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Supporting information

Aqueous Sodium Tosylate: A Sustainable Medium for Alkylations

Sem Bleus,[†] Jeltzlin Zaïnah Semerel,[†,‡] Wim Dehaen[†*]

[a] Sustainable Chemistry for Metals and Molecules, Department of Chemistry, KU Leuven, Celestijnenlaan 200F, B-3001, Leuven, Belgium.

[b] SISSTEM Program, Faculty of Arts and Science, University of Aruba, J. Irausquin Plein 4, Oranjestad, Aruba

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Experimental details

General information

The chemicals and solvents were obtained from commercial sources (Alfa Aesar, Acros Organics, BLDPharm, Carl Roth, Honeywell Fluka, TCI Europe or Thermo Fischer Scientific) and used without further purification. Sodium *p*-toluenesulfonate was obtained from TCI Europe (technical grade, >90% purity). Methyl tosylate was acquired from Acros Organics, while ethyl and propyl tosylate were purchased at BLDPharm. Thin-layer chromatography (TLC) was performed on silica gel 0.20 mm 60 with fluorescent indicator UV254 (pre-coated aluminium sheets) from Merck. Compounds were visualised under visible light or UV irradiation (254 nm).

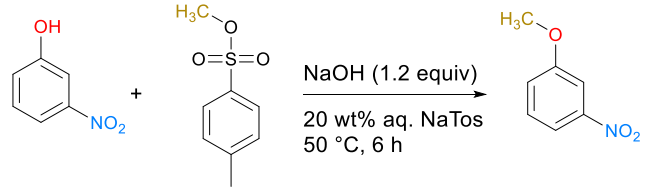
Nuclear magnetic resonance (NMR) spectra were recorded on a Bruker Avance III HD 400 spectrometer with a Bruker Ascend^{TM} 400 magnet system (^{1}H basic frequency of 400.17 MHz) and a 5 mm PABBO BB/19F-1H/D probe with z-gradients or on a Bruker Avance II+ 600 spectrometer with a Bruker 600 UltraShield^{TM} magnet system (^{1}H basic frequency of 600.13 MHz) and a 5 mm PABBO BB-1H/D probe with z-gradients. ^{13}C-detected experiments were ^{1}H-decoupled using power-gated decoupling. All samples were dissolved in deuterated chloroform ($CDCl_3$). Data were recorded at room temperature using TopSpin 3.6.x. ^{1}H data were calibrated using tetramethylsilane (TMS) as an internal calibration reference, while ^{13}C data were calibrated using the CDCl3 1:1:1 triplet at 77.16 ppm. The chemical shifts (δ) are expressed in parts per million (ppm). The following abbreviations were used: s (singlet), d (doublet), t (triplet), q (quartet), sept (septet), m (multiplet), brd (broadened). The prefix app. denotes the apparent multiplicity of a signal, indicating the general shape and form of the multiplet in the spectrum, even though this is not theoretically expected based on the molecular structure of the compound and/or some higher order fine structure could be observed. Coupling constants (*J*) are reported in Hertz (Hz). Mass spectra were acquired on a single quadrupole atmospheric pressure solids analysis probe (ASAP) mass spectrometer (RADIAN ASAP JCA021, Waters, Milford, MA, USA) tuned and calibrated versus an internal calibrant. The instrument was operated in dual ion with a source temperature of 150 °C, a cone voltage of 15 V and a corona current of 3 µA in the positive mode.

Reaction optimisation

An optimisation regarding process sustainability with 3-nitrophenol **1aa** and methyl tosylate **2aa** and as model substrates (Table S1) was performed. As a proof of principle, the alkylation was initially carried out using 30 wt% NaTos, and an excess of NaOH (2.2 equiv) and MeTos (2.2 equiv). qNMR indicated a 94% yield for the corresponding nitroanisole **3aa** (entry 1, Table S1). Then, the hydrotrope concentration was minimised (entries 1-3, Table S1) since it is the principal waste contributor. A decrease to 20 wt% NaTos did not affect the yield. A further lowering negatively impacted the reaction outcome, even for an extended reaction time, as **2aa** was insufficiently soluble in the aqueous phase. Next, the reagent excess was addressed as it is undesired in a green chemistry context. Reducing the NaOH content (entry 1 *vs.* entries 4-5, Table S1) down to 1.1 equiv did not change the yield of **3aa**, while 1 equiv diminished the yield to 79%. In contrast, reducing the quantity of the alkylating agent **2aa** (entries 6-8, Table S1) influenced the yield more significantly. The optimum between reaction greenness and conversion was found for an amount of 1.1 equiv with an 83% product formation. The more noticeable decline in yield could be attributed to tosylate ester hydrolysis, as NMR analysis revealed the presence of methanol. Lower temperatures avoided the side-product formation but required an elongated reaction time (entries 9-11, Table S1). An optimum was obtained for 50 °C and 6 h with only a 7% decrease in yield compared to the initial reaction conditions.

From these optimised results, the reaction was further improved towards product isolation. The reaction was first scaled up to 2.5 mmol (entry 12, Table S1), which did not substantially impact the yield. The product, moreover, precipitated from the reaction mixture upon cooling to room temperature, omitting the need for solvents or dilution during work-up. The residue obtained after filtration contained a minor amount of unconverted phenol **1aa**, removable by washing with aqueous NaOH. The post-treatment could be omitted by increasing the NaOH content in the reaction mixture by 0.1 equiv (entry 13, Table S1), severely reducing the total base input. Simultaneously, the larger scale allowed for a stoichiometric amount of **2aa** (entry 14, Table S1) without compromising the yield. These final conditions furnished an 87% yield after a solventless work-up only including simple filtration (entry 14, Table S1). A control experiment in pure water (entry 15, Table S1) under the same conditions only afforded a 50% qNMR yield. Here, **3aa** could not be isolated without solvents due to unconverted **2aa** being present.

Table S1: Reaction condition optimisation for the methylation of phenols



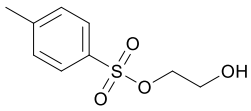
1aa, 1 equiv **2aa**, 1 equiv **3aa**

Entry	Y_{NaTos} (wt%)	*t* (h)	NaOH (equiv)	MeTos (equiv)	*T* (°C)	Yield[a] (%)
1	30	4	2.2	2.2	70	93
2	20	4	2.2	2.2	70	93
3	10	4	2.2	2.2	70	78 (80[b])
4	20	4	1.1	2.2	70	91
5	20	4	1.0	2.2	70	79
6	20	4	1.1	1.2	70	84
7	20	4	1.1	1.1	70	83
8	20	4	1.1	1.0	70	64
9	20	4	1.1	1.1	50	75
10	20	4	1.1	1.1	rt	52
11	20	6	1.1	1.1	50	88
12	20	6	1.1	1.1	50	85[c]
13	20	6	1.2	1.1	50	85[c]
14	**20**	**6**	**1.2**	**1.0**	**50**	**87[c] (87[d])**
15	0 (H_2O)	6	1.2	1.0	50	50[c]

[a] Quantified by ^{1}H-qNMR with 1,3,5-trimethoxybenzene (TMB) as internal standard; [b] Reaction time: 18 h; [c] 2.5 mmol scale; [d] Isolated yield

Experimental procedures

Preparation of 2-hydroxyethyl tosylate (**2cs**)



Tosyl chloride (0.5 g, 2.6 mmol) was added to ethylene glycol (8.0 ml, 143.0 mmol) and the mixture was stirred at room temperature for 5 min. Then, pyridine (0.21 ml, 2.6 mmol) was added dropwise over 2 min. The reaction mixture was stirred at room temperature for 2 h, diluted with EtOAc (25 ml) and washed with water (5x25 ml). The organic layer was dried over $MgSO_4$ and concentrated *in vacuo* to afford compound **2cs** as a colourless oil (0.42 g, 73%).

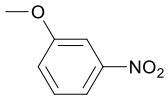
^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.81 (app. d, *J* = 8.5 Hz, 2 H), 7.36 (app. d, *J* = 8.5 Hz, 2 H), 4.15 (t, *J* = 4.6, 2 H), 3.82 (dt, *J* = 6.5, 4.6 Hz, 2 H), 2.46 (s, 3 H), 1.96 (t, *J* = 6.5 Hz, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 145.3, 132.8, 130.1, 128.1, 71.7, 60.9, 21.8

^{1}H-NMR and ^{13}C-NMR are consistent with the literature.[1]

Alkylation procedures

General procedure: To a test tube, the nucleophile (1 equiv.), NaOH (1.2 equiv.) and 20 wt% NaTos (0.42 M) were added. After complete dissolution at 50 °C, the substituted tosylate (1 equiv.) was added. The solution was stirred at 50 °C in a heating block until TLC indicated full conversion of the alkyl tosylate. Then, the reaction mixture was allowed to cool to room temperature. In the case the compound precipitated, it was filtered off (General procedure **A**) and washed with water. In the case the compound oiled out (General procedure **B**), the organic layer was collected with a pipette. In some cases, the reaction mixture was cooled to 8 °C to maximise phase separation of the product (General procedure **C**). In each case, the corresponding products did not require further purification.

1-Methoxy-3-nitrobenzene (**3aa**)

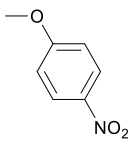


The compound was prepared according to General procedure **A** starting from 3-nitrophenol **1aa** (0.350 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3aa** as a yellow solid (0.334 g, 87%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.83 (app. ddd, *J* = 8.2, 2.2, 1.1 Hz, 1 H), 7.73 (app. dd, J = 2.5, 2.3 Hz, 1 H), 7.43 (app. dd, *J* = 8.2, 8.1 Hz, 1 H), 7.23 (app. ddd, *J* = 8.1, 2.5, 1.1 Hz 1 H), 3.90 (s, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 160.3, 149.4, 130.0, 121.4, 115.9, 108.2, 56.0; MS (ASAP, *m/z*): 153 $[M]^+$, 138 [M-15].

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[2]

1-Methoxy-4-nitrobenzene (**3ac**)

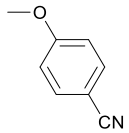


The compound was prepared according to General procedure **A** starting from 4-nitrophenol **1ac** (0.350 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3ac** as an off-white solid (0.276 g, 72%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.21 (app d, J = 9.3 Hz, 2 H), 6.96 (app. d, J = 9.3 Hz, 2 H), 3.91 (s, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.7, 141.7, 126.1, 114.2, 56.1; MS (ASAP, *m/z*): 153 $[M]^+$, 138 $[M\text{-}15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[3]

4-Methoxybenzonitrile (**3ad**)

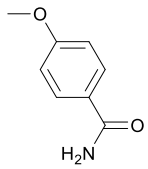


The compound was prepared according to General procedure **A** starting from 4-hydroxybenzonitrile **1ad** (0.300 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3ad** as white needles (0.237 g, 71%).

^{1}H-NMR (600 MHz, $CDCl_3$): δ (ppm) = 7.59 (app. d, J = 9.0 Hz, 2 H), 6.95 (app. d, J = 9.0 Hz, 2 H), 3.86 (s, 3 H); ^{13}C-NMR (151 MHz, $CDCl_3$): δ (ppm) = 163.0, 134.1, 119.4, 114.9, 104.1, 55.7; MS (ASAP, *m/z*): 133 $[M]^+$, 118 $[M\text{-}15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[4]

4-Methoxybenzamide (**3ae**)

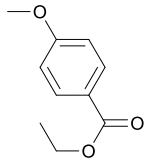


The compound was prepared according to General procedure **C** starting from 4-hydroxybenzamide **1ae** (0.345 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3ae** as a white solid (0.279 g, 73%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.78 (app. d, J = 9.0, 2 H), 6.94 (app. d, J = 9.0 Hz, 2 H), 5.78 (brd s, 2 H), 3.86 (s, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 168.9, 162.8, 129.4, 125.7, 114.0, 55.6; MS (ASAP, *m/z*): 151 $[M]^+$, 136 $[M\text{-}15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[5]

Ethyl 4-methoxybenzoate (**3af**)

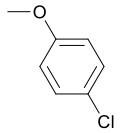


The compound was prepared according to General procedure **B** starting from ethyl 4-hydroxybenzoate **1af** (0.418 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3af** as a colourless oil (0.309 g, 68%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.00 (d, J = 9.2 Hz, 2 H), 6.91 (d, J = 9.2 Hz, 2 H), 4.35 (q, J = 6.9 Hz, 2 H), 3.86 (s, 3 H), 1.38 (t, J = 7.0 Hz, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 166.6, 163.4, 131.7, 123.1, 113.7, 60.8, 55.6, 14.5; MS (ASAP, *m/z*): 180 $[M]^+$, 165 $[M-15]^+$, 135 $[M-45]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[6]

1-Chloro-4-methoxybenzene (**3ag**)

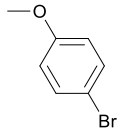


The compound was prepared according to General procedure **B** starting from 1-chloro-4-hydroxybenzene **1ag** (0.418 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3ag** as a yellow oil (0.344 g, 96%).

^{1}H-NMR (600 MHz, $CDCl_3$): δ (ppm) = 7.24 (app. d, J = 9.1 Hz, 2 H), 6.83 (app. d, J = 9.1 Hz, 2 H), 3.79 (s, 3 H); ^{13}C-NMR (151 MHz, $CDCl_3$): δ (ppm) = 158.3, 129.4, 125.7, 115.3, 55.6; MS (ASAP, *m/z*): 145 $[MH+2]^+$, 143 $[MH]^+$, 130 $[MH+2-15]^+$, 128 $[MH-15]^+$.

^{1}H-NMR and ^{13}C-NMR data are consistent with the literature.[7]

1-Bromo-4-methoxybenzene (**3ah**)

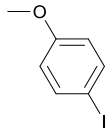


The compound was prepared according to General procedure **B** starting from 1-bromo-4-hydroxybenzene **1ah** (0.432 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3ah** as a pale yellow oil (0.417 g, 89%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.38 (app. d, J = 9.1 Hz, 2 H), 6.78 (app. d, J = 9.1 Hz, 2 H), 3.78 (s, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 158.8, 132.4, 115.9, 112.9, 55.6; MS (ASAP, *m/z*): 188 $[M+2]^+$, 186 $[M]^+$, 173 $[M+2-15]^+$, 171 $[M-15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[7]

1-Iodo-4-methoxybenzene (**3ai**)

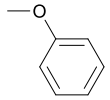


The compound was prepared according to General procedure **A** starting from 1-iodo-4-hydroxybenzene **1ai** (0.552 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3ai** as a brown solid (0.500 g, 85%).

^{1}H-NMR (600 MHz, $CDCl_3$): δ (ppm) = 7.56 (app. d, J = 9.1 Hz, 2 H), 6.68 (app. d, J = 9.1 Hz, 2 H), 3.78 (s, 3 H); ^{13}C-NMR (151 MHz, $CDCl_3$): δ (ppm) = 159.6, 138.3, 116.5, 82.8, 55.5; MS (ASAP, *m/z*): 234 $[M]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[8]

Methoxybenzene (**3aj**)

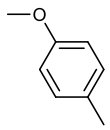


The compound was prepared according to General procedure **B** starting from phenol **1aj** (0.237 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3aj** as a colourless oil (0.201 g, 74%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.30 (app. dd, J = 8.8, 7.4 Hz, 2 H), 6.96 (app. dd, J = 7.4, 1.0 Hz, 1 H) 6.92 (app. dd, J = 8.8, 1.0 Hz, 1 H), 3.83 (s, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 159.7, 129.6, 120.8, 114.0, 55.3; MS (ASAP, *m/z*): 108 $[M]^+$, 93 $[M\text{-}15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[9]

1-Methoxy-4-methylbenzene (**3ak**)

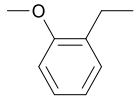


The compound was prepared according to General procedure **B** starting from *p*-cresol **1ak** (0.272 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in 1-methoxy-4-methylbenzene **3ak** as a yellow oil (0.265 g, 86%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.09 (app. d, J = 8.7 Hz, 2 H), 6.81 (app. d, J = 8.7 Hz, 2 H), 3.79 (s, 3 H), 2.30 (s, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 157.6, 130.0, 130.0, 113.8, 55.4; MS (ASAP, *m/z*): 122 $[M]^+$, 107 $[M\text{-}15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[10]

1-Ethyl-2-methoxybenzene (**3al**)

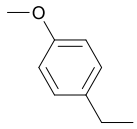


The compound was prepared according to General procedure **B** starting from 2-ethylphenol **1al** (0.304 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3al** as an orange oil (0.274 g, 81%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.24-7.16 (m, 2 H), 6.93 (m, 1 H), 6.87 (m, 1 H), 3.86 (s, 3 H), 2.68 (q, J = 7.6 Hz, 2 H), 1.22 (t, J = 7.6 Hz, 2 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 157.5, 132.8, 129.0, 126.9, 120.6, 110.3, 55.4, 23.3, 14.3; MS (ASAP, *m/z*): 136 $[M]^+$, 121 $[M\text{-}15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[11]

1-Ethyl-4-methoxybenzene (**3am**)

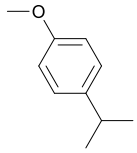


The compound was prepared according to General procedure **B** starting from 4-ethylphenol **1am** (0.304 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3am** as a yellow oil (0.293 g, 86%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.12 (app. d, J = 8.7 Hz, 2 H), 6.84 (app. d, J = 8.7 Hz, 2 H), 3.80 (s, 3 H), 2.60 (q, J = 7.6 Hz, 2 H), 1.22 (t, J = 7.6 Hz, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 157.7, 136.5, 128.8, 113.9, 55.4, 28.1, 16.0; MS (ASAP, *m/z*): 136 $[M]^+$, 121 $[M\text{-}15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[12]

1-Isopropyl-4-methoxybenzene (**3an**)

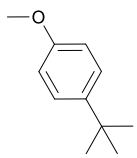


The compound was prepared according to General procedure **B** starting from 4-isopropyl-phenol **1an** (0.343 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3an** as an orange oil (0.340 g, 90%).

^{1}H-NMR (600 MHz, $CDCl_3$): δ (ppm) = 7.15 (app. d, J = 8.7 Hz, 2 H), 6.85 (app. d, J = 8.7 Hz, 2 H), 3.79 (s, 3 H), 2.87 (sept, J = 7.0 Hz , 1 H), 1.23 (d, J = 7.0 Hz, 6 H); ^{13}C-NMR (151 MHz, $CDCl_3$): δ (ppm) = 157.7, 141.1, 127.3, 113.7, 55.3, 33.3, 24.2; MS (ASAP, *m/z*): 150 $[M]^+$, 135 $[M\text{-}15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[10]

1-(*Tert*-butyl)-4-methoxybenzene (**3ao**)

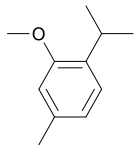


The compound was prepared according to General procedure **B** starting from 4-(*tert*-butyl)-phenol **1ao** (0.378 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3ao** as a colourless oil (0.384 g, 93%).

^{1}H-NMR (600 MHz, $CDCl_3$): δ (ppm) = 7.32 (app. d, J = 9.0 Hz, 2 H), 6.85 (app. d, J = 9.0 Hz, 2 H), 3.80 (s, 3 H), 1.31 (s, 9 H); ^{13}C-NMR (151 MHz, $CDCl_3$): δ (ppm) = 157.4, 143.5, 126.4, 113.5, 55.4, 34.2, 31.7; MS (ASAP, *m/z*): 165 $[M]^+$, 150 $[M-15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[13]

1-Isopropyl-2-methoxy-4-methylbenzene (**3ap**)

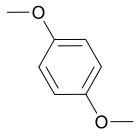


The compound was prepared according to General procedure **C** starting from 2-isopropyl-5-methylphenol **1ap** (0.378 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.38 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3ap** as a yellow oil (0.389 g, 94%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.10 (app d., J = 7.6 Hz, 1 H), 6.75 (app. dd, J = 7.6, 1.8 Hz, 1 H), 6.69-6.66 (app. d, J = 1.8 Hz, 1 H), 3.82 (s, 3 H), 3.28 (sept, J = 6.9 Hz, 1 H), 2.34 (s, 3 H), 1.20 (d, J = 6.9 Hz, 6 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 156.8, 136.5, 134.2, 125.9, 121.2, 111.5, 55.5, 26.5, 23.0, 21.5; MS (ASAP, *m/z*): 164 $[M]^+$, 149 $[M-15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[14]

1,4-Dimethoxybenzene (**3aq**)

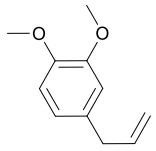


The compound was prepared according to General procedure **A** starting from 4-methoxyphenol **1aq** (0.272 g, 2.2 mmol), NaOH (0.105 g, 2.6 mmol) and methyl tosylate **2aa** (0.33 ml, 2.2 mmol) stirred for 6 h, resulting in compound **3aq** as a white solid (0.260 g, 86%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 6.84 (s, 4 H), 3.77 (s, 6 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 153.9, 114.8, 55.9; MS (ASAP, *m/z*): 139 $[MH]^+$, 123 $[MH-15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[15]

4-Allyl-1,2-dimethoxybenzene (**3ar**)

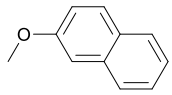


The compound was prepared according to General procedure **B** starting from 4-allyl-2-methoxyphenol **1ar** (0.410 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.33 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3ar** as a yellow oil (0.369 g, 83%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 6.81 (app. d, *J* = 7.9 Hz, 1 H), 6.75-6.70 (m, 2 H), 5.96 (ddt, *J* = 16.8 Hz, *J* = 10.1 Hz, *J* = 6.7 Hz, 1 H), 5.11-5.04 (m, 2 H), 3.87 (s, 3 H), 3.86 (s, 3 H), 3.34 (*d*, J = 6.7 Hz, 2 H)); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.0, 147.5, 137.8, 132.8, 120.5, 115.7, 112.0, 111.4, 56.1, 55.9, 39.9; MS (ASAP, *m/z*): 179 $[MH]^+$, 178 $[M]^+$, 147 $[MH-30]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[16]

2-Methoxynaphthalene (**3as**)

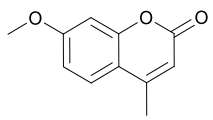


The compound was prepared according to General procedure **A** starting from 2-naphthol **1as** (0.363 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.33 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3as** as an off-white solid (0.374 g, 94%).

^{1}H-NMR (600 MHz, $CDCl_3$): δ (ppm) = 7.80-7.76 (m, 1 H), 7.76-7.73 (m, 2 H), 7.45 (app. ddd, J = 8.1, 6.7, 1.2 Hz, 1 H), 7.37-7.33 (app. ddd, J = 8.1, 6.7, 1.2 Hz, 1 H), 7.18-7.14 (m, 2 H), 3.93 (s, 3 H); ^{13}C-NMR (151 MHz, $CDCl_3$): δ (ppm) = 157.7, 134.7, 129.5, 129.1, 127.8, 126.9, 126.5, 123.7, 118.9, 105.9, 55.4; MS (ASAP, *m/z*): 159 $[MH]^+$, 158 $[M]^+$, 144 $[MH-15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[9]

7-Methoxy-4-methyl-2*H*-chromen-2-one (**3at**)

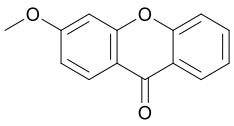


The compound was prepared according to General procedure **A** starting from 7-hydroxy-4-methyl-2*H*-chromen-2-one **1at** (0.443 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.33 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3at** as a white solid (0.364 g, 76%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.51 (app. d, *J* = 8.9 Hz, 1 H), 6.86 (app. dd, *J* = 8.9, 2.5 Hz, 1 H), 6.83 (app. d, *J* = 2.5 Hz, 1 H), 6.14 (q, *J* = 1.3 Hz, 1 H), 3.88 (s, 1 H), 2.40 (d, *J* = 1.3 Hz, 1 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 162.8, 161.4, 155.5, 152.7, 125.7, 113.7, 112.5, 112.1, 101.0, 55.9, 18.8; MS (ASAP, *m/z*): 191 $[MH]^+$, 190 $[M]^+$, 176 $[MH-15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[17]

3-Methoxy-9*H*-xanthen-9-one (**3au**)

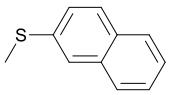


The compound was prepared according to General procedure **A** starting from 3-hydroxy-9*H*-xanthen-9-one **1au** (0.532 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.33 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3au** as a white solid (0.514 g, 91%).

^{1}H-NMR (600 MHz, $CDCl_3$): δ (ppm) = 8.33 (app. dd, *J* = 8.0 , 1.7 Hz, 1 H), 8.25 (app. d, *J* = 8.9 Hz, 1 H), 7.69 (app. Ddd, *J* = 8.6, 7.1, 1.7 Hz, 1 H), 7.45 (app. dd, *J* = 8.4, 1.2 Hz, 1 H), 7.37 (app. ddd, *J* = 8.0, 7.1, 1.2 Hz, 1 H), 6.94 (app. dd, *J* = 8.9, 2.4 Hz, 1 H), 6.88 (app. d, *J* = 2.4 Hz, 1 H), 3.93 (s, 3 H); ^{13}C-NMR (151 MHz, $CDCl_3$): δ (ppm) = 176.4, 165.2, 158.2, 156.4, 134.4, 128.4, 126.8, 124.0, 122.1, 117.8, 116.0, 113.4, 100.3, 56.0; MS (ASAP, *m/z*): 227 $[MH]^+$, 226 $[M]^+$, 212 $[MH-15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[18]

(Methyl)(naphtalen-2-yl)sulfane (**3ba**)

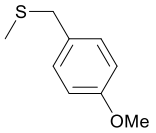


The compound was prepared according to General procedure **A** starting from naphthalene-2-thiol **1ba** (0.403 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.33 ml, 2.5 mmol) stirred for 3 h under nitrogen atmosphere, resulting in compound **3ba** as a white solid (quant., 0.433 g).

^{1}H-NMR (600 MHz, $CDCl_3$): δ (ppm) = 7.78 (app. d, *J* = 7.4 Hz, 1 H), 7.76-7.72 (m, 2 H), 7.61 (app. d, *J* = 1.6 Hz, 1 H), 7.48-7.45 (m, 1 H), 7.42-7.40 (m, 1 H), 7.38 (app. dd, *J* = 8.6, 1.9 Hz, 1 H), 2.99 (s, 3 H); ^{13}C-NMR (151 MHz, $CDCl_3$): δ (ppm) = 136.2, 134.0, 131.4, 128.3, 127.9, 127.0, 126.7, 125.8, 125.4, 123.5, 16.0; MS (ASAP, *m/z*): 175 $[MH]^+$, 174 $[M]^+$, 159 $[M-15]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[19]

(4-Methoxybenzyl)(methyl)sulfane (**3bb**)

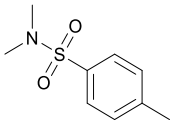


The compound was prepared according to General procedure **B** starting from 4-methoxyphenyl)methanethiol **1bb** (0.388 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.33 ml, 2.5 mmol) stirred for 3 h under nitrogen atmosphere, resulting in compound **3bb** as a colourless oil (quant., 0.422 g).

^{1}H-NMR (600 MHz, $CDCl_3$): δ (ppm) = 7.22 (app. d, *J* = 8.7 Hz, 1 H), 6.85 (app. d, *J* = 8.7 Hz, 1 H), 3.80 (s, 3 H), 3.64 (s, 3 H), 1.99 (s, 3 H); ^{13}C-NMR (151 MHz, $CDCl_3$): δ (ppm) = 158.7, 130.4, 130.0, 114.0, 55.4, 37.9, 15.0; MS (ASAP, *m/z*): 175 $[MH]^+$, 174 $[M]^+$, 159 $[M-15]^+$; MS (ASAP, *m/z*): 168 $[M]^+$, 121 $[M-47]^+$.

