Supporting Information

for

Electrochemical formal homocoupling of sec-alcohols

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Experimental procedure, characterization data, and copies of NMR spectra of the products
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1. General information

Unless otherwise noted, all reactions were performed under air atmosphere. Commercially available chemicals were purchased from Sigma-Aldrich, Tokyo Chemical Industry Co., Ltd., Nacalai Tesque, Inc., and FUJIFILM Wako Pure Chemical Corporation and used as received unless otherwise noted. Anhydrous MeCN (“super dehydrated” grade) was purchased from FUJIFILM Wako Pure Chemical Corporation and used as received. The products were isolated by flash column chromatography (CHROMATOREX 60B, Fuji silysis).

Infrared (IR) spectra were recorded on a SHIMADZU IRAffinity-1 spectrometer and expressed as frequency of absorption (cm⁻¹). ¹H, ¹³C{¹H}, and ¹⁹F NMR spectra were recorded on a JEOL JNM-ECZ400R (400 MHz for ¹H NMR, 100 MHz for ¹³C{¹H} NMR, 375 MHz for ¹⁹F NMR). Chemical shift values are expressed in parts per million (ppm) relative to internal TMS (δ 0.00 ppm for ¹H NMR) or deuterated solvent peaks (δ 77.0 ppm for CDCl₃ and δ 39.5 ppm for DMSO-d₆). Abbreviations are as follows: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet; br, broad. High-resolution mass spectra (HRMS) were obtained on JEOL JMS-700N (EI) or JEOL JMS-T100TD (DART or ESI) spectrometers.
2. Experimental section

2.1. General procedure for the electrochemical synthesis of vic-1,2 diols

A cylinder-type undivided cell was charged with Et_{4}NBr (21 mg, 0.1 mmol) and imidazole (3.4 mg, 0.05 mmol). Anhydrous MeCN (5 mL), water (0.125 mL), and sec-alcohol 1 (1.0 mmol) was successively added. The reaction vessel was equipped with two Pt electrodes (1 × 2 cm²). Then, 4 F/mol of electricity was passed through the mixture at 0 °C under constant current conditions (50 mA). The reaction was quenched with saturated aqueous Na_{2}S_{2}O_{3}, and the most of MeCN was removed under reduced pressure. The residue was extracted with AcOEt. The combined organic layers were dried over Na_{2}SO_{4}, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel to afford the desired product 2 as a mixture of dl and meso isomers. The dl:meso ratio was determined by ^{1}H NMR analysis.

2,3-Diphenylbutane-2,3-diol (2a)

Silica gel column chromatography (hexane/AcOEt = 8:2) gave 2a (94.3 mg, 0.389 mmol, 78% yield) as a white solid; dl:meso 90:10; ^{1}H NMR (400 MHz, CDCl₃): δ 7.26-7.19 (m, 10H + 10H, dl and meso), 2.54 (s, 2H, dl), 2.25 (s, 2H, meso), 1.59 (s, 6H, meso), 1.51 (s, 6H, dl); ^{13}C{^{1}H} NMR (100 MHz, CDCl₃): δ 143.7, 143.3, 127.3, 127.2, 127.04, 126.96, 126.9, 126.8, 78.8, 78.5, 25.0, 24.8.

The ^{1}H and ^{13}C{^{1}H} NMR spectra are in accordance with those reported in the literature.

2,3-Di-p-tolylbutane-2,3-diol (2b)

Silica gel column chromatography (hexane/AcOEt = 5:1) gave 2b (77.7 mg, 0.287 mmol, 57% yield) as a white solid; dl:meso = 91:9; ^{1}H NMR (400 MHz, CDCl₃): δ 7.17-7.05 (m, 8H + 8H, dl and meso), 2.51 (s, 2H, dl), 2.34 (s, 6H, dl), 2.33 (s, 6H, meso) 2.17 (s, 2H, meso), 1.54 (s, 6H, meso), 1.47 (s, 6H, dl); ^{13}C{^{1}H} NMR (100 MHz, CDCl₃): δ 140.8, 140.5, 136.5, 136.3, 127.9, 127.8, 127.3, 126.8, 78.7, 78.5, 25.1, 24.9, 20.94, 20.91.

