Regioselectivities in Alkyne Activation: Synthesis of 2-(bicyclo[3.1.0]hexan-1-yl)furan Derivatives by Au-Catalyzed Cyclization and Cyclopropanation

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1. Experimentals

**A General Information.** All solvents were reagent grade. All chemicals were purchased from Aldrich Chemical Co. Reactions were normally carried out under argon atmosphere in flame-dried glassware. Merck silica gel 60 (partial size 0.04-0.063 mm) was employed for flash chromatography. The sample was analyzed and/or separated on a μ-Porasil column (25 cm x 2.5 cm) by elution with gradient of ethyl acetate and hexane. The flow rate of the indicated elution solvent was maintained at 3-5 mL/min. $^1$H NMR and $^{13}$C NMR spectra were obtained in CDCl$_3$ at 400 MHz Varian NMR spectrometer.

**Typical Procedure.** To a 5 mL new test tube containing AuBr$_3$ (5 mol%) in dry toluene (0.5 mL) was added a toluene solution (0.5 mL) of 2-alkynyl-1-cyclohexenealdehyde 1m (0.14 mmol) at 0℃ under argon atmosphere. The reaction mixture was stirred for 0.1h at 0℃ by monitoring the reaction progress by TLC periodically. Upon completion, the reaction was quenched with a drop of triethylamine and the solvent was removed under vacuum. The crude product was subjected for flash column chromatography (SiO$_2$, nhexane/ EtOAc = 20:1) to afford the pure products 2m in 80% yield. The spectral data of all products are the followings.

2. Spectroscopic data of compounds 2a-2t, 3m, and 4m

**Spectroscopic data of compound 2a:** (colorless oil, $R_f$ = 0.24, hexane/EtOAc=10/1); FT-IR (neat, cm$^{-1}$) 2981, 2933, 2857, 1732, 1444, 1368, 1244, 1181, 1154, 1095; $^1$H-NMR (400MHz, CDCl$_3$) $\delta$ 6.96 (s, 1H), 4.22–4.12 (m, 4H), 2.86 (d, $J$ = 13.6 Hz, 1H), 2.71 (d, $J$ = 13.6Hz, 1H), 2.65–2.60 (m, 2H), 2.55–2.52 (m, 2H), 2.50–2.47 (m, 2H), 1.73–1.60 (m, 5H), 1.27–1.20 (m, 6H), 0.98–0.94 (m, 1H), 0.60–0.57 (m, 1H); $^{13}$C-NMR (100MHz, CDCl$_3$) $\delta$ 172.71, 171.61, 149.03, 134.59, 122.39, 116.42, 94.36, 61.74, 61.61, 59.63, 39.10, 35.78, 26.22, 24.45, 23.44, 21.22, 20.99, 20.33, 15.67, 13.97; HRMS (EI) calculated for C$_{20}$H$_{26}$O$_5$ 346.1780; found, 346.1782.

**Spectroscopic data of compound 2b:** (colorless oil, $R_f$ = 0.22, hexane/EtOAc=10/1); FT-IR (neat, cm$^{-1}$) 2930, 2855, 1730, 1445, 1246, 1182, 1094; $^1$H-NMR (400MHz, CDCl$_3$) $\delta$ 7.18–7.08 (m, 5H), 6.90 (s, 1H), 4.27–4.16 (m, 4H), 3.09–2.89 (m, 1H), 2.39–2.34 (m, 2H), 2.27–2.24 (m, 2H), 1.46 (d, $J$ = 5.2Hz, 2H), 1.30–1.22 (m, 7H), 1.13 (d, $J$ = 5.6Hz, 1H); $^{13}$C-NMR (100MHz, CDCl$_3$) $\delta$ 172.72, 171.61, 149.03, 134.59, 122.39, 116.42, 94.36, 61.74, 61.61, 59.63, 39.10, 35.78, 26.22, 24.45, 23.44, 21.22, 20.99, 20.33, 15.67, 13.97; HRMS (EI) calculated for C$_{26}$H$_{30}$O$_5$ 422.2093; found, 422.2090.

