Supporting Information
Silver-Mediated Oxidative C–C Bond Sulfonylation/Arylation of Methylene cyclopropanes with Sodium Sulfinates: Facile Access to 3-Sulfonyl-1,2-Dihydronaphthalenes

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List of Contents

1. General Information S1
2. Experimental Section S1
   2.1 General procedure for the synthesis of methylcyclopropanes (1): S1
   2.2 Typical Experimental Procedure for the Silver-Mediated synthesis of 3-Sulfonyl-1,2-Dihydronaphthalenes from MCPs and Sodium Sulfinates S1-S2
   2.3 Table S1: Screening the optimal conditions S2-S3
3. Analytical data S3-S12
4. Reference S12
5. $^1$H and $^{13}$C spectra S13-S47
1. General Information

All reactions were carried out with magnetic stirring and in dried glassware. Standard syringe techniques were applied for transfer of dry solvents. All reagents and solvents were commercially available and used without any further purification unless specified. Proton (\(^1\)H NMR) and carbon (\(^{13}\)C NMR) nuclear magnetic resonance spectra were recorded at 400 MHz and 100 MHz, respectively. The chemical shifts are given in parts per million (ppm) on the delta (\(\delta\)) scale. 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. Analytical TLC was performed on precoated silica gel plates. 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 methylcyclopropanes (1):

All methylcyclopropanes (MCPs) (1) were synthesized according to the known methods\(^{[1-3]}\).

2.2 Typical Experimental Procedure for the Silver-Mediated synthesis of 3-Sulfonyl-1,2-Dihydronaphthalenes from MCPs and Sodium Sulfinates.

\[
\text{R}^1 \text{R}^2 + \text{R}^3\text{SO}_2\text{Na} \xrightarrow{\text{AgNO}_3 (10 \text{ mol } \%), \text{K}_2\text{S}_2\text{O}_8 (2 \text{ equiv})} \text{toluene (2 mL), Ar, 80 }^\circ\text{C, 48 h}} \rightarrow \text{3}
\]

To a Schlenk tube were added 1 (0.2 mmol), 2 (1.5 equiv, 0.3 mmol), AgNO\(_3\) (10 mol %), K\(_2\)S\(_2\)O\(_8\) (2 equiv, 0.4 mmol), and toluene (2 mL). Then the mixture was stirred at 80 \(^\circ\)C (oil bath temperature) in argon atmosphere (1 atm) for 36 h until complete consumption of starting material as monitored by TLC and GC-MS analysis. After the reaction was finished, the reaction mixture was washed with brine. The aqueous phase was re-extracted with EtOAc (3×10 mL). The combined organic extracts were dried over Na\(_2\)SO\(_4\) and concentrated in vacuum. The residue was
purified by silica gel flash column chromatography (hexane/ethyl acetate = 20 : 1 to 10 : 1) to afford the desired products 3.

### 2.3 Table S1: Screening the optimal conditions

Initially, we set out to investigate the difunctionalization of 1-(benzyloxy)-2-(cyclopropylidene-methyl)-benzene (1a) with sodium p-tolylsulfinate (2a) to identify the optimal reaction conditions. As shown in Table 1, we found that treatment of substrate 1a with sodium sulfinate 2a, AgNO₃ (10 mol%) and K₂S₂O₈ (1.5 equiv) in toluene at 80 °C under argon atmosphere for 36 hour produced the target product, 5-(benzyloxy)-3-tosyl-1,2-dihydronaphthalene 3aa, in 88% yield (entry 1). Next, a range of silver catalysts, such as Ag₂CO₃, Ag₂SO₄, AgF, AgSCN and AgIO₃, were tested (entries 2–6). Although the reactions in presence of these silver salts could take place smoothly, none of them was superior to AgNO₃. We noted that the desired product 3aa could also be obtained in 35% yield absence of silver salt (entry 7). Reducing the amount of AgNO₃ to 5 mol % afforded the product 3aa in 71% yield (entry 8). A series of oxidants, including DDQ (2,3-dicyano-5,6-dichlorobenzoquinone), (NH₄)₂S₂O₈, PhI(OAc)₂ ((diacetoxyiodo)benzene), BQ (benzoquinone), DTBP (di-tert-butyl peroxide), and TBHP ( tert-butyl hydroperoxide), were examined, and no obvious improvement of the reaction yields was obtained (entries 9–14). The results showed that the K₂S₂O₈ was important for the ring-opening/cyclization, the absence of K₂S₂O₈ led to no detectable amounts of 2-sulfonylated 3,4-dihydronaphthalene 3aa (entry 15). Several solvents were also surveyed, suggesting that toluene is the best suited solvent according to the reaction yields, as other solvents such as bezene, dioxane, "BuOAc, DMF, and DMSO could not improve the reaction yield (entries 16–20). A moderate yield was afforded by using dioxane in the reaction system (entry 17). The variation of the reaction temperatures indicated that 80 °C was best suited temperatures (entries 21–22). A lower temperature led to the MCPs unactive and a higher temperature resulted in decomposing of the starting materials. We were delighted to find that conducting the reaction under air atmosphere gave the desired product 3aa in 84% yield (entry 23). Additionally, no obvious improvement of the yield was afforded when the
difunctionalization reaction was carried out with a longer reaction time (entry 24). To our delight, a 1 g (3.77 mmol) of substrate 1a could generate the desired product 3aa in good yield (entry 25).

Table S1. Screening of Optimal Reaction Conditions

<table>
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<th>entry</th>
<th>catalyst (mol %)</th>
<th>oxidant</th>
<th>solvent</th>
<th>T (°C)</th>
<th>yield (%)</th>
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</tr>
<tr>
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* Reaction conditions: 1a (0.2 mmol), 2a (0.3 mmol, 1.5 equiv), catalyst (10 mol %), oxidant (0.4 mmol, 2 equiv) and solvent (2 mL) at 80 °C under an argon atmosphere for 36 h.