^{1}H-NMR and ^{13}C-NMR are consistent with the literature.[20]

N,*N*,4-Trimethylbenzenesulfonamide (**3bc**)

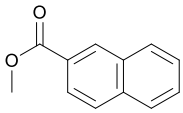


The compound was prepared according to General procedure **A** starting from *N*,4-dimethylbenzenesulfonamide **1bc** (0.466 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.33 ml, 2.5 mmol) stirred for 6 h, resulting in compound **3bc** as a white solid (0.449 g, 90%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.67 (app. d, *J* = 8.1 Hz, 2 H), 7.33 (app. d, *J* = 8.1 Hz, 2 H), 2.69 (s, 6 H), 2.44 (s, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 143.6, 132.6, 129.8, 128.0, 38.1, 21.7; MS (ASAP, *m/z*): 200 $[MH]^+$, 155 $[M-45]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[21]

Methyl 2-naphthoate (**3bd**)

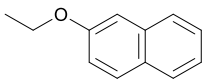


The compound was prepared according to General procedure **A** starting from 2-naphthoic acid **1bd** (0.433 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and methyl tosylate **2aa** (0.33 ml, 2.5 mmol) stirred for 65 h. Instead of a wash with water, the residue was washed with 1 N NaOH, resulting in compound **3bd** as a white solid (0.297 g, 63%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.62 (app. s, 1 H), 8.07 (app. dd, *J* = 8.6, 1.8 Hz, 1 H), 7.92 (m , 3 H), 7.57 (m , 2 H), 3.99 (s, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 167.4, 135.7, 132.6, 131.2, 129.5, 128.4, 128.3, 127.9, 127.5, 126.8, 125.4, 52.4; MS (ASAP, *m/z*): 186 $[M]^+$, 155 $[M-31]^+$, 127 $[M-59]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[22]

2-Ethoxynaphthalene (**3bs**)

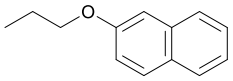


The compound was prepared according to General procedure **A** starting from 2-naphtol **1as** (0.363 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and ethyl tosylate **2bs** (0.33 ml, 2.5 mmol) stirred for 16 h, resulting in compound **3bs** as an orange solid (0.379 g, 88%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.78-7.71 (m, 3 H), 7.43 (app. ddd, *J* = 8.1, 6.9, 1.2 Hz, 1 H), 7.33 (app. ddd, *J* = 8.1, 6.9, 1.2 Hz, 1 H), 7.15 (app. dd, *J* = 8.8, 2.5 Hz, 1 H), 7.13 (app. d, *J* = 2.5 Hz, 1 H), 4.16 (q, *J* = 7.0 Hz, 2 H), 1.49 (t, *J* = 7.0 Hz, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 157.1, 134.8, 129.5, 129.0, 127.8, 126.8, 126.4, 123.6, 119.1, 106.7, 63.6, 15.0; MS (ASAP, *m/z*): 173 $[MH]^+$, 172 $[M]^+$, 144 $[MH-29]^+$, 127 $[M-45]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[23]

2-Propoxynaphthalene (**3cs**)

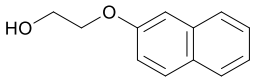


The compound was prepared according to General procedure **A** starting from 2-naphtol **1as** (0.363 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and propyl tosylate **2cs** (0.44 ml, 2.5 mmol) stirred for 16 h in 40wt% NaTos. Cooling in an ice bath and filtration while cold resulted in compound **3cs** as an off-white solid (0.318 g, 68%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.78-7.70 (m, 3 H), 7.43 (app. ddd, *J* = 8.1, 6.8, 1.2 Hz, 1 H), 7.32 (app. ddd, *J* = 8.1, 6.8, 1.2 Hz, 1 H), 7.19-7.12 (m, 2 H), 4.05 (t, *J* = 6.6 Hz, 2 H), 1.88 (tq, J = 7.5, 6.6 Hz, 2 H), 1.09 (t, *J* = 7.5 Hz, 3 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 157.2, 134.8, 129.4, 129.0, 127.8, 126.8, 126.4, 123.6, 119.2, 106.7, 69.7, 22.7, 10.7; MS (ASAP, *m/z*): 187 $[MH]^+$, 186 $[M]^+$, 144 $[MH-43]^+$, 127 $[M-59]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[23]

2-(Naphthalen-2-yloxy)ethan-1-ol (**3ds**)



The compound was prepared according to General procedure **A** starting from 2-naphthol **1as** (0.363 g, 2.5 mmol), NaOH (0.121 g, 3.0 mmol) and 2-hydroxyethyl tosylate **2ds** (0.544 g, 2.5 mmol) stirred for 6 h, resulting in compound **3ds** as off-white crystalline platelets (0.365 g, 77%).

^{1}H-NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.80-7.70 (m, 3 H), 7.45 (app. ddd, *J* = 8.2, 6.8, 1.3 Hz, 1 H), 7.35 (app. ddd, *J* = 8.2, 6.8, 1.3 Hz, 1 H), 7.21-7.15 (m, 2 H), 4.22 (t, *J* = 4.6 Hz, 2 H), 4.04 (dt, *J* = 5.9, 4.6 Hz, 2 H), 2.09 (t, *J* = 6.2 Hz, 1 H); ^{13}C-NMR (101 MHz, $CDCl_3$): δ (ppm) = 156.7, 134.6, 129.7 129.3, 127.8, 126.9, 126.6, 124.0, 118.9, 107.0, 69.3, 61.7; MS (ASAP, *m/z*): 189 $[MH]^+$, 188 $[M]^+$, 144 $[MH-45]^+$, 128 $[MH-61]^+$.

^{1}H-NMR, ^{13}C-NMR and MS data are consistent with the literature.[24]

Recyclability procedure

For the recyclability study, the synthesis of **2as** was performed according to a modification of General procedure **A**. A round-bottom flask was charged with 2-naphthol **1as** (3.63 g, 25.2 mmol), NaOH (1.21 g, 30.2 mmol) and 20 wt% NaTos (60 ml). The mixture was stirred in an oil bath at 50 °C until full dissolution of the reagents. Then, methyl tosylate **2aa** (3.8 ml, 25.2 mmol) was added and the mixture was stirred for 16 h at 50 °C. The reaction mixture was allowed to cool to room temperature and the precipitate was filtered off. The initial filtrate was collected for subsequent cycles. The residue was washed with water, resulting in compound **3as** as an off-white solid (3.74 g, 94%). The procedure was repeated for the next nine runs using the initial filtrate from the previous run, 1 equiv **1as** (3.63 g, 25.2 mmol), 1 equiv NaOH (1.01 g, 25.2 mmol) and 1 equiv NaTos (3.8 ml, 25.2 mmol).

NMR spectra (^{1}H-NMR and ^{13}C-NMR)

