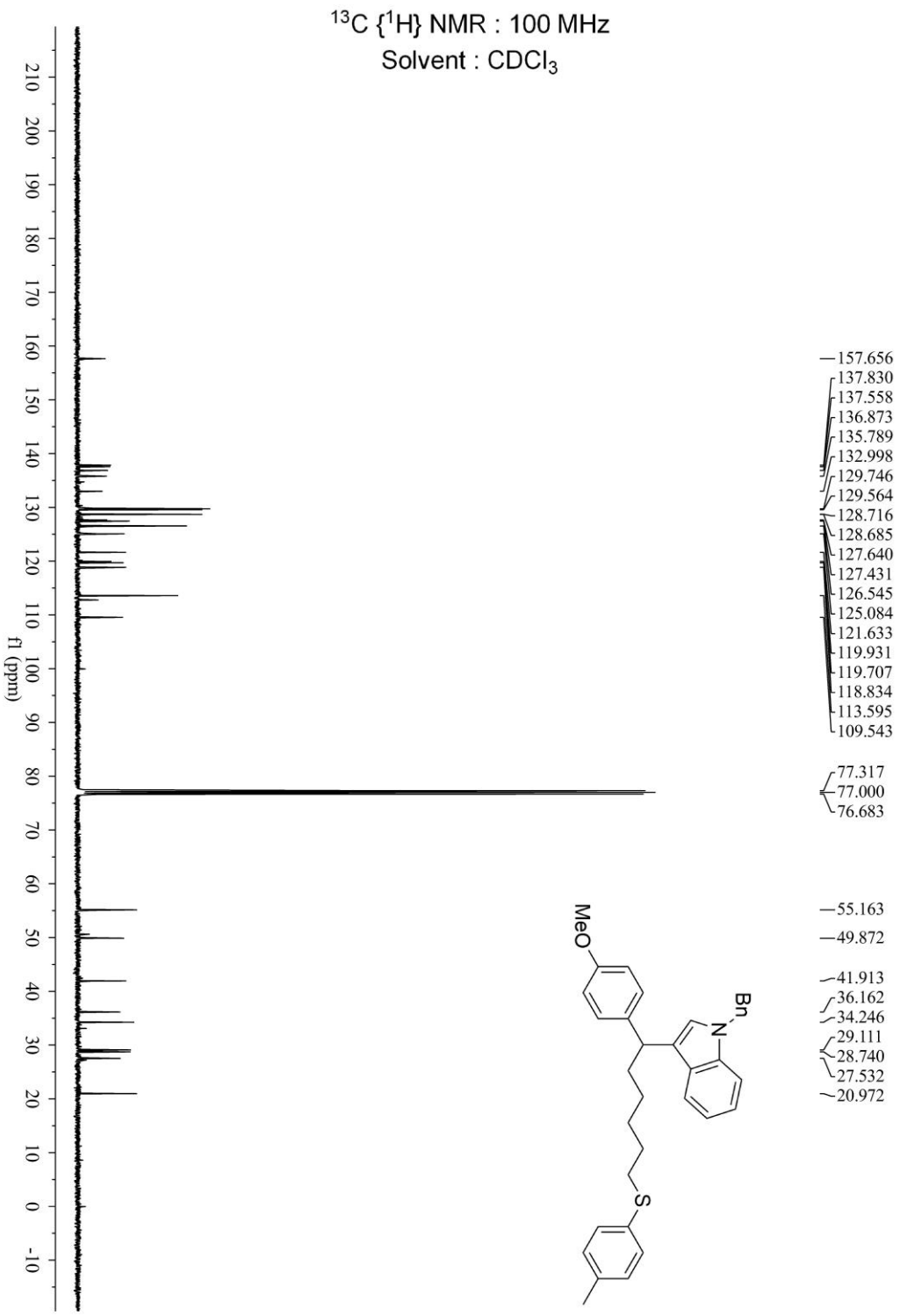
1-Ethyl-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4aao)



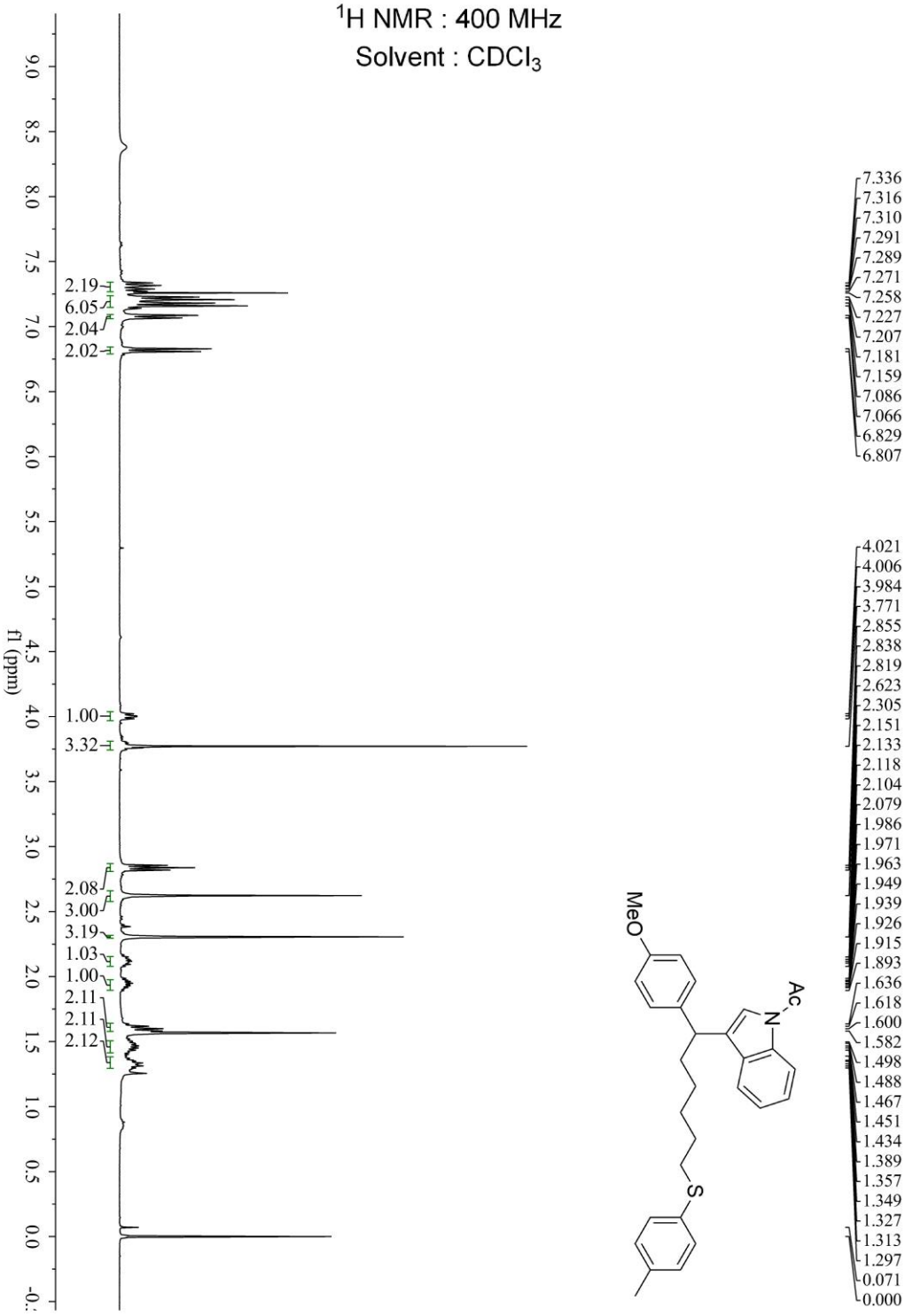

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.604
137.641
136.170
135.732
133.009
129.700
129.538
128.700
127.470
123.795
121.226
119.637
119.322
118.454
113.546
109.085
77.317
77.000
76.682
55.112
41.928
40.736
36.194
34.219
29.077
28.736
27.518
20.942
15.459
MeO
Et
N
S