Isolated yield. Isolated yield. Over 85% of raw material 1a was recovered, and the rest was decomposed.

Under air atmosphere. For 48 h. 1a (1 g, 4.24 mmol) and solvent (10 mL) for 72 h.

3. Analytical data

5-(Benzyloxy)-3-tosyl-1,2-dihyronaphthalene (3aa): Yield: 68.7 mg, 88%; yellow solid, mp 82.5-84.3 °C (uncorrected); ¹H NMR (400 MHz, CDCl₃) δ: 8.04 (s, 1H), 7.81 (d, J = 8.0 Hz, 2H), 7.42-7.40 (m, 4H), 7.36-7.30 (m, 3H), 7.18 (t, J = 8.0 Hz, 1H), 6.78 (d, J = 8.4 Hz, 1H), 6.72 (d, J = 7.6 Hz,
1H), 5.14 (s, 2H), 2.82 (t, J = 8.0 Hz, 2H), 2.47 (t, J = 8.0 Hz, 2H), 2.42 (s, 3H); 13C NMR (100 MHz, CDCl3) δ: 155.9, 140.0, 137.2, 137.0, 136.8, 136.6, 131.1, 129.7, 129.4, 128.7, 128.0, 127.9, 127.1, 120.4, 120.2, 110.7, 70.3, 27.9, 21.6, 21.3; HRMS (ESI-TOF) m/z: C24H23O3S (M + H)+ cored for 391.1362, found 391.1368.

5-Methoxy-3-tosyl-1,2-dihydronaphthalene (3ba): Yield: 50.3 mg, 80%; yellow oil; 1H NMR (400 MHz, CDCl3) δ: 8.02 (s, 1H), 7.81 (d, J = 8.4 Hz, 2H), 7.31 (d, J = 8.0 Hz, 2H), 7.21 (d, J = 8.0 Hz, 1H), 6.76-6.70 (m, 2H), 3.86 (s, 3H), 2.81 (t, J = 8.4 Hz, 2H), 2.47-2.42 (m, 5H); 13C NMR (100 MHz, CDCl3) δ: 156.8, 144.0, 137.1, 137.0, 136.6, 131.2, 129.7, 129.6, 127.9, 120.0, 119.9, 109.1, 55.5, 27.9, 21.6, 21.4; HRMS (ESI-TOF) m/z: C18H19O3S (M + H)+ cored for 315.1049, found 315.1056.

6-(Benzyloxy)-3-tosyl-1,2-dihydronaphthalene (3ca) and 8-(benzyloxy)-3-tosyl-1,2-dihydronaphthalene (3ca’): Yield: 69.4 mg, 89%; yellow oil; 1H NMR (400 MHz, CDCl3) δ: 7.80 (d, J = 8.0 Hz, 2H), 7.52 (d, J = 12.8 Hz, 1H), 7.43-7.31 (m, 7H), 7.18 (t, J = 8.0 Hz, 0.6H), 7.03 (d, J = 8.8 Hz, 0.4H), 6.95-6.88 (m, 2H), 5.06 (s, 2H), 2.92 (t, J = 8.4 Hz, 1.2H), 2.78 (t, J = 8.0 Hz, 0.8H), 2.48-2.43 (m, 5H); 13C NMR (100 MHz, CDCl3) δ: 157.7, 155.3, 144.3, 138.6, 136.8, 136.7, 136.5, 134.7, 134.6, 132.1, 131.9, 129.8, 129.8, 128.6, 128.6, 128.0, 128.0, 127.8, 127.4, 127.4, 127.1, 123.9, 121.9, 116.6, 115.2, 114.2, 70.2, 29.7, 26.7, 22.1, 21.6, 21.1, 20.3; HRMS (ESI-TOF) m/z: C24H23O3S (M + H)+ cored for 391.1362, found 391.1368.

6-Methoxy-3-tosyl-1,2-dihydronaphthalene (3da) and 8-methoxy-3-tosyl-1,2-dihydronaphthalene (3da’): Yield: 51.5 mg, 82%; white solid, mp 83.1-84.3 °C (uncorrected); 1H NMR (400 MHz, CDCl3) δ: 7.80 (d, J = 8.4 Hz, 2H), 7.52 (s, 1H), 7.32 (d, J = 8.0 Hz, 2H), 7.20 (t, J = 8.0 Hz, 0.7H), 7.04 (d, J = 9.2 Hz, 0.3H), 6.89 (t, J = 7.2 Hz, 1.4H), 6.82 (s, 0.6H), 3.81 (s, 2.1H), 3.80 (s, 0.9H), 2.85 (t, J = 7.6 Hz, 1.4H), 2.79 (t, J = 8.0 Hz, 0.6H), 2.49-2.43 (m, 5H); 13C NMR (100 MHz, CDCl3) δ: 157.5, 155.2, 143.3, 138.0, 137.5, 135.5, 133.7, 133.7, 130.9, 128.8, 128.8, 127.6, 127.0, 126.5, 126.4, 122.4, 120.5, 114.7, 113.2, 111.7, 51.5, 54.4, 28.7, 28.3, 26.1, 25.7, 21.1, 20.6; HRMS (ESI-TOF) m/z: C18H16O3S (M + H)+ cored for 315.1049, found 315.1056.
6-Methoxy-3-tosyl-1,2-dihydronaphthalene (3da): Yield: 51.5 mg, 82%; white solid, mp 82.0-84.9 °C (uncorrected); \( ^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \): 7.80 (d, \( J = 8.4 \) Hz, 2H), 7.53 (s, 1H), 7.32 (d, \( J = 8.0 \) Hz, 2H), 7.20 (t, \( J = 8.0 \) Hz, 1H), 6.89 (t, \( J = 7.2 \) Hz, 2H), 3.81 (s, 3H), 2.85 (t, \( J = 8.4 \) Hz, 2H), 2.47-2.43 (m, 5H); \( ^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \): 156.2, 144.2, 138.5, 136.5, 134.7, 131.9, 129.8, 128.0, 127.4, 123.4, 121.5, 112.7, 55.5, 21.6, 21.1, 20.0; HRMS (ESI-TOF) m/z: C\(_{18}\)H\(_{19}\)O\(_3\)S (M + H\(^+\)) calcd for 315.1049, found 315.1056.