The ^{1}H and ^{13}C{^{1}H} NMR spectra are in accordance with those reported in the literature.
2,3-Bis(4-(tert-butyl)phenyl)butane-2,3-diol (2c)

Silica gel column chromatography (hexane/AcOEt = 8:1) gave 2c (79.6 mg, 0.225 mmol, 45% yield) as a white solid; \textit{dl}:\textit{meso} 87:13; \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}): \textit{\delta} 7.30-7.18 (m, 8H + 8H, \textit{dl} and \textit{meso}), 2.53 (s, 2H, \textit{dl}), 2.11 (s, 2H, \textit{meso}), 1.53 (s, 6H, \textit{meso}), 1.48 (s, 6H, \textit{dl}), 1.32 (s, 18H, \textit{dl} and \textit{meso}), 1.31 (s, 18H, \textit{meso}). \textsuperscript{13}C\{	extsuperscript{1}H\} NMR (100 MHz, CDCl\textsubscript{3}): \textit{\delta} 149.8, 149.6, 140.9, 140.6, 126.9, 126.5, 124.14, 124.07, 78.6, 78.3, 34.4, 34.3, 34.2, 31.4, 31.3, 25.1; IR (ATR): 3555, 2955, 2901, 1510, 1458, 1400, 1360, 1269, 1215, 1157, 1111, 1091, 1045, 1014 cm\textsuperscript{-1}; HRMS (ESI) \textit{m}/\textit{z}: [M+Na]\textsuperscript{+} calcd for C\textsubscript{24}H\textsubscript{34}NaO\textsubscript{2} 377.2457, found 377.2464.

2,3-Bis(4-fluorophenyl)butane-2,3-diol (2d)

Silica gel column chromatography (hexane/AcOEt = 8:2) gave 2d (98.0 mg, 0.352 mmol, 70% yield) as a white solid; \textit{dl}:\textit{meso} 90:10; \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}): \textit{\delta} 7.20-7.17 (m, 4H, \textit{meso}), 7.14-7.10 (m, 4H, \textit{dl}), 6.95-6.89 (m, 4H + 4H, \textit{dl} and \textit{meso}), 2.49 (s, 2H, \textit{dl}), 2.25 (s, 2H, \textit{meso}), 1.57 (s, 6H, \textit{meso}), 1.49 (s, 6H, \textit{dl}). \textsuperscript{13}C\{	extsuperscript{1}H\} NMR (100 MHz, CDCl\textsubscript{3}): \textit{\delta} 162.0 (d, \textsuperscript{1}J\textsubscript{CF} = 245.6 Hz), 161.9 (d, \textsuperscript{4}J\textsubscript{CF} = 3.9 Hz), 139.4 (d, \textsuperscript{4}J\textsubscript{CF} = 3.9 Hz), 139.0 (d, \textsuperscript{2}J\textsubscript{CF} = 2.9 Hz), 129.0 (d, \textsuperscript{3}J\textsubscript{CF} = 8.7 Hz), 128.6 (d, \textsuperscript{3}J\textsubscript{CF} = 7.7 Hz), 113.92 (d, \textsuperscript{2}J\textsubscript{CF} = 20.2 Hz), 113.87 (d, \textsuperscript{2}J\textsubscript{CF} = 21.2 Hz), 78.6, 78.3, 20.1, 24.8; \textsuperscript{19}F NMR (375 MHz, CDCl\textsubscript{3}) \textit{\delta} −115.8, −116.1; HRMS (ESI) \textit{m}/\textit{z}: [M+Na]\textsuperscript{+} calcd for C\textsubscript{16}H\textsubscript{16}NaO\textsubscript{2} 301.1016, found 301.1031.

The \textsuperscript{1}H and \textsuperscript{13}C\{	extsuperscript{1}H\} NMR spectra are in accordance with those reported in the literature.