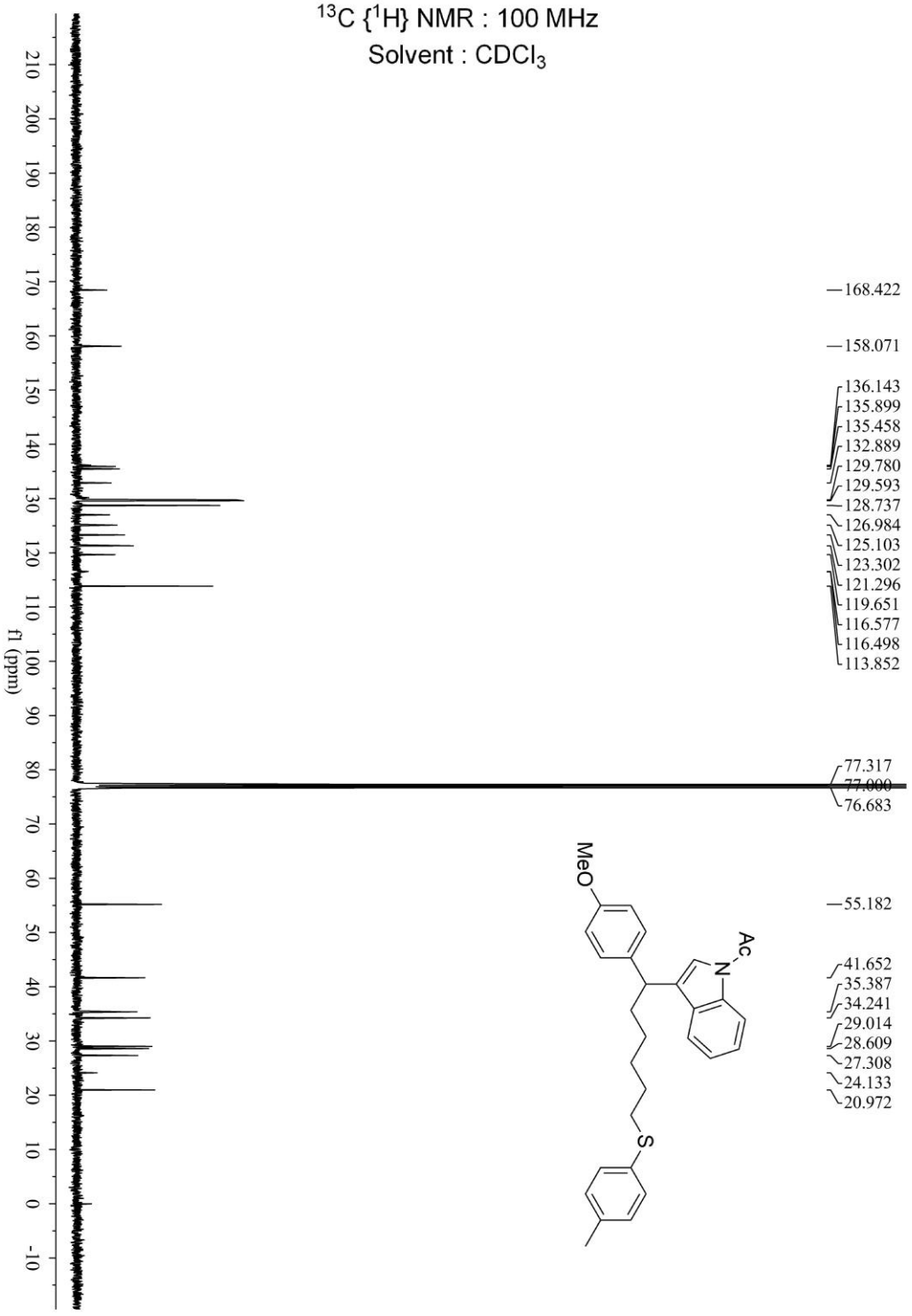
1-Benzyl-3-(1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4aap)



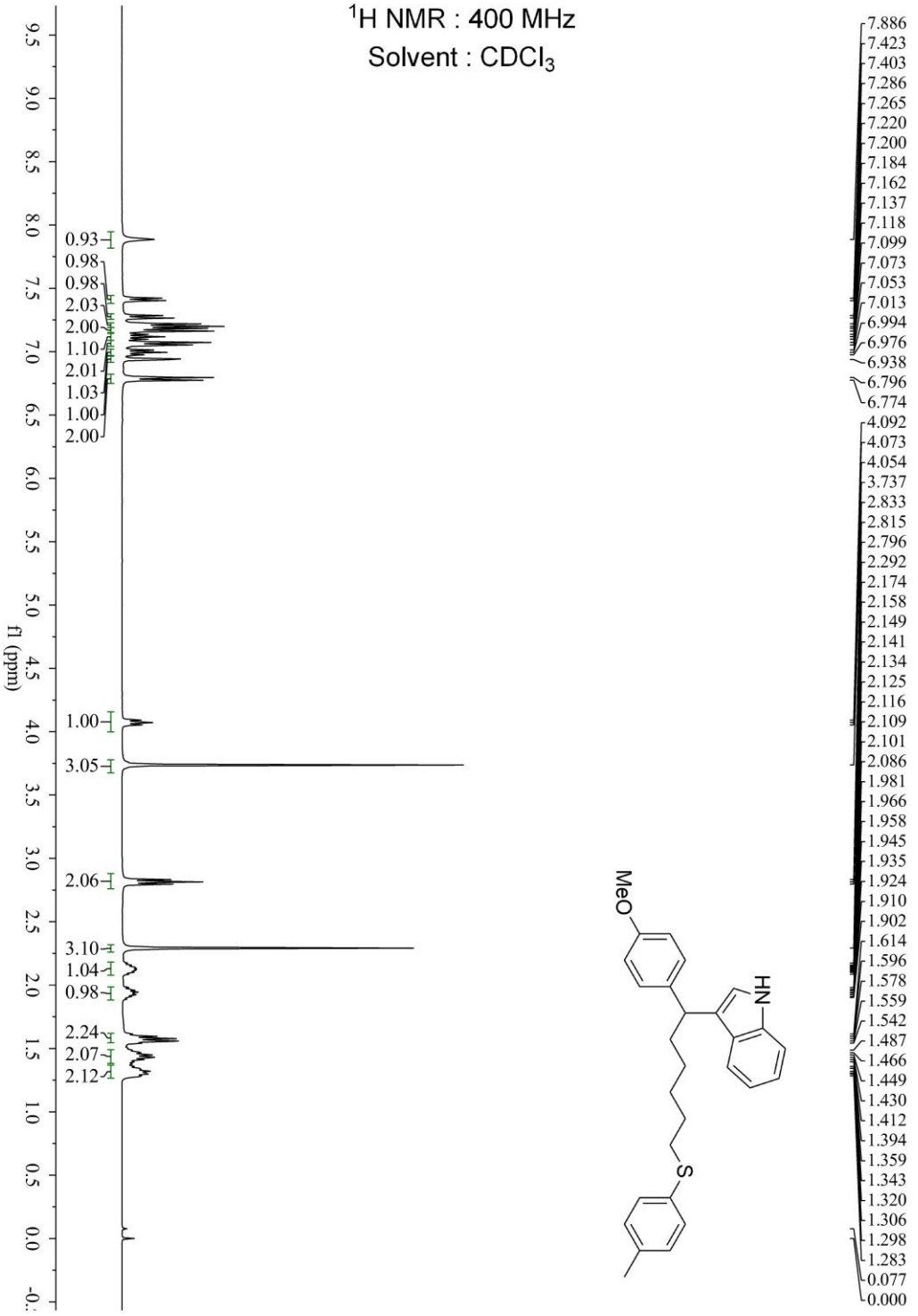

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
157.656
137.830
137.558
136.873
135.789
132.998
129.746
129.564
128.716
128.685
127.640
127.431
126.545
125.084
121.633
119.931
119.707
118.834
113.595
109.543
77.317
77.000
76.683
55.163
49.872
41.913
36.162
34.246
29.111
28.740
27.532
20.972
MeO
Bn
N
S

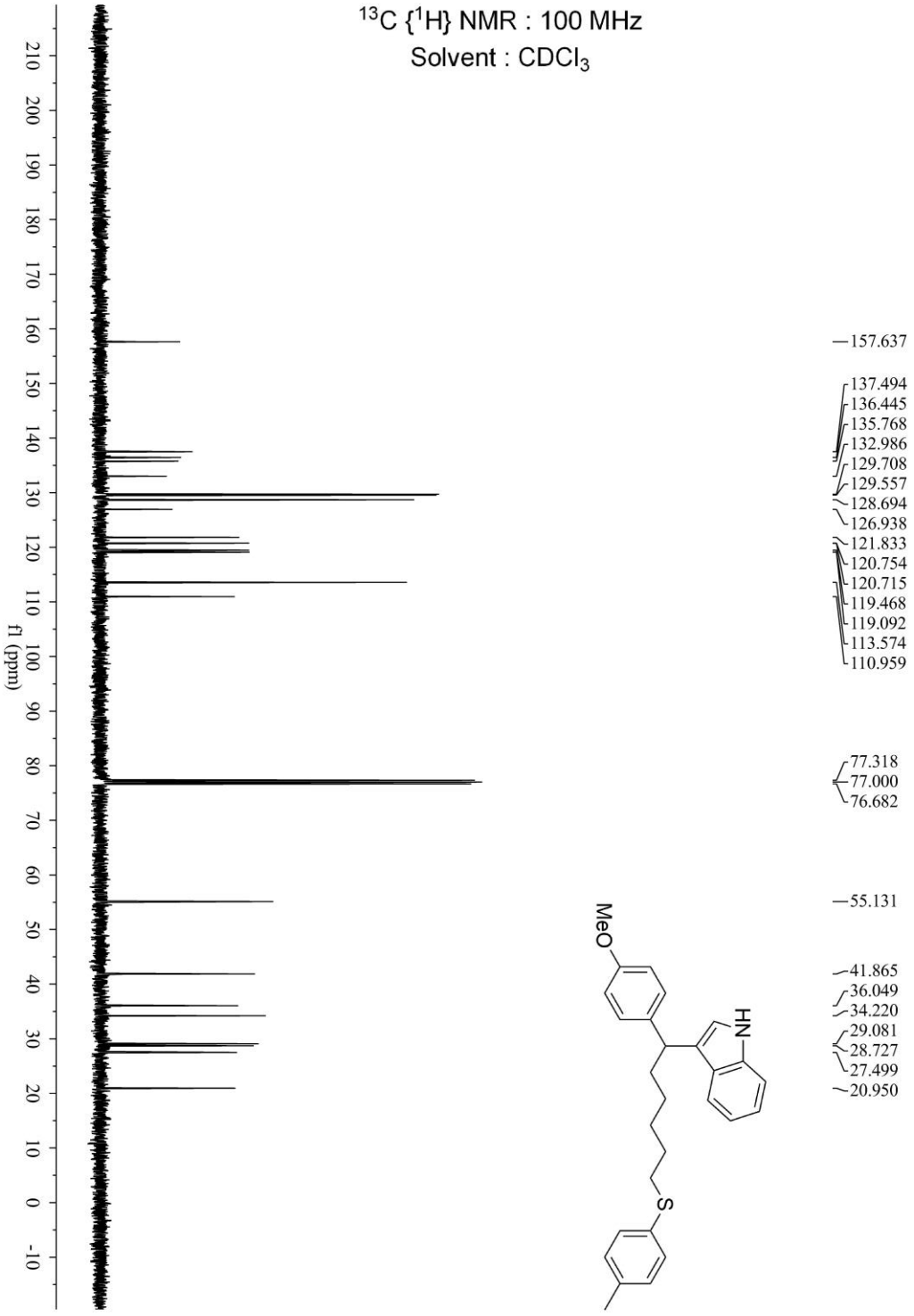
1-(3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1*H*-indol-1-yl)ethan-1-one (4aaq)