7-(Benzylxoy)-3-tosyl-1,2-dihydronaphthalene yellow solid (3ea): Yield: 71.8 mg, 92%; yellow solid, mp 95.7-97.0 °C (uncorrected); \( ^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \): 7.79 (d, \( J = 8.4 \) Hz, 2H), 7.54-7.52 (m, 1H), 7.42-7.36 (m, 4H), 7.35-7.32 (m, 3H), 7.19 (d, \( J = 8.0 \) Hz, 1H), 5.07 (s, 2H), 2.82 (t, \( J = 8.0 \) Hz, 2H), 2.45 (t, \( J = 8.0 \) Hz, 2H), 2.42 (s, 3H); \( ^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \): 160.5, 144.1, 137.6, 136.9, 136.4, 135.4, 134.6, 130.5, 129.8, 128.6, 128.1, 127.9, 127.4, 124.3, 114.8, 112.7, 70.0, 28.0, 21.6, 21.5; HRMS (ESI-TOF) m/z: C\(_{24}\)H\(_{23}\)O\(_3\)S (M + H\(^+\)) calcd for 391.1362, found 391.1368.

7-Methoxy-3-tosyl-1,2-dihydronaphthalene (3fa): Yield: 54.0 mg, 86%; yellow solid, mp 102.1-103.5 °C (uncorrected); \( ^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \): 7.79 (d, \( J = 6.4 \) Hz, 2H), 7.53 (s, 1H), 7.32 (d, \( J = 8.0 \) Hz, 2H), 7.20 (d, \( J = 8.4 \) Hz, 1H), 6.76-6.73 (m, 1H), 6.70 (s, 1H), 3.81 (s, 3H), 2.83 (t, \( J = 8.4 \) Hz, 2H), 2.48-2.44 (m, 2H), 2.43 (s, 3H); \( ^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \): 161.3, 144.0, 137.6, 136.9, 136.4, 135.2, 134.7, 130.5, 129.8, 128.0, 127.4, 124.3, 114.8, 112.7, 70.0, 28.0, 21.6, 21.5; HRMS (ESI-TOF) m/z: C\(_{18}\)H\(_{19}\)O\(_3\)S (M + H\(^+\)) calcd for 315.1049, found 315.1056.

7-Methyl-3-tosyl-1,2-dihydronaphthalene (3ga): Yield: 48.3 mg, 81%; white solid, mp 108.7-109.9 °C (uncorrected); \( ^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \): 7.83-7.78 (m, 3H), 7.37-7.32 (m, 2H), 7.16 (t, \( J = 7.6 \) Hz, 1H), 7.06 (d, \( J = 7.2 \) Hz, 1H), 6.96 (d, \( J = 7.2 \) Hz, 1H), 2.81 (t, \( J = 8.0 \) Hz, 2H), 2.46-2.44 (m, 8H); \( ^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \): 144.2, 138.3, 136.7, 136.5, 135.9, 131.6, 130.0, 129.8, 129.4, 128.9, 127.9, 125.5, 28.3, 21.6, 21.4, 19.0; HRMS (ESI-TOF) m/z: C\(_{18}\)H\(_{19}\)O\(_2\)S (M + H\(^+\)) calcd for 299.1100, found 299.1107.
7-Phenyl-3-tosyl-1,2-dihydronaphthalene (3ha): Yield: 62.7 mg, 87%; yellow oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 7.83 (s, 2H), 7.61 (s, 1H), 7.57 (s, 2H), 7.46-7.42 (m, 3H), 7.37-7.26 (m, 5H), 2.93 (t, $J$ = 8.4 Hz, 2H), 2.53 (t, $J$ = 8.4 Hz, 2H), 2.43 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 144.3, 143.2, 140.2, 138.2, 136.6, 136.0, 134.4, 130.1, 129.8, 129.4, 128.8, 128.0, 127.8, 127.0, 126.5, 125.8, 27.8, 21.8, 21.6; HRMS (ESI-TOF) $m/z$: C$_{23}$H$_{21}$O$_2$S (M + H)$^+$ calcld for 361.1257, found 361.1266.

7-Chloro-3-tosyl-1,2-dihydronaphthalene (3ia): Yield: 49.0 mg, 77%; white solid, mp 64.6-66.1 $^\circ$C (uncorrected); $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 7.80 (d, $J$ = 8.0 Hz, 2H), 7.52 (s, 1H), 7.34 (d, $J$ = 8.0 Hz, 2H), 7.22-7.17 (m, 2H), 7.12 (s, 1H), 2.84 (t, $J$ = 8.0 Hz, 2H), 2.48 (t, $J$ = 8.4 Hz, 2H), 2.43 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 144.4, 138.8, 137.2, 136.3, 135.9, 133.5, 129.9, 129.9, 129.5, 128.0, 127.9, 127.2, 27.4, 21.6, 21.4; HRMS (ESI-TOF) $m/z$: C$_{17}$H$_{16}$ClO$_2$S (M + H)$^+$ calcld for 319.0554, found 319.0562.