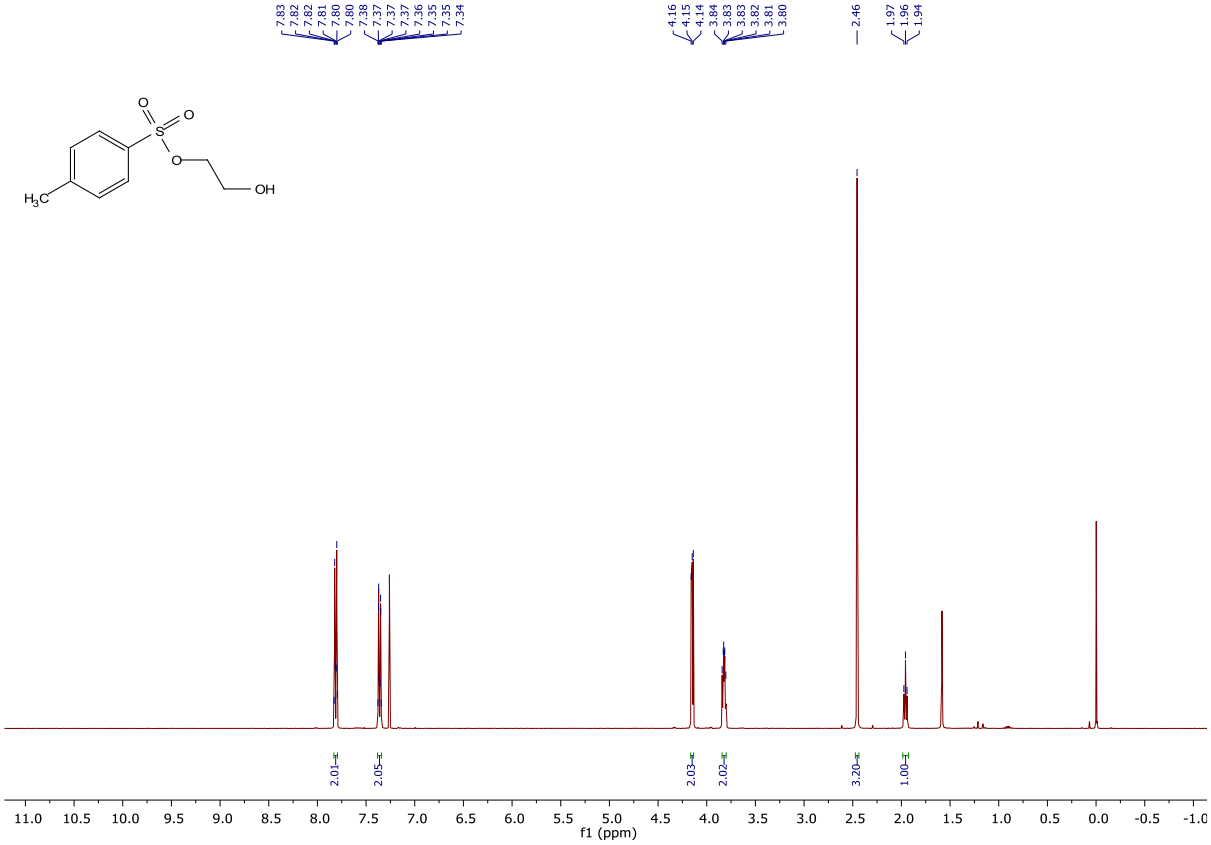


Figure S1: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **2cs**

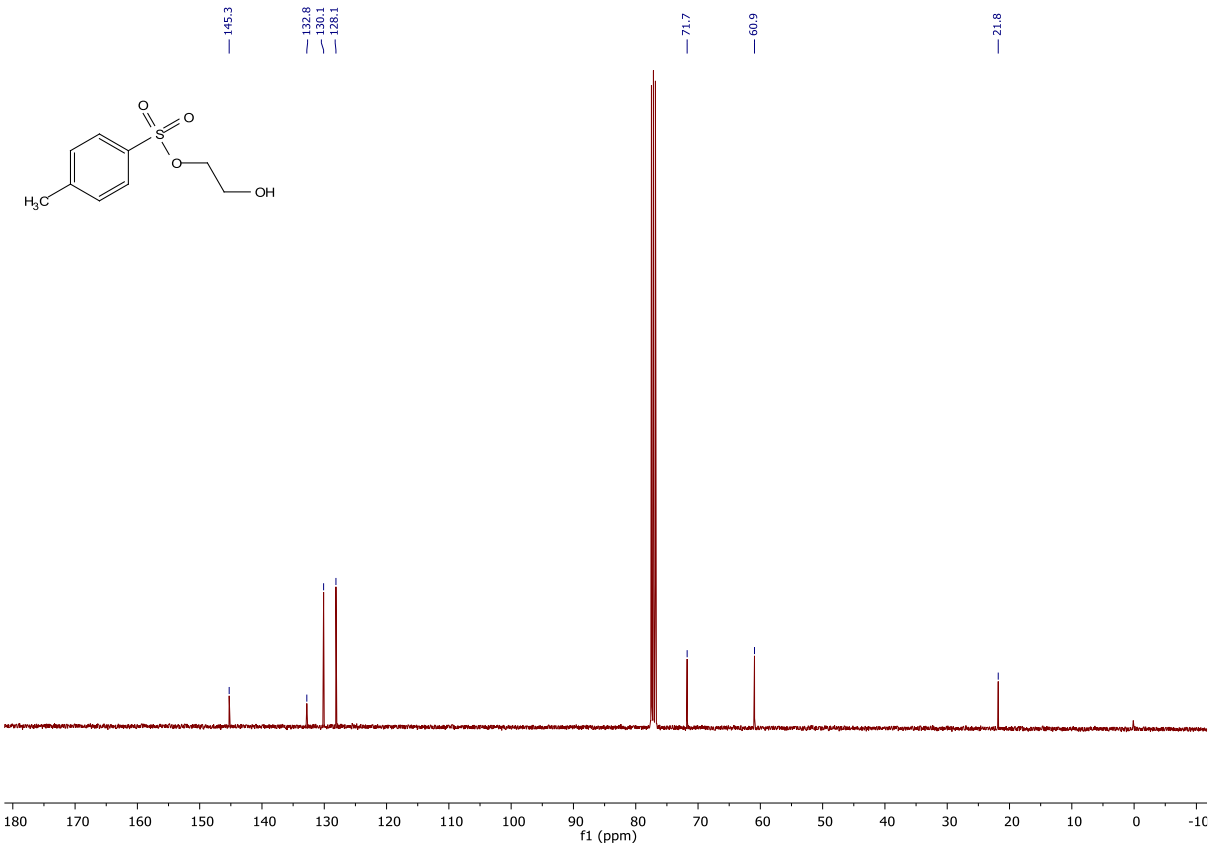


Figure S2: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **2cs**

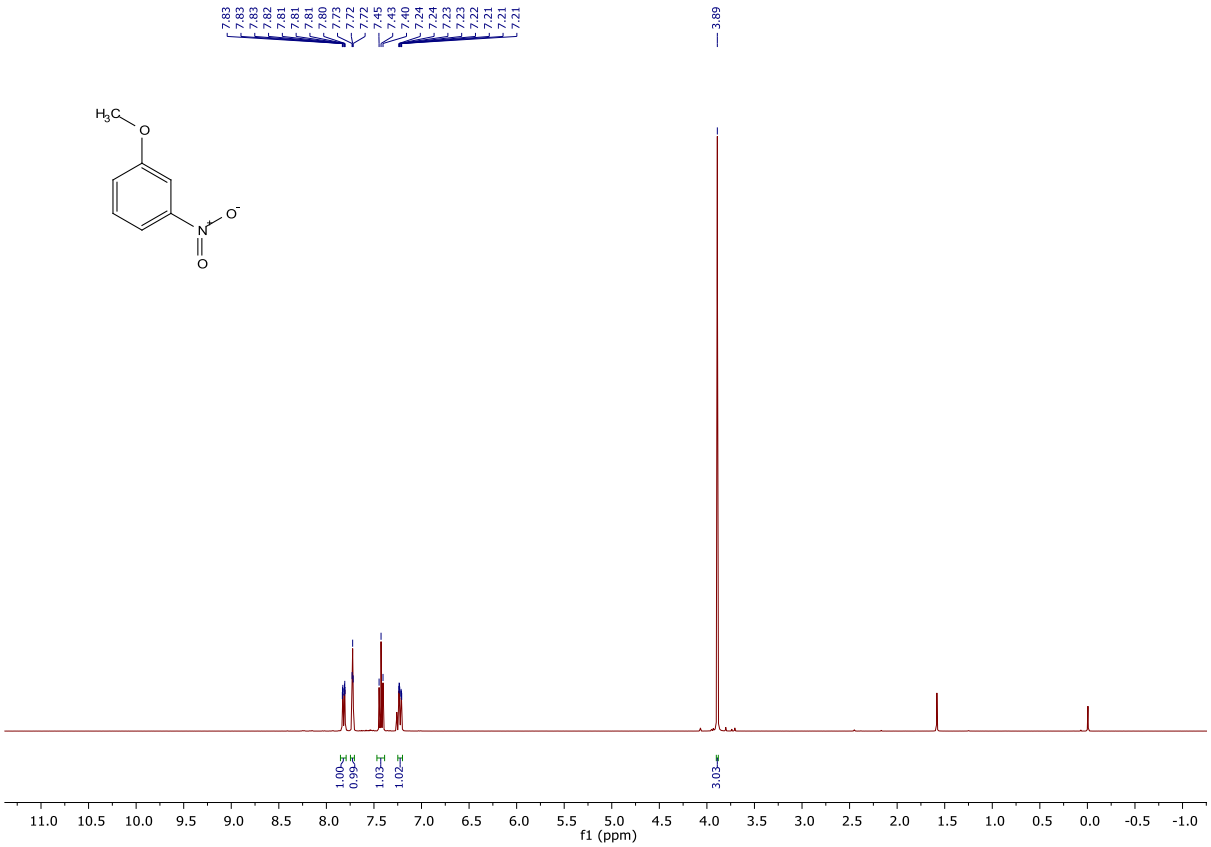


Figure S3: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3aa**

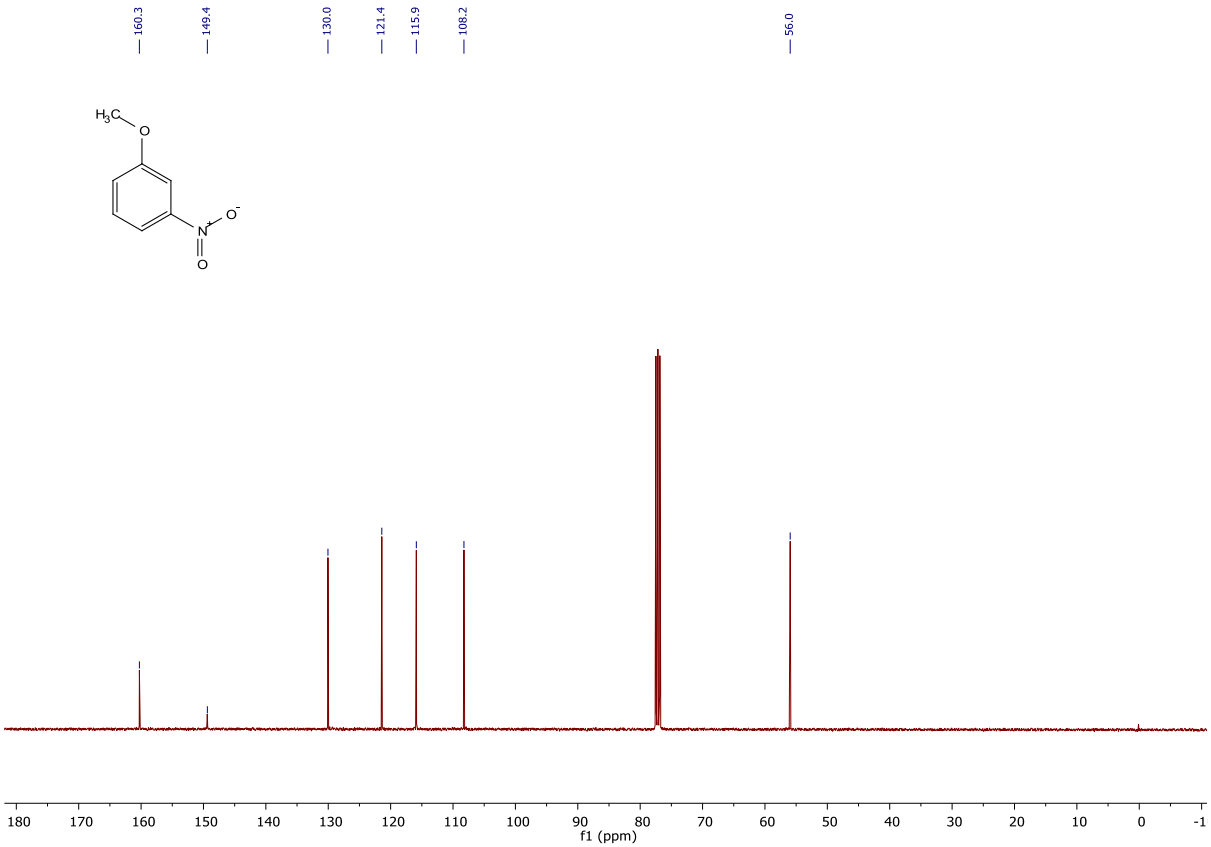


Figure S4: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3aa**

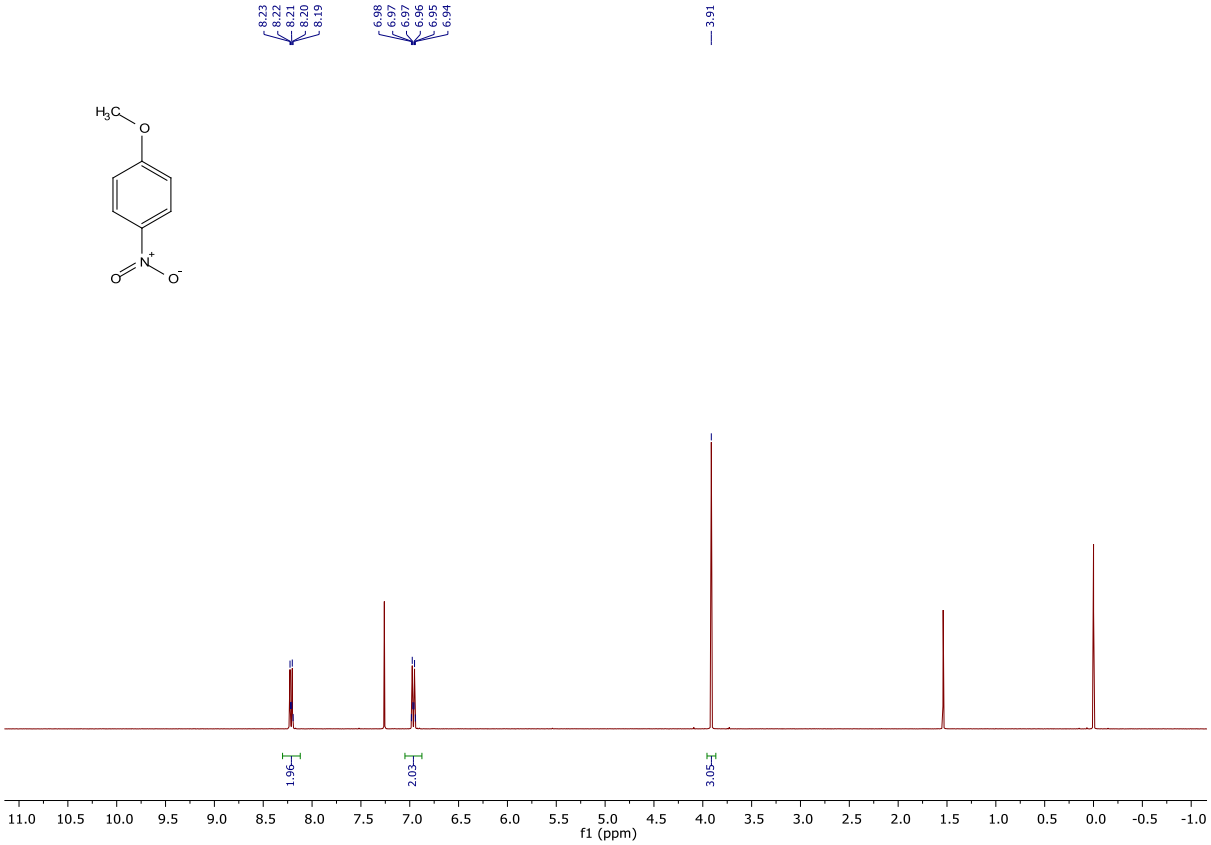


Figure S5: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3ac**

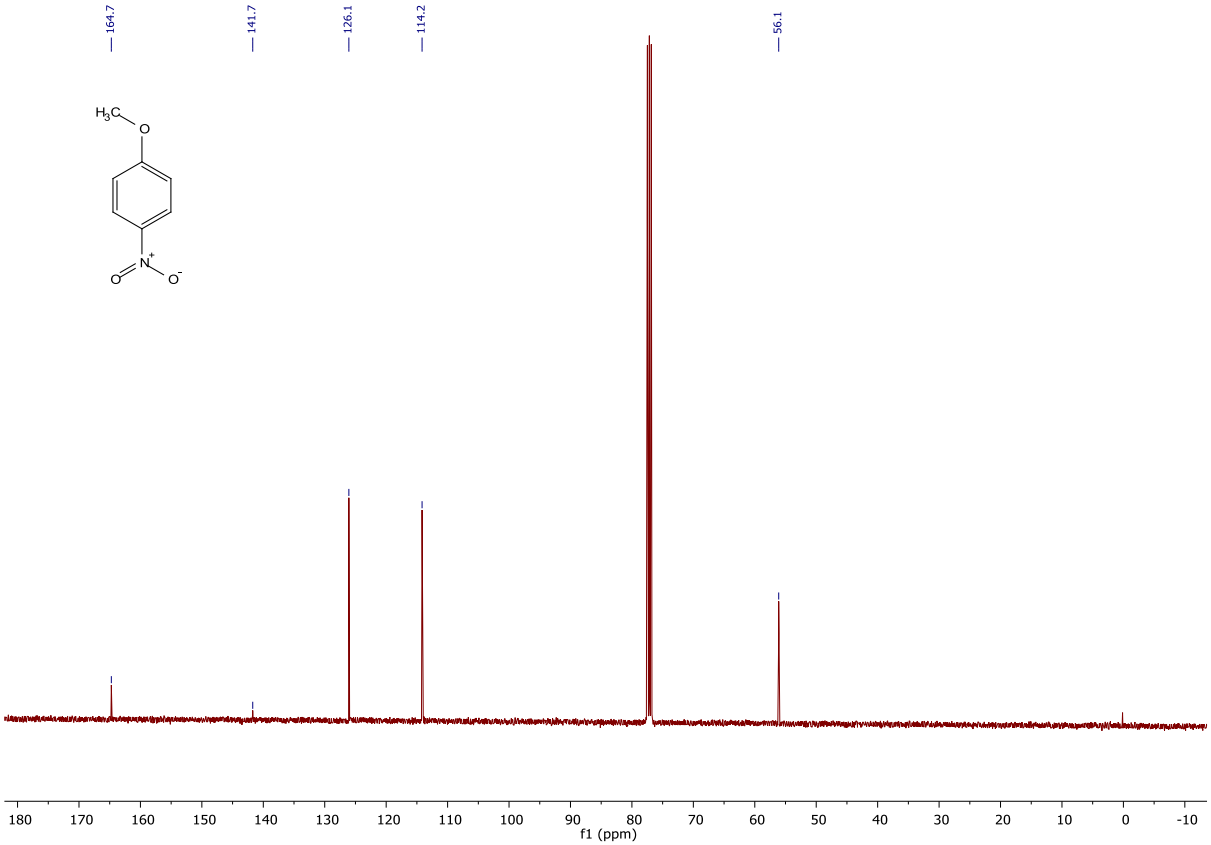


Figure S6: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3ac**

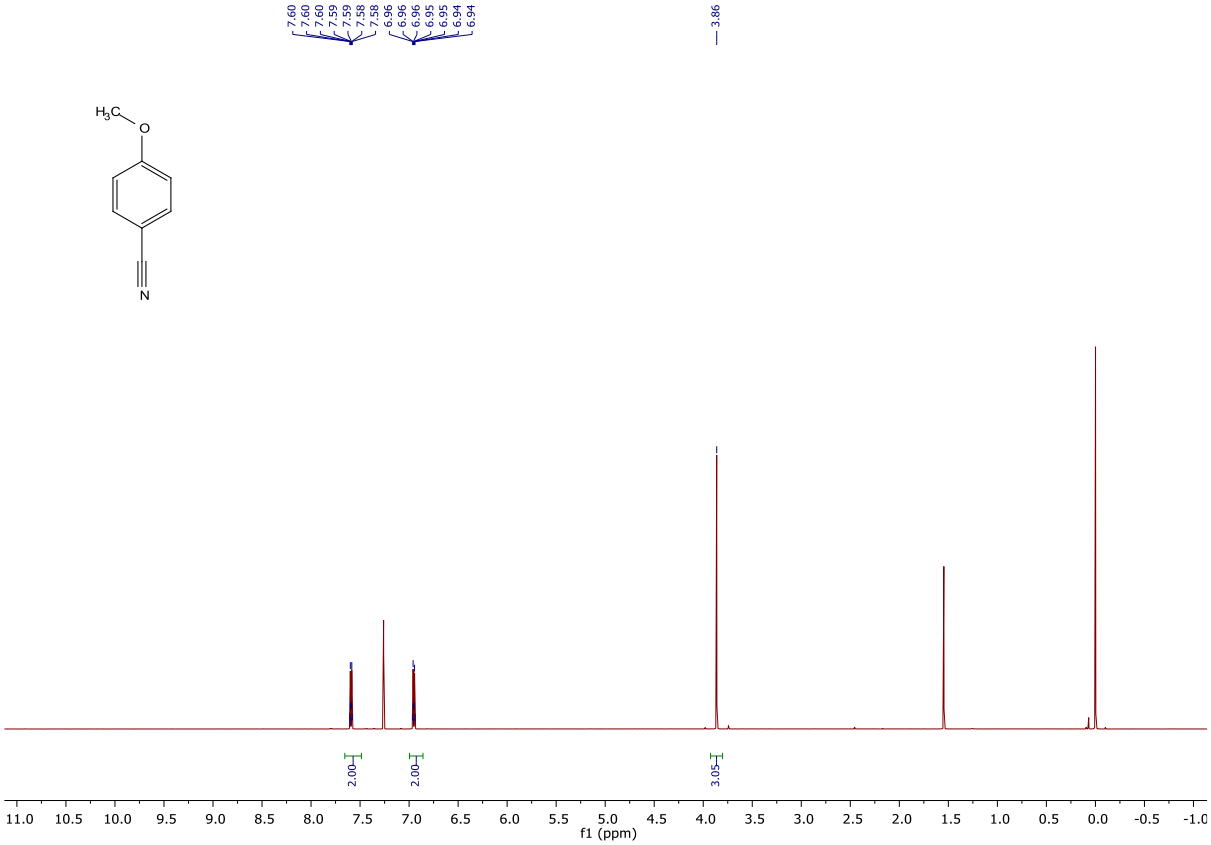


Figure S7: ^{1}H-NMR spectrum (600 MHz, $CDCl_3$) of **3ad**

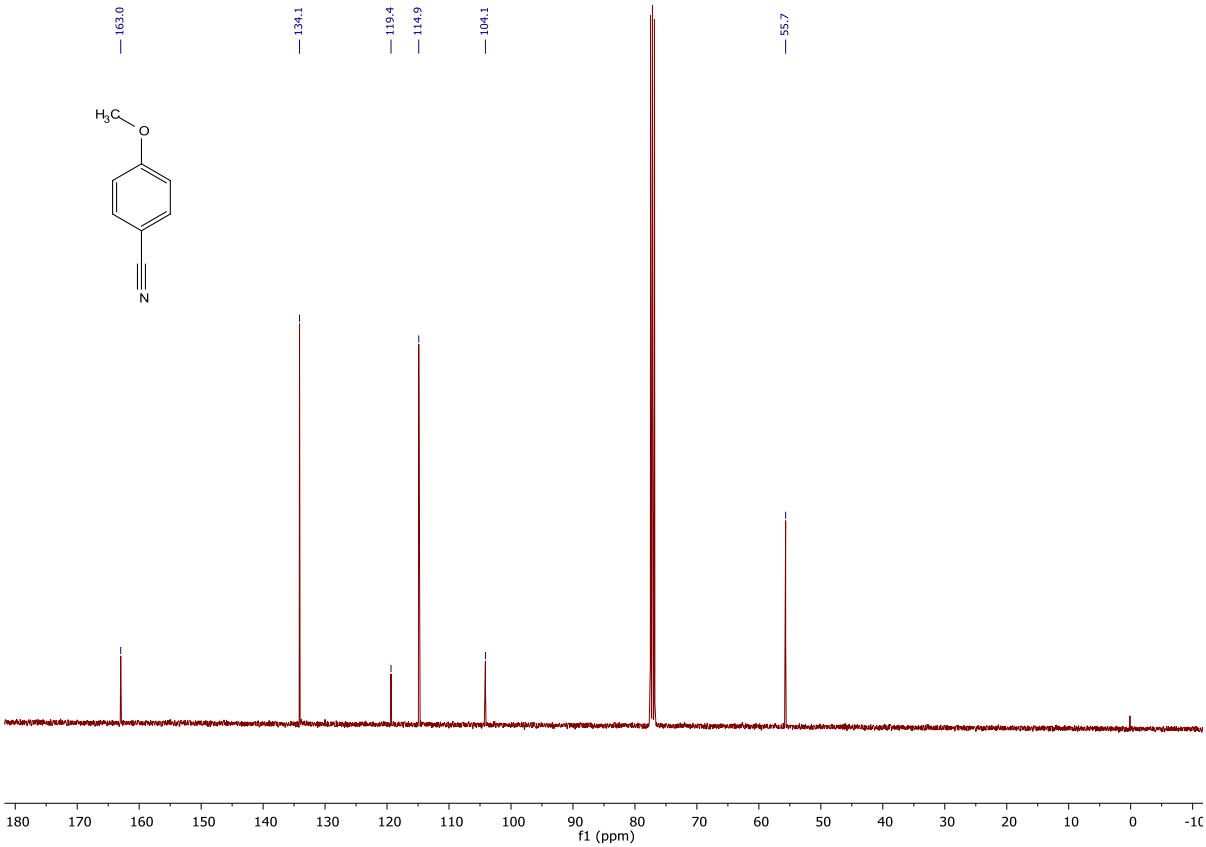


Figure S8: ^{13}C-NMR spectrum (151 MHz, $CDCl_3$) of **3ad**

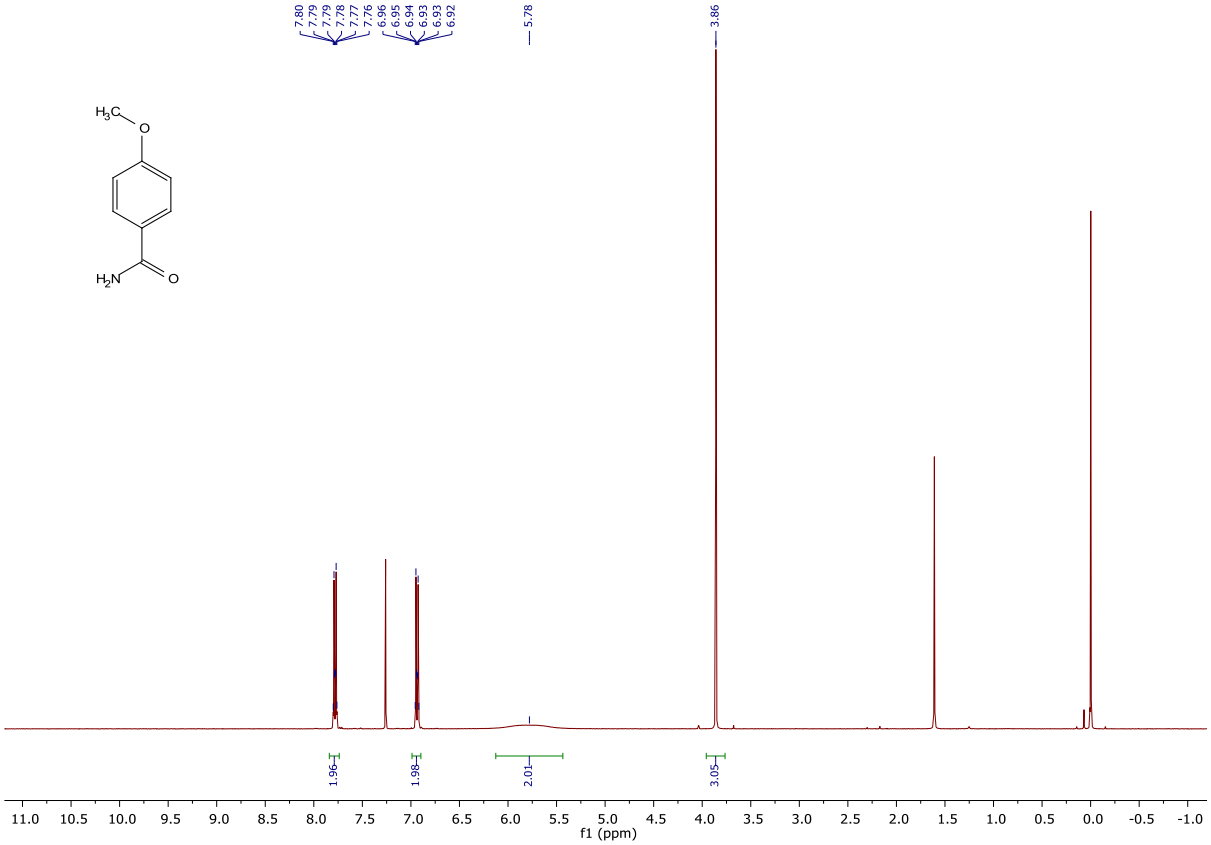


Figure S9: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3ae**

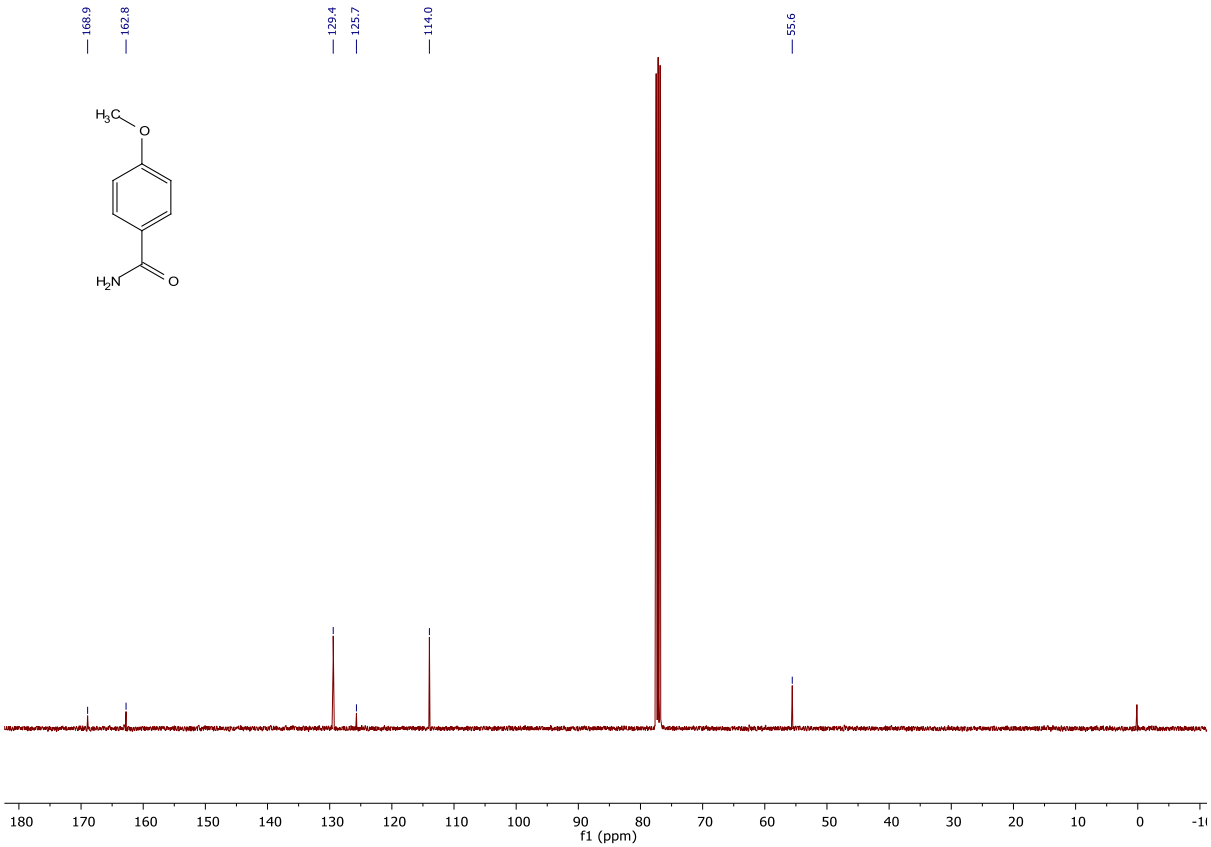


Figure S10: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3ae**

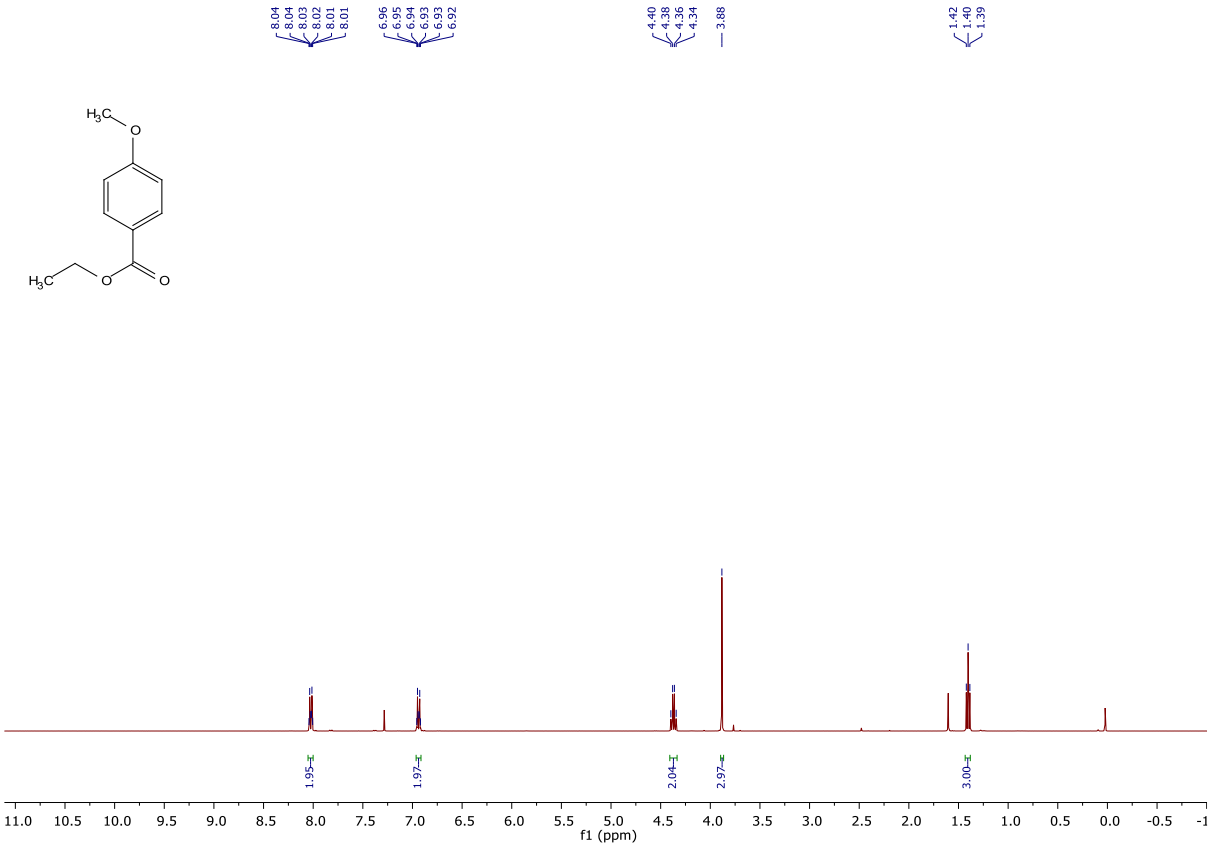


Figure S11: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3af**

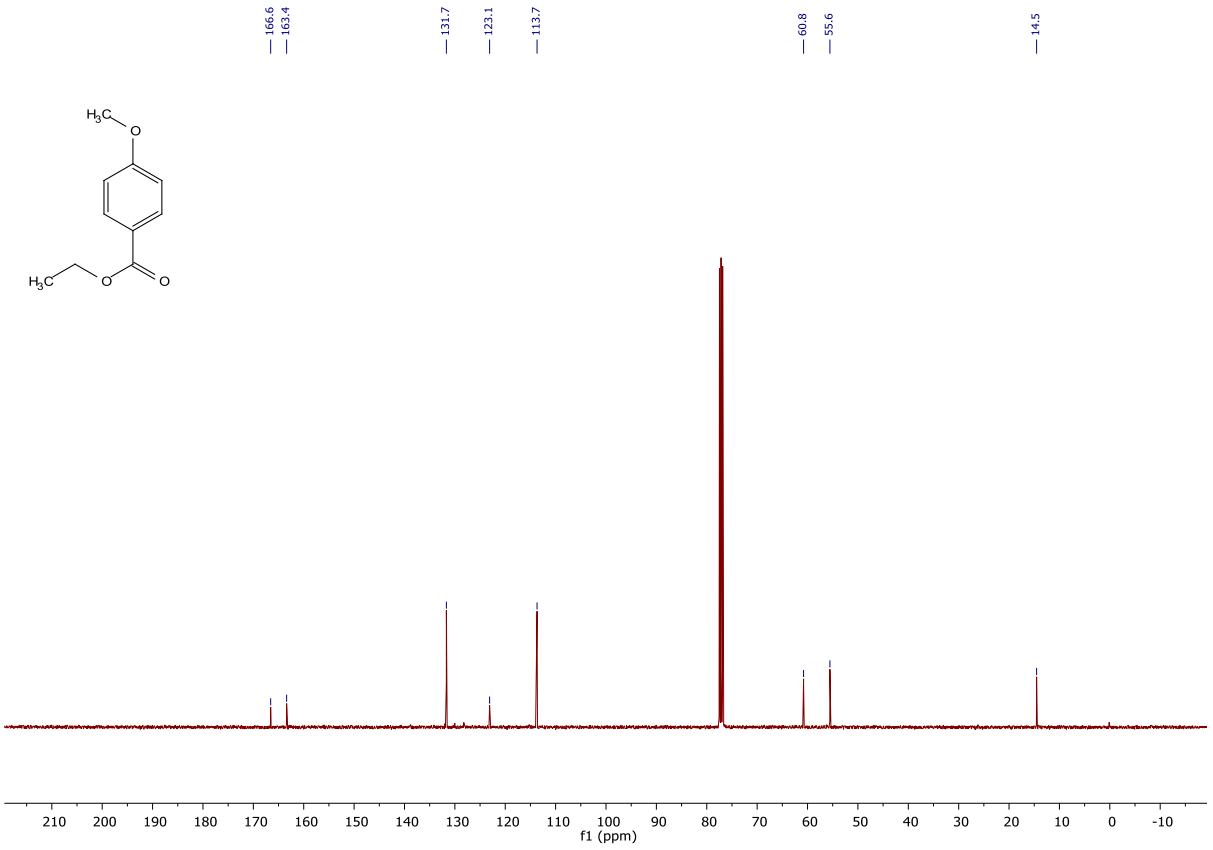


Figure S12: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3af**