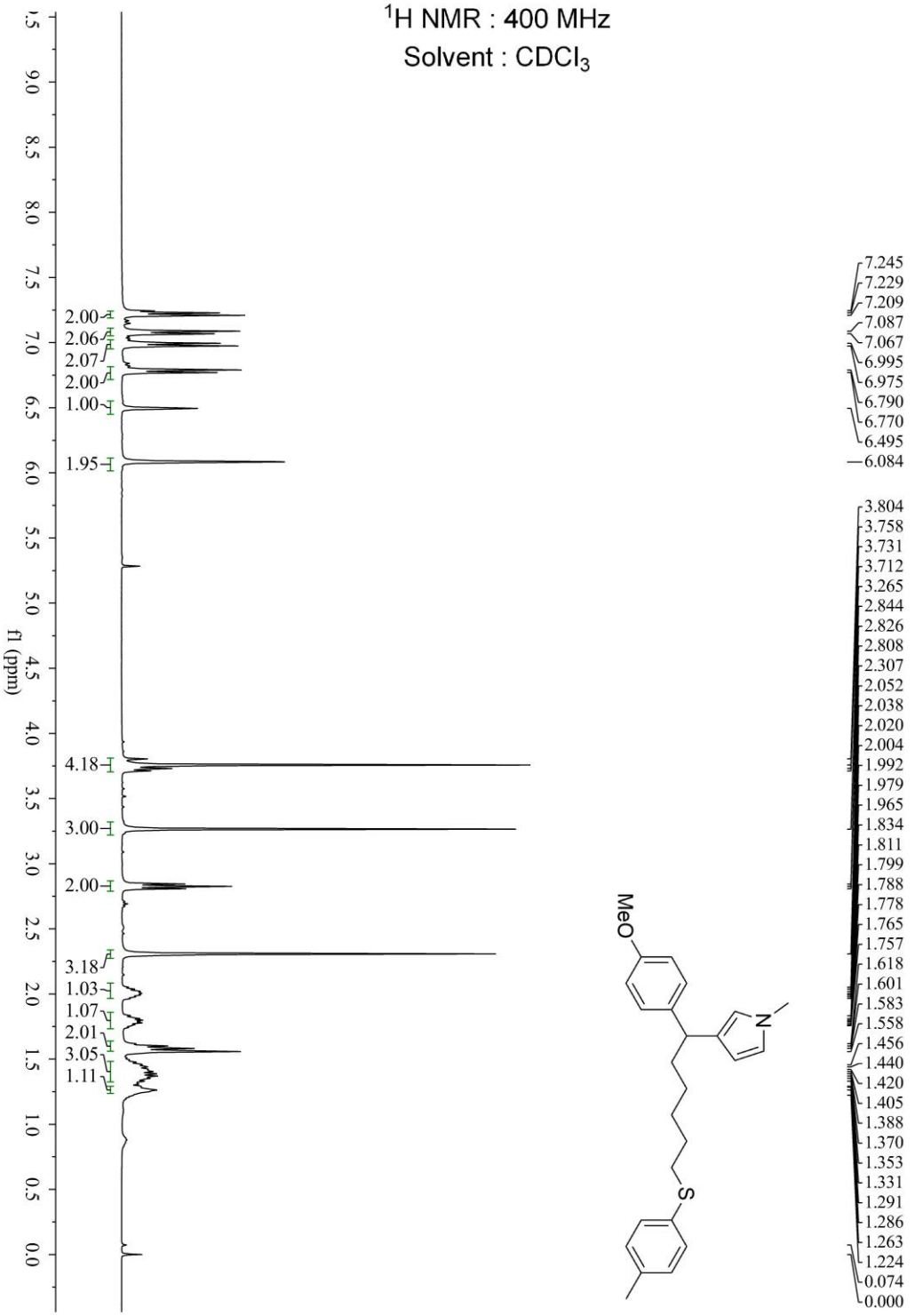

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
168.422
158.071
136.143
135.899
135.458
132.889
129.780
129.593
128.737
126.984
125.103
123.302
121.296
119.651
116.577
116.498
113.852
77.317
77.000
76.683
55.182
41.652
35.387
34.241
29.014
28.609
27.308
24.133
20.972
MeO
N
Ac
S

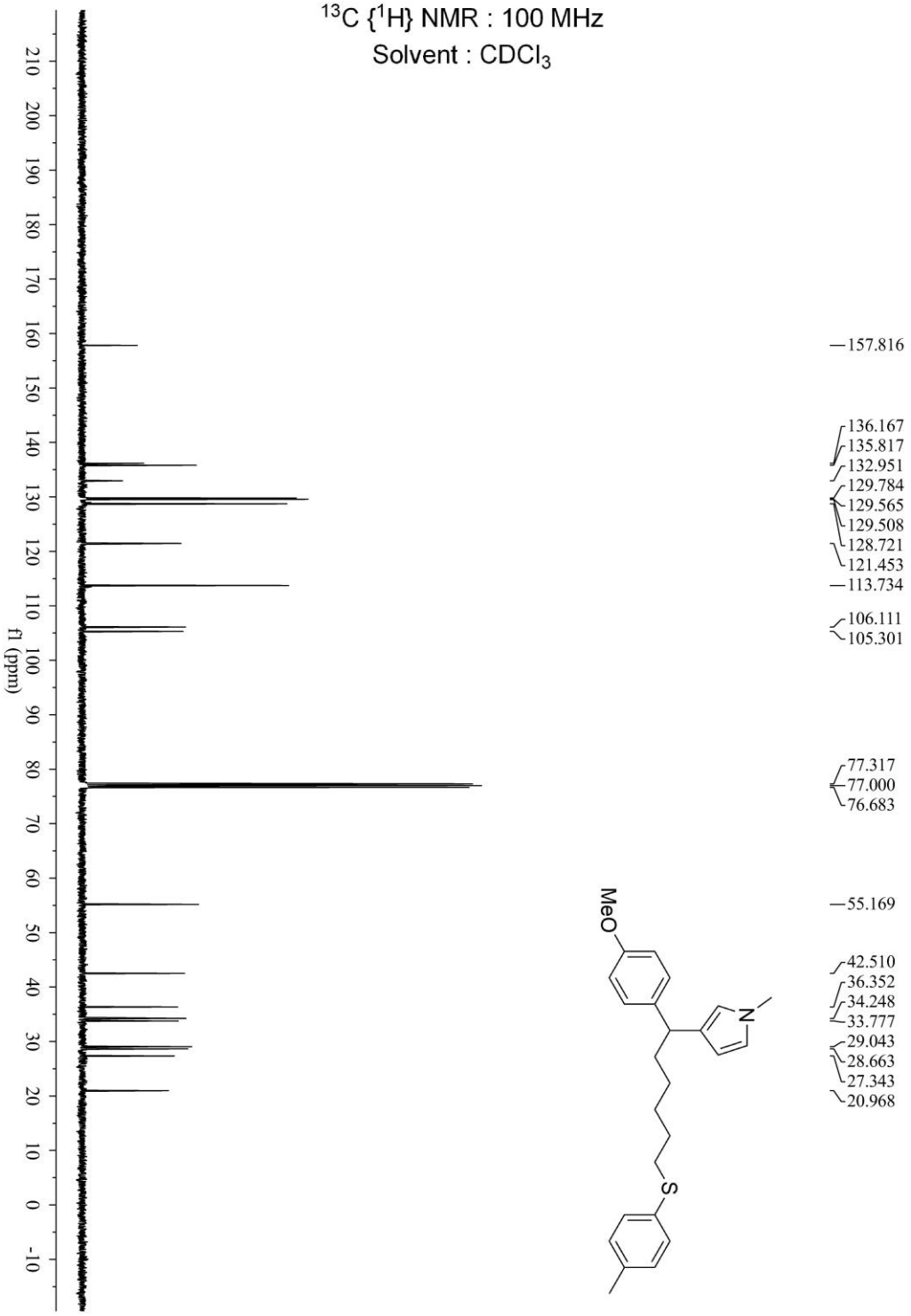
3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1*H*-indole (4aas)