3-Tosyl-7-(trifluoromethyl)-1,2-dihydronaphthalene (3ja): Yield: 51.4 mg, 73%; white solid, mp 74.1-76.0 $^\circ$C (uncorrected); $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 7.81 (d, $J$ = 8.4 Hz, 2H), 7.57 (s, 1H), 7.49 (d, $J$ = 8.0 Hz, 1H), 7.37-7.32 (m, 4H), 2.92 (t, $J$ = 8.0 Hz, 2H), 2.53 (t, $J$ = 8.0 Hz, 2H), 2.44 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 144.7, 141.3, 136.1, 136.0, 134.2, 133.0, 130.0, 129.9, 129.0, 128.1, 128.0, 124.5, 124.5, 124.1, 124.1, 122.4, 27.4, 21.6, 21.5; $^{19}$F NMR (282 MHz, CDCl$_3$): $\delta$: -62.9 (s, 3F); HRMS (ESI-TOF) $m/z$: C$_{18}$H$_{16}$F$_3$O$_2$S (M + H)$^+$ calcld for 353.0818, found 353.0824.

5,7-Dimethoxy-3-tosyl-1,2-dihydronaphthalene (3ka): Yield: 46.8 mg, 68%; yellow oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 7.93 (s, 1H), 7.79 (d, $J$ = 8.4 Hz, 2H), 7.29 (t, $J$ = 8.8 Hz, 2H), 6.28 (t, $J$ = 8.4 Hz, 2H), 3.83 (s, 3H), 3.80 (s, 3H), 2.78 (t, $J$ = 8.0 Hz, 2H), 2.44-2.40 (m, 5H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 162.5, 158.3, 143.7, 138.7, 137.3, 133.2, 129.9, 129.7, 127.8, 113.5, 104.9, 96.3, 55.5, 55.4, 28.6, 21.6, 21.4; HRMS (ESI-TOF) $m/z$: C$_{19}$H$_{21}$O$_4$S (M + H)$^+$ calcld for 345.1155, found 345.1160.

6,7-Dimethoxy-3-tosyl-1,2-dihydronaphthalene (3la): Yield: 48.9 mg, 71%; yellow oil; $^1$H
NMR (400 MHz, CDCl$_3$) $\delta$: 7.80 (d, $J = 8.4$ Hz, 2H), 7.50 (s, 1H), 7.32 (d, $J = 8.0$ Hz, 2H), 6.79 (s, 1H), 6.66 (s, 1H), 3.88 (s, 6H), 2.80 (t, $J = 8.0$ Hz, 2H), 2.46(t, $J = 8.4$ Hz, 2H), 2.43 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 150.5, 147.7, 144.1, 136.9, 135.7, 134.8, 129.8, 128.9, 127.9, 123.5, 112.0, 111.0, 56.1, 56.0, 27.4, 21.7, 21.6; HRMS (ESI-TOF) m/z: C$_{19}$H$_{21}$O$_4$S (M + H)$^+$ calscd for 345.1155, found 345.1160.

5-Bromo-7-tosyl-8,9-dihydronaphtho[1,2-d][1,3]dioxole (3ma): Yield: 37.4 mg, 46%; yellow oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 7.85 (t, $J = 7.2$ Hz, 2H), 7.37 (d, $J = 8.0$ Hz, 2H), 7.08 (s, 1H), 6.79 (s, 1H), 6.04 (s, 2H), 3.57 (t, $J = 8.0$ Hz, 2H), 2.77 (t, $J = 8.0$ Hz, 2H), 2.46 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 149.3, 147.6, 144.8, 140.8, 139.7, 135.8, 130.0, 128.3, 126.3, 115.6, 113.2, 108.5, 102.3, 41.3, 30.2, 21.7; HRMS (ESI-TOF) m/z: C$_{18}$H$_{16}$BrO$_4$S (M + H)$^+$ calscd for 406.9947, found 406.9956.

3-Tosyl-1,2-dihydronaphthalene (3na): Yield: 42.0 mg, 74%; white solid, mp 80.4-81.7 $^\circ$C (uncorrected); $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 7.80 (d, $J = 8.4$ Hz, 2H), 7.57 (s, 1H), 7.33 (d, $J = 8.4$ Hz, 2H), 7.30-7.23 (m, 3H), 7.13 (d, $J = 6.8$ Hz, 1H), 2.86 (t, $J = 8.0$ Hz, 2H), 2.49 (t, $J = 8.0$ Hz, 2H), 2.43 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 144.3, 138.4, 136.5, 135.5, 134.7, 131.0, 130.4, 129.8, 129.0, 128.0, 127.7, 127.1, 27.5, 21.7, 21.6; HRMS (ESI-TOF) m/z: C$_{17}$H$_{17}$O$_2$S (M + H)$^+$ calscd for 285.0944, found 285.0952.

5-(Benzyloxy)-3-((4-(tert-butyl)phenyl)sulfonyl)-1,2-dihydronaphthalene (3ab): Yield: 76.9 mg, 89%; yellow soli, mp 113.8-115.1 $^\circ$C (uncorrected); $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 8.08 (s, 1H), 7.84 (d, $J = 8.8$ Hz, 2H), 7.51 (d, $J = 8.8$ Hz, 2H), 7.44-7.38 (m, 4H), 7.35-7.33 (m, 1H), 7.17 (t, $J = 8.0$ Hz, 1H), 6.78 (d, $J = 8.4$ Hz, 1H), 6.71 (d, $J = 7.6$ Hz, 1H), 5.14 (s, 2H), 2.83 (t, $J = 8.0$ Hz, 2H), 2.48 (t, $J = 8.0$ Hz, 2H), 1.32 (s, 9H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 156.9, 155.8, 137.2, 136.9, 136.8, 136.6, 131.1, 129.5, 128.6, 127.9, 127.7, 127.1, 126.1, 120.4, 120.2, 110.7, 70.2, 35.1, 31.0, 27.9, 21.4; HRMS (ESI-TOF) m/z: C$_{27}$H$_{26}$O$_5$S (M + H)$^+$ calscd for 433.1832, found 433.1837.