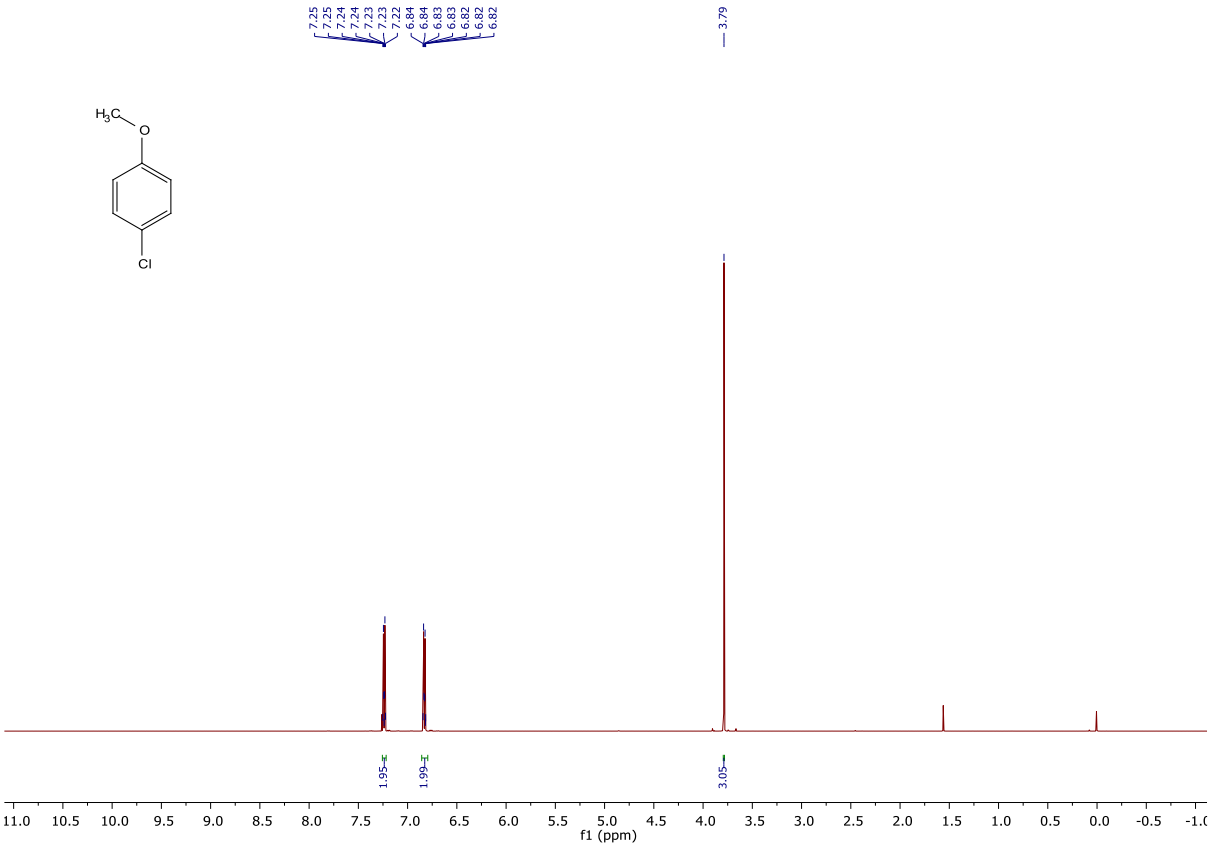


Figure S13: ^{1}H-NMR spectrum (600 MHz, $CDCl_3$) of **3ag**

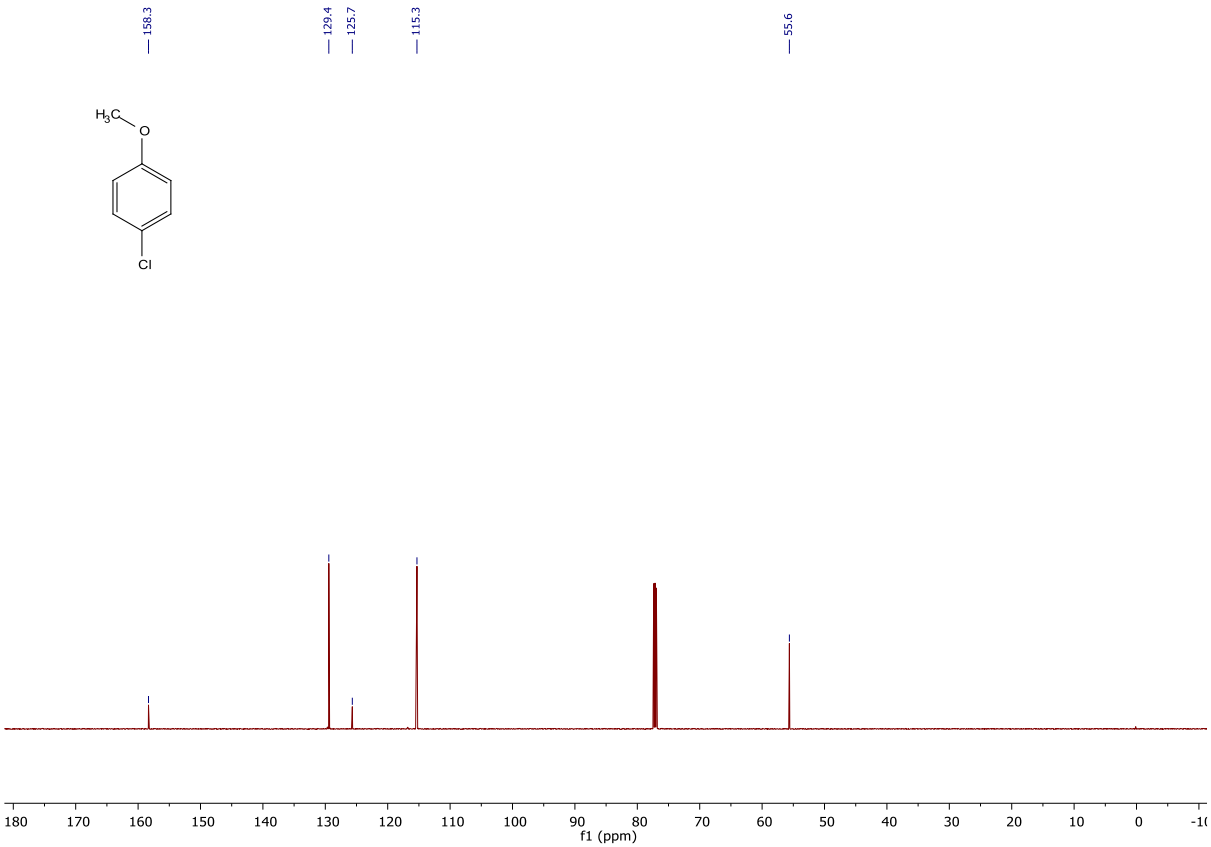


Figure S14: ^{13}C-NMR spectrum (151 MHz, $CDCl_3$) of **3ag**

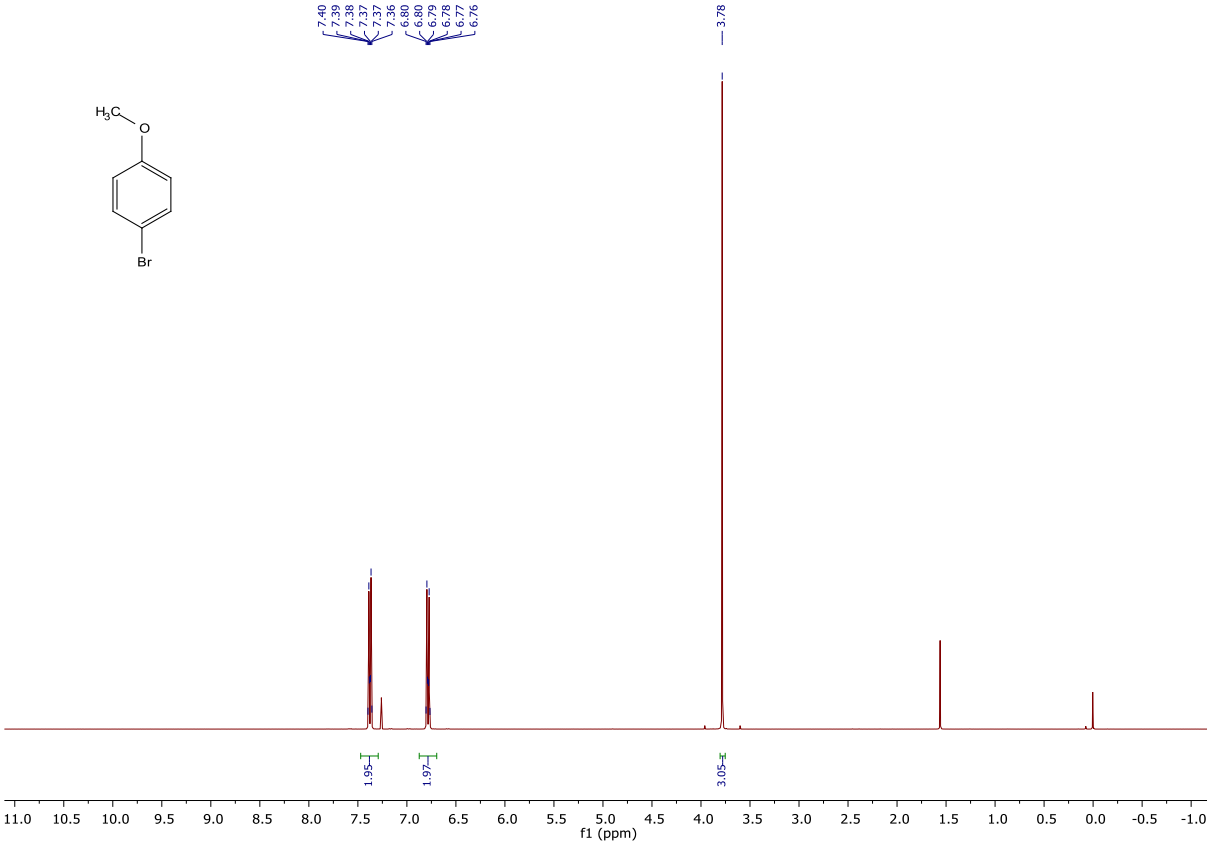


Figure S15: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3ah**

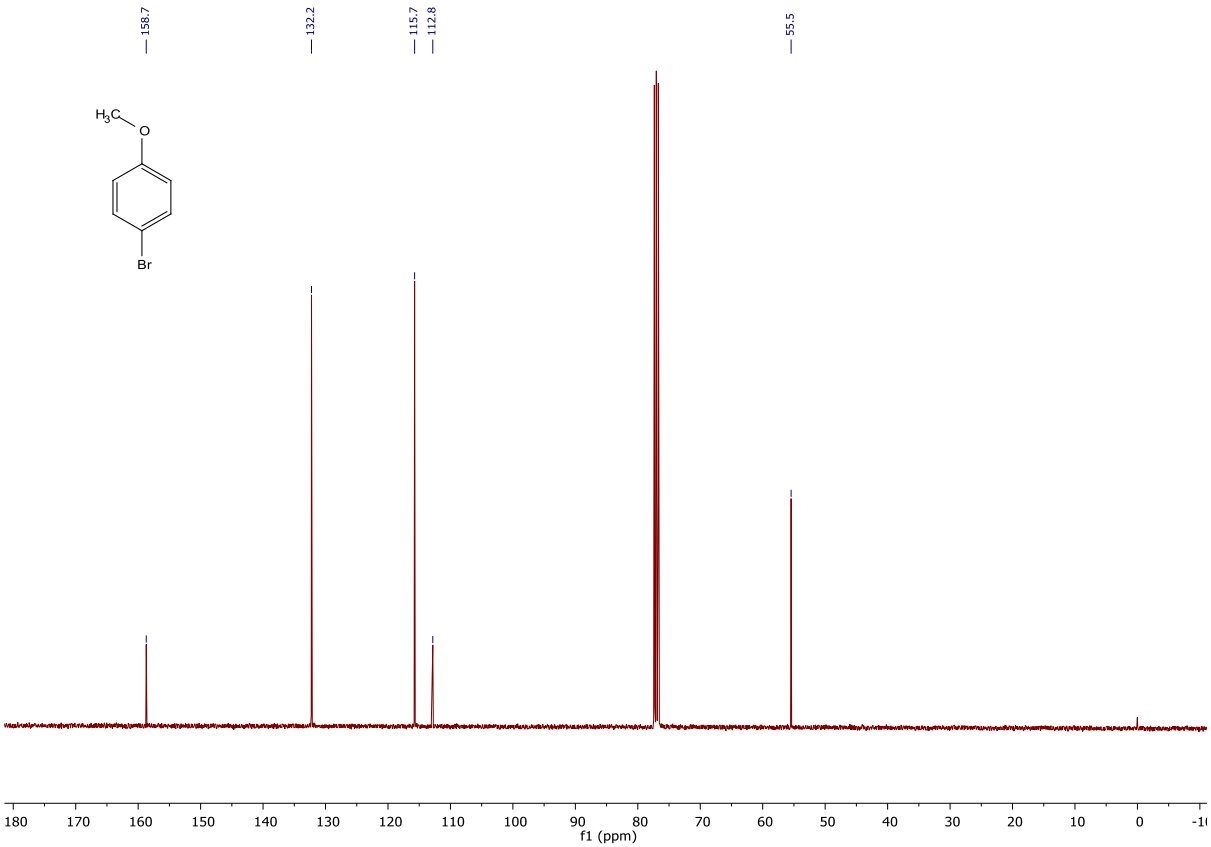


Figure S16: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3ah**

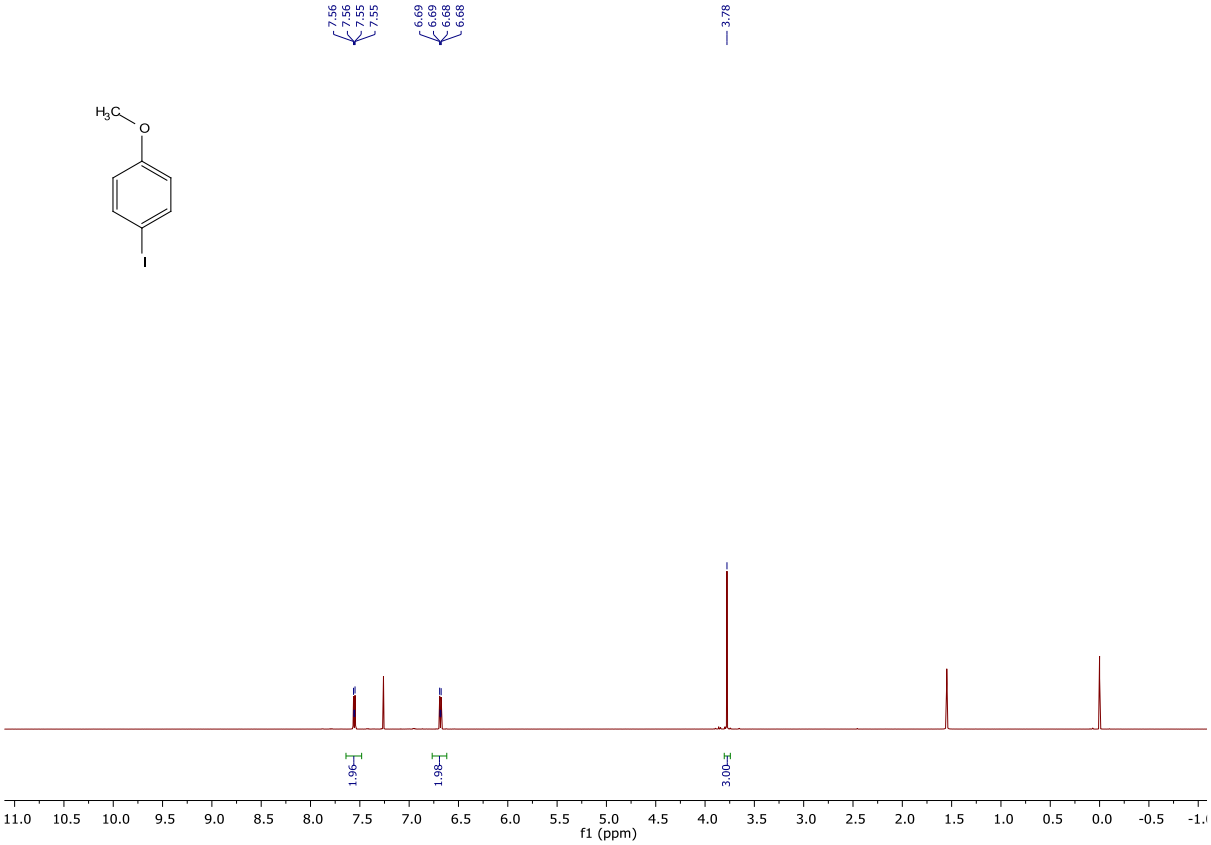


Figure S17: ^{1}H-NMR spectrum (600 MHz, $CDCl_3$) of **3ai**

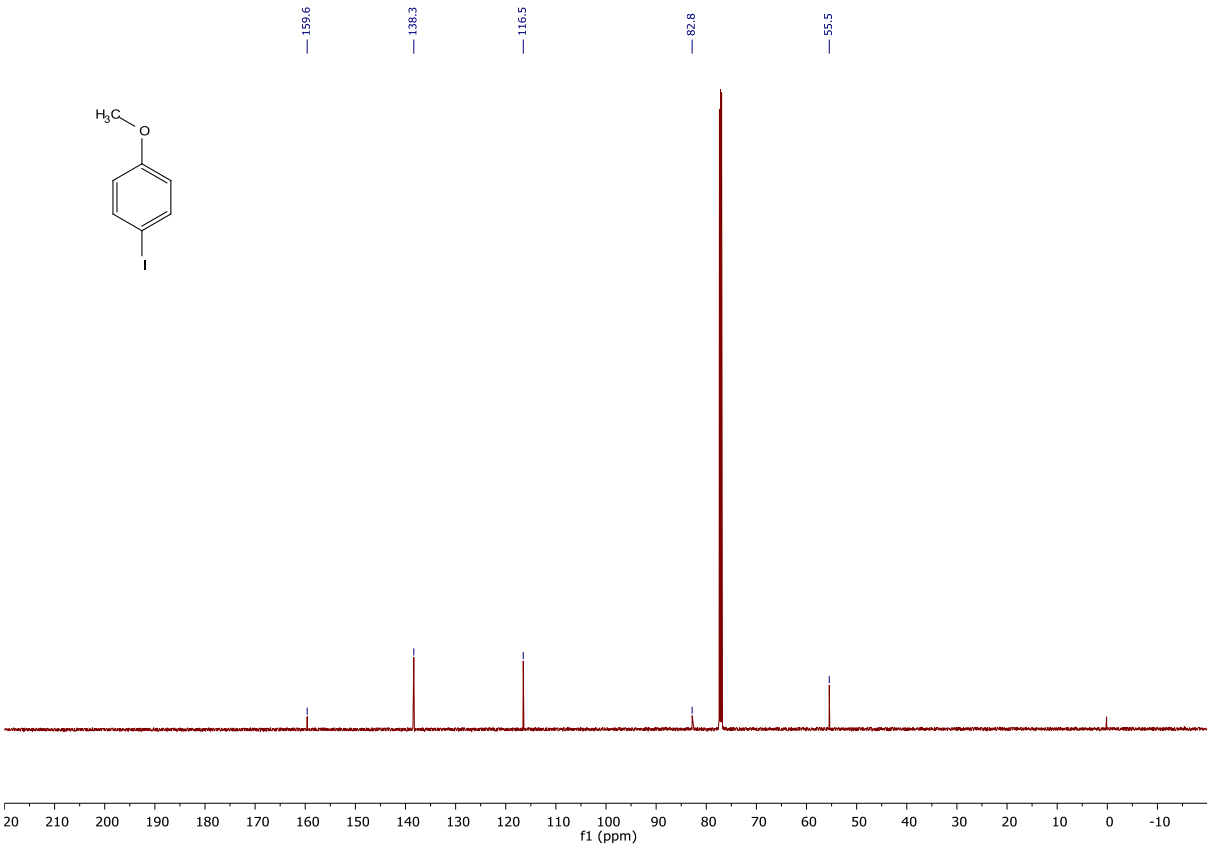


Figure S18: ^{13}C-NMR spectrum (151 MHz, $CDCl_3$) of **3ai**

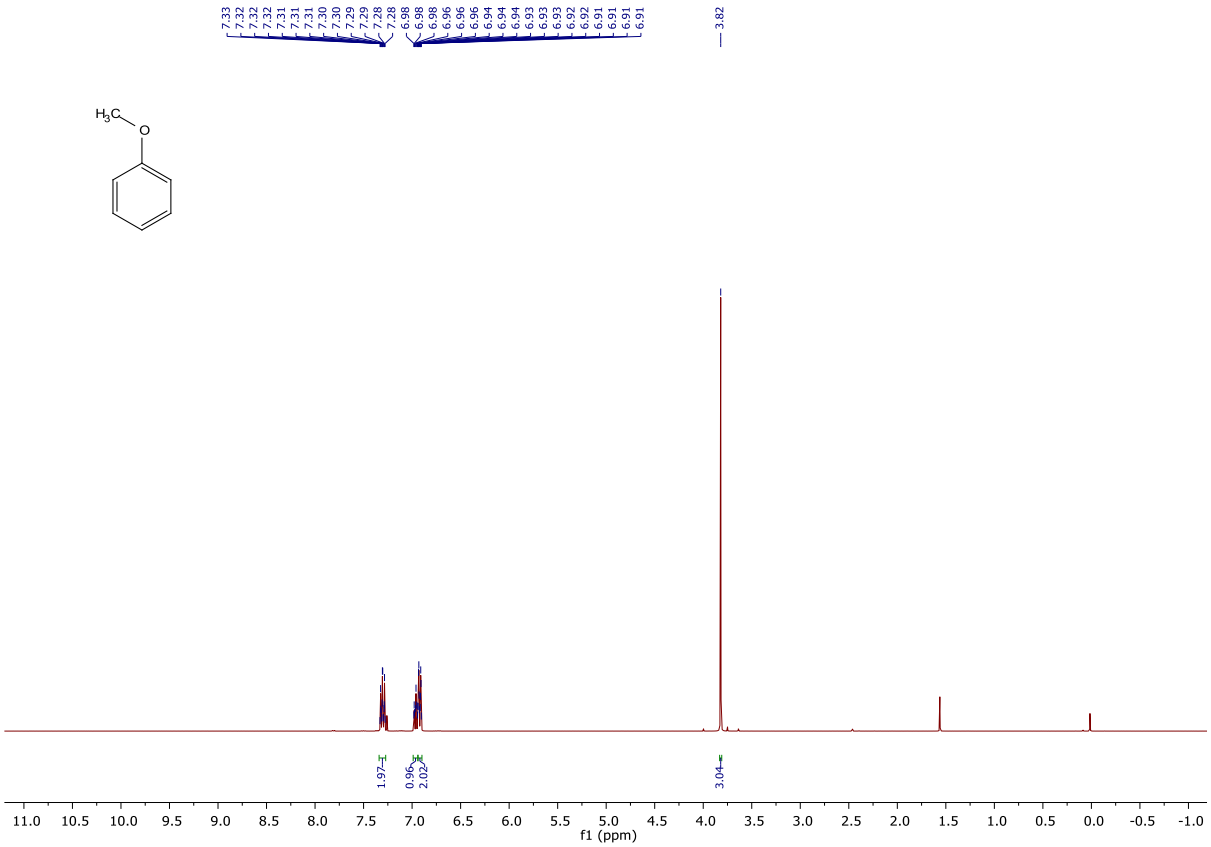


Figure S19: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3aj**

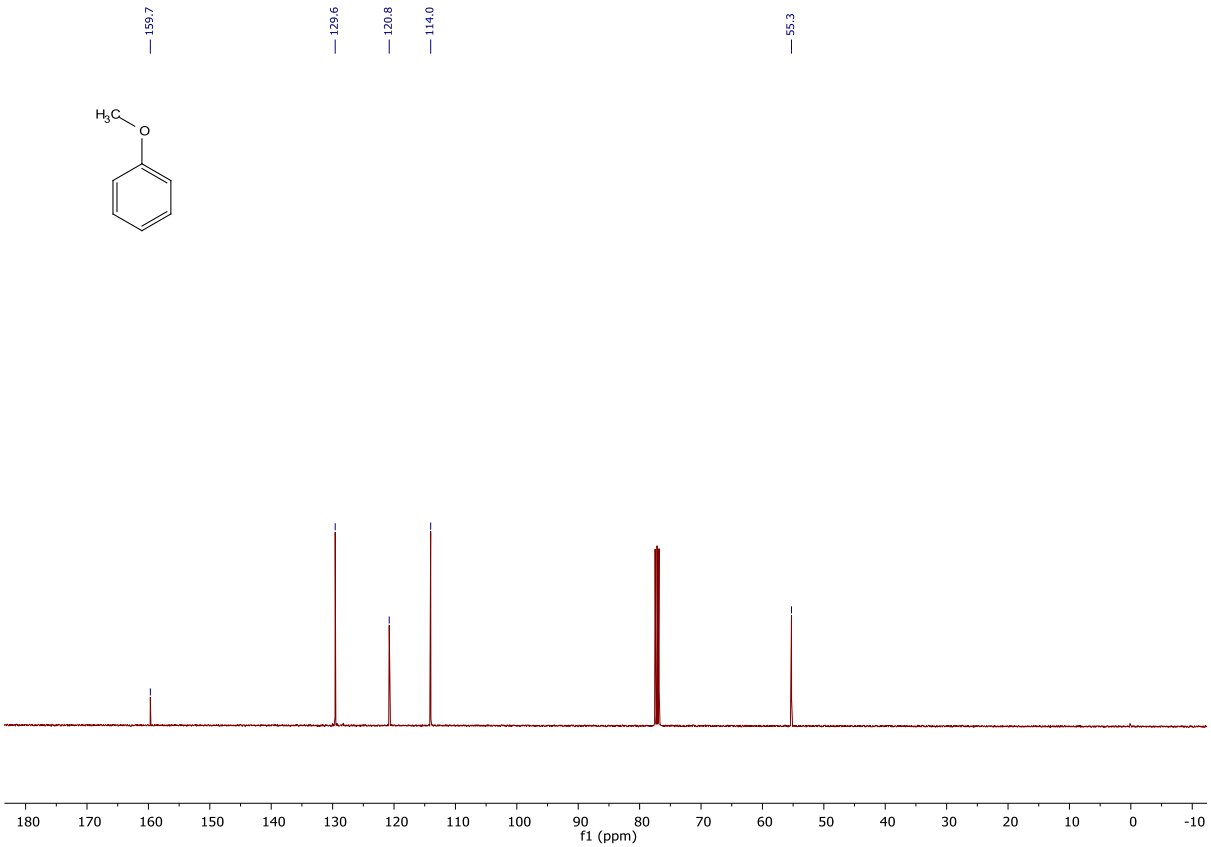


Figure S20: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3aj**

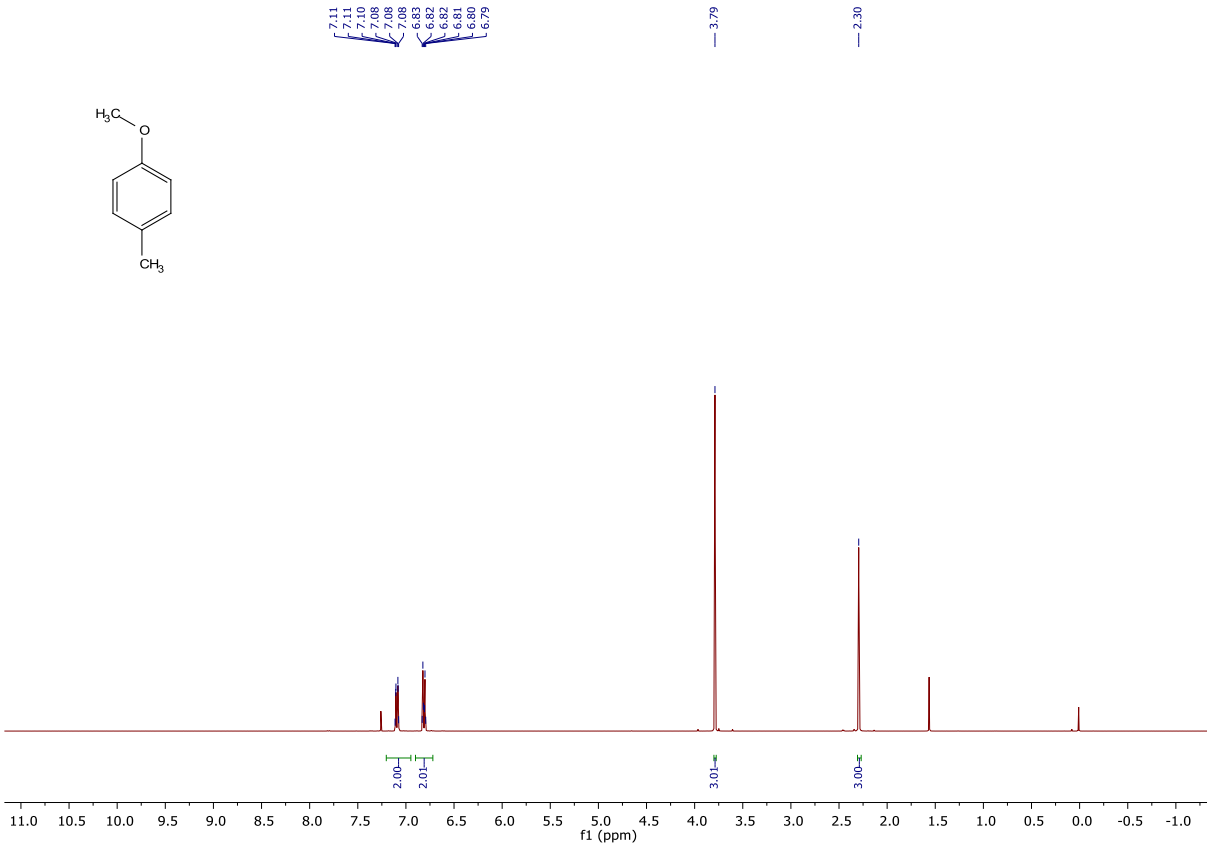


Figure S21: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3ak**

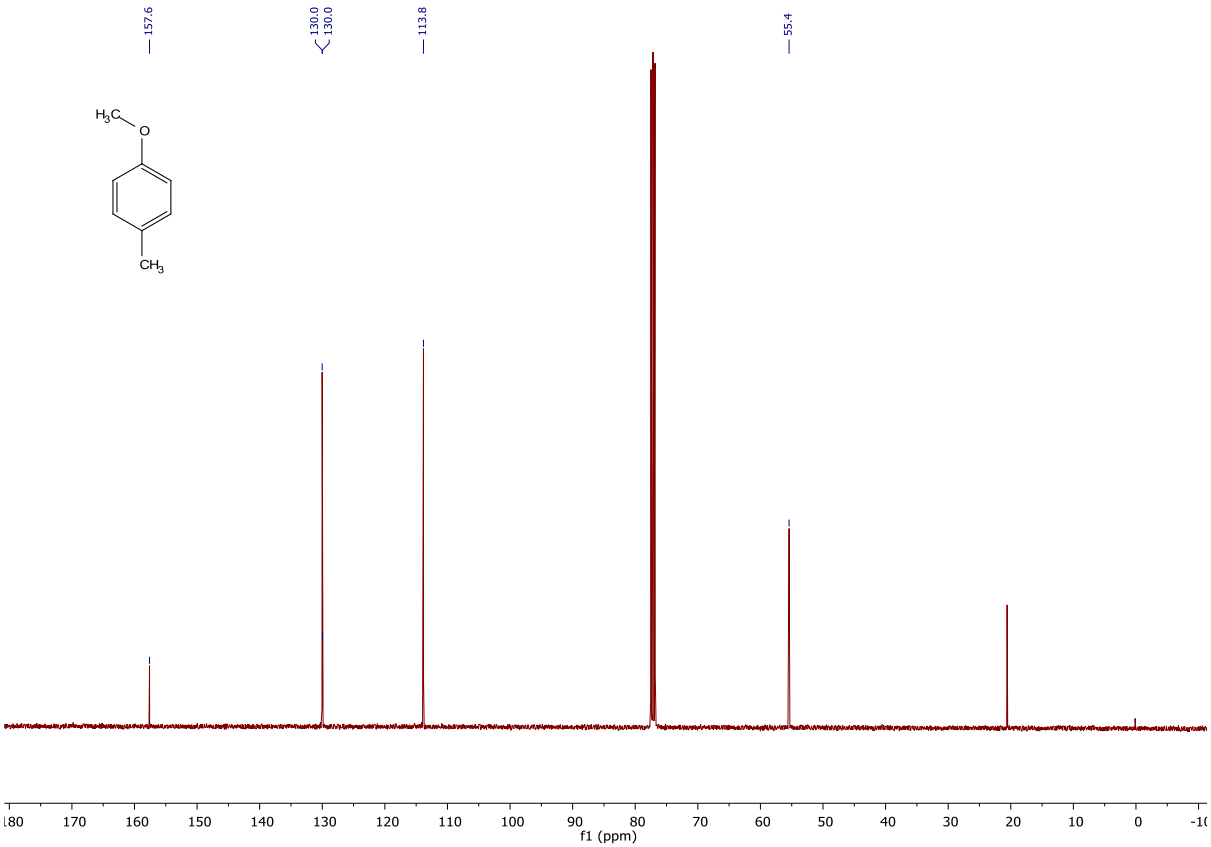


Figure S22: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3ak**

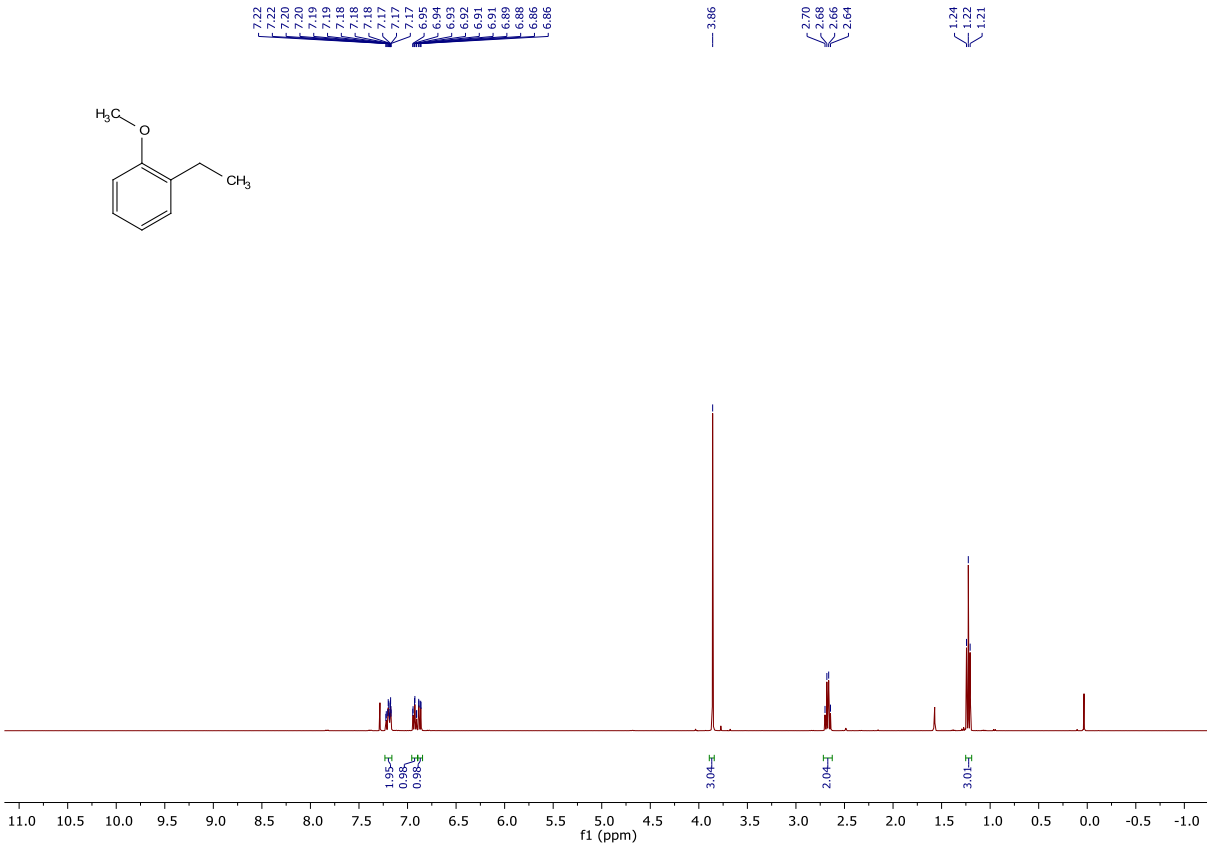


Figure S23: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3al**

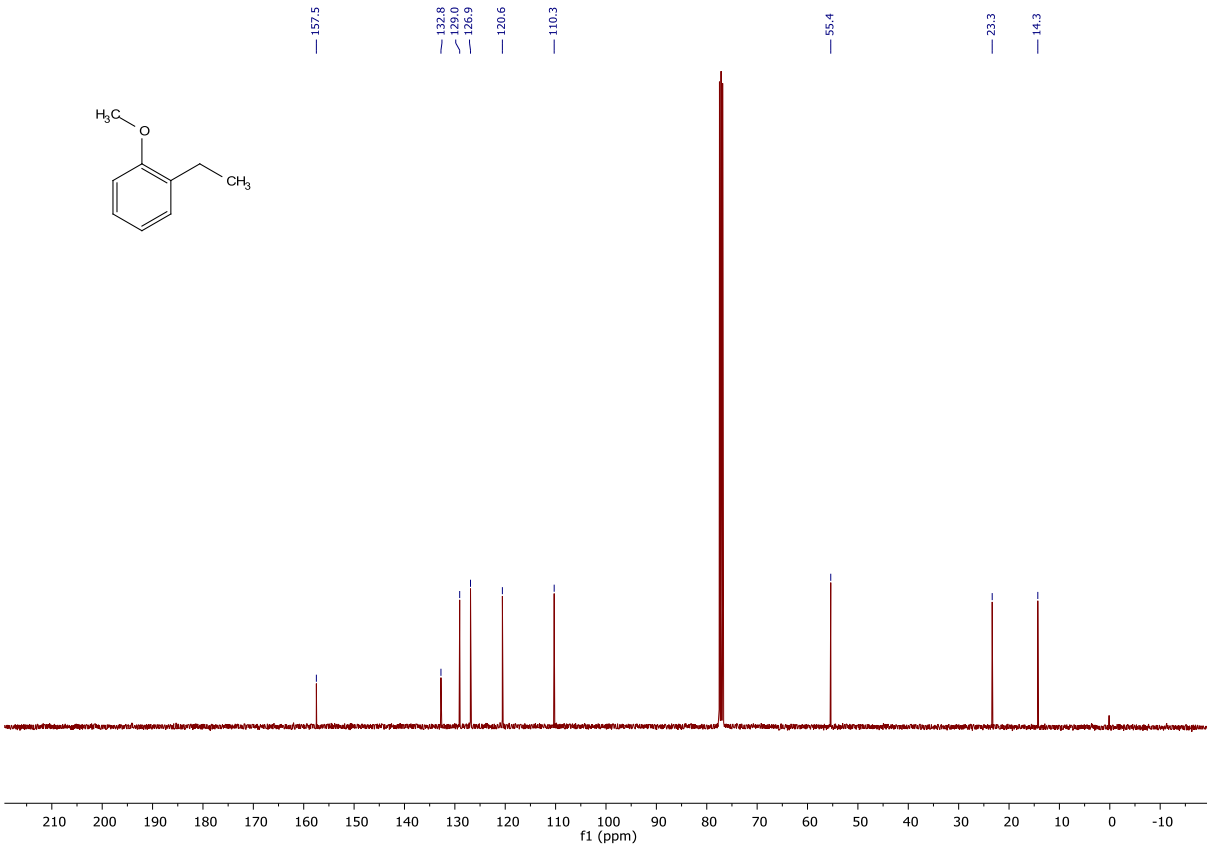


Figure S24: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3al**

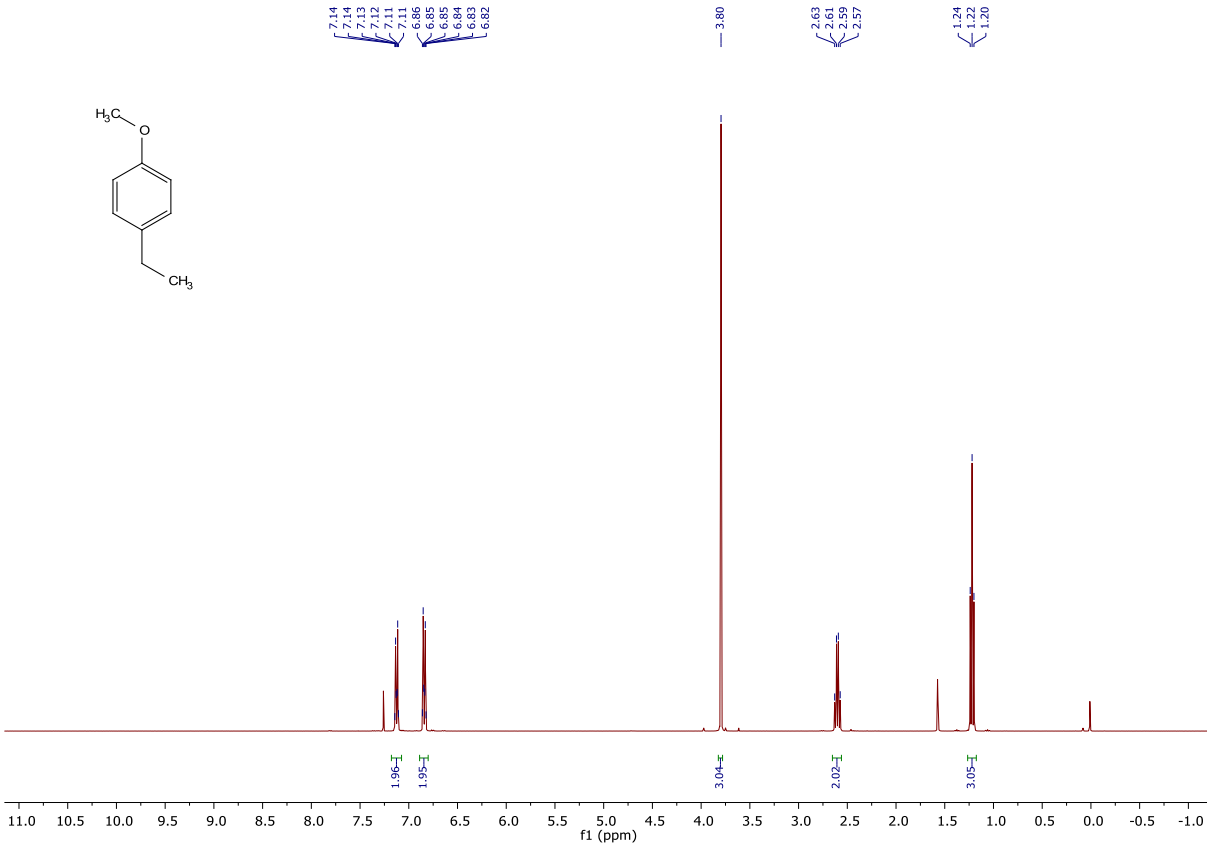