**Spectroscopic data of compound 2c:** (colorless oil, $R_f$ = 0.35, hexane/EtOAc=10/1); FT-IR (neat, cm$^{-1}$) 2980, 2921, 2846, 1732, 1445, 1366, 1245; $^1$H-NMR (400MHz, CDCl$_3$) $\delta$ 7.18–7.08 (m, 5H), 6.90 (s, 1H), 4.27–4.16 (m, 4H), 3.09–2.89 (m, 1H), 2.39–2.34 (m, 2H), 2.27–2.24 (m, 2H), 1.46 (d, $J$ = 5.2Hz, 2H), 1.30–1.22 (m, 7H), 1.13 (d, $J$ = 5.6Hz, 1H); $^{13}$C-NMR (100MHz, CDCl$_3$) $\delta$ 172.72, 171.61, 149.03, 134.59, 122.39, 116.42, 94.36, 61.74, 61.61, 59.63, 39.10, 35.78, 26.22, 24.45, 23.44, 21.22, 20.99, 20.33, 15.67, 13.97; HRMS (EI) calculated for C$_{15}$H$_{18}$O$_3$ 346.1780; found, 346.1782.
Spectroscopic data of compound 2d: (colorless oil, Rf = 0.29, hexane/EtOAc=10/1); FT-IR (neat, cm\(^{-1}\)) 2981, 2930, 2855, 1833, 1733, 1447, 1250, 1094; \(^1\)H-NMR (400MHz, CDCl\(_3\)) \(\delta\) 7.14–7.06 (m, 3H), 7.00 (d, \(J = 7.2\) Hz, 2H), 6.92 (s, 1H), 4.28–4.17 (m, 4H), 3.02–2.96 (m, 2H), 2.98 (ABq, \(\Delta \delta = 124.0\) Hz, \(J = 14.0\) Hz, 2H), 2.43–2.37 (m, 1H), 2.31–2.25 (m, 3H), 1.73–1.65 (m, 1H), 1.60–1.49 (m, 3H), 1.44–1.33 (m, 2H), 1.30–1.22 (m, 6H), 1.19 (d, \(J = 6.0\) Hz, 1H), 0.98–0.88 (m, 1H); \(^{13}\)C-NMR (100MHz, CDCl\(_3\)) \(\delta\) 172.63, 171.66, 147.12, 140.39, 135.88, 128.31, 127.68, 126.99, 125.74, 125.00, 61.88, 61.76, 57.78, 41.89, 40.00, 37.38, 33.56, 32.61, 29.66, 28.78, 25.91, 25.72, 20.93, 13.98; HRMS (EI) calculated for C\(_{27}\)H\(_{32}\)O\(_3\), 436.2250; found, 436.2242.

Spectroscopic data of compound 2e: (colorless oil, Rf = 0.48, hexane/EtOAc=10/1); FT-IR (neat, cm\(^{-1}\)) 2979, 2930, 2856, 1731, 1445, 1366, 1249, 1180, 1094, 1068, 1012; \(^1\)H-NMR (400MHz, CDCl\(_3\)) \(\delta\) 6.96 (s, 1H), 4.23–4.12 (m, 4H), 2.86 (d, \(J = 13.6\) Hz, 1H), 2.66–2.42 (m, 7H), 1.76 (bs, 2H), 1.68–1.63 (m, 5H), 1.26 (t, \(J = 7.6\) Hz, 6H), 0.90–0.86 (m, 1H), 0.63–0.60 (m, 1H); \(^{13}\)C-NMR (100MHz, CDCl\(_3\)) \(\delta\) 172.72, 171.61, 150.61, 135.80, 126.83, 120.81, 61.74, 61.61, 59.74, 40.38, 35.81, 31.69, 30.39, 25.64, 25.59, 24.23, 22.28, 21.30, 15.67, 13.97; HRMS (EI) calculated for C\(_{27}\)H\(_{32}\)O\(_3\), 374.2093; found, 374.2098.

Spectroscopic data of compound 2f: (colorless oil, Rf = 0.37, hexane/EtOAc=10/1); FT-IR (neat, cm\(^{-1}\)) 2930, 2858, 1757, 1597, 1447, 1346, 1167; \(^1\)H-NMR (400MHz, CDCl\(_3\)) \(\delta\) 7.68 (d, \(J = 8\) Hz, 2H), 7.33 (d, \(J = 7.6\) Hz, 2H), 6.96 (s, 1H), 3.61 (d, \(J = 9.2\) Hz, 2H), 3.27 (d, \(J = 8.8\) Hz, 1H), 2.97 (d, \(J = 9.2\) Hz, 1H), 2.44 (s, 3H), 2.40 (bs, 2H), 2.38–2.25 (m, 2H), 1.68–1.65 (m, 2H), 1.61–1.58 (m, 2H), 1.03 (ABq, \(\Delta \delta = 68.0\) Hz, \(J = 4.8\) Hz, 2H), 0.98 (s, 3H); \(^{13}\)C-NMR (100MHz, CDCl\(_3\)) \(\delta\) 144.45, 143.45, 136.03, 133.57, 129.62, 127.54, 122.22, 119.88, 54.67, 52.44, 28.91, 28.71, 23.28, 23.00, 21.50, 20.96, 20.15, 18.61, 15.75; HRMS (EI) calculated for C\(_{25}\)H\(_{18}\)NO\(_3\), 371.1555; found, 371.1551.