5-(Benzyloxy)-3-((4-methoxyphenyl)sulfonyl)-1,2-dihydronaphthalene (3ac): Yield: 69.0 mg,
85%; yellow solid, mp 52.1-53.5 °C (uncorrected); \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\): 8.00 (s, 1H), 7.85 (d, \(J = 9.2\) Hz, 2H), 7.42-7.38 (m, 4H), 7.36-7.33 (m, 1H), 7.18 (t, \(J = 8.0\) Hz, 1H), 6.98 (d, \(J = 8.8\) Hz, 2H), 6.78 (d, \(J = 8.4\) Hz, 1H), 6.72 (d, \(J = 7.6\) Hz, 1H), 5.13 (s, 2H), 3.86 (s, 3H), 2.83 (t, \(J = 8.0\) Hz, 2H), 2.47 (t, \(J = 8.4\) Hz, 2H); \(^13\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\): 163.4, 155.8, 137.4, 137.2, 136.6, 131.2, 131.1, 130.2, 128.9, 128.7, 128.0, 127.1, 120.5, 120.3, 114.3, 110.7, 70.3, 55.6, 28.0, 21.3; HRMS (ESI-TOF) \(m/z\): C\(_{24}\)H\(_{23}\)O\(_4\)S (M + H)\(^+\) calcd for 407.1312, found 407.1316.

5-(Benzyloxy)-3-((4-fluorophenyl)sulfonyl)-1,2-dihydronaphthalene (3ad): Yield: 64.6 mg, 82%; colorless oil; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\): 8.04 (s, 1H), 7.96-7.92 (m, 2H), 7.42-7.38 (m, 4H), 7.37-7.34 (m, 1H), 7.20 (t, \(J = 7.6\) Hz, 3H), 6.79 (d, \(J = 8.4\) Hz, 1H), 6.73 (d, \(J = 7.6\) Hz, 1H), 5.14 (s, 2H), 2.84 (t, \(J = 8.4\) Hz, 2H), 2.47 (t, \(J = 8.0\) Hz, 2H); \(^13\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\): 166.7, 164.2, 155.9, 137.2, 136.5, 131.4, 130.8, 130.7, 130.0, 128.7, 128.0, 127.1, 120.3, 120.2, 116.5, 116.3, 110.7, 70.3, 27.9, 21.3; \(^19\)F NMR (282 MHz, CDCl\(_3\)): \(\delta\): -104.3 (s, 1F); HRMS (ESI-TOF) \(m/z\): C\(_{23}\)H\(_{20}\)FO\(_3\)S (M + H)\(^+\) calcd for 395.1112, found 395.1118.

5-(Benzyloxy)-3-((4-chlorophenyl)sulfonyl)-1,2-dihydronaphthalene (3ae): Yield: 65.6 mg, 80%; yellow oil; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\): 8.06 (s, 1H), 7.86 (d, \(J = 8.4\) Hz, 2H), 7.49 (d, \(J = 8.4\) Hz, 2H), 7.42-7.37 (m, 4H), 7.36-7.34 (m, 1H), 7.20 (t, \(J = 8.0\) Hz, 1H), 6.79 (d, \(J = 8.4\) Hz, 1H), 6.73 (d, \(J = 7.2\) Hz, 1H), 5.14 (s, 2H), 2.84 (t, \(J = 8.4\) Hz, 2H), 2.47 (t, \(J = 8.0\) Hz, 2H); \(^13\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\): 156.0, 139.8, 138.4, 137.2, 136.5, 131.4, 130.8, 130.7, 130.0, 128.7, 128.0, 127.1, 120.3, 120.2, 116.5, 116.3, 110.7, 70.3, 27.9, 21.3; HRMS (ESI-TOF) \(m/z\): C\(_{23}\)H\(_{20}\)ClO\(_3\)S (M + H)\(^+\) calcd for 411.0816, found 411.0824.

5-(Benzyloxy)-3-((4-bromophenyl)sulfonyl)-1,2-dihydronaphthalene (3af): Yield: 69.9 mg, 77%; yellow oil; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\): 8.07 (s, 1H), 7.79 (d, \(J = 7.6\) Hz, 2H), 7.66 (d, \(J = 8.8\) Hz, 2H), 7.40-7.35 (m, 1H), 7.20 (t, \(J = 8.0\) Hz, 1H), 6.79 (d, \(J = 8.4\) Hz, 1H), 6.73 (t, \(J = 7.6\) Hz, 1H), 5.14 (s, 2H), 2.83 (t, \(J = 8.0\) Hz, 2H),
2.46 (t, J = 8.0 Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 156.0, 139.0, 137.2, 136.5, 136.1, 132.4, 131.5, 130.5, 129.5, 128.7, 128.4, 128.1, 127.1, 120.3, 120.2, 110.8, 70.3, 27.9, 21.3; HRMS (ESI-TOF) m/z: C$_{23}$H$_{20}$BrO$_3$S (M + H)$^+$ calcd for 455.0311, found 455.0318.