2,3-Bis(4-chlorophenyl)butane-2,3-diol (2e)

Silica gel column chromatography (hexane/AcOEt = 8:2) gave 2e (88.3 mg, 0.283 mmol, 57% yield) as a white solid; \textit{dl}:\textit{meso} 89:11; \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}): \textit{\delta} 7.23-7.09 (m, 8H + 8H, \textit{dl} and \textit{meso}), 2.48 (s, 2H, \textit{dl}), 2.19 (s, 2H, \textit{meso}), 1.55 (s, 6H, \textit{meso}), 1.48 (s, 6H, \textit{dl}). \textsuperscript{13}C\{	extsuperscript{1}H\} NMR (100 MHz, CDCl\textsubscript{3}): \textit{\delta} 142.1, 141.6, 133.1, 132.9, 128.8, 128.4, 127.3, 127.2, 78.4, 78.2, 24.9, 24.6.

The \textsuperscript{1}H and \textsuperscript{13}C\{	extsuperscript{1}H\} NMR spectra are in accordance with those reported in the literature.
2,3-Bis(4-methoxy carbonylphenyl)butane-2,3-diol (2f)

Silica gel column chromatography (hexane/AcOEt = 3:1) gave 2f (127.3 mg, 0.355 mmol, 71% yield) as a white solid; dl:meso 89:11; 1H NMR (400 MHz, DMSO-d6): δ 7.85 (d, J = 8.7 Hz, 4H, meso), 7.64-7.62 (m, 4H + 4H, dl and meso), 7.20 (d, J = 8.2 Hz, 4H, dl), 5.37 (s, 2H, dl), 5.21 (s, 2H, meso), 3.85 (s, 6H, meso), 3.79 (s, 6H, dl), 1.60 (s, 6H, dl), 1.27 (s, 6H, meso); 13C{1H} NMR (100 MHz, DMSO-d6): δ 166.4, 166.3, 152.4, 152.0, 128.0, 127.5, 127.4, 127.1, 126.9, 77.2, 76.9, 51.93, 51.85, 24.8, 24.6; HRMS (ESI) m/z: [M+Na]+ calcd for C20H22NaO6 381.1314, found 381.1324.

The 1H and 13C{1H} NMR spectra are in accordance with those reported in the literature.

2,3-Bis(4-(trifluoromethyl)phenyl)butane-2,3-diol (2g)

Silica gel column chromatography (hexane/AcOEt = 8:2) gave 2g (135.6 mg, 0.358 mmol, 72% yield) as a yellow amorphous; dl:meso 85:15; 1H NMR (400 MHz, CDCl3): δ 7.52-7.50 (m, 4H dl and 4H, meso), 7.45 (d, J = 8.5 Hz, 4H, meso), 7.30 (d, J = 8.2 Hz, 4H, dl), 2.57 (s, 2H, dl), 2.18 (s, 2H, meso), 1.57 (s, 6H, meso), 1.54 (s, 6H, dl); 13C{1H} NMR (100 MHz, CDCl3): δ 147.6, 147.1, 129.5 (q, 2JCF = 32.4 Hz), 129.3 (q, 2JCF = 32.1 Hz), 127.7, 127.4, 124.2 (q, 1JCF = 272.0 Hz), 124.14 (q, 3JCF = 3.9 Hz), 124.12 (q, 1JCF = 272.0 Hz), 78.6, 78.3, 25.0, 24.7; 19F NMR (375 MHz, CDCl3): δ -62.4.

The 1H and 13C{1H} NMR spectra are in accordance with those reported in the literature.

2,3-Bis(4-cyanophenyl)butane-2,3-diol (2h)

Silica gel column chromatography (hexane/AcOEt = 2:1) gave 2h (64.3 mg, 0.220 mmol, 44% yield) as a white solid; dl:meso 74:26; 1H NMR (400 MHz, DMSO-d6): δ 7.74 (d, J = 8.5 Hz, 4H, meso), 7.68 (d, J = 8.5 Hz, 4H, meso), 7.51 (d, J = 8.5 Hz, 4H, dl), 7.23 (d, J = 8.5 Hz, 4H, dl), 5.55 (s, 2H, dl), 5.38 (s, 2H, meso), 1.61 (s, 6H, dl), 1.23 (s, 6H, meso); 13C{1H} NMR (100 MHz, DMSO-d6): δ 152.4, 152.0, 130.6, 130.1, 128.6, 127.9, 119.20, 119.16, 108.9, 108.5, 77.0, 76.7, 24.6, 24.3; HRMS (ESI) m/z: [M+H]+ calcd for C18H17N2O2 293.1290, found 293.1281.
Silica gel column chromatography (hexane/AcOEt = 8:1) gave 2i (88.9 mg, 0.329 mmol, 66% yield) as a colorless amorphous; 