Figure S25: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3am**

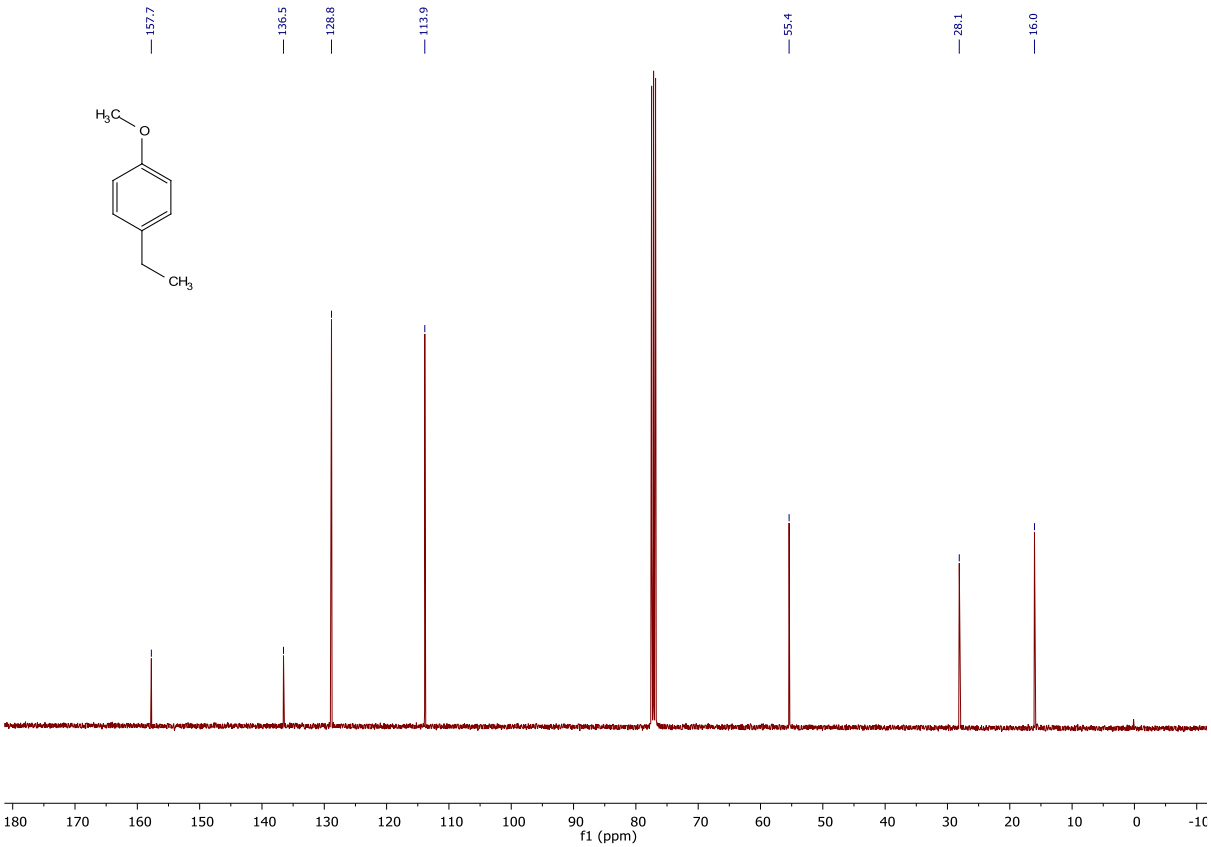


Figure S26: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3am**

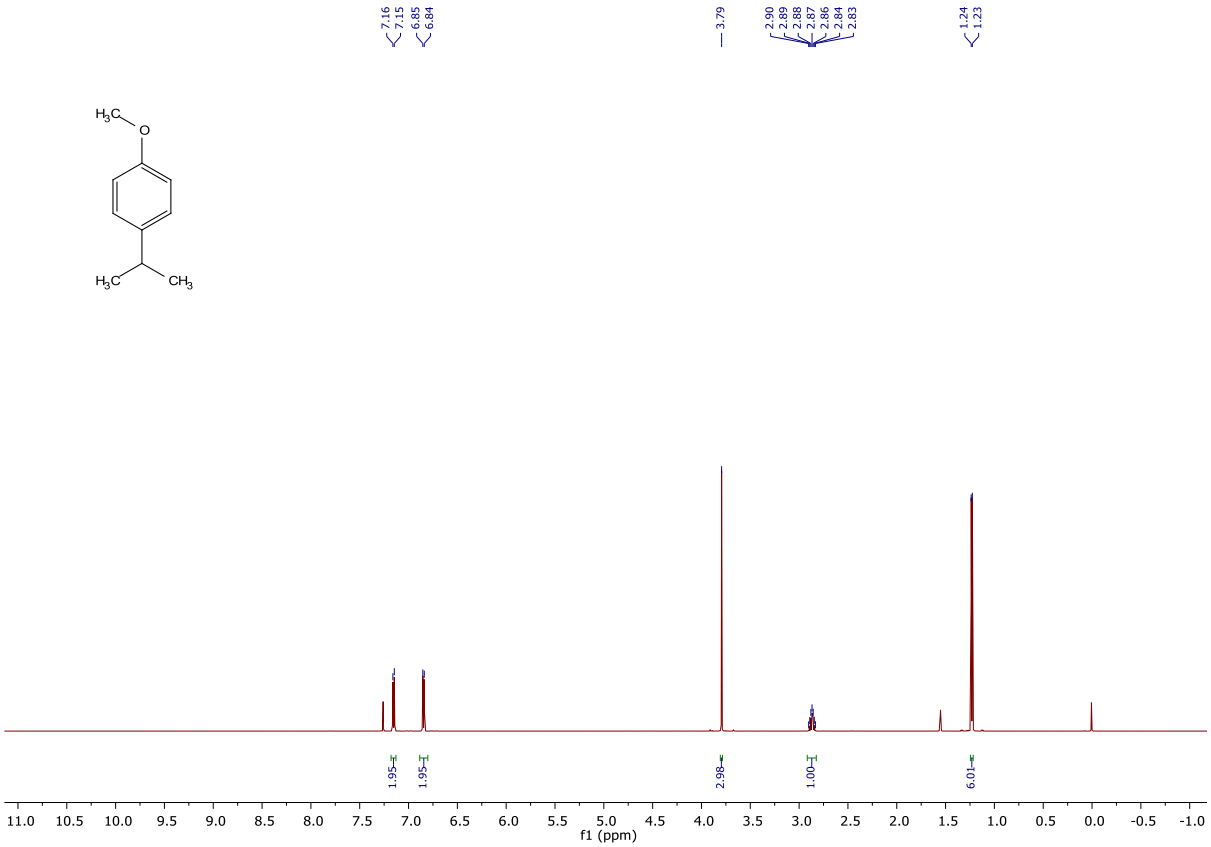


Figure S27: ^{1}H-NMR spectrum (600 MHz, $CDCl_3$) of **3an**

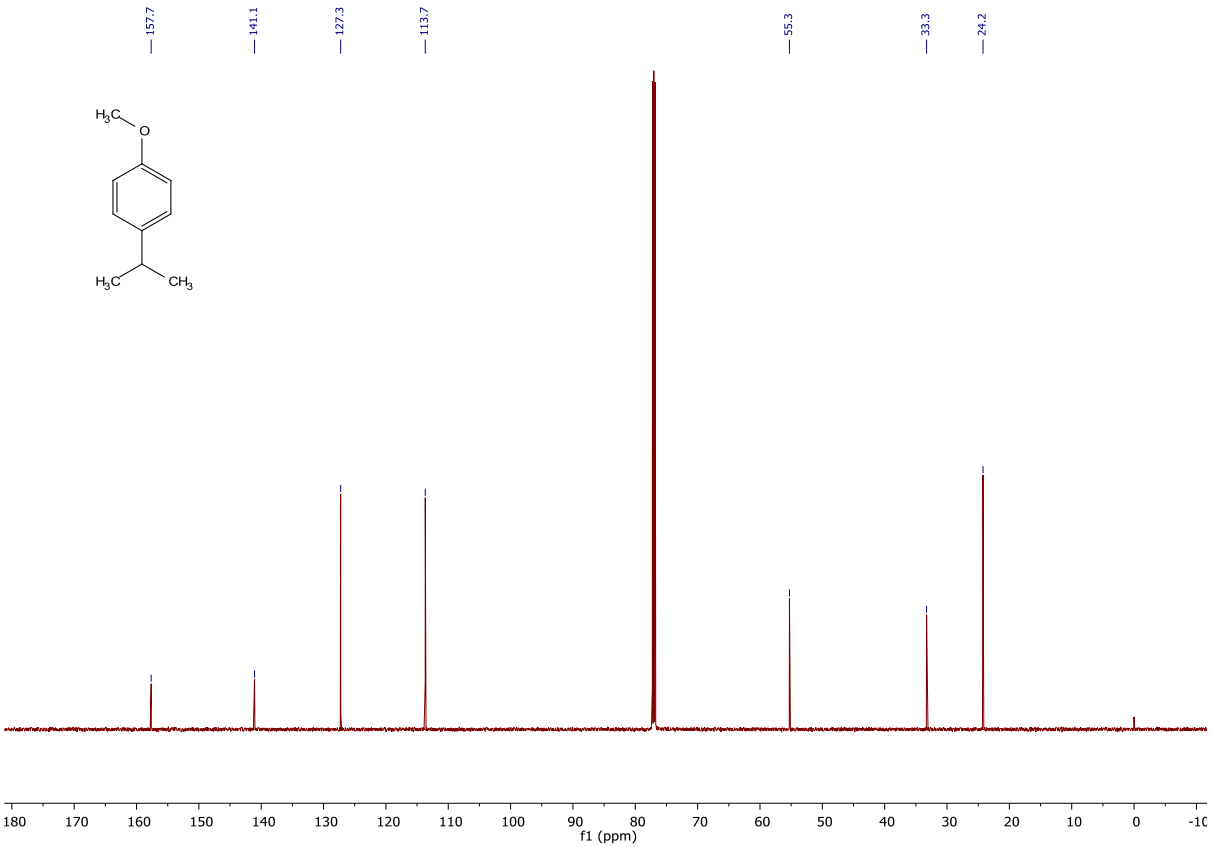


Figure S28: ^{13}C-NMR spectrum (151 MHz, $CDCl_3$) of **3an**

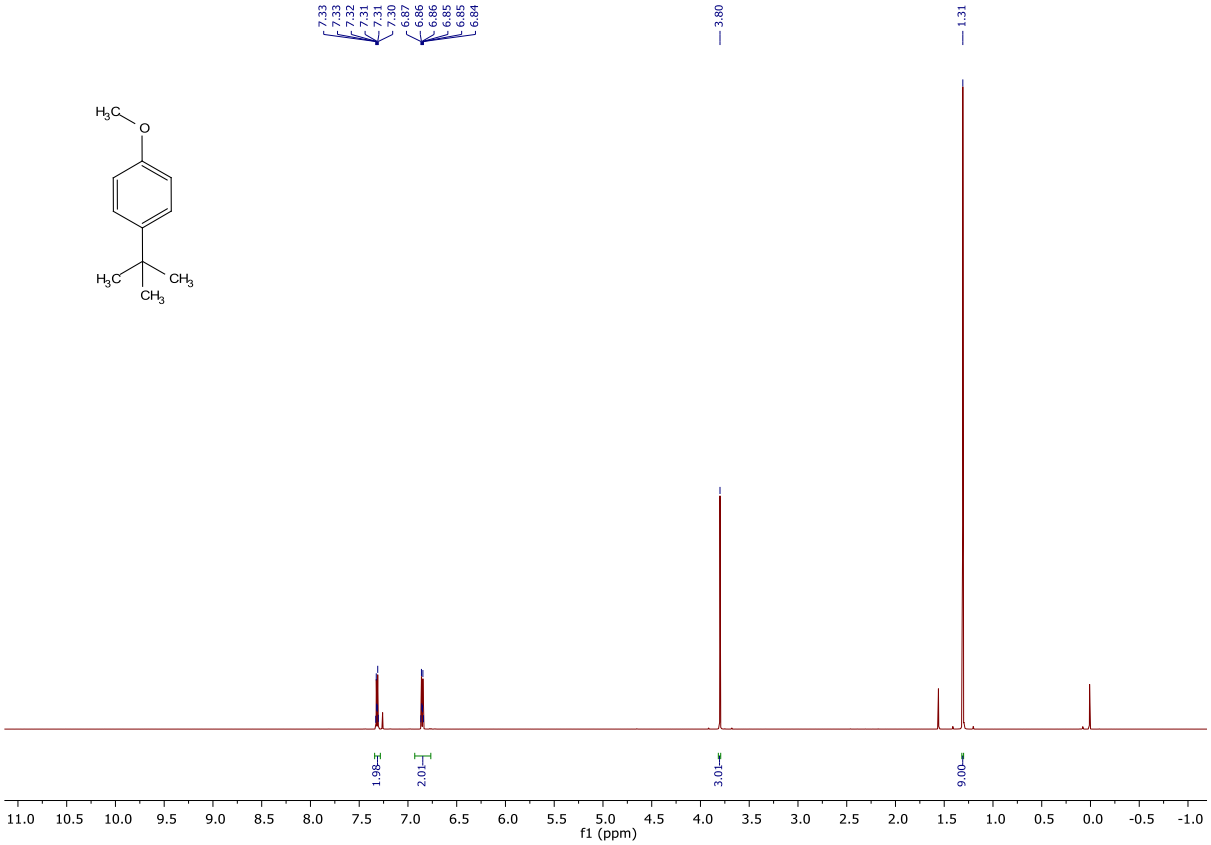


Figure S29: ^{1}H-NMR spectrum (600 MHz, $CDCl_3$) of **3ao**

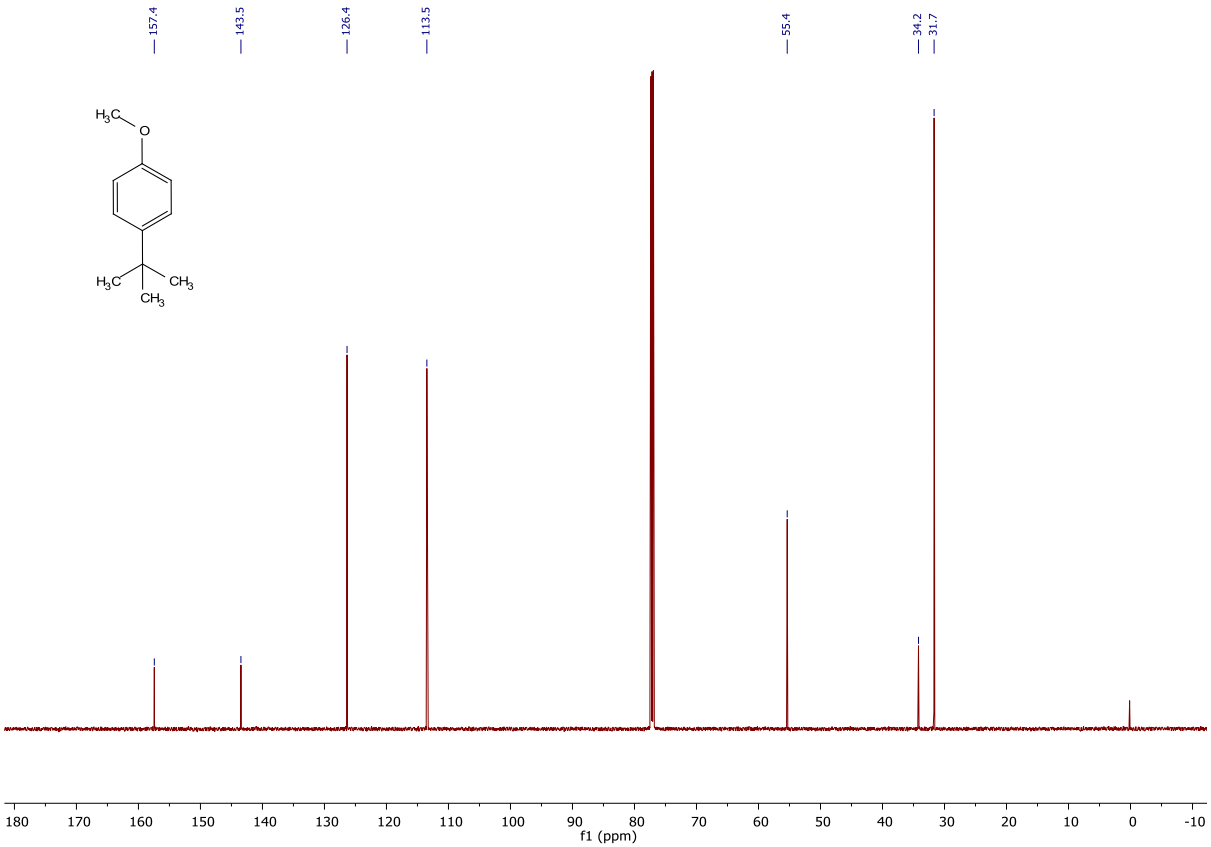


Figure S30: ^{13}C-NMR spectrum (151 MHz, $CDCl_3$) of **3ao**

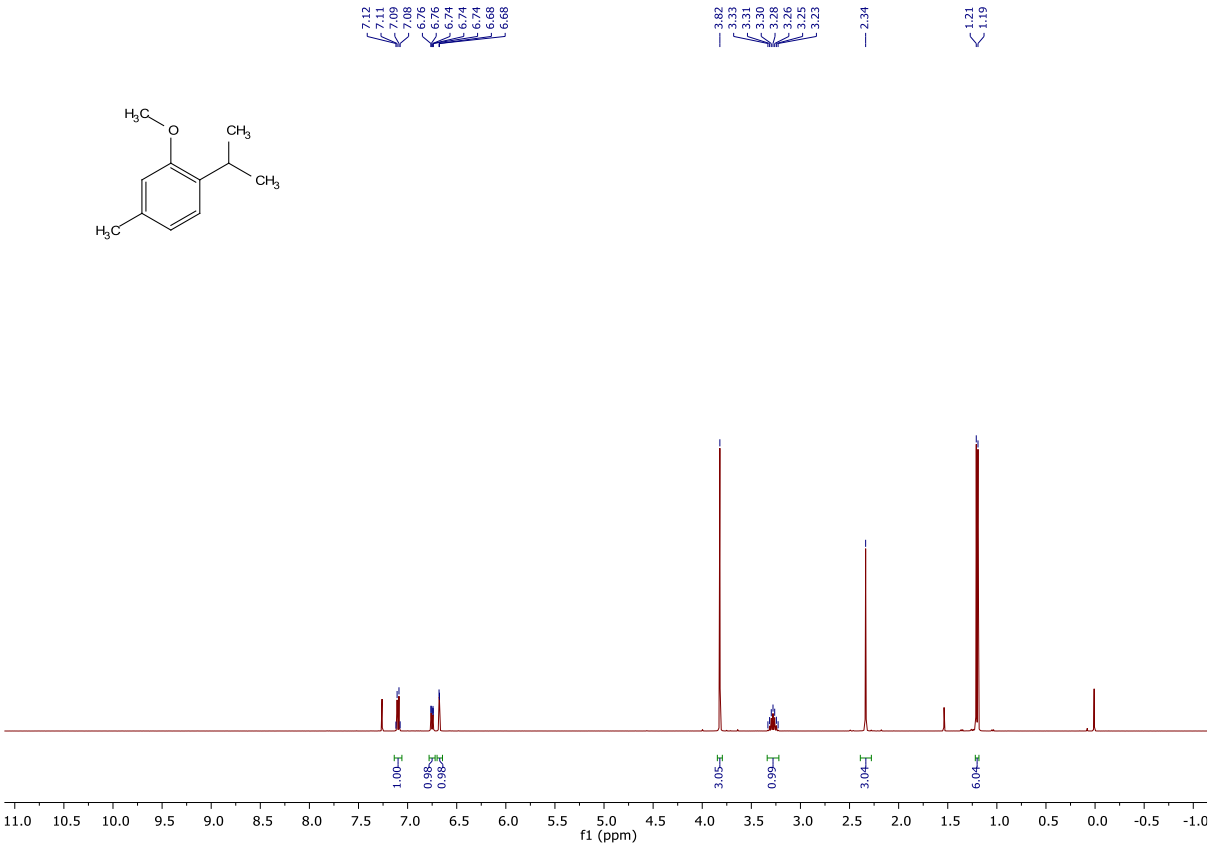


Figure S31: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3ap**

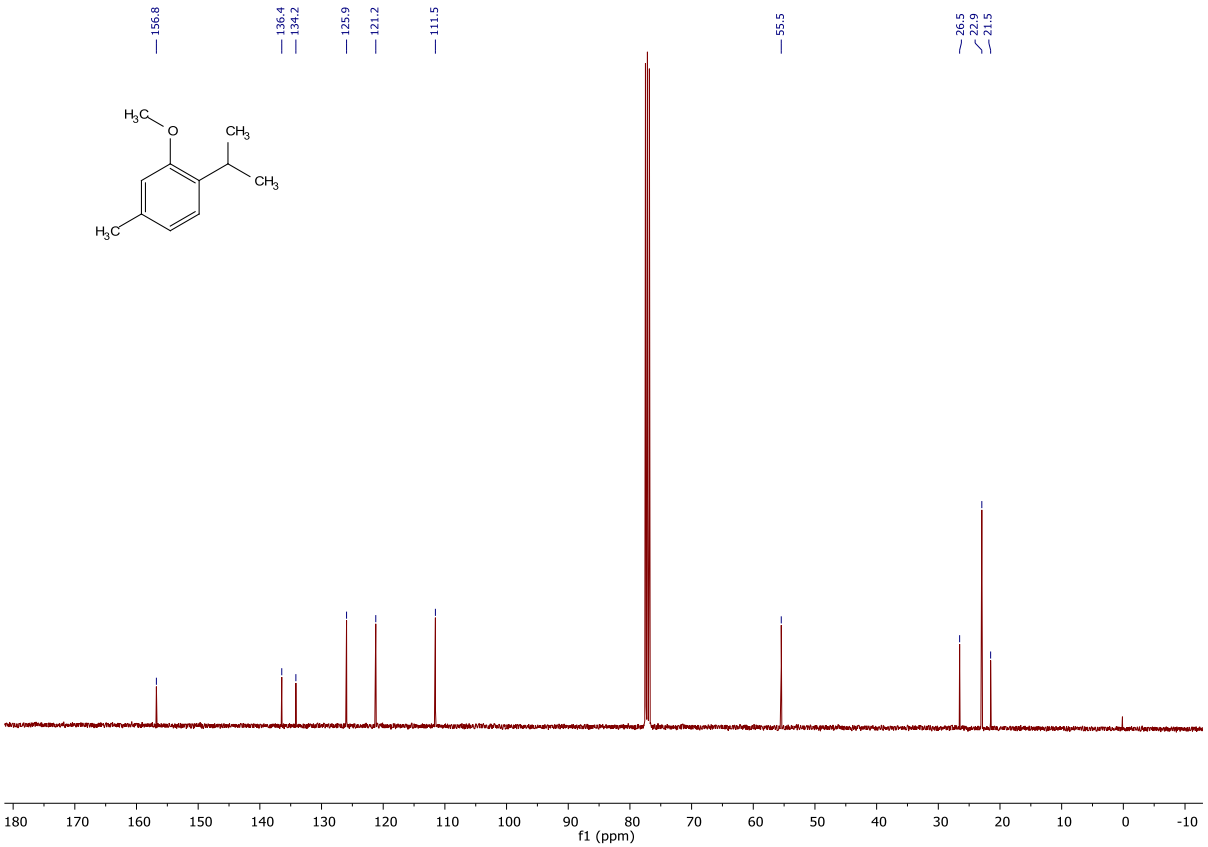


Figure S32: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3ap**

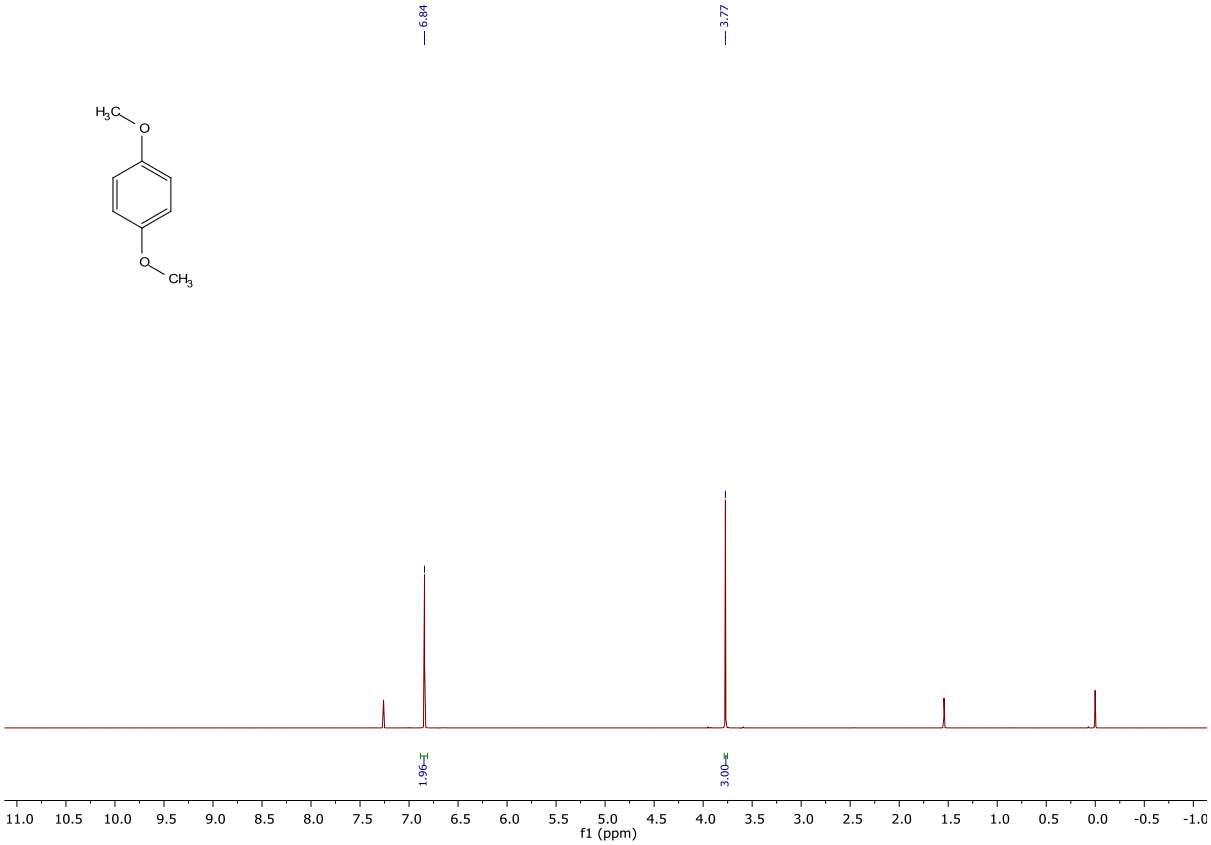


Figure S33: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3aq**

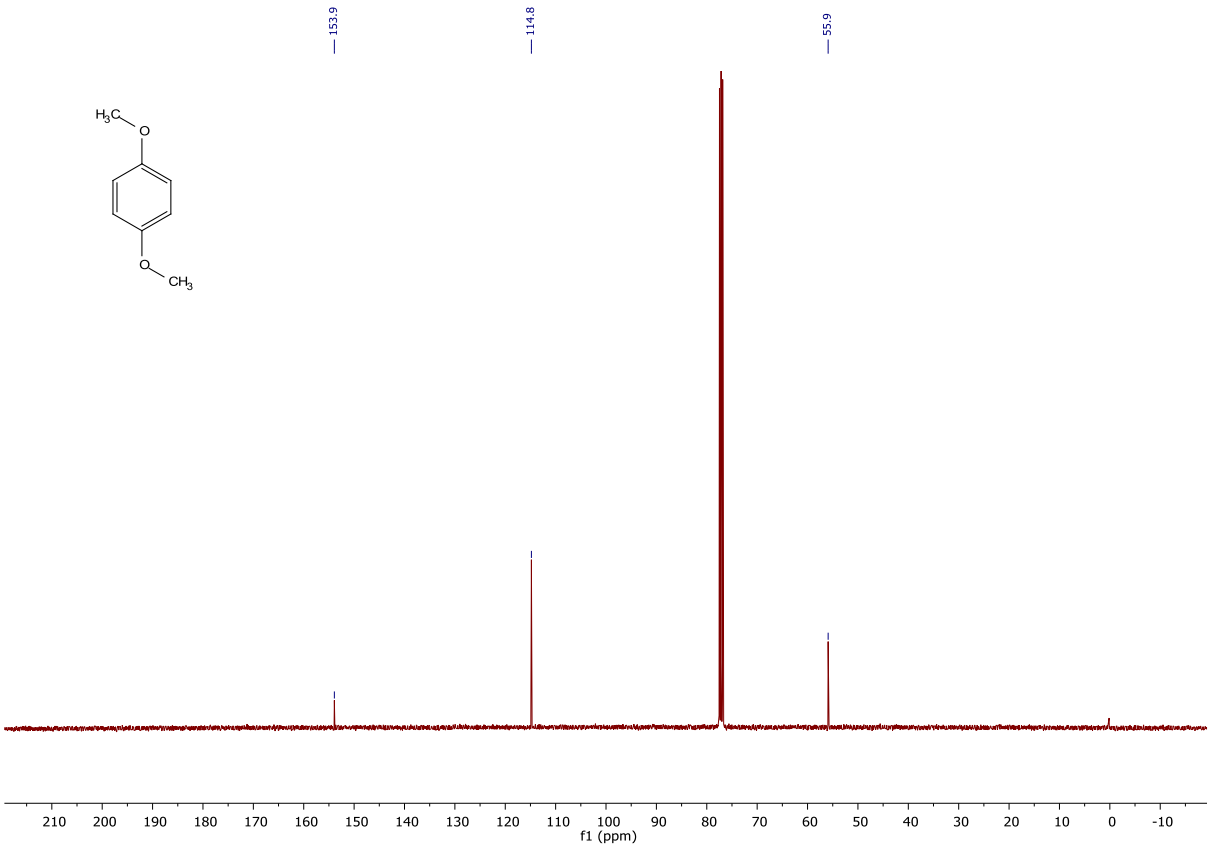


Figure S34: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3aq**

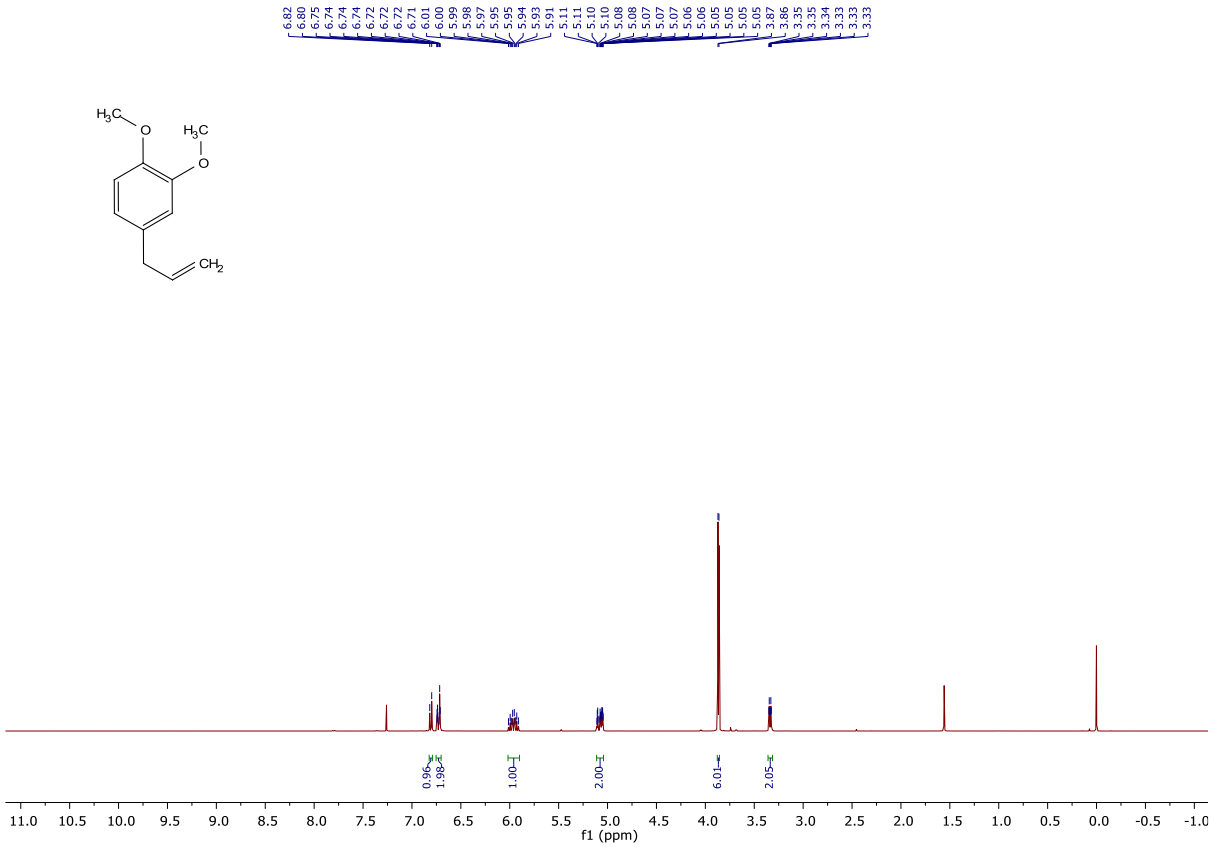


Figure S35: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3ar**

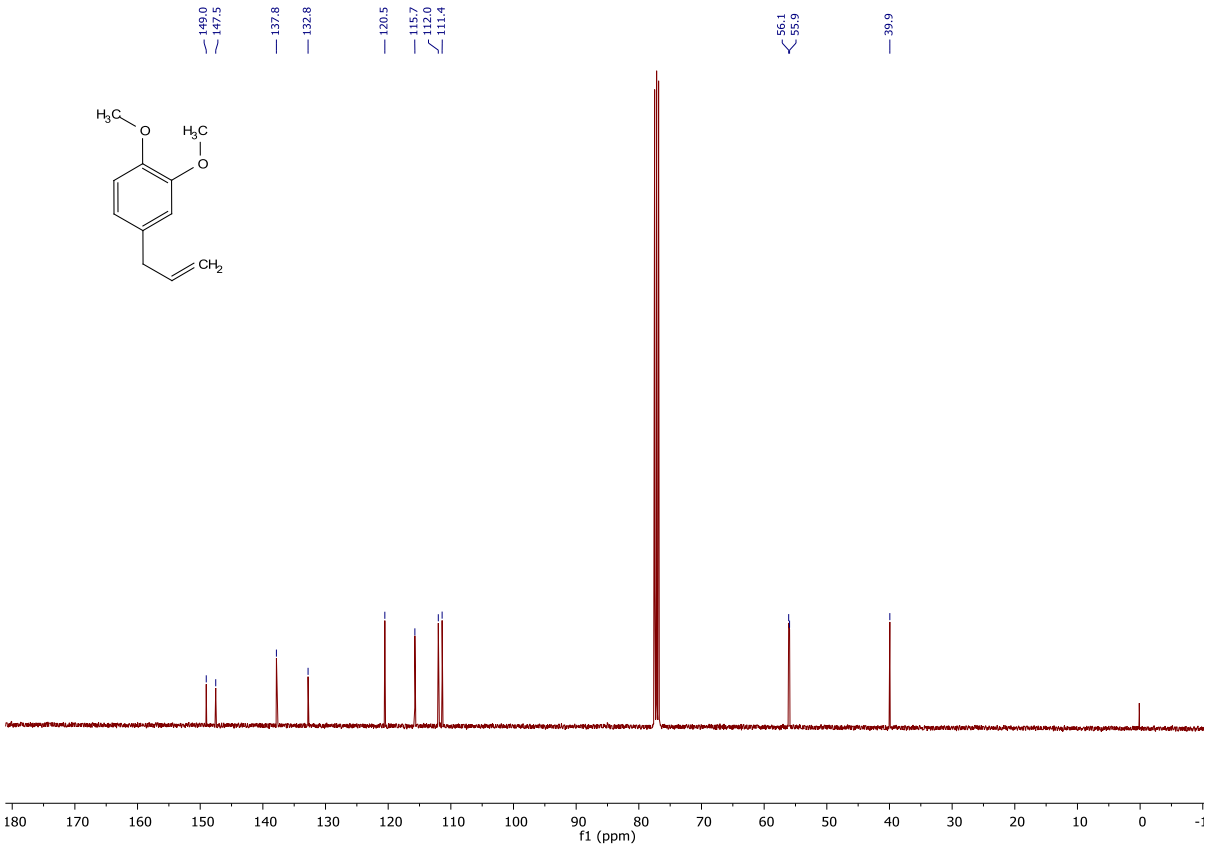


Figure S36: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3ar**

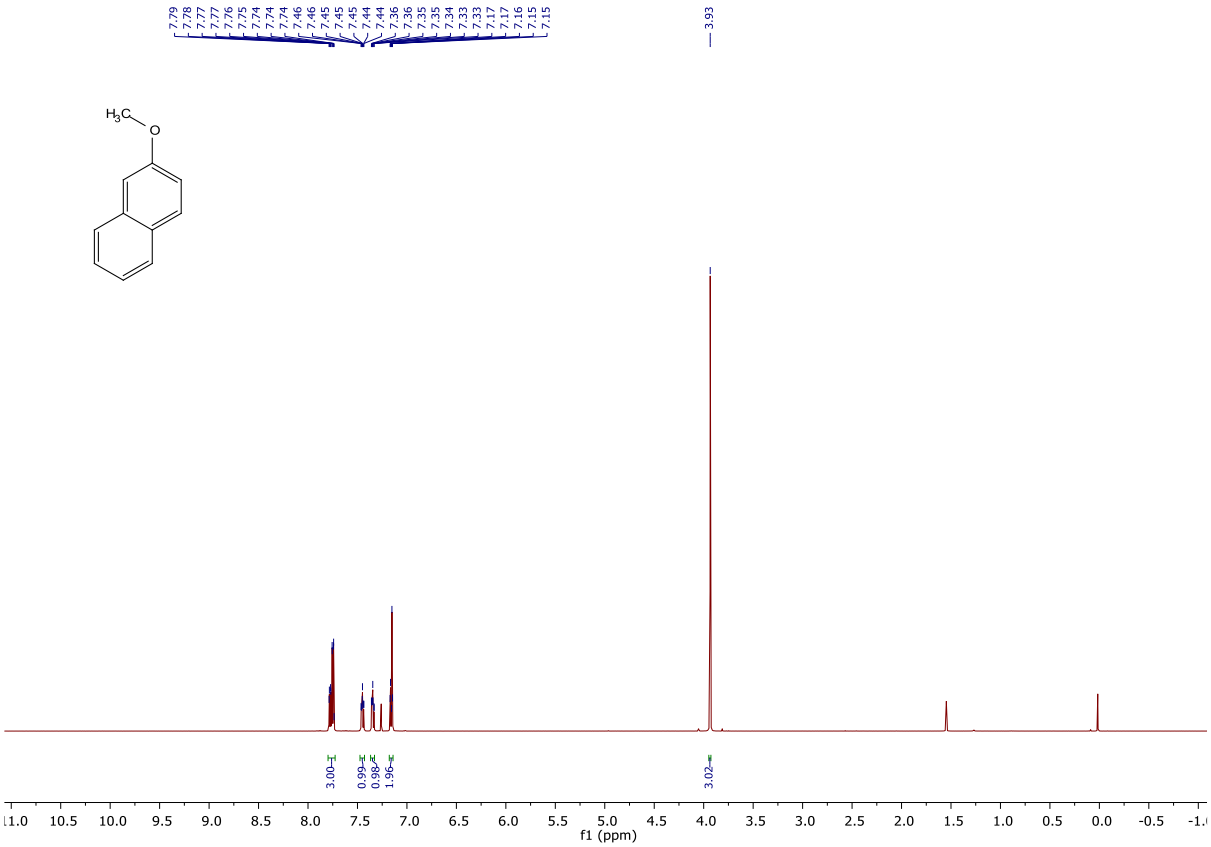