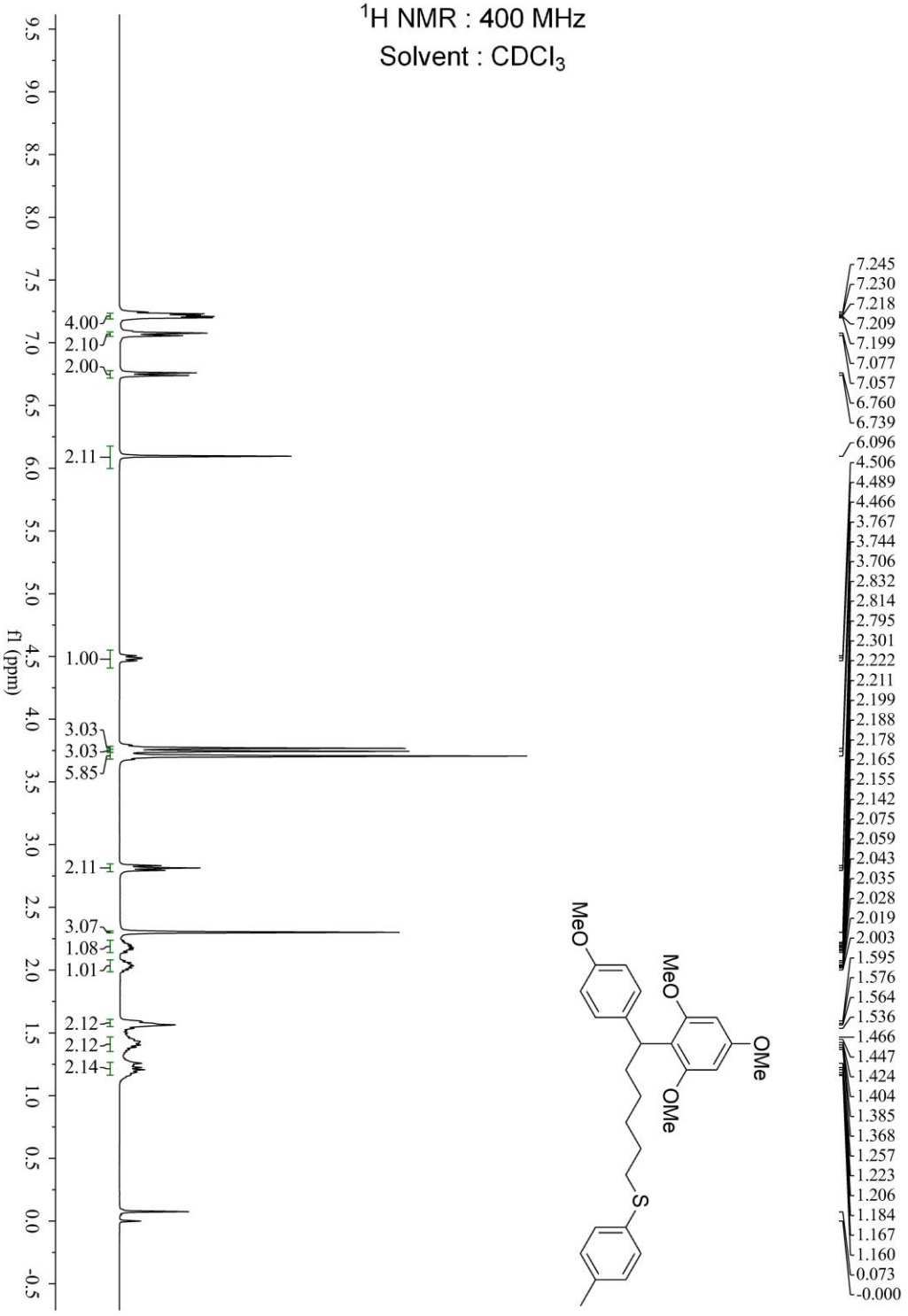

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
157.637
137.494
136.445
135.768
132.986
129.708
129.557
128.694
126.938
121.833
120.754
120.715
119.468
119.092
113.574
110.959
77.318
77.000
76.682
55.131
41.865
36.049
34.220
29.081
28.727
27.499
20.950
MeO
NH
S

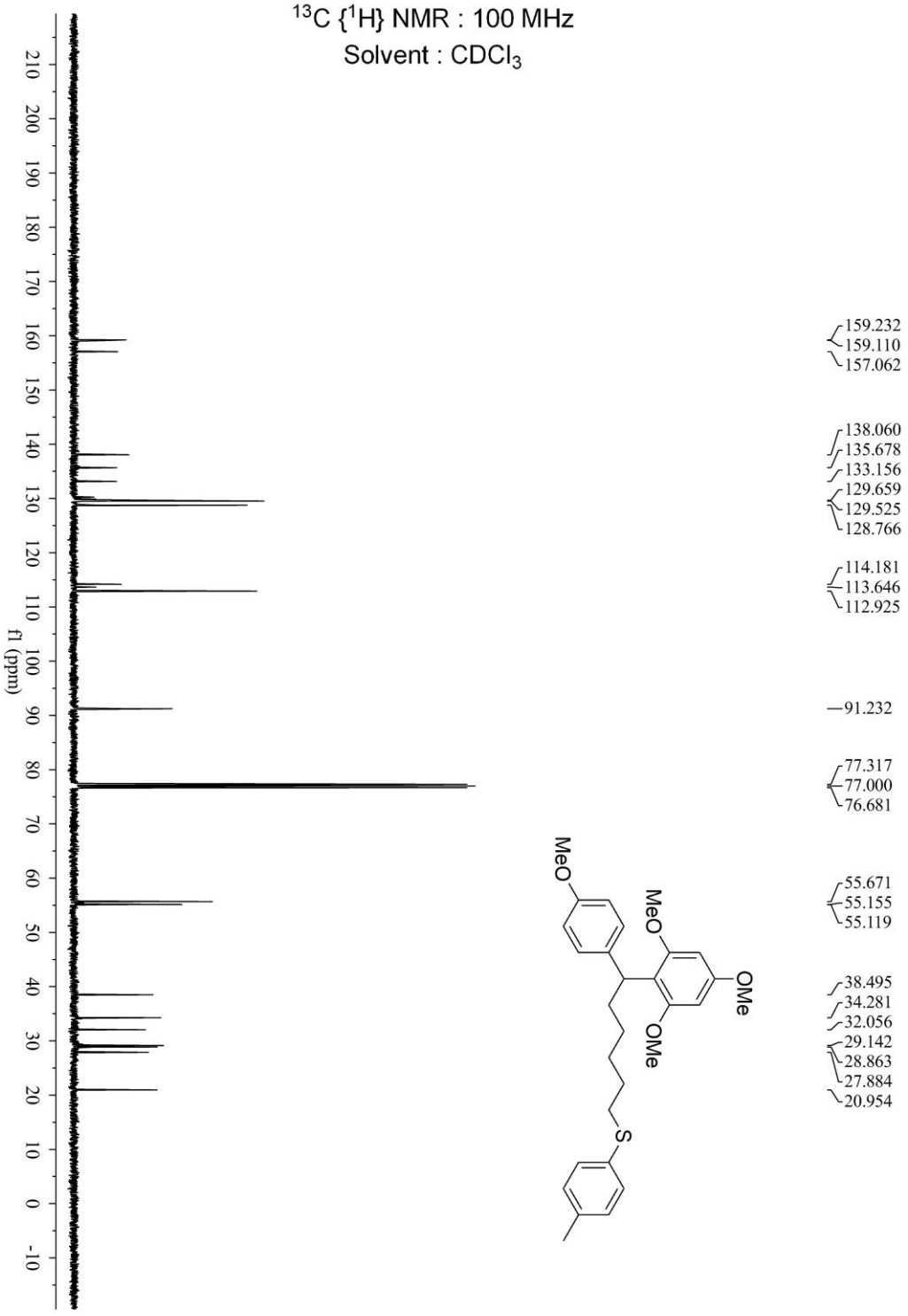
3-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-1-methyl-1*H*-pyrrole (4aat)