\( \text{d}l: \text{meso} \ 91:9; \)

\(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta 7.15-7.00 \) (m, 8H + 8H, \( \text{d}l \) and \( \text{meso} \)), 2.52 (s, 2H, \( \text{d}l \)), 2.30 (s, 6H, \( \text{d}l \)), 2.29 (s, 6H, \( \text{meso} \)), 2.20 (s, 2H, \( \text{meso} \)), 1.56 (s, 6H, \( \text{meso} \)), 1.48 (s, 6H, \( \text{d}l \)); 

\(^{13}\)C\(^{\{1\}}\)H NMR (100 MHz, CDCl\(_3\)): \( \delta 143.6, 143.3, 136.6, 136.4, 128.2, 127.8, 127.6, 127.5, 127.1, 126.9, 124.4, 123.9, 78.8, 78.6, 25.0, 24.9, 21.5; IR (ATR): 3447, 2984, 1607, 1487, 1450, 1369, 1238, 1136, 1065, 1043 cm\(^{-1}\); HRMS (DART) \( m/z: [M+H]^+ \) calcd for C\(_{18}\)H\(_{23}\)O\(_2\) 271.1698, found 271.1687.

Silica gel column chromatography (hexane/AcOEt = 8:2) gave 2j (116.8 mg, 0.375 mmol, 75% yield) as a colorless amorphous; 

\( \text{d}l: \text{meso} \ 88:12; \)

\(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta 7.32-6.98 \) (m, 8H + 8H, \( \text{d}l \) and \( \text{meso} \)), 2.51 (s, 2H, \( \text{d}l \)), 2.16 (s, 2H, \( \text{meso} \)), 1.54 (s, 6H, \( \text{meso} \)), 1.49 (s, 6H, \( \text{d}l \)); 

\(^{13}\)C\(^{\{1\}}\)H NMR (100 MHz, CDCl\(_3\)): \( \delta 145.7, 145.2, 133.4, 133.3, 128.5, 128.4, 127.6, 127.3, 127.1, 125.5, 125.2, 78.5, 78.2, 25.0, 24.7; IR (ATR): 3431, 2990, 1595, 1568, 1411, 1373, 1200, 1144, 1061 cm\(^{-1}\); HRMS (EI) \( m/z: [M+H]^+ \) calcd for C\(_{16}\)H\(_{16}\)Cl\(_2\)O\(_2\) 310.0527, found 310.0520.

Silica gel column chromatography (hexane/AcOEt = 5:1) gave 2k (47.5 mg, 0.176 mmol, 35% yield) as a colorless amorphous; 

\( \text{d}l: \text{meso} \ 87:13; \)

\(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta 7.18-7.00 \) (m, 8H + 8H, \( \text{d}l \) and \( \text{meso} \)), 2.40 (s, 2H, \( \text{meso} \)), 2.36 (s, 2H, \( \text{d}l \)), 2.08 (br s, 6H, \( \text{meso} \)), 2.06 (br s, 6H, \( \text{d}l \)), 1.733 (s 6H, \( \text{meso} \)), 1.727 (s, 6H, \( \text{d}l \)); 

\(^{13}\)C\(^{\{1\}}\)H NMR (100 MHz, CDCl\(_3\)): \( \delta 141.44, 141.38, 137.4, 132.74, 132.69, 129.9, 129.4, 127.3, 127.1, 124.83, 124.79, 82.7, 82.3, 27.3, 23.3, 23.1.

The \(^1\)H and \(^{13}\)C\(^{\{1\}}\)H NMR spectra are in accordance with those reported in the literature. \(^6\)
**3,4-Diphenylhexane-3,4-diol (2l)**

![Chemical Structure](image)

Silica gel column chromatography (hexane/AcOEt = 20:1) gave 2l (71.1 mg, 0.263 mmol, 53% yield) as a white solid; *dI*:meso 87:13; $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.29-7.15 (m, 10H + 10H, *dI* and meso), 2.56 (s, 2H, *dI*), 2.35 (dq, $J = 14.7, 7.2$ Hz, 2H, meso), 2.12-2.03 (m, 2H + 2H, *dI* and meso), 1.70 (dq, $J = 14.6, 7.4$ Hz, 2H, *dI*), 1.60-1.53 (m, 2H, meso), 0.60 (t, $J = 7.3$ Hz, 6H, *dI*), 0.59 (t, $J = 7.3$ Hz, 6H, meso); $^{13}$C {$^1$H} NMR (100 MHz, CDCl$_3$): $\delta$ 141.2, 140.2, 128.3, 127.6, 127.3, 126.8, 126.6, 81.9, 81.8, 28.1, 27.6, 7.7, 7.5.