Figure S37: ^{1}H-NMR spectrum (600 MHz, $CDCl_3$) of **3as**

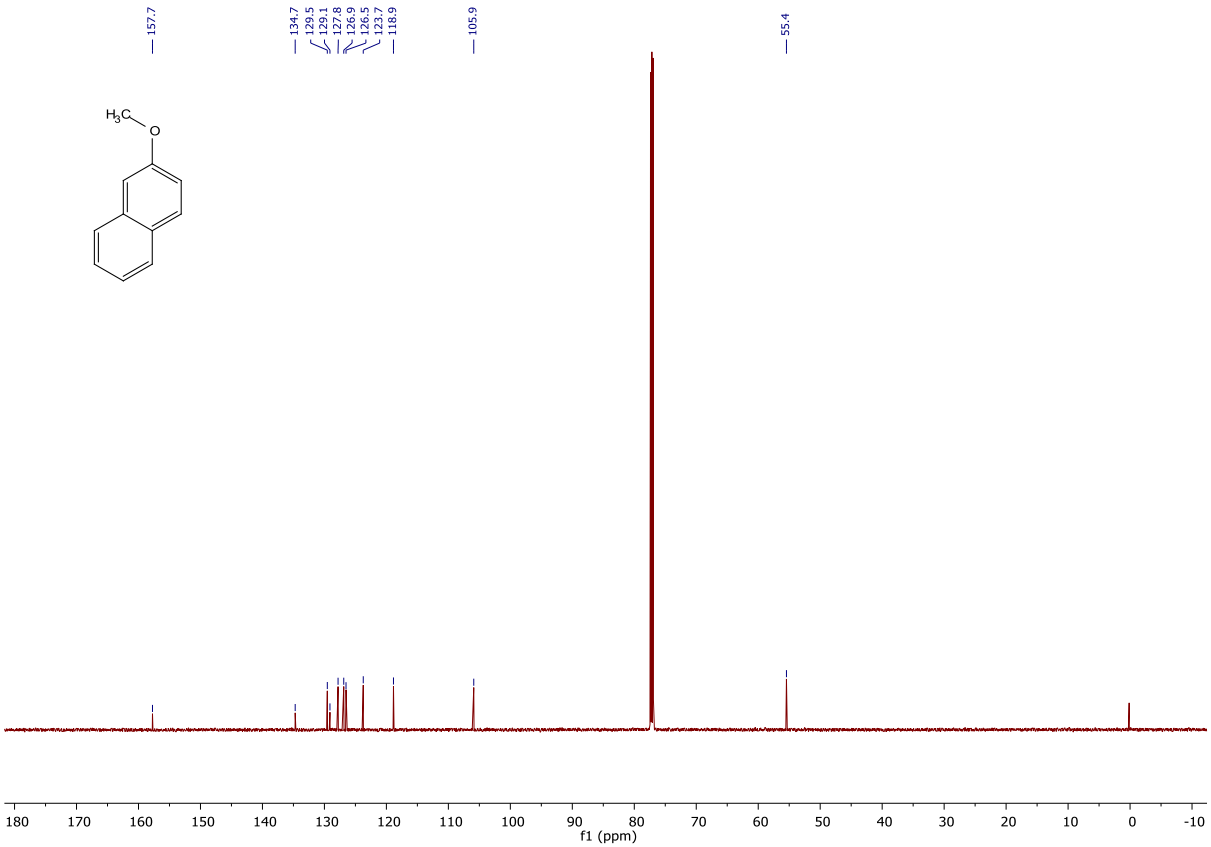


Figure S38: ^{13}C-NMR spectrum (151 MHz, $CDCl_3$) of **3as**

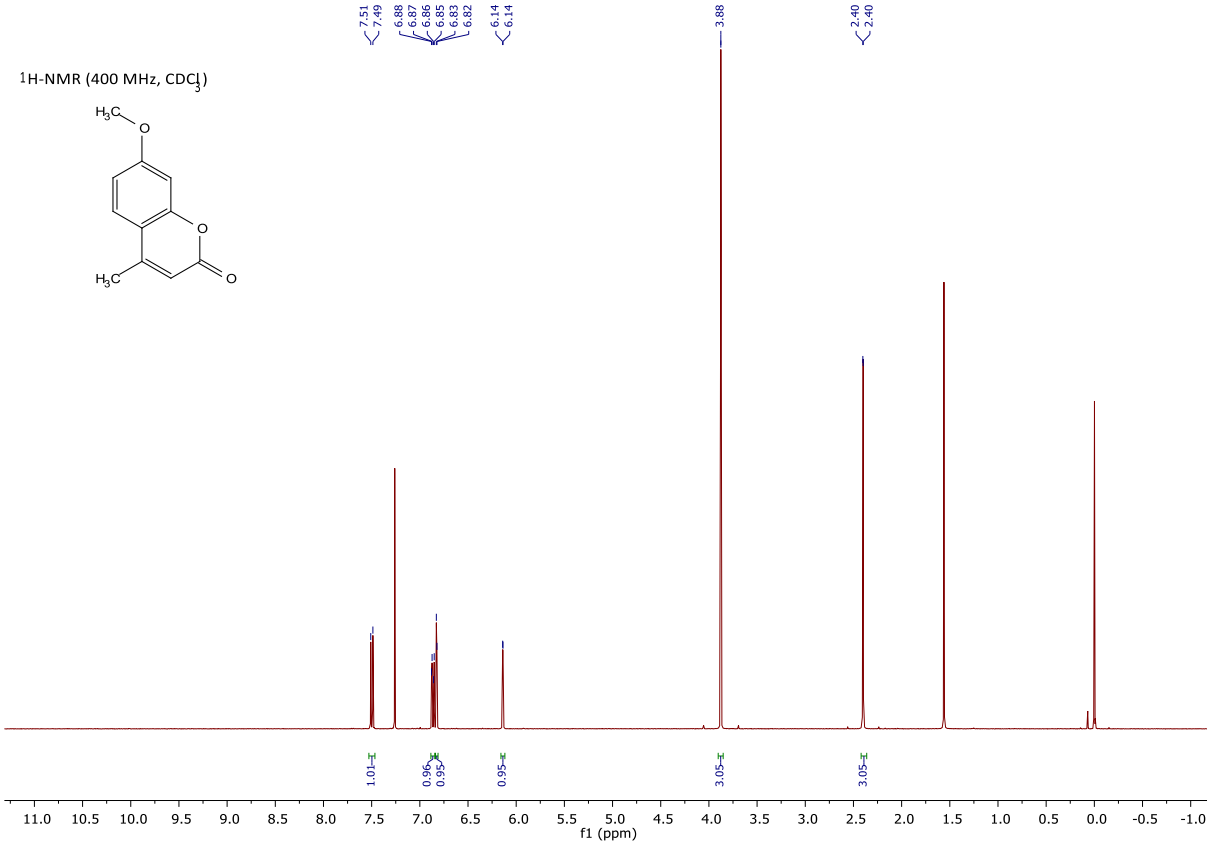


Figure S39: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3at**

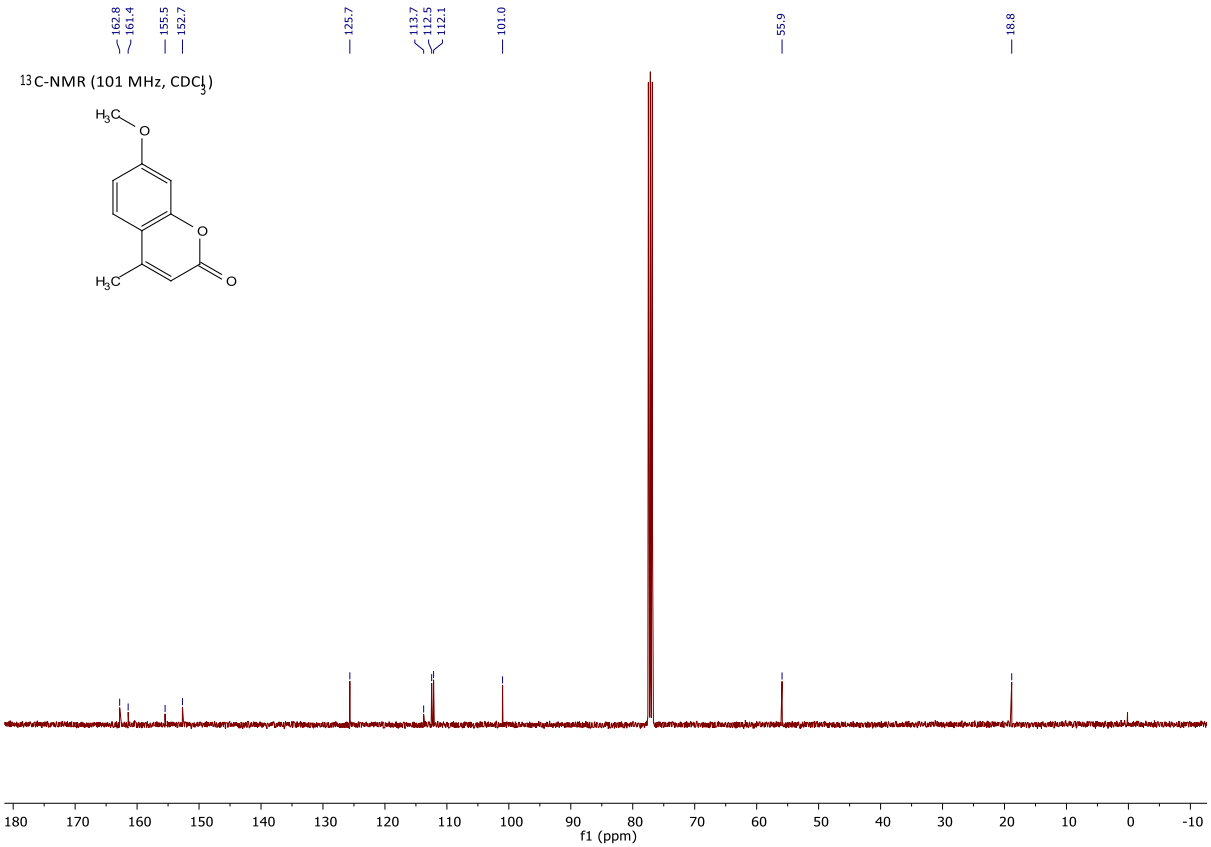


Figure S40: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3at**

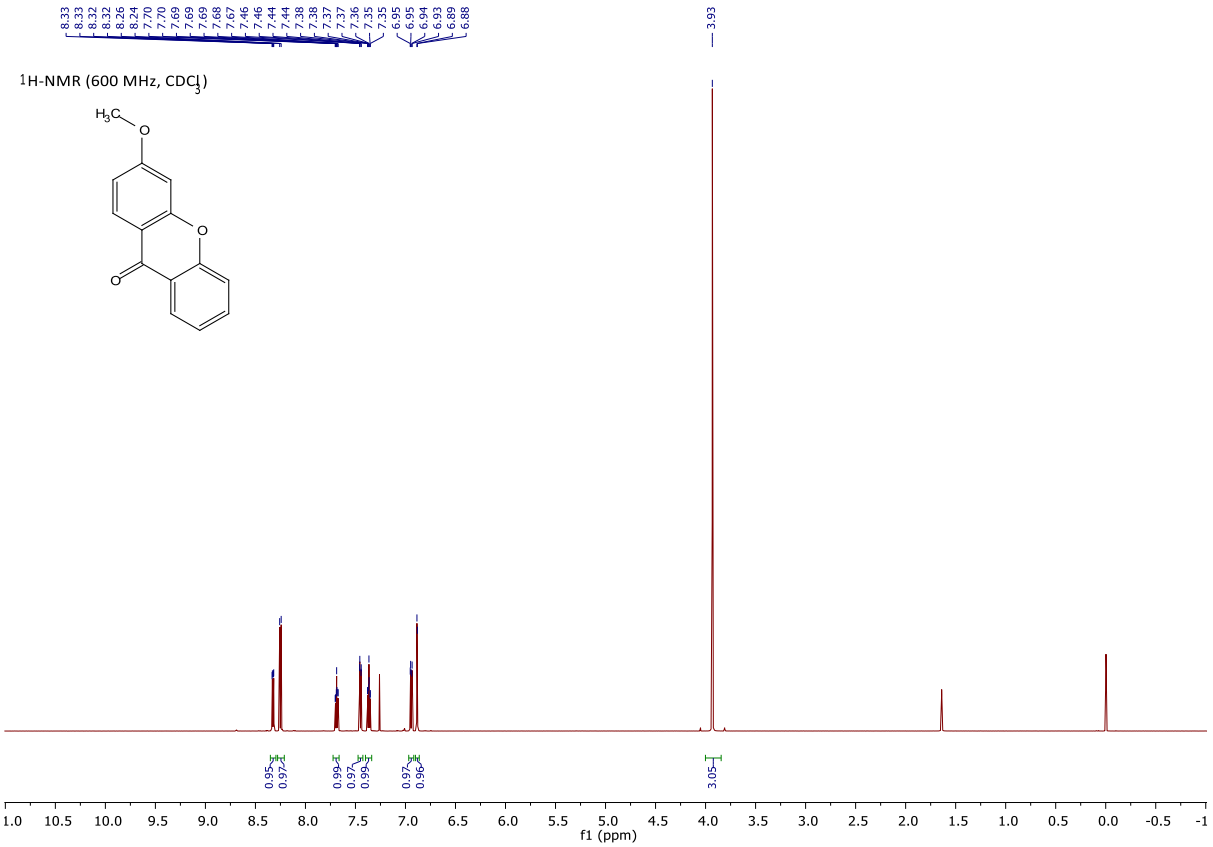


Figure S41: ^{1}H-NMR spectrum (600 MHz, $CDCl_3$) of **3au**

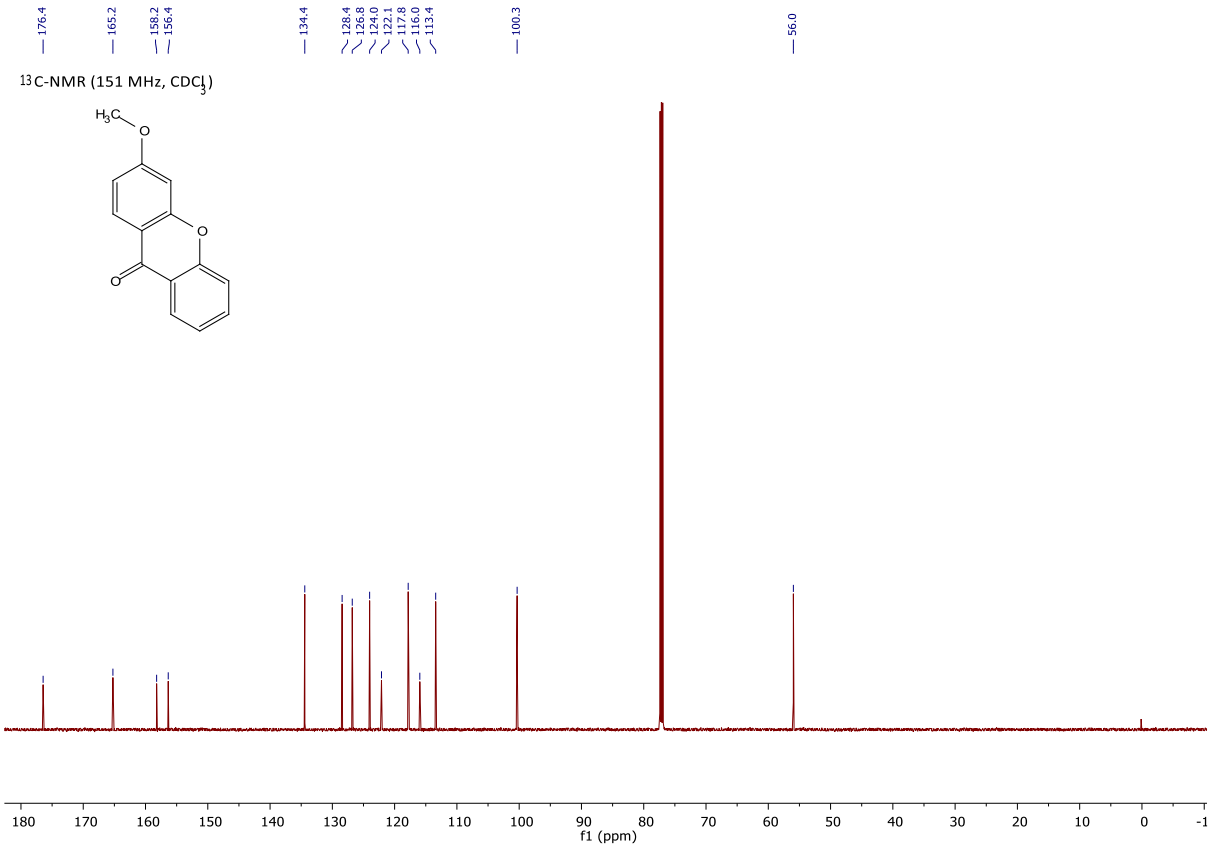


Figure S42: ^{13}C-NMR spectrum (151 MHz, $CDCl_3$) of **3au**

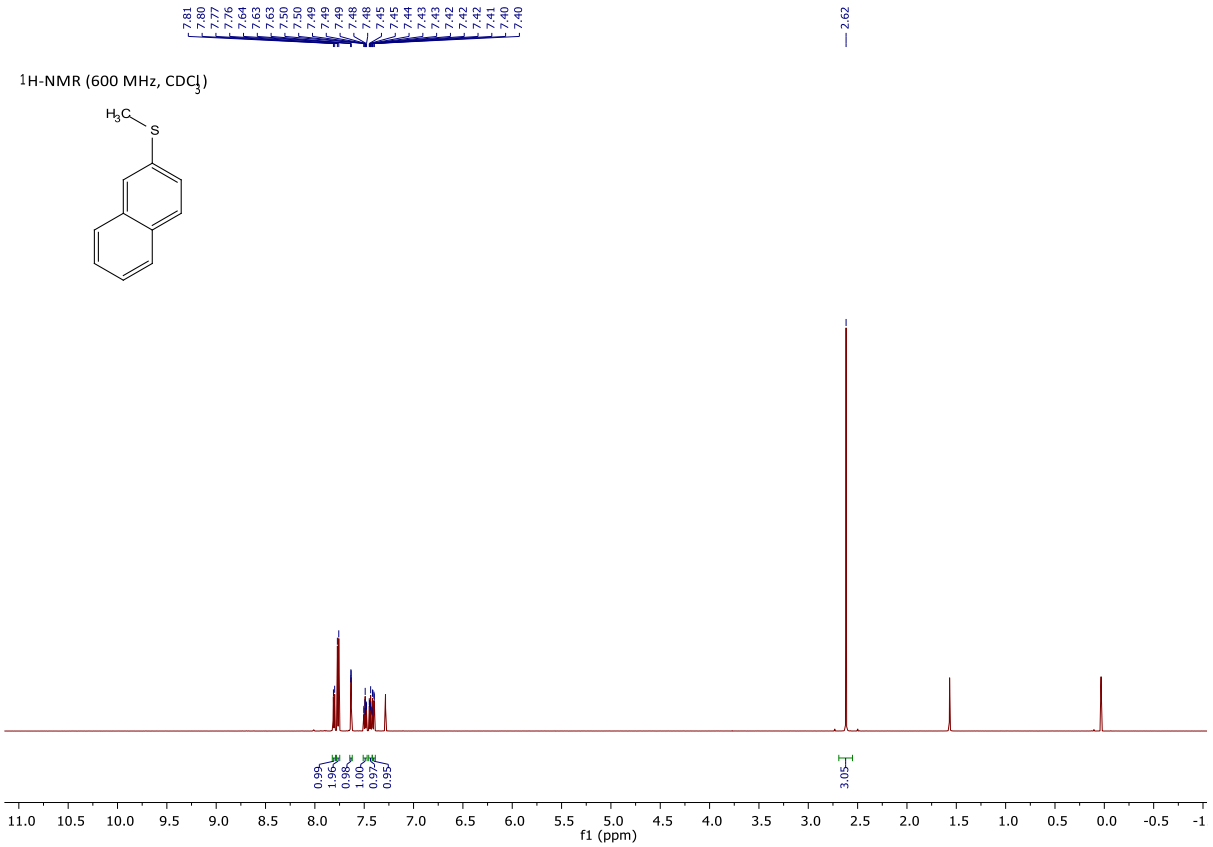


Figure S43: ^{1}H-NMR spectrum (600 MHz, $CDCl_3$) of **3ba**

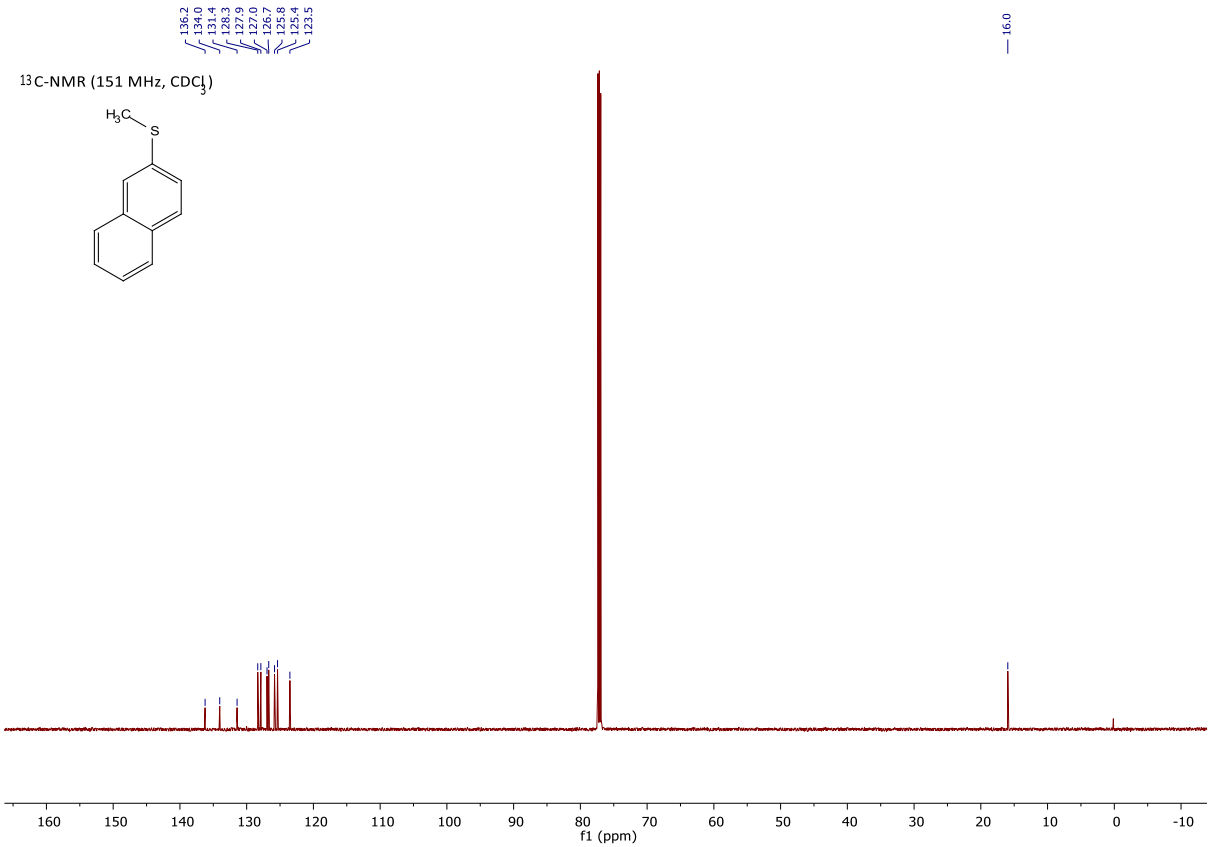


Figure S44: ^{13}C-NMR spectrum (151 MHz, $CDCl_3$) of **3ba**

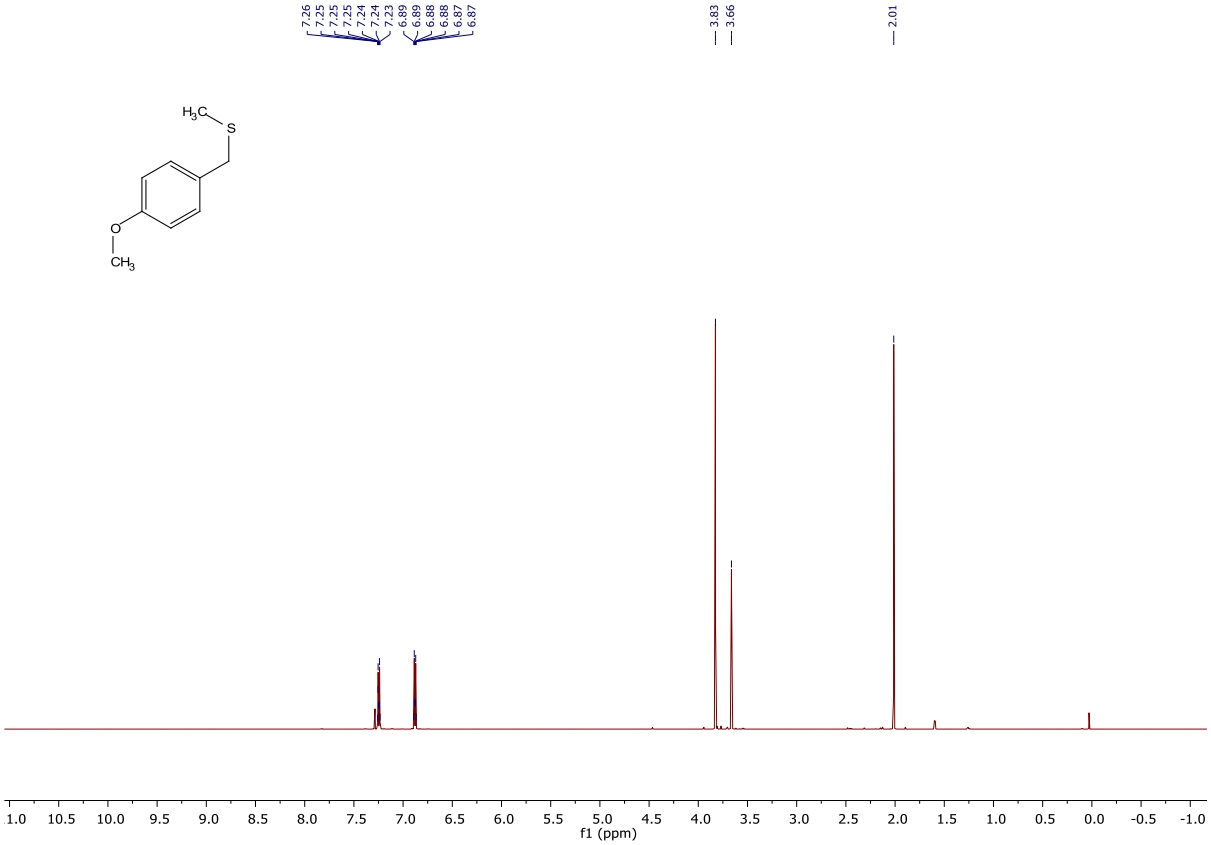


Figure S45: ^{1}H-NMR spectrum (600 MHz, $CDCl_3$) of **3bb**

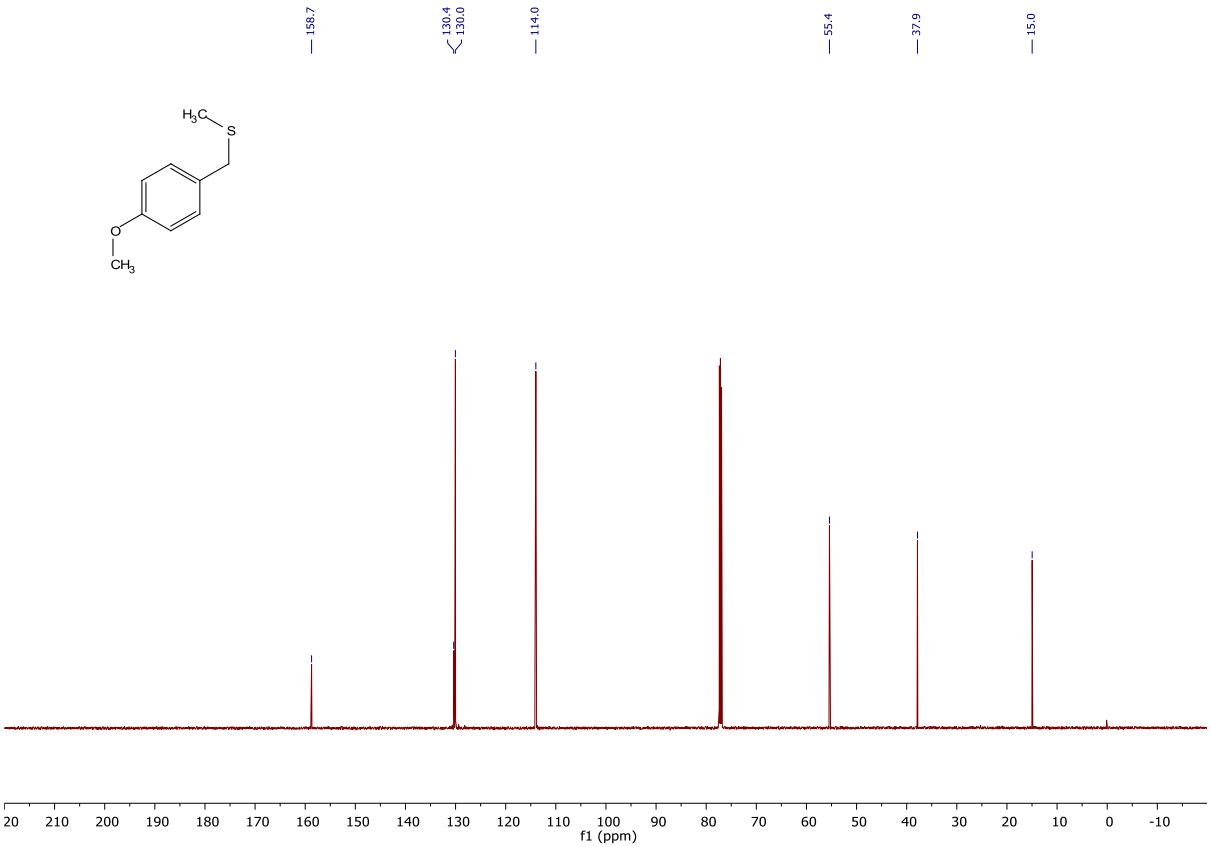


Figure S46: ^{13}C-NMR spectrum (151 MHz, $CDCl_3$) of **3bb**

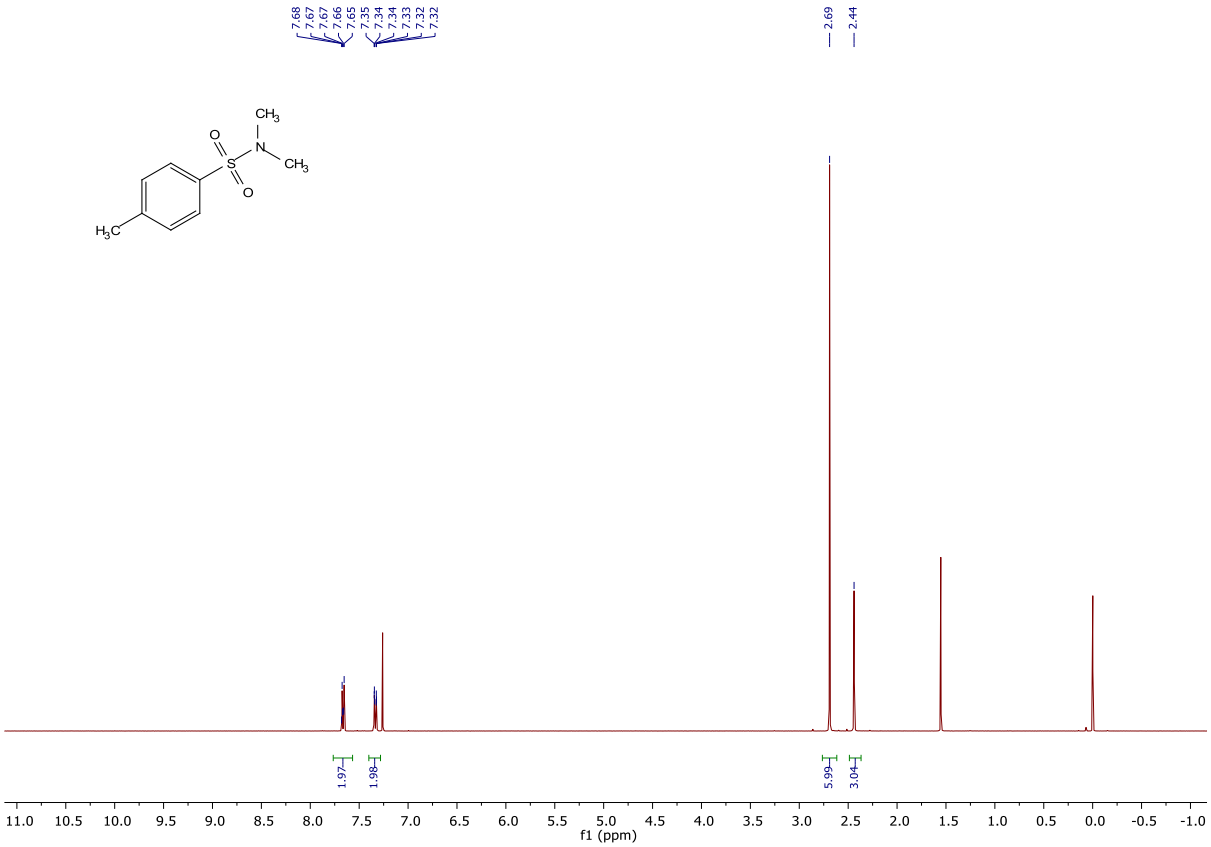


Figure S47: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3bc**

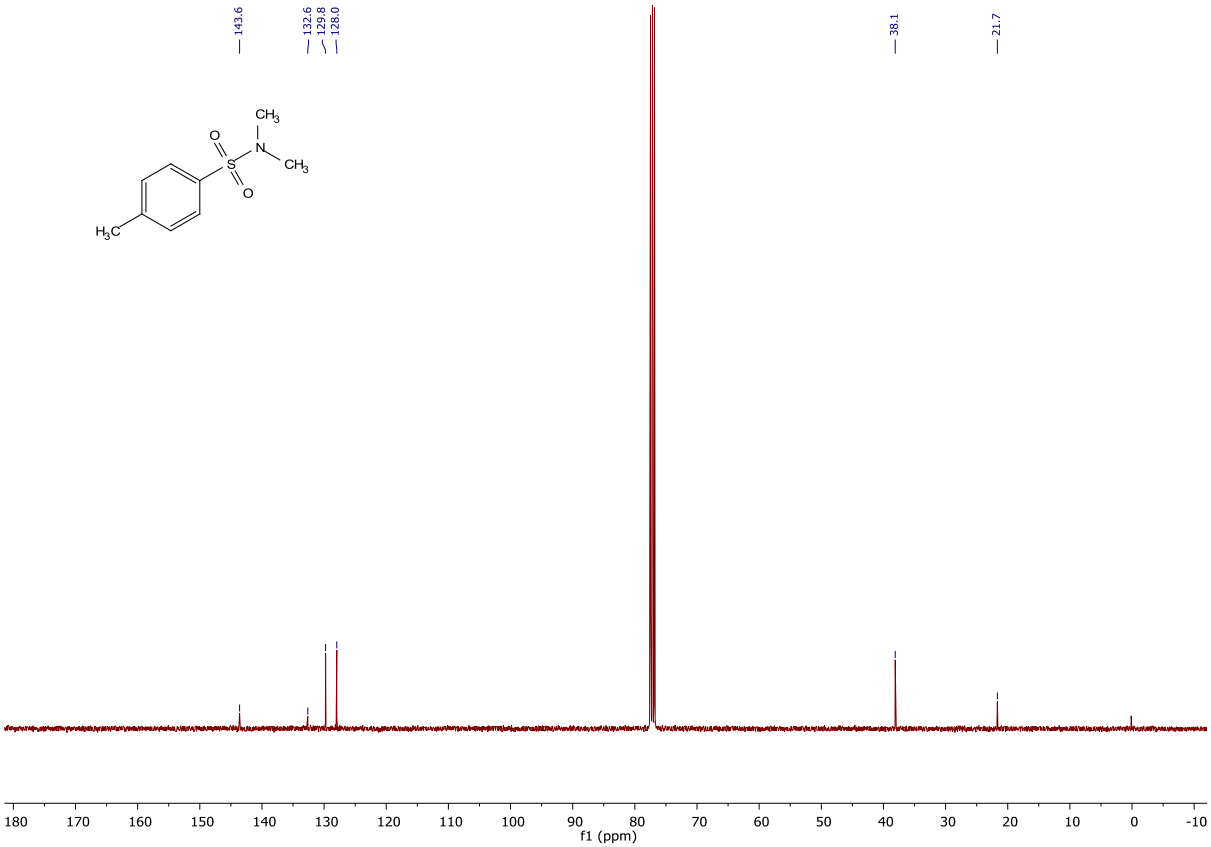


Figure S48: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3bc**

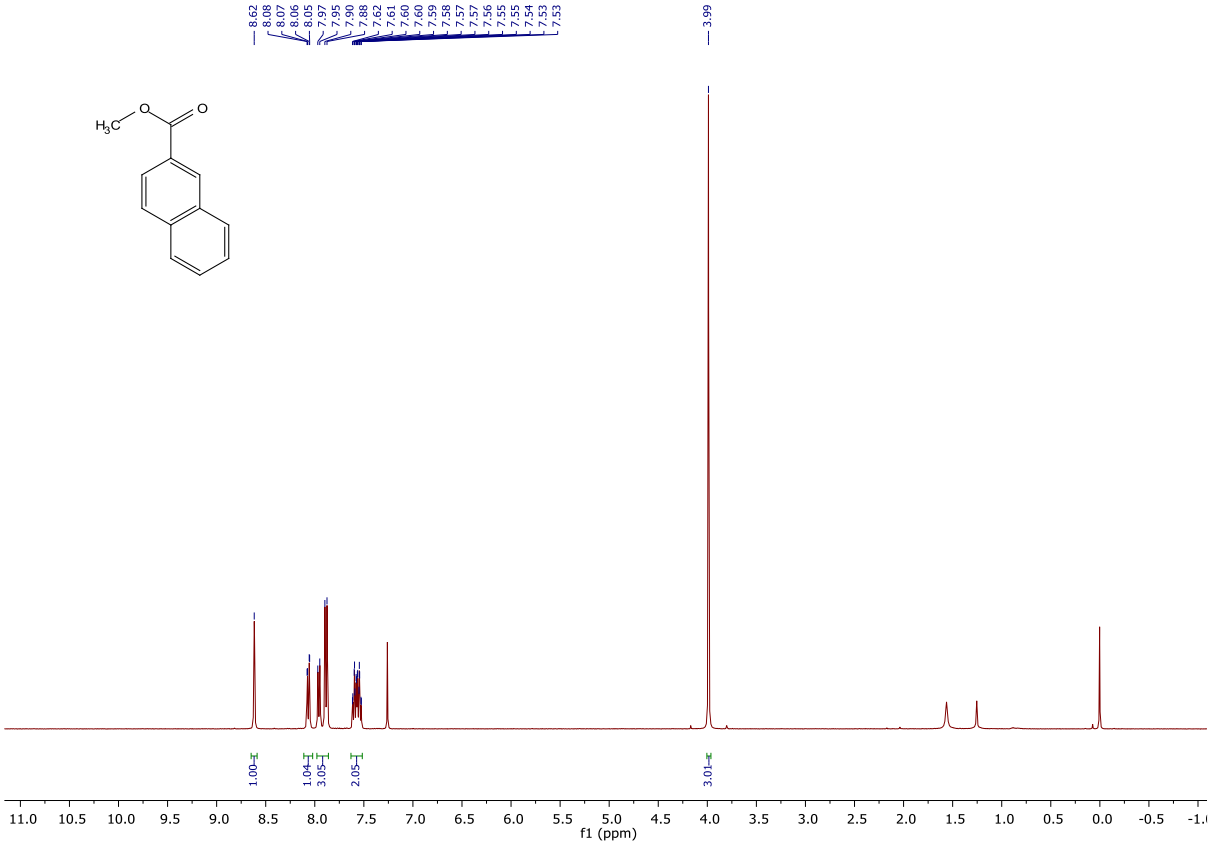


Figure S49: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3bd**