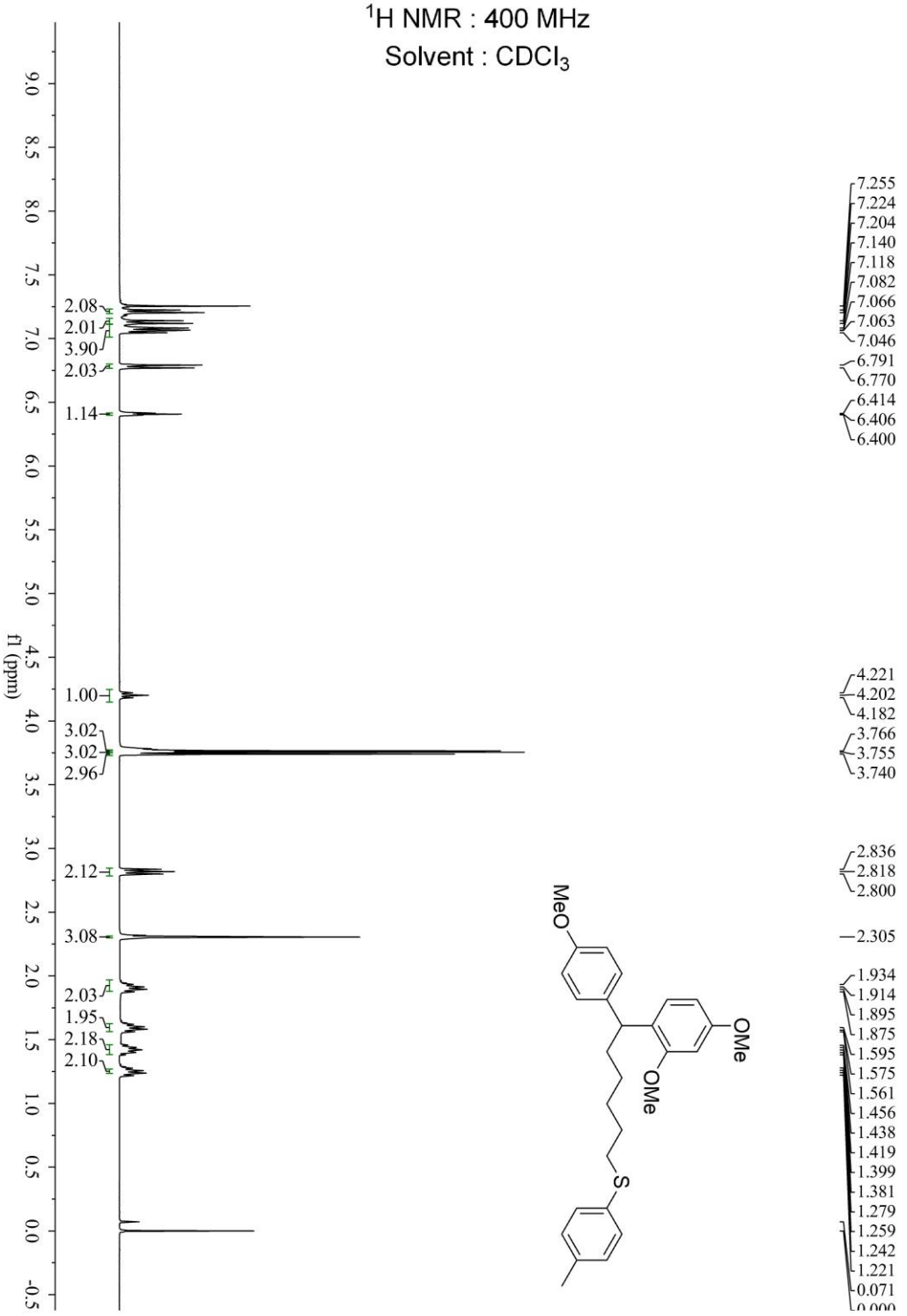

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.816
136.167
135.817
132.951
129.784
129.565
129.508
128.721
121.453
113.734
106.111
105.301
77.317
77.000
76.683
55.169
42.510
36.352
34.248
33.777
29.043
28.663
27.343
20.968
MeO
N
S

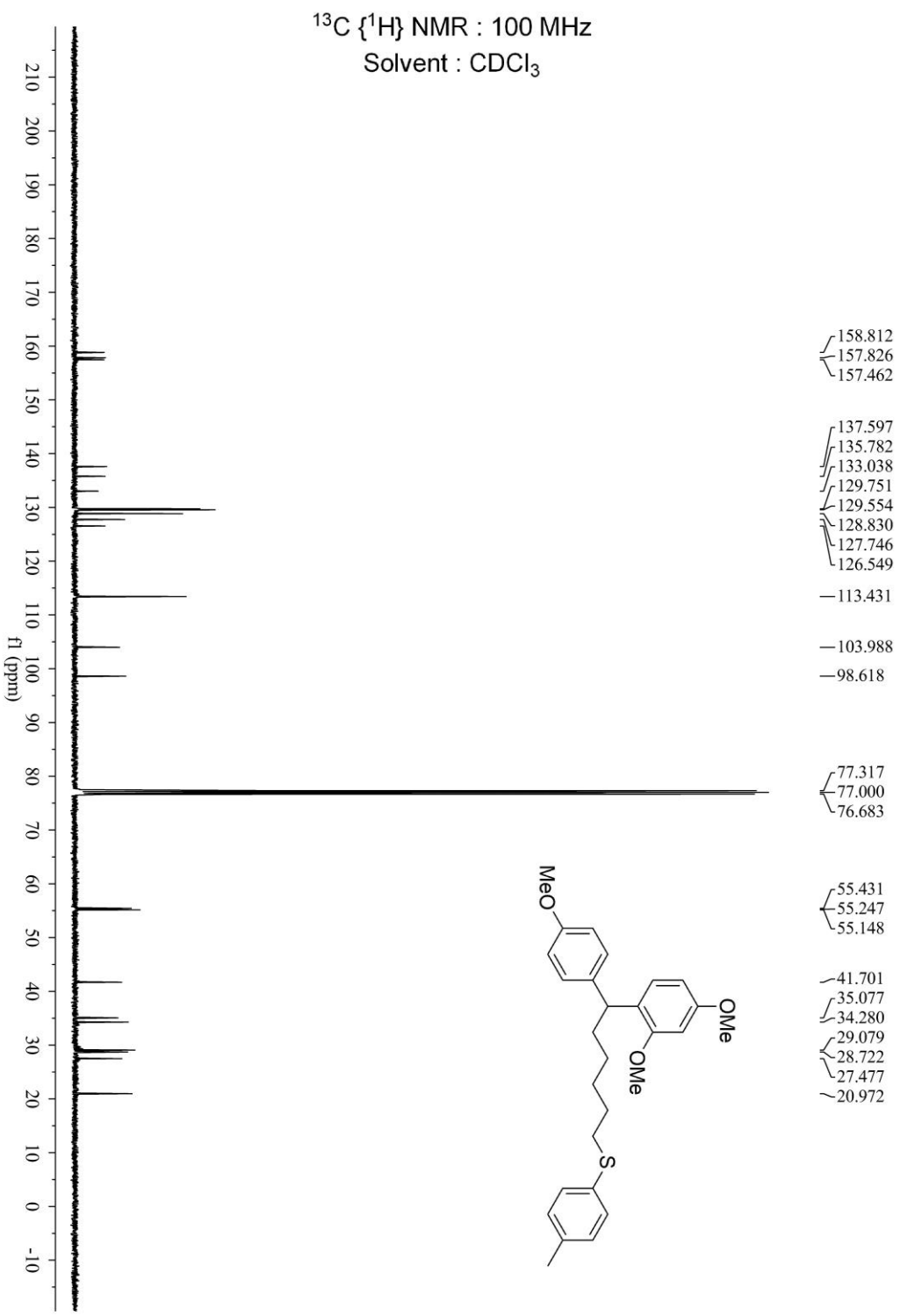
(6-(4-Methoxyphenyl)-6-(2,4,6-trimethoxyphenyl)hexyl)(*p*-tolyl)sulfane (4aau)



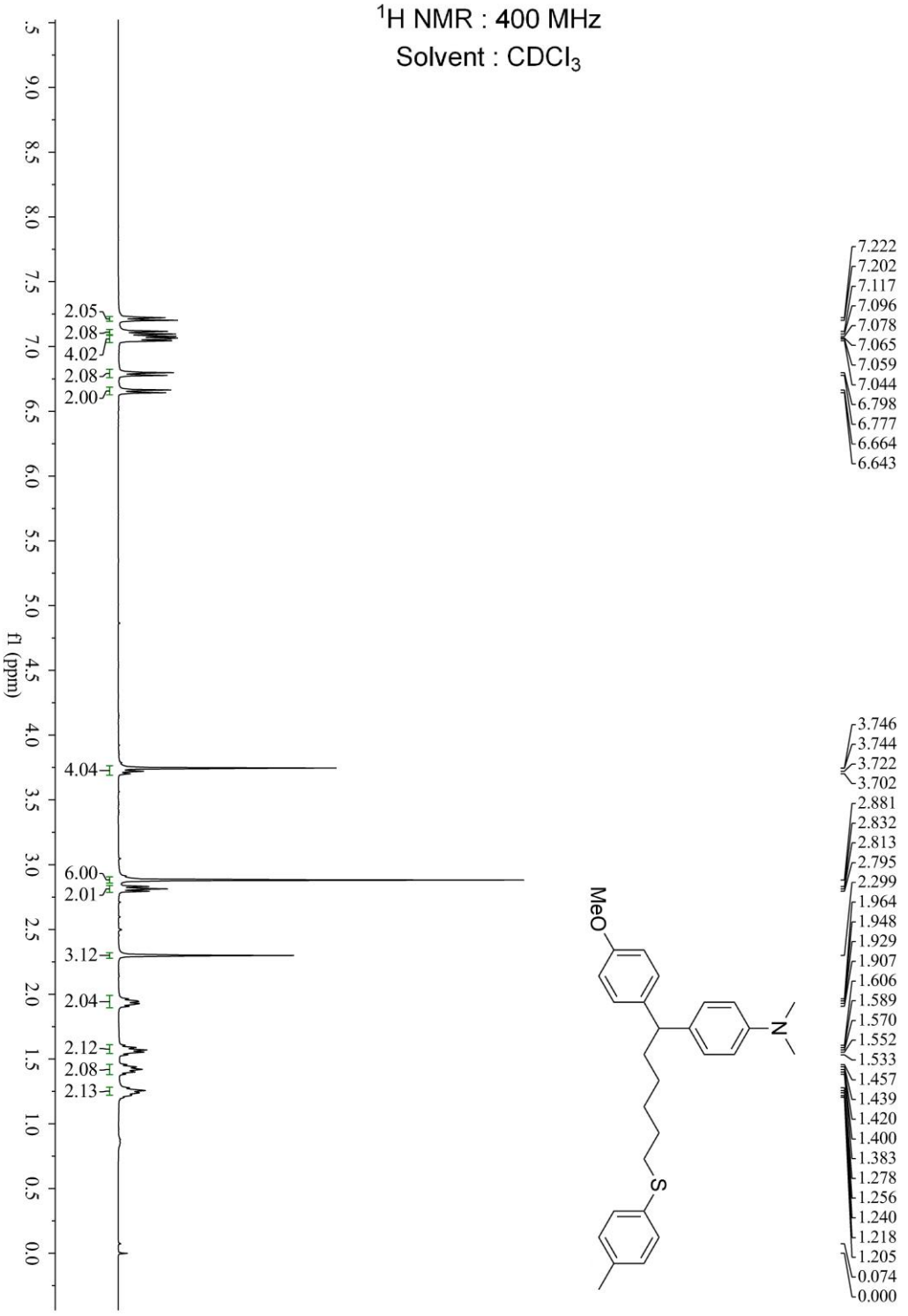

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
159.232
159.110
157.062
138.060
135.678
133.156
129.659
129.525
128.766
114.181
113.646
112.925
91.232
77.317
77.000
76.681
55.671
55.155
55.119
38.495
34.281
32.056
29.142
28.863
27.884
20.954
MeO
MeO
OMe
OMe
S