5-(Benzyloxy)-3-((4-(trifluoromethyl)phenyl)sulfonyl)-1,2-dihydronaphthalene (3ag): Yield: 63.9 mg, 72%; white solid, mp 74.7-76.3 $^\circ$C (uncorrected); $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 8.13 (s, 1H), 8.06 (d, J = 8.0 Hz, 2H), 7.79 (d, J = 8.4 Hz, 2H), 7.43-7.36 (m, 5H), 7.21 (t, J = 8.0 Hz, 1H), 6.80 (d, J = 8.4 Hz, 1H), 6.73 (d, J = 7.2 Hz, 1H), 5.15 (s, 2H), 2.84 (t, J = 8.0 Hz, 2H), 2.47 (t, J = 8.0 Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 156.1, 137.3, 136.4, 135.5, 131.8, 131.5, 128.7, 128.5, 128.1, 127.2, 126.3, 126.3, 120.3, 120.1, 110.8, 70.4, 27.9, 21.4; HRMS (ESI-TOF) m/z: C$_{24}$H$_{20}$F$_3$O$_3$S (M + H)$^+$ calcd for 445.1080, found 445.1086.

1-(4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)phenyl)ethanone (3ah): Yield: 58.5 mg, 70%; yellow oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 8.21 (s, 1H), 7.91 (s, 4H), 7.43-7.39 (m, 5H), 7.31-7.26 (m, 1H), 7.03 (t, J = 7.2 Hz, 2H), 5.10 (s, 2H), 3.64 (t, J = 8.0 Hz, 2H), 2.82 (t, J = 8.0 Hz, 2H), 2.62 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 196.6, 143.2, 140.3, 139.8, 137.5, 136.2, 131.5, 128.9, 128.7, 128.6, 128.3, 127.5, 122.1, 121.0, 112.3, 70.4, 41.5, 30.7, 26.9; HRMS (ESI-TOF) m/z: C$_{25}$H$_{23}$O$_4$S (M + H)$^+$ calcd for 419.1312, found 419.1317.

5-(Benzyloxy)-3-((4-nitrophenyl)sulfonyl)-1,2-dihydronaphthalene (3ai): Yield: 53.1 mg, 63%; yellow oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 8.36 (d, J = 9.2 Hz, 2H), 8.14-8.11 (m, 3H), 7.43-7.38 (m, 4H), 7.37-7.35 (m, 1H), 7.22 (t, J = 8.0Hz, 1H), 6.81 (d, J = 8.4 Hz, 1H), 6.74 (d, J = 7.6 Hz, 1H), 5.15 (s, 2H), 2.85 (t, J = 8.0 Hz, 2H), 2.48 (t, J = 7.6 Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 156.2, 150.4, 145.9, 137.3, 136.3, 135.0, 132.2, 132.1, 129.2, 128.7, 128.2, 127.2, 124.4, 120.3, 119.9, 110.9, 70.4, 27.8, 21.3; HRMS (ESI-TOF) m/z: C$_{23}$H$_{20}$NO$_3$S (M + H)$^+$ calcd for 422.1057, found 422.1064.

5-(Benzyloxy)-3-(m-tolylsulfonyl)-1,2-dihydronaphthalene (3aj): Yield: 60.9 mg, 78%; yellow oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 8.05 (s, 1H), 7.73-7.71 (m, 2H), 7.43-7.37 (m, 6H), 7.35-7.32
(m, 1H), 7.18 (t, \( J = 8.0 \) Hz, 1H), 6.79 (d, \( J = 8.4 \) Hz, 1H), 6.72 (d, \( J = 7.6 \) Hz, 1H), 5.13 (s, 2H), 2.82 (t, \( J = 8.4 \) Hz, 2H), 2.50-2.46 (m, 2H), 2.41 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \): 155.9, 139.7, 139.3, 137.3, 136.9, 136.6, 133.9, 131.2, 129.7, 128.9, 128.6, 128.2, 128.0, 127.1, 125.1, 120.4, 120.3, 110.8, 70.3, 27.9, 21.4, 21.3; HRMS (ESI-TOF) \( m/z \): C\(_{24}\)H\(_{23}\)O\(_3\)S (M + H)\(^+\) calcd for 391.1362, found 391.1368.

5-(Benzyloxy)-3-(\( \alpha \)-tolylsulfonyl)-1,2-dihydronaphthalene (3ak): Yield: 56.2 mg, 72%; white oil; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \): 8.10 (d, \( J = 7.2 \) Hz, 1H), 8.06 (s, 1H), 7.48 (t, \( J = 7.2 \) Hz, 1H), 7.42-7.35 (m, 6H), 7.31 (d, \( J = 7.6 \) Hz, 1H), 7.17 (d, \( J = 7.6 \) Hz, 1H), 7.03 (t, \( J = 8.0 \) Hz, 2H), 5.08 (s, 2H), 3.55 (t, \( J = 8.0 \) Hz, 2H), 2.78 (t, \( J = 8.0 \) Hz, 2H), 2.36 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \): 156.7, 138.7, 137.9, 137.3, 136.1, 135.8, 133.7, 132.8, 131.2, 130.4, 128.8, 128.6, 128.2, 127.7, 126.5, 122.4, 121.0, 112.2, 70.4, 41.7, 30.4, 19.9; HRMS (ESI-TOF) \( m/z \): C\(_{24}\)H\(_{23}\)O\(_3\)S (M + H)\(^+\) calcd for 391.1362, found 391.1368.

2-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)benzonitrile (3al): Yield: 57.0 mg, 71%; yellow oil; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \): 8.30 (s, 1H), 8.20 (d, \( J = 7.6 \) Hz, 1H), 7.76-7.68 (m, 3H), 7.38-7.32 (m, 6H), 7.00-6.97 (m, 2H), 5.11 (s, 2H), 3.61 (t, \( J = 8.0 \) Hz, 2H), 2.90 (t, \( J = 8.0 \) Hz, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \): 156.5, 141.3, 141.1, 136.3, 135.9, 135.6, 133.4, 132.9, 131.5, 130.5, 129.2, 128.6, 128.0, 127.3, 122.0, 121.0, 115.3, 112.8, 111.6, 70.4, 41.2, 30.7; HRMS (ESI-TOF) \( m/z \): C\(_{24}\)H\(_{20}\)NO\(_3\)S (M + H)\(^+\) calcd for 402.1158, found 402.1166.