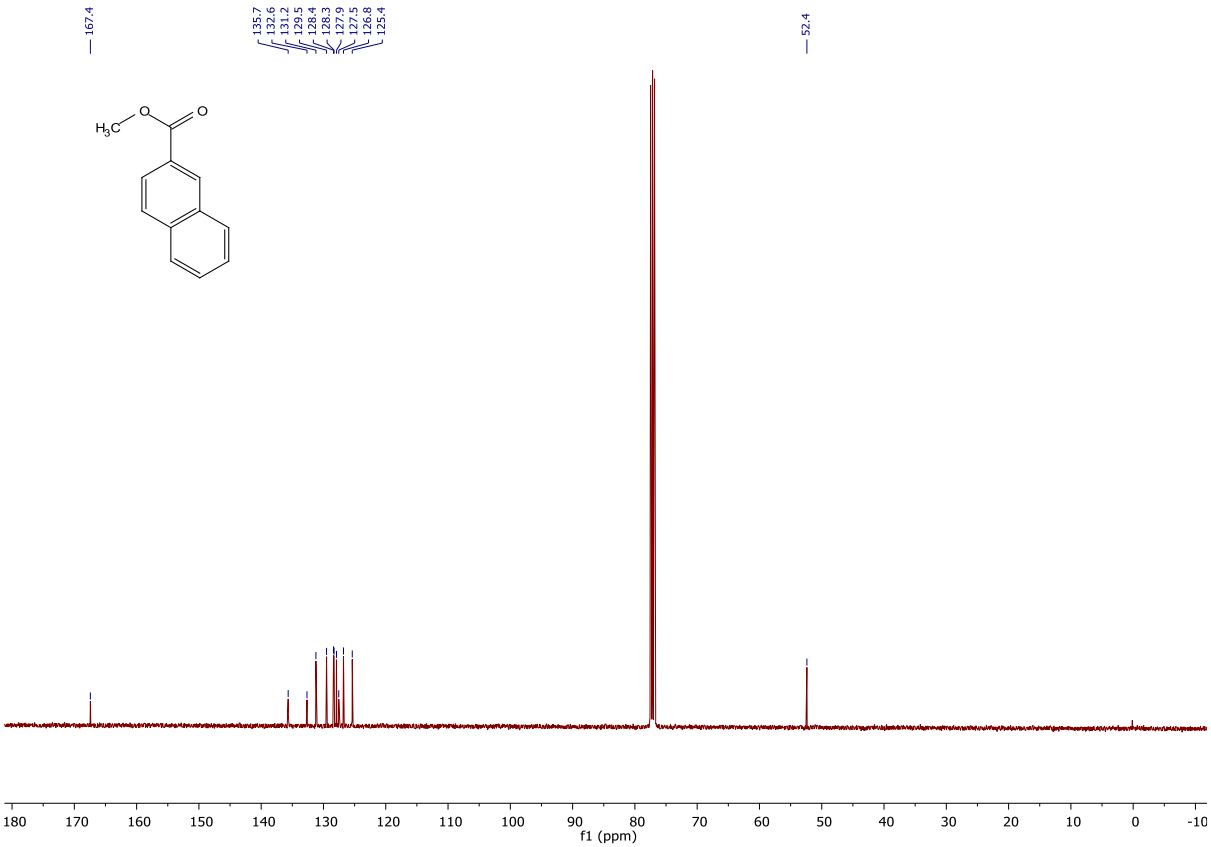


Figure S50: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3bd**

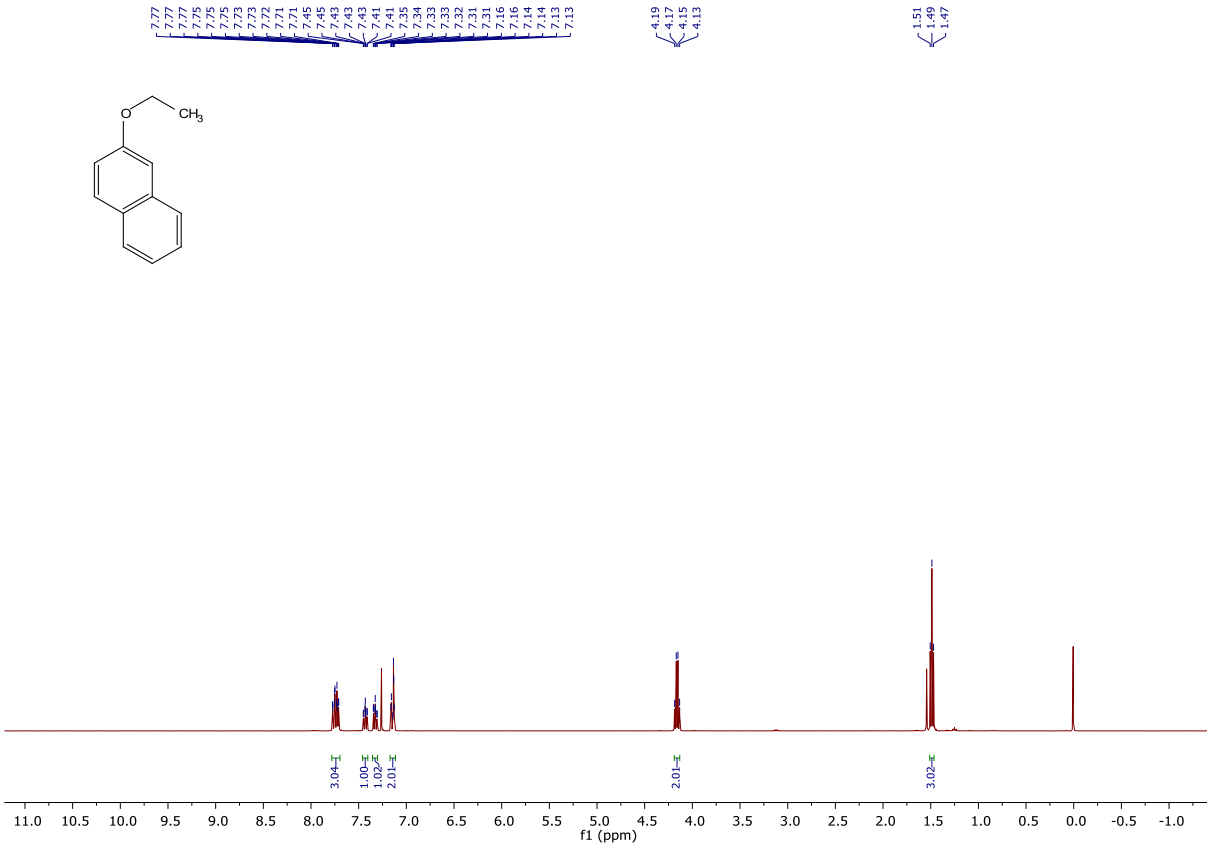


Figure S51: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3bs**

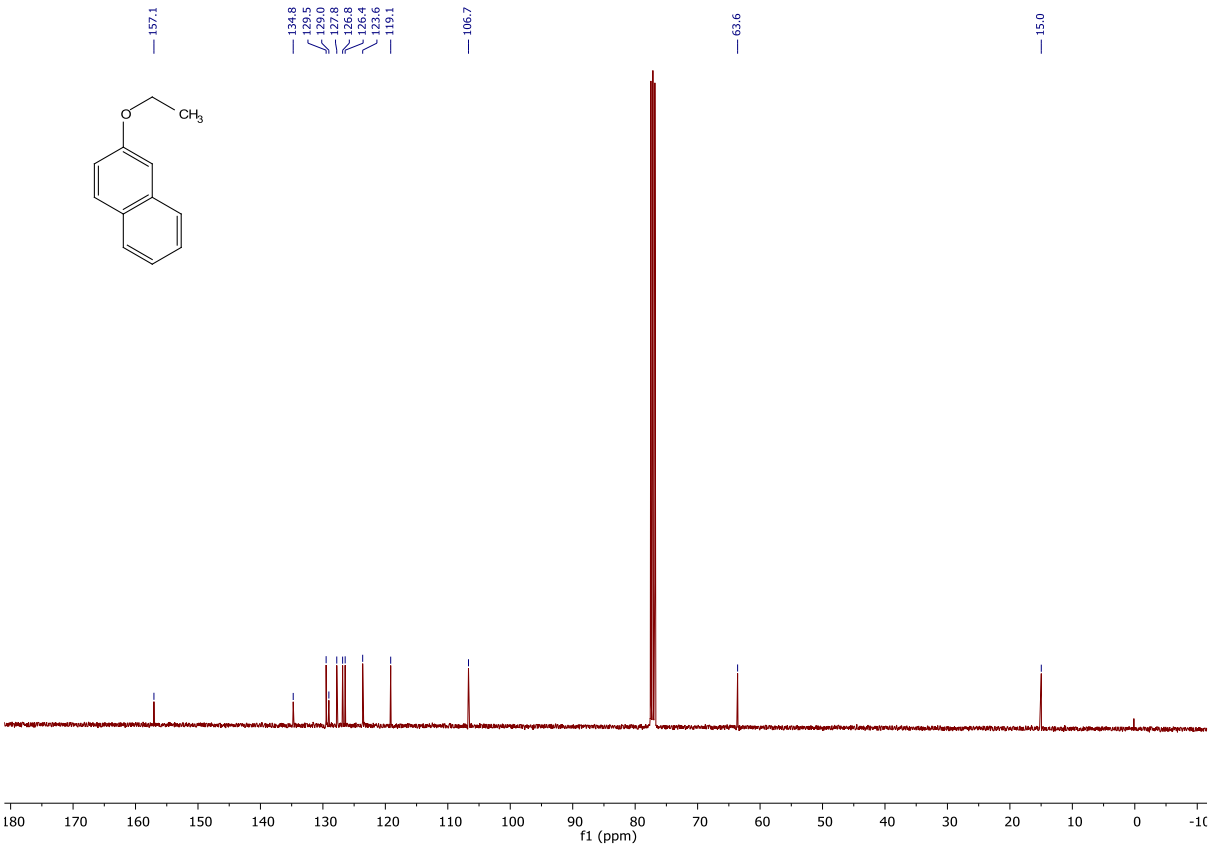


Figure S52: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3bs**

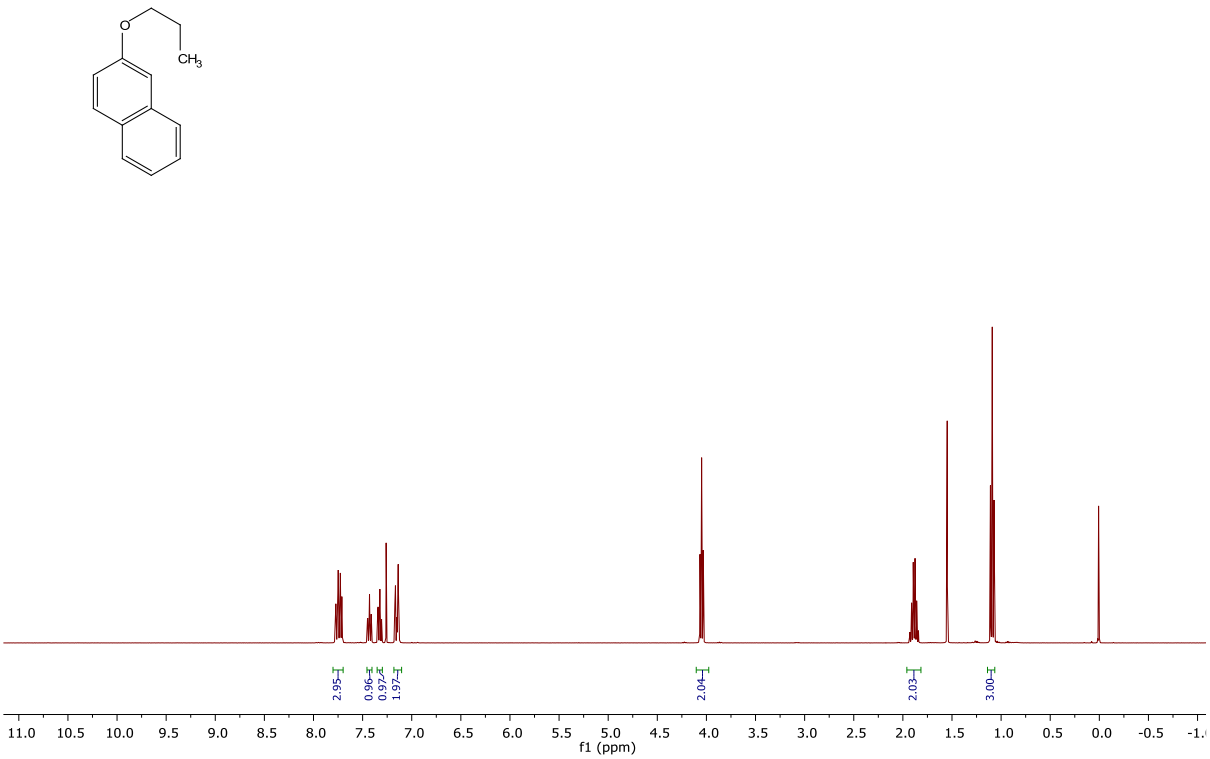


Figure S53: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3cs**

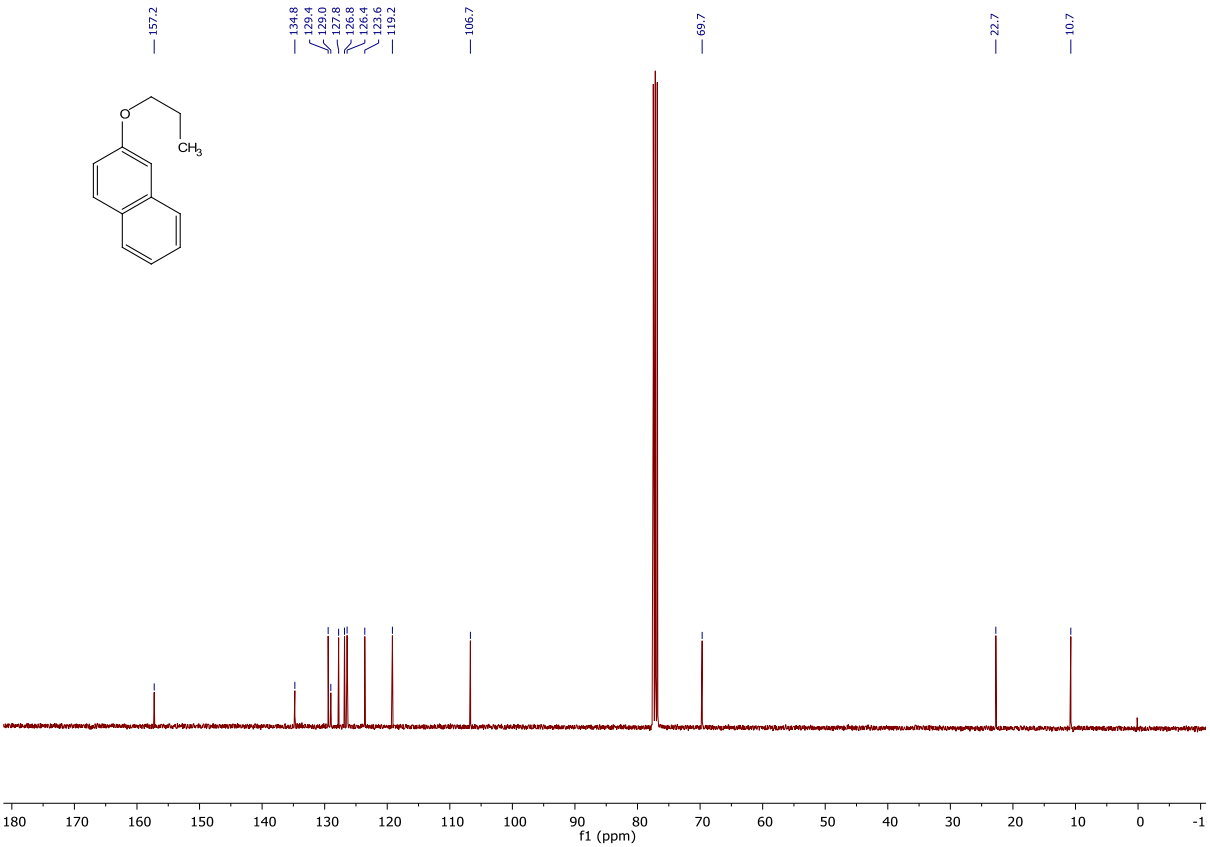


Figure S54: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3cs**

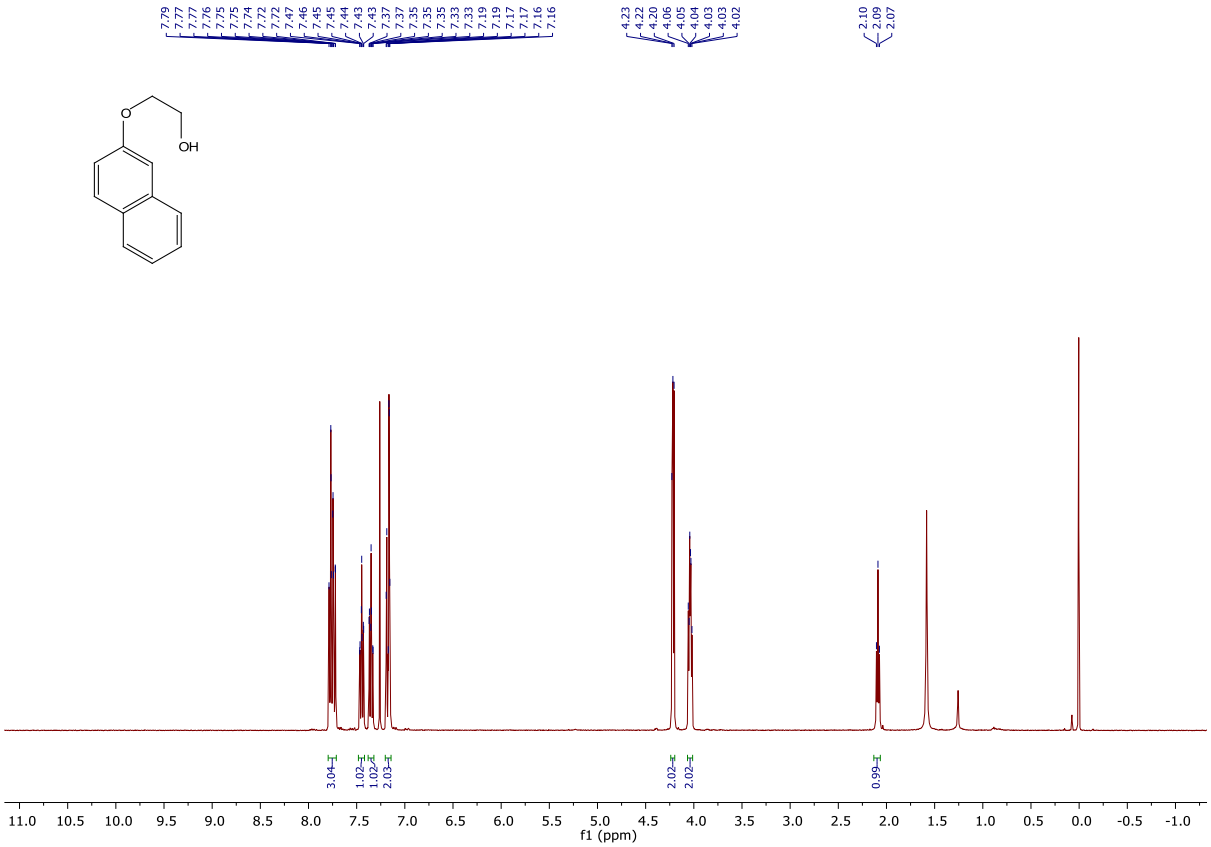


Figure S55: ^{1}H-NMR spectrum (400 MHz, $CDCl_3$) of **3ds**

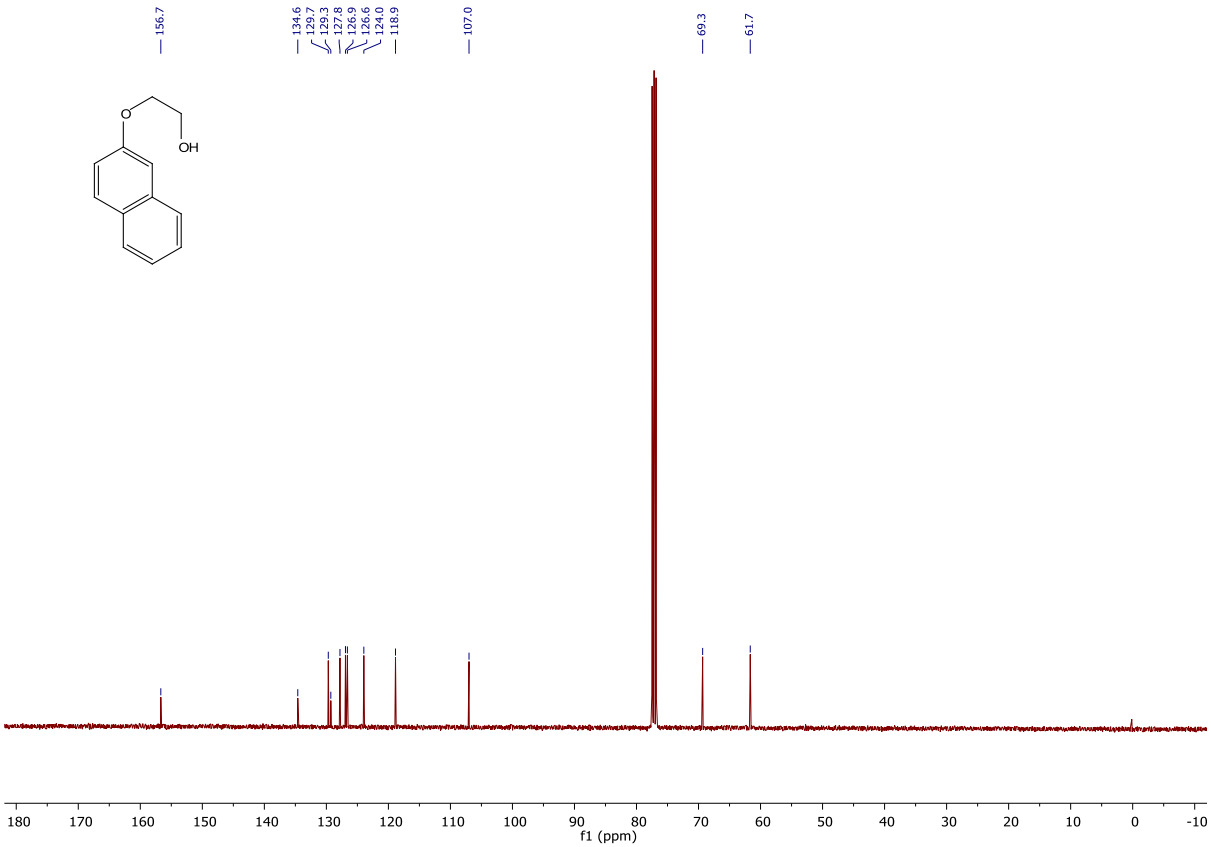


Figure S56: ^{13}C-NMR spectrum (101 MHz, $CDCl_3$) of **3bs**

Determination of the E factors

Table S2: Data used for E factor determination of 2-naphthol methylations for different solvent (Entry 1-9) and literature procedures (Entry 10-19)

$$E\ factor = \frac{m_{total\ waste}}{m_{product}} = \frac{m_{starting\ materials} + m_{solvents} - m_{product}}{m_{product}}$$

Entry	2-Naphthol	Alkylating agent	Solvent	Auxiliary	Yield (%)	E factor
1[a]	0.363 g	0.469 g MeTos	1.13 g NaTos[b]	0.121 g NaOH	93	5.1
2[c]	21.76 g	28.12 g MeTos	13.08 g NaTos[b]	6.16 g NaOH	93	2.1
3[d]	36.27 g	46.86 g MeTos	13.08 g NaTos[b]	10.26 g NaOH	93	1.9