Spectroscopic data of compound 2g: (colorless oil, Rf = 0.37, hexane/EtOAc=10/1); FT-IR (neat, cm\(^{-1}\)) 2928, 2857, 1758, 1597, 1446, 1345, 1164; \(^1\)H-NMR (400MHz, CDCl\(_3\)) \(\delta\) 7.67 (d, \(J = 8\) Hz, 2H), 7.32 (d, \(J = 8.4\) Hz, 2H), 6.94 (s, 1H), 3.62 (d, \(J = 9.2\) Hz, 2H), 3.06 (ABq, \(\Delta \delta = 44.0\) Hz, \(J = 9.2\) Hz, 2H), 2.44 (s, 3H), 2.42–2.39 (m, 2H), 2.35–2.31 (m, 2H), 1.78–1.69 (m, 2H), 1.57–1.45 (m, 2H), 0.99 (ABq, \(\Delta \delta = 112.0\) Hz, \(J = 4.4\) Hz, 0.98 (s, 3H); \(^{13}\)C-NMR (100MHz, CDCl\(_3\)) \(\delta\) 145.90, 143.45, 136.62, 133.53, 129.60, 128.21, 127.53, 126.15, 54.72, 53.85, 32.68, 29.59, 28.48, 28.45, 27.95, 25.85, 25.70, 21.52, 19.35, 16.05; HRMS (EI) calculated for C\(_{25}\)H\(_{18}\)NO\(_3\), 385.1712; found, 385.1717.

Spectroscopic data of compound 2h: (colorless oil, Rf = 0.37, hexane/EtOAc=10/1); FT-IR (neat, cm\(^{-1}\)) 2930, 2856, 1598, 1446, 1348, 1164, 1004, 1015; \(^1\)H-NMR (400MHz, CDCl\(_3\)) \(\delta\) 7.72 (d, \(J = 8.4\) Hz, 2H), 7.35 (d, \(J = 8.0\) Hz, 2H), 7.18–7.12 (m, 3H), 6.98–6.96 (m, 2H), 6.89 (s, 1H), 3.82 (ABq, \(\Delta \delta = 52.0\) Hz, \(J = 9.2\) Hz, 2H), 3.47 (ABq, \(\Delta \delta = 40.0\) Hz, \(J = 9.2\) Hz, 2H), 2.46 (s, 3H), 2.38–2.28 (m, 4H), 2.18–2.14 (m, 1H), 1.66 (d, \(J = 5.2\) Hz, 1H), 1.61–1.55 (m, 2H), 1.47 (bs, 2H); \(^{13}\)C-NMR (100MHz, CDCl\(_3\)) \(\delta\) 143.65, 142.76, 137.26, 136.12, 133.41, 129.73, 128.08, 127.60, 126.72, 122.24.
Spectroscopic data of compound 2i: (colorless oil, \( R_f = 0.37 \); hexane/EtOAc = 10/1); FT-IR (neat, \( cm^{-1} \)) 2922, 2848, 1763, 1598, 1447, 1348, 1166, 1104, 1028; \( ^1\)H-NMR (400MHz, CDCl3) \( \delta \): 7.72 (d, \( J = 8.0Hz, 2H \)), 7.14–7.08 (m, 2H), 6.94 (s, 1H), 6.84 (d, \( J = 6.8Hz, 2H \)), 6.72 (t, \( J = 7.2Hz, 1H \)), 6.62 (d, \( J = 8.0Hz, 2H \)), 3.92 (ABq, \( \Delta \delta = 68.0Hz, J = 9.2Hz, 1H \)), 3.56 (dd, \( J = 4.0, 4.4Hz, 1H \)), 3.36 (d, \( J = 9.2Hz, 2H \)), 2.54 (t, \( J = 4.0Hz, 1H \)), 2.41 (d, \( J = 4.8Hz, 3H \)), 2.36–2.29 (m, 1H), 2.33 (d, \( J = 14.0, 3.6, 6.4Hz, 1H \)), 1.57 (m, 2H), 1.43–1.39 (m, 1H), 1.25 (bs, 1H); \( ^1\)C-NMR (100MHz, CDCl3) \( \delta \): 147.98, 144.26, 138.29, 135.71, 129.23, 127.97, 127.58, 127.12, 126.49, 53.90, 53.79, 35.86, 32.50, 31.65, 29.50, 28.84, 25.74, 25.61, 21.51, 19.73; HRMS (EI) calculated for C25H20NO3S 447.1868; found, 447.1870.