5-(Benzyloxy)-3-((2-nitrophenyl)sulfonyl)-1,2-dihydronaphthalene (3am): Yield: 37.9 mg, 45%; yellow oil; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \): 8.18 (d, \( J = 8.0 \) Hz, 1H), 7.99 (s, 1H), 7.72-7.71 (m, 2H), 7.66-7.63 (m, 1H), 7.40-7.33 (m, 6H), 7.06-6.98 (m, 2H), 5.10 (s, 2H), 3.68 (t, \( J = 8.0 \) Hz, 2H), 3.05 (t, \( J = 7.2 \) Hz, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \): 156.8, 148.7, 138.7, 137.5, 136.3, 134.6, 132.4, 132.2, 132.1, 131.6, 128.9, 128.6, 128.0, 127.3, 124.9, 122.0, 121.0, 112.6, 70.4, 41.4, 30.5; HRMS (ESI-TOF) \( m/z \): C\(_{23}\)H\(_{20}\)NO\(_5\)S (M + H)\(^+\) calcd for 422.1057, found 422.1064.

5-(Benzyloxy)-3-(mesitylsulfonyl)-1,2-dihydronaphthalene (3an): Yield: 53.5 mg, 64%; yellow oil; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \): 7.80 (s, 1H), 7.40-7.36 (m, 5H), 7.28 (t, \( J = 7.6 \) Hz, 1H), 7.03-
6.98 (m, 2H), 6.87 (s, 2H), 5.04 (s, 2H), 3.61 (t, $J = 8.0$ Hz, 2H), 2.86 (t, $J = 8.4$ Hz, 2H), 2.52 (s, 6H), 2.28 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 156.6, 143.3, 140.8, 139.0, 136.1, 134.9, 132.3, 131.1, 130.9, 128.7, 128.6, 121.1, 127.7, 122.4, 120.9, 112.1, 70.4, 30.1, 22.6, 21.0; HRMS (ESI-TOF) m/z: C$_{26}$H$_{27}$O$_3$S (M + H)$^+$ calcd for 419.1675, found 419.1675.

6-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-2,3-dihydrobenzofuran (3ao): Yield: 53.4 mg, 65%; yellow oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 7.99 (s, 1H), 7.72-7.71 (m, 2H), 7.41-7.38 (m, 4H), 7.36-7.34 (m, 1H), 7.18 (t, $J = 8.0$ Hz, 1H), 6.85 (d, $J = 8.8$ Hz, 1H), 6.78 (d, $J = 8.4$ Hz, 1H), 6.73 (d, $J = 7.2$ Hz, 1H), 5.13 (s, 2H), 4.66 (t, $J = 8.8$ Hz, 2H), 3.24 (t, $J = 7.2$ Hz, 2H), 2.82 (d, $J = 8.8$ Hz, 2H), 2.48 (t, $J = 8.0$ Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 164.3, 155.8, 137.5, 137.2, 136.6, 131.1, 131.0, 129.8, 128.7, 128.6, 128.5, 128.0, 127.1 (2C), 125.2, 120.3, 110.7, 109.6, 72.3, 70.2, 29.0, 28.0, 21.3; (HRMS (ESI-TOF) m/z: C$_{25}$H$_{23}$O$_4$S (M + H)$^+$ calcd for 419.1312, found 419.1317.

2-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)naphthalene (3ap): Yield: 67.3 mg, 79%; green solid, mp 155.4-156.7 °C (uncorrected); $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 8.03 (d, $J = 8.8$ Hz, 1H), 7.99-7.96 (m, 2H), 7.92-7.87 (m, 2H), 7.62-7.59 (m, 2H), 7.37-7.32 (m, 4H), 7.28 (t, $J = 7.6$ Hz, 2H), 7.22 (d, $J = 7.2$ Hz, 1H), 7.04-6.98 (m, 2H), 5.13 (s, 2H), 4.66 (t, $J = 8.8$ Hz, 2H), 3.42 (t, $J = 6.4$ Hz, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 155.9, 137.3, 136.6, 136.6, 136.5, 135.1, 132.2, 131.3, 129.5, 129.5, 129.2, 129.0, 128.7, 128.0, 127.9, 127.5, 127.1, 122.9, 120.4, 120.3, 110.7, 70.3, 27.9, 21.4; HRMS (ESI-TOF) m/z: C$_{27}$H$_{23}$O$_3$S (M + H)$^+$ calcd for 427.1362, found 427.1369.

5-(Benzyloxy)-3-(phenylsulfonyl)-1,2-dihydronaphthalene (3aq): Yield: 64.7 mg, 86%; yellow solid, mp 105.0-156.6 °C (uncorrected); $^1$H NMR (400 MHz, CDCl$_3$) $\delta$: 8.07 (s, 1H), 7.93 (d, $J = 8.0$ Hz, 2H), 7.59 (d, $J = 7.2$ Hz, 1H), 7.52 (t, $J = 7.2$ Hz, 2H), 7.43-7.36 (m, 4H), 7.35-7.32 (m, 1H), 7.18 (t, $J = 8.0$ Hz, 2H), 6.79 (d, $J = 8.4$ Hz, 1H), 6.72 (d, $J = 7.6$ Hz, 1H), 5.14 (s, 2H), 2.82 (t, $J = 8.0$ Hz, 2H), 2.50-2.45 (m, 2H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$: 155.9, 139.8, 137.2, 136.6, 136.5, 133.1, 131.3, 129.9, 129.1, 128.7, 128.0, 127.9, 127.1, 120.3, 120.3, 110.7, 70.3,
27.9, 21.3; HRMS (ESI-TOF) m/z: C_{23}H_{21}O_3S (M + H)^+ calcd for 377.1206, found 377.1211.