4	0.363 g	0.469 g MeTos	6 ml ACN	0.121 g NaOH	65	21.0
5	0.363 g	0.469 g MeTos	6 ml DMSO	0.121 g NaOH	86	21.1
6	0.363 g	0.469 g MeTos	6 ml EG	0.121 g NaOH	62	30.1
7	0.363 g	0.469 g MeTos	0.049 g SDS	0.121 g NaOH	80	2.2
8	0.363 g	0.469 g MeTos	/ (Water)	0.121 g NaOH	56	3.3 (829)[e]
9	0.363 g	0.469 g MeTos	/ (Neat)	0.121 g NaOH	31	6.8 (1467)[e]
10[25]	100 g	52.8 mL MeI	1,4 L THF	18.31 g NaH	93	13.5
11[26]	2 g	1.5 mL Me_2SO_4	20 mL acetone	6 g K_2CO_3	93	11.6
12[27]	0.5 mol	0.8 mol Me_2CO_3		0.04 mol K_2CO_3	96[f]	1.0
13[28]	0.1 mol	0.18 mol Me_2CO_3		0.05 mol [BMIm]Cl	99.8[f]	1.5
14[29]	0.1 mL[g]	1.2 mL Me_2CO_3		0.1 g methionine	94	12.1
15[30]	0.9 M	2.0 ml 10:1 DMC-DMF[h]		7.4 mg Bu_3N	88	7.1
16[31]	2 mol	6 mol DMC	6 mol DMF	30.4 g DBU	95	3.3
17[32]	50 mmol	9.0 g DMC	19 ml sulfolane	0.760 g DBU	97	4.4
18[33]	2.73 mmol	3 mL Me_2CO_3	3 mL ACN	0.273 mmol DMI-CO_2	90	14.4
19[34]	1.67 M	22.2 mL Me_2CO_3[h]		0.83 M Me_2S	99	3.0

[a] Based on a single run, [b] The density of 20 wt% NaTos was determined to be 1.09 gmL^{-1}, [c] Based on 6 recycling runs, [d] Based on 10 recycling runs, [e] Work-up by column chromatography included, [f] GC yield, [g] Estimated using a density of 1.22 gmL^{-1}, [h] Estimated by correcting for the volumes of auxiliary and starting material

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