Spectroscopic data of compound 2j: (colorless oil, \( R_f = 0.40 \); hexane/EtOAc = 10/1); FT-IR (neat, \( cm^{-1} \)) 2929, 2850, 1598, 1504, 1476, 1364, 1199, 1119; \( ^1\)H-NMR (400MHz, CDCl3) \( \delta \): 7.22 (d, \( J = 87.6Hz, 2H \)), 7.14–7.08 (m, 2H), 6.94 (s, 1H), 6.84 (d, \( J = 6.8Hz, 2H \)), 6.72 (t, \( J = 7.2Hz, 1H \)), 6.62 (d, \( J = 8.0Hz, 2H \)), 3.92 (ABq, \( \Delta \delta = 68.0Hz, J = 9.2Hz, 1H \)), 3.56 (dd, \( J = 4.0, 4.4Hz, 1H \)), 3.36 (d, \( J = 9.2Hz, 2H \)), 2.54 (t, \( J = 4.0Hz, 1H \)), 2.41 (d, \( J = 4.8Hz, 3H \)), 2.36–2.29 (m, 1H), 2.33 (d, \( J = 14.0, 3.6, 6.4Hz, 1H \)), 1.57 (m, 2H), 1.43–1.39 (m, 1H), 1.25 (bs, 1H); \( ^1\)C-NMR (100MHz, CDCl3) \( \delta \): 147.98, 144.26, 138.29, 135.71, 129.23, 127.66, 127.03, 125.64, 122.11, 120.38, 116.68, 112.31, 55.01, 50.58, 33.64, 33.46, 29.39, 23.13, 23.10, 20.47, 20.14; HRMS (EI) calculated for C24H20NO3S 433.1703; found, 433.1709.

Spectroscopic data of compound 2k: (colorless oil, \( R_f = 0.41 \); hexane/EtOAc = 10/1); FT-IR (neat, \( cm^{-1} \)) 2921, 2843, 1674, 1599, 1505, 1365, 1199, 1031; \( ^1\)H-NMR (400MHz, CDCl3) \( \delta \): 7.25–7.21 (m, 2H), 7.13–7.06 (m, 2H), 6.95 (s, 1H), 6.76–6.70 (m, 3H), 6.61 (d, \( J = 8.0Hz, 2H \)), 3.88 (ABq, \( \Delta \delta = 40.0Hz, J = 9.2Hz, 1H \)), 3.58 (dd, \( J = 4.0, 4.0Hz, 1H \)), 3.36 (d, \( J = 9.2Hz, 1H \)), 2.51 (t, \( J = 4.4Hz, 1H \)), 2.38 (d, \( J = 4.4Hz, 2H \)), 2.31–2.19 (m, 3H), 1.67–1.57 (m, 2H), 1.47–1.42 (m, 42H), 1.36–1.19 (m, 2H); \( ^1\)C-NMR (100MHz, CDCl3) \( \delta \): 147.95, 145.02, 138.45, 136.14, 129.20, 128.30, 127.61, 126.76, 126.39, 125.58, 116.67, 112.30, 55.66, 50.62, 33.60, 33.50, 32.54, 29.89, 29.71, 28.56, 25.94, 25.64; HRMS (EI) calculated for C24H18NO3S 355.1936; found, 355.1930.

Spectroscopic data of compound 2m: (colorless oil, \( R_f = 0.48 \); hexane/EtOAc = 10/1); FT-IR (neat, \( cm^{-1} \)) 2931, 2860, 1558, 1453, 1100, 1073, 1027; \( ^1\)H-NMR (400MHz, CDCl3) \( \delta \): 7.31–7.42 (m, 5H), 7.02 (s, 1H), 4.52 (ABq, \( \Delta \delta = 142.0Hz, J = 12Hz, 2H \)), 3.79 (s, 1H), 2.51 (bs, 4H), 1.84–1.75 (m, 1H), 1.66 (bs, 4H), 1.47 (d, \( J = 10.4Hz, 2H \)), 1.21–1.19 (m, 2H), 1.16 (s, 3H), 1.00 (s, 3H); \( ^1\)C-NMR (100MHz, CDCl3) \( \delta \): 151.04, 140.09, 135.65, 128.80, 127.92, 127.72, 122.79, 116.38, 90.85, 76.09, 49.843, 43.87, 33.824, 30.43, 27.29, 24.25, 24.12, 23.79, 22.32, 21.39, 21.10; HRMS (EI) calculated for C17H12O 336.2089; found, 336.2087.