The $^1$H and $^{13}$C {$^1$H} NMR spectra are in accordance with those reported in the literature.$^1$

**Diethyl 2,3-dihydroxy-2,3-dimethylsuccinate (2m)**

![Chemical Structure](image)

Silica gel column chromatography (hexane/AcOEt = 2:1) gave 2m (70.1 mg, 0.299 mmol, 60% yield) as a white solid; *dI*:meso 61:39; $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 4.34-4.21 (m, 4H + 4H, *dI* and meso), 3.83 (s, 2H, *dI*), 3.59 (s, 2H, meso), 1.53 (s, 6H, *dI*), 1.51 (s, 6H, meso), 1.35-1.29 (m, 6H + 6H, *dI* and meso); $^{13}$C {$^1$H} NMR (100 MHz, CDCl$_3$): $\delta$ 174.8, 174.3, 78.6, 78.5, 62.3, 62.2, 20.5, 20.4, 14.02, 13.96.

The $^1$H and $^{13}$C {$^1$H} NMR spectra are in accordance with those reported in the literature.$^1$

**1,1,2,2-Tetraphenylethane-1,2-diol (2n)**

![Chemical Structure](image)

Silica gel column chromatography (hexane/AcOEt = 20:1) gave 2n (115.2 mg, 0.314 mmol, 63% yield) as a white solid; $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.32-7.27 (m, 8H), 7.21-7.14 (m, 12H), 3.02 (s, 2H); $^{13}$C {$^1$H} NMR (100 MHz, CDCl$_3$): $\delta$ 144.1, 128.6, 127.3, 126.9, 83.0.

The $^1$H and $^{13}$C {$^1$H} NMR spectra are in accordance with those reported in the literature.$^3$
Silica gel column chromatography (hexane/AcOEt = 20:1) gave 2o (105.3 mg, 0.249 mmol, 50% yield) as a white solid; \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.15 (d, \(J = 8.2\) Hz, 8H), 6.96 (d, \(J = 8.2\) Hz, 8H), 2.95 (s, 2H), 2.27 (s, 12H); \(^{13}\)C{\(^1\)H} NMR (100 MHz, CDCl\(_3\)): \(\delta\) 141.5, 136.3, 128.4, 127.9, 82.8, 21.0. The \(^1\)H and \(^{13}\)C{\(^1\)H} NMR spectra are in accordance with those reported in the literature.\(^3\)

Silica gel column chromatography (hexane/AcOEt = 20:1) gave 2p (133.0 mg, 0.303 mmol, 61% yield) as a white solid; \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.27-7.21 (m, 8H), 6.90-6.84 (m, 8H), 2.86 (s, 2H); \(^{13}\)C{\(^1\)H} NMR (100 MHz, CDCl\(_3\)): \(\delta\) 161.8 (d, \(J_{CF} = 247.6\) Hz), 139.6 (d, \(J_{CF} = 2.9\) Hz), 130.3 (d, \(J_{CF} = 7.7\) Hz), 114.3 (d, \(J_{CF} = 21.2\) Hz), 82.5; \(^{19}\)F NMR (375 MHz, CDCl\(_3\)): -114.9. The \(^1\)H and \(^{13}\)C{\(^1\)H} NMR spectra are in accordance with those reported in the literature.\(^3\)