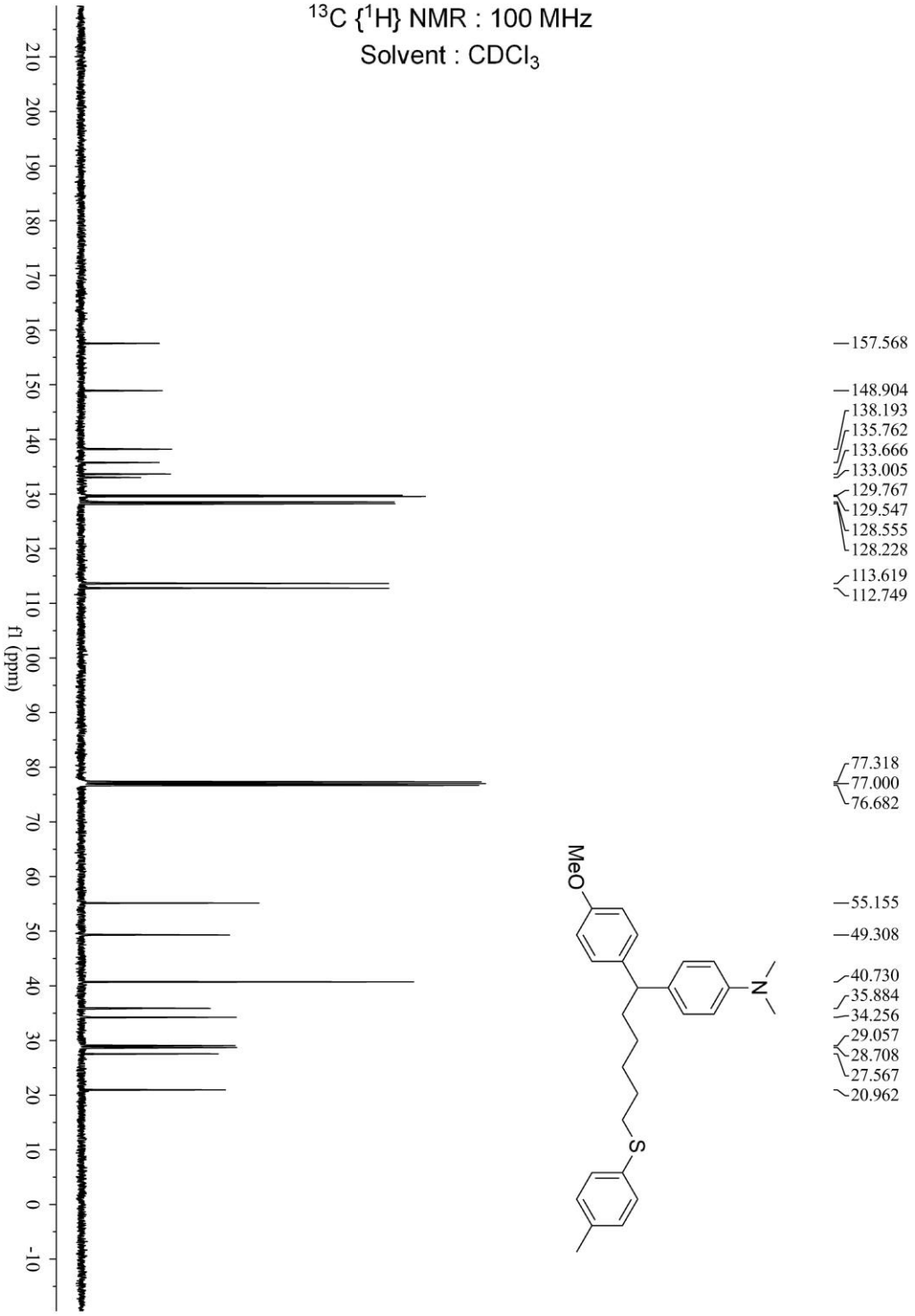
(6-(2,4-Dimethoxyphenyl)-6-(4-methoxyphenyl)hexyl)(*p*-tolyl)sulfane (4aav)



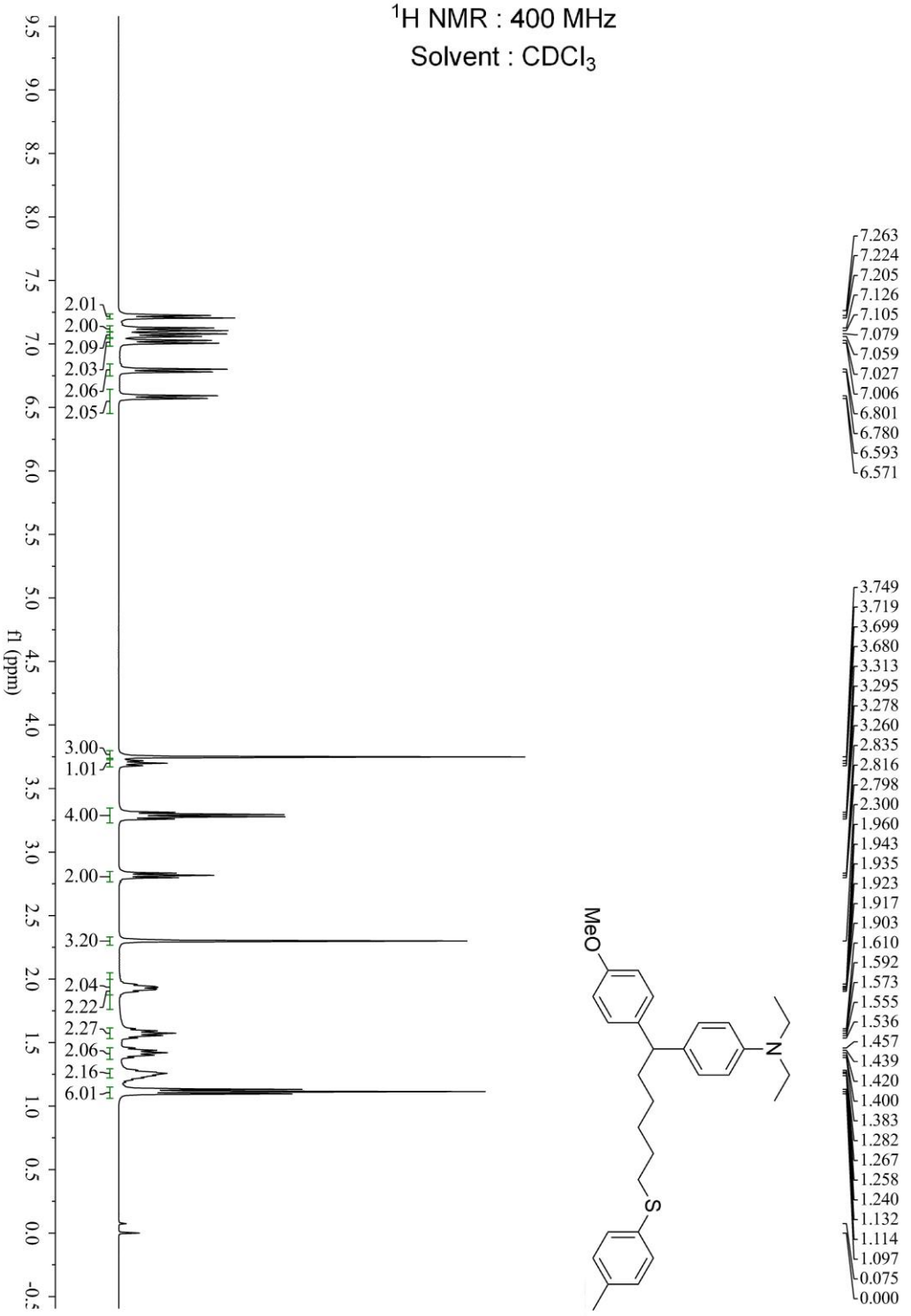

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
158.812
157.826
157.462
137.597
135.782
133.038
129.751
129.554
128.830
127.746
126.549
113.431
103.988
98.618
77.317
77.000
76.683
55.431
55.247
55.148
41.701
35.077
34.280
29.079
28.722
27.477
20.972
MeO
OMe
OMe
S