2-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)thiophene (3ar): Yield: 50.4 mg, 66%; yellow solid, mp 83.4-85.1 °C (uncorrected); \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}) \( \delta \): 8.16 (s, 1H), 7.63-7.62 (m, 2H), 7.40-7.35 (m, 5H), 7.31 (d, \( J = 7.2 \) Hz, 2H), 7.05-7.01 (m, 3H), 5.10 (s, 2H), 3.66 (t, \( J = 8.0 \) Hz, 2H), 2.97 (t, \( J = 8.0 \) Hz, 2H); \textsuperscript{13}C NMR (100 MHz, CDCl\textsubscript{3}) \( \delta \): 156.7, 140.7, 138.9, 137.9, 136.3, 134.1, 131.3, 128.7, 128.6, 128.4, 128.1, 127.8, 127.3, 122.3, 121.0, 112.4, 70.3, 41.7, 30.7; HRMS (ESI-TOF) m/z: C\textsubscript{21}H\textsubscript{19}O\textsubscript{3}S\textsubscript{2} (M + H)^+ calcd for 383.0770, found 383.0775.

\textit{S-p-toly1 4-methylbenzenesulfonothioate} (4): yield: 11.7 mg, 21%; \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}) \( \delta \): 7.46 (d, \( J = 8.4 \) Hz, 2H), 7.25-7.21 (m, 4H), 7.14 (d, \( J = 8.0 \) Hz, 2H), 2.43 (s, 3H), 2.38 (s, 3H); \textsuperscript{13}C NMR (100 MHz, CDCl\textsubscript{3}) \( \delta \): 144.6, 142.0, 140.4, 136.5, 130.2, 129.3, 127.6, 124.5, 21.7, 21.5; HRMS (ESI-TOF) m/z: C\textsubscript{14}H\textsubscript{15}O\textsubscript{2}S\textsubscript{2} (M + H)^+ calcd for 279.0508, found 279.0516.

4. References


5-Methoxy-3-tosyl-1,2-dihydronaphthalene (3ba)
6-(Benzyloxy)-3-tosyl-1,2-dihydronaphthalene (3ca)
6-Methoxy-3-tosyl-1,2-dihydronaphthalene (3da)
7-(Benzyloxy)-3-tosyl-1,2-dihydronaphthalene yellow solid (3ea)
7-Methoxy-3-tosyl-1,2-dihydronaphthalene (3fa)
7-Methyl-3-tosyl-1,2-dihydronaphthalene (3ga)
7-Phenyl-3-tosyl-1,2-dihydronaphthalene (3ha)
7-Chloro-3-tosyl-1,2-dihydronaphthalene (3ia)
3-Tosyl-7-(trifluoromethyl)-1,2-dihydronaphthalene (3ja)
5,7-Dimethoxy-3-tosyl-1,2-dihydronaphthalene (3ka)
6,7-Dimethoxy-3-tosyl-1,2-dihydronaphthalene (3la)
5-Bromo-7-tosyl-8,9-dihydronaphtho[1,2-d][1,3]dioxole (3ma)
3-Tosyl-1,2-dihydronaphthalene (3na)
5-(Benzyloxy)-3-((4-(tert-butyl)phenyl)sulfonyl)-1,2-dihydronaphthalene (3ab)
5-(Benzyloxy)-3-((4-methoxyphenyl)sulfonyl)-1,2-dihydonaphthalene (3ac)
5-(Benzyloxy)-3-((4-fluorophenyl)sulfonyl)-1,2-dihydronaphthalene (3ad)
5-(Benzyloxy)-3-((4-chlorophenyl)sulfonyl)-1,2-dihydronaphthalene (3ae)
5-(Benzyloxy)-3-((4-bromophenyl)sulfonyl)-1,2-dihydronaphthalene (3af)
5-(Benzyloxy)-3-((4-(trifluoromethyl)phenyl)sulfonyl)-1,2-dihydronaphthalene (3ag)
1-(4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)phenyl)ethanone (3ah)
5-(Benzyloxy)-3-((4-nitrophenyl)sulfonyl)-1,2-dihydronaphthalene (3ai)
5-(Benzyloxy)-3-(m-tolylsulfonyl)-1,2-dihyronaphthalene (3aj)
5-(Benzyloxy)-3-(o-tolylsulfonyl)-1,2-dihydronaphthalene (3ak)
2-((8-(Benzyloxy)-3,4-dihyronaphthalen-2-yl)sulfonyl)benzonitrile (3a)
5-(Benzyl oxy)-3-((2-nitrophenyl)sulfonyl)-1,2-dihydropnaphthalene (3am)
5-(Benzylmethoxy)-3-(mesitylsulfonyl)-1,2-dihydronaphthalene (3a)**

**Chemical Structure**

![Chemical Structure](image)

**1H NMR Spectrum**

![1H NMR Spectrum](image)

**13C NMR Spectrum**

![13C NMR Spectrum](image)
6-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-2,3-dihydrobenzofuran (3ao)
2-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)naphthalene (3ap)
5-(Benzyloxy)-3-(phenylsulfonyl)-1,2-dihydronaphthalene (3aq)
2-((8-(Benzylxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)thiophene (3ar)
47

S-p-tolyl 4-methylbenzenesulfonothioate (4)