### 2.2. Cross-coupling reaction

A cylinder-type undivided cell was charged with Et\(_4\)NBr (21 mg, 0.1 mmol) and imidazole (0.05 mmol). Anhydrous MeCN (5 mL), water (0.125 mL), 1a (61 mg, 0.5 mmol), and 1f (90 mg, 0.5 mmol) was successively
added. The reaction vessel was equipped with two Pt electrodes ($1 \times 2$ cm$^2$). Then, 4 F/mol (386 C) of electricity was passed through the mixture at 0 °C under constant current conditions (50 mA). The reaction was quenched with saturated aqueous Na$_2$S$_2$O$_3$, and the most of MeCN was removed under reduced pressure. The residue was extracted with AcOEt. The combined organic layers were dried over Na$_2$SO$_4$, filtered, and concentrated under reduced pressure. Purification on silica gel column chromatography (hexane/AcOEt = 4:1) afford 2af (50.4 mg, 0.165 mmol, 33%), 2a (27.8 mg, 0.114 mmol), and 2f (36.8 mg, 0.105 mmol). The diastereomeric ratios were determined by $^1$H NMR analysis.

**Methyl 4-(2,3-dihydroxy-3-phenylbutan-2-yl)benzoate (2af)**

Yellow amorphous; $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.91-7.88 (m, 2H + 2H, major and minor), 7.34-7.14 (m, 7H + 7H, major and minor), 3.90 (s, 3H, major), 3.91 (s, 3H, minor), 2.68 (br s, 1H, major), 2.49 (br s, 1H, major), 2.39 (br s, 1H, minor), 2.21 (br s, 1H, minor), 1.59 (s, 3H, minor), 1.58 (s, 3H, minor), 1.52 (s, 3H, major), 1.49 (s, 3H, major); $^{13}$C $^1$H NMR (100 MHz, CDCl$_3$): $\delta$ 167.1, 149.2, 148.7, 143.4, 143.0, 128.6, 128.4, 128.32, 128.26, 127.5, 127.35, 127.27, 127.2, 127.1, 126.8, 78.9, 78.7, 78.5, 52.1, 25.0, 24.9, 24.73, 24.69; IR (ATR): 3482, 2991, 2949, 1703, 1609, 1437, 1277, 1190, 1113, 1017 cm$^{-1}$; HRMS (ESI) m/z: [M+Na]$^+$ calcd for C$_{18}$H$_{20}$NaO$_4$ 301.1259, found 323.1260.

### 2.3. Large-scale experiment

A 100 mL round bottom two-neck flask was charged with Et$_4$NBr (210 mg, 1 mmol) and imidazole (51.1 mg, 0.75 mmol). Anhydrous MeCN (50 mL), water (1.25 mL), and 1-phenylethanol (1a, 1.22 g, 10 mmol) was successively added. The reaction vessel was equipped with two Pt electrodes ($5 \times 5$ cm$^2$; submerged area, approximately 20 cm$^2$). Then, 4 F/mol of electricity was passed through the mixture at 0 °C under constant current conditions (500 mA). The reaction was quenched with saturated aqueous Na$_2$S$_2$O$_3$, and the most of MeCN was removed under reduced pressure. The residue was extracted with AcOEt. The combined organic layers were dried over Na$_2$SO$_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel to afford the desired product 2a (866.1 mg, 3.58 mmol, 72% yield, dl:meso 90:10) as a white solid.
3. References


4. \(^{1}H\), \(^{13}C\{^{1}H\}\), and \(^{19}F\) NMR spectra
2d
$^{19}$F NMR
(CDCl$_3$, 375 MHz)
$2e$

$^1$H NMR
(CDCl₃, 400 MHz)

$^1$H NMR
(CDCl₃, 400 MHz)

$^{13}$C($^1$H) NMR
(CDCl₃, 100 MHz)

$^{13}$C($^1$H) NMR
(CDCl₃, 100 MHz)
2f
$^1$H NMR
(DMSO-d$_6$, 400 MHz)

2f
$^{13}$C($^1$H) NMR
(DMSO-d$_6$, 100 MHz)
$\text{19F NMR}$
\((\text{CDCl}_3, 375 \text{ MHz})\)
**S24**

**2l**

$^1$H NMR
(CDCl$_3$, 400 MHz)

$^{13}$C{$^1$H} NMR
(CDCl$_3$, 100 MHz)
$\text{F}$

$\text{F}$

$\text{F}$

$\text{OH}$

$\text{HO}$

$\text{2p}$

$^{19}\text{F NMR}$

$(\text{CDCl}_3, 375 \text{ MHz})$