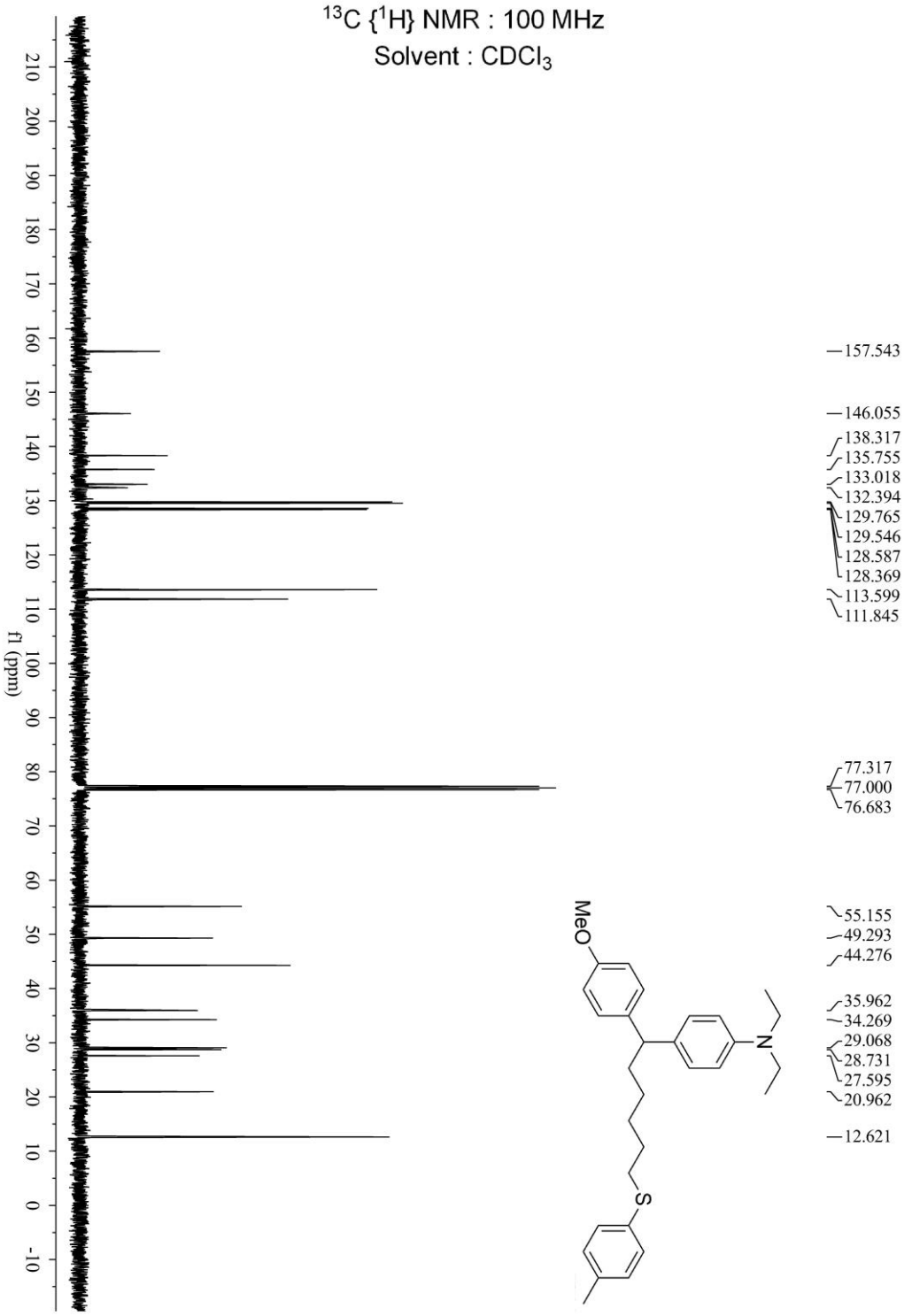
4-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-*N*,*N*-dimethylaniline (4aaw)



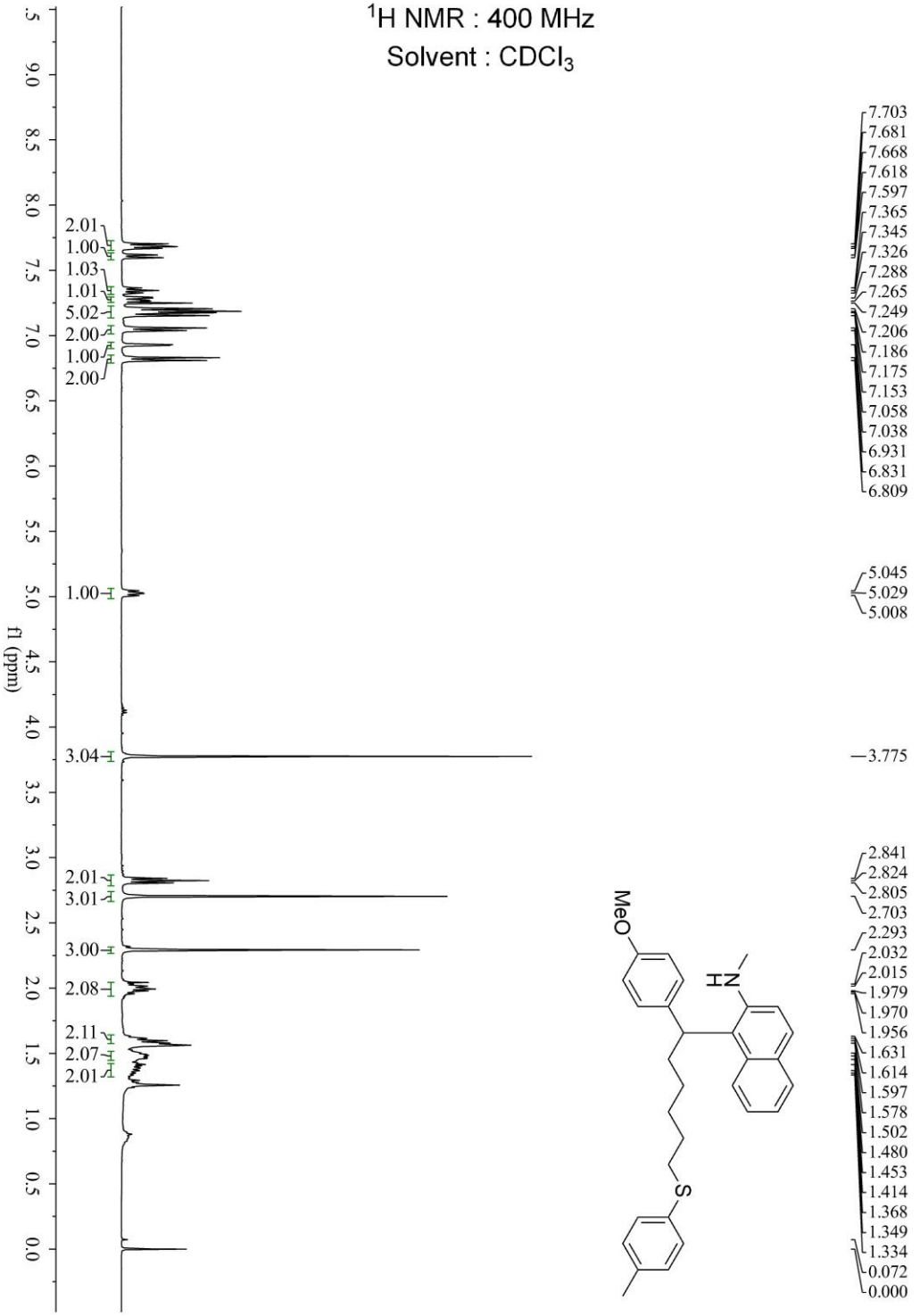

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
157.568
148.904
138.193
135.762
133.666
133.005
129.767
129.547
128.555
128.228
113.619
112.749
77.318
77.000
76.682
55.155
49.308
40.730
35.884
34.256
29.057
28.708
27.567
20.962
MeO
N
S

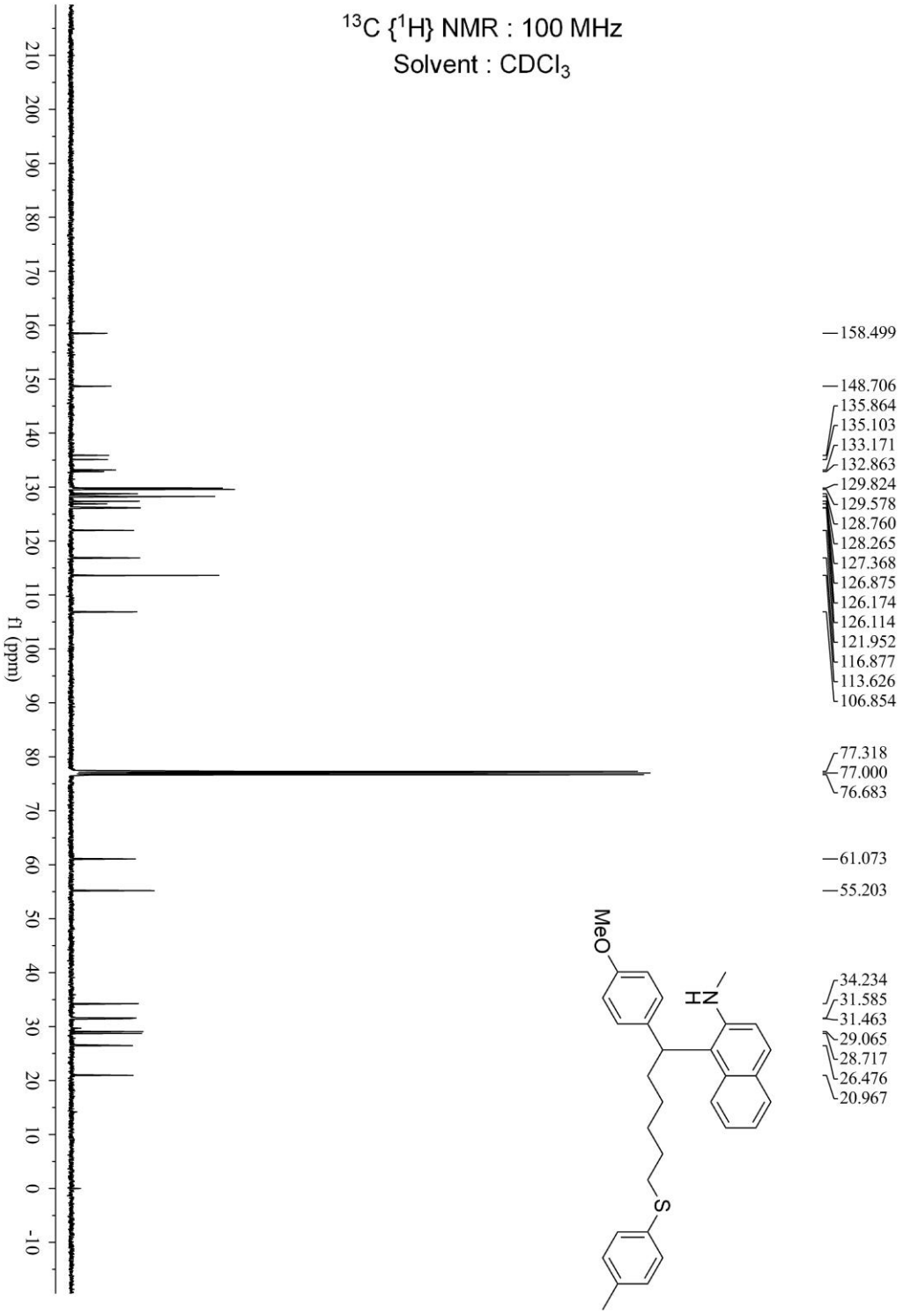
_N,N_-Diethyl-4-(1-(4-methoxyphenyl)-6-(_p_-tolylthio)hexyl)aniline (4aax)



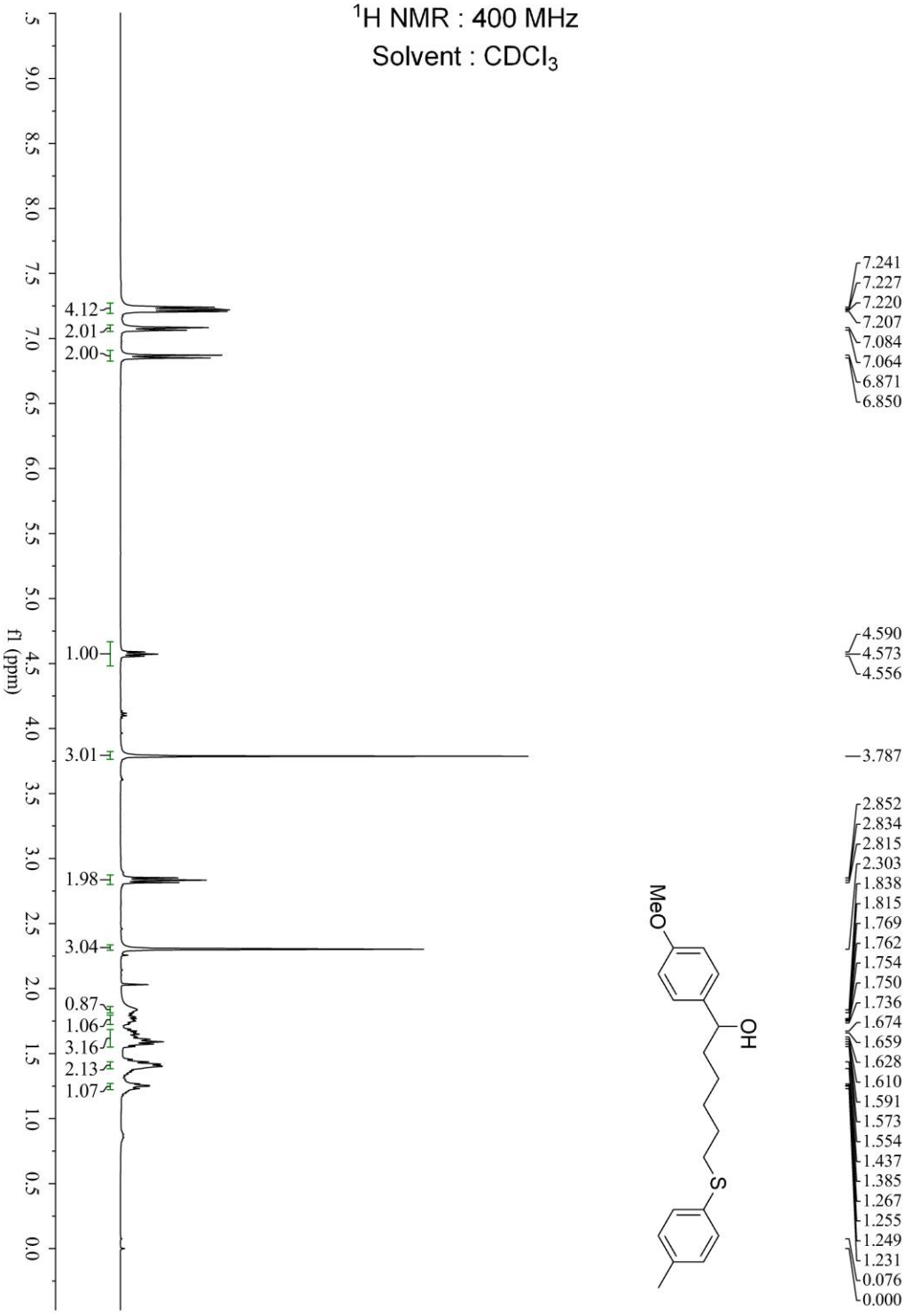

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
157.543
146.055
138.317
135.755
133.018
132.394
129.765
129.546
128.587
128.369
113.599
111.845
77.317
77.000
76.683
55.155
49.293
44.276
35.962
34.269
29.068
28.731
27.595
20.962
12.621
MeO
N
S

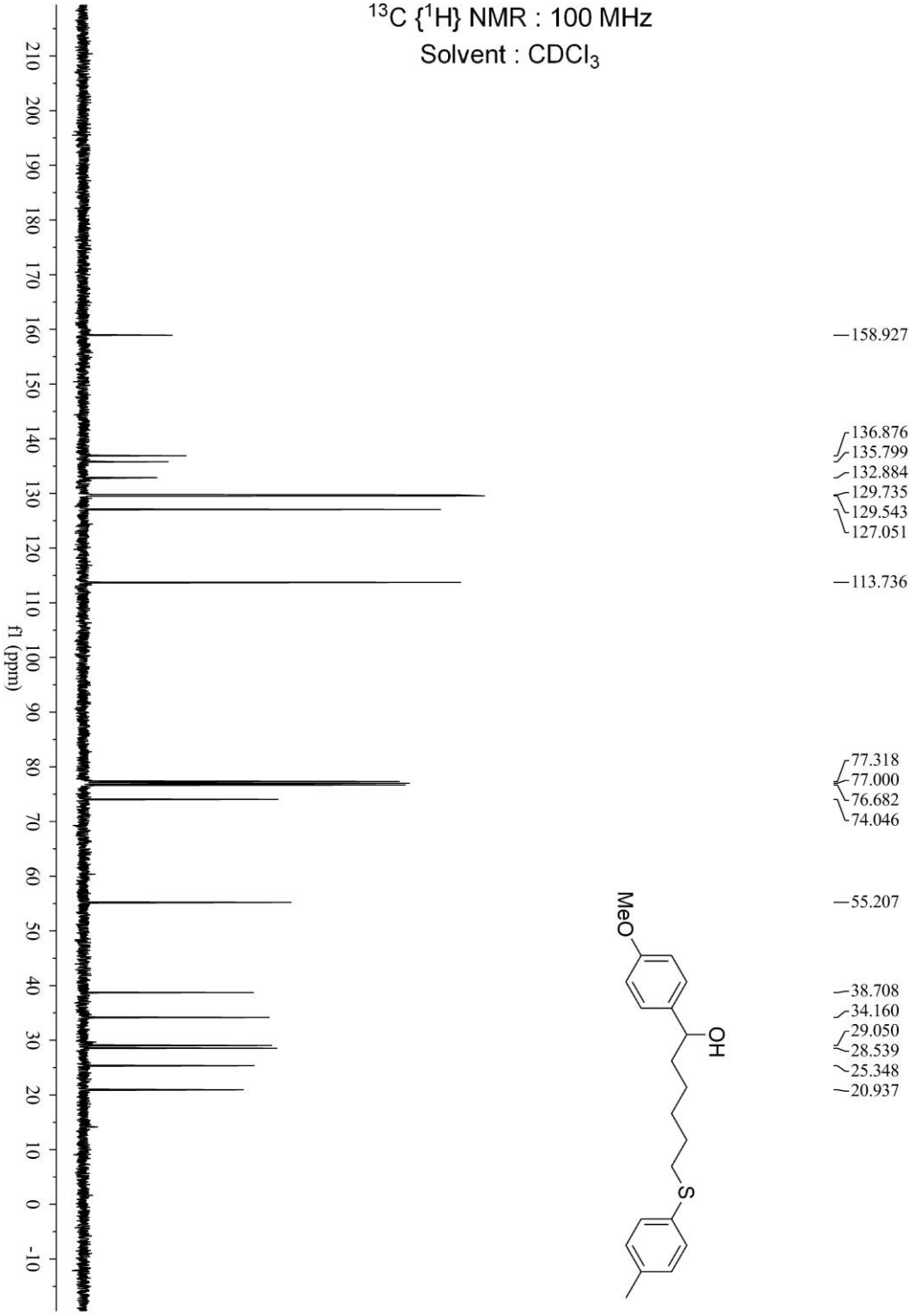
1-(1-(4-Methoxyphenyl)-6-(*p*-tolylthio)hexyl)-*N*-methylnaphthalen-2-amine (4aay)




^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
158.499
148.706
135.864
135.103
133.171
132.863
129.824
129.578
128.760
128.265
127.368
126.875
126.174
126.114
121.952
116.877
113.626
106.854
77.318
77.000
76.683
61.073
55.203
34.234
31.585
31.463
29.065
28.717
26.476
20.967
MeO
HN
S

1-(4-methoxyphenyl)-6-(*p*-tolylthio)hexan-1-ol




^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
f1 (ppm)
158.927
136.876
135.799
132.884
129.735
129.543
127.051
113.736
77.318
77.000
76.682
74.046
55.207
38.708
34.160
29.050
28.539
25.348
20.937
MeO
OH
S