Spectroscopic data of compound 3m: (colorless oil, \( R_f = 0.12 \); hexane/EtOAc = 10/1); FT-IR (neat, \( cm^{-1} \)) 2929, 2860, 1452, 1063; \( ^1\)H-NMR (400MHz, CDCl3) \( \delta \): 6.02 (bs, 1H), 5.98 (s, 1H), 5.43 (s, 1H), 4.27 (m, 1H), 2.97–2.95 (m, 1H), 2.33–2.22 (m, 4H), 2.11 (dt, \( J = 3.6Hz, 1H \)), 1.00 (s, 3H), 1.00 (s, 3H), 1.00 (s, 3H).
1.97–1.92 (m, 1H), 1.79–1.71 (m, 3H), 1.67 (dd, J = 2.8 Hz, 2H), 1.43–1.37 (m, 1H), 1.09 (s, 3H), 1.02 (s, 3H);

$^{13}$C-NMR (100 MHz, CDCl$_3$) $\delta$ 142.22, 141.30, 140.21, 133.61, 126.21, 121.78, 74.51, 48.40, 43.46, 43.00, 42.81, 35.78, 29.36, 26.87, 26.05, 23.85; HRMS (EI) calculated for C$_{17}$H$_{20}$O$_2$ 230.1671; found, 230.1673.

Spectroscopic data of compound 4m: (colorless oil, $R_f$ = 0.33, hexane/EtOAc = 10/1); FT-IR (neat, cm$^{-1}$) 2978, 2860, 1728, 1591, 1450, 1427; $^1$H-NMR (400 MHz, CDCl$_3$) $\delta$ 7.34–7.29 (m, 5H), 5.84 (s, 1H), 5.37 (bs, 1H), 4.48 (ABq, $\Delta$ $\delta$ = 48 Hz, J = 12.0 Hz, 2H), 3.64 (bs, J = 96.0 Hz, 1H), 3.33 (s, 1H), 2.28 (bs, 2H), 2.13–2.01 (m, 2H), 1.86–1.81 (m, 2H), 1.1.74–1.1.68 (m, 1H), 1.62–1.58 (m, 1H), 1.35–1.26 (m, 2H), 1.08 (s, 3H), 0.87 (s, 3H); $^{13}$C-NMR (100 MHz, CDCl$_3$) $\delta$ 213.69, 138.36, 135.15, 129.08, 128.80, 128.42, 127.35, 120.87, 91.67, 72.60, 49.76, 42.20, 40.13, 37.83, 33.52, 32.22, 27.47, 26.85, 24.53, 23.405; HRMS (EI) calculated for C$_{17}$H$_{20}$O$_2$ 336.2089; found, 336.2087.

Spectroscopic data of compound 2n: (colorless oil, $R_f$ = 0.51, hexane/EtOAc = 10/1); FT-IR (neat, cm$^{-1}$) 2921, 2850, 1762, 1604, 1448, 1363, 1127, 1074, 1028; $^1$H-NMR (400 MHz, CDCl$_3$) $\delta$ 7.20–7.23 (m, 5H), 7.00 (s, 1H), 4.52 (ABq, $\Delta$ $\delta$ = 147.2 Hz, J = 12.4 Hz, 2H), 2.60–2.45 (m, 4H), 1.89–1.84 (m, 1H), 1.78–1.74 (m, 2H), 1.68–1.51 (m, 6H), 1.30 (t, J = 4.4 Hz, 1H), 1.18 (s, 3H), 1.12–1.09 (m, 1H), 1.00 (s, 3H); $^{13}$C-NMR (100 MHz, CDCl$_3$) $\delta$ 151.72, 139.41, 135.47, 128.11, 127.15, 127.02, 122.65, 91.35, 70.36, 47.78, 43.15, 32.83, 30.27, 29.73, 29.23, 25.97, 25.90, 25.73, 24.01, 19.92; HRMS (EI) calculated for C$_{24}$H$_{30}$O$_2$ 350.2246; found, 350.2250.

Spectroscopic data of compound 2o: (colorless oil, $R_f$ = 0.48, hexane/EtOAc = 10/1); FT-IR (neat, cm$^{-1}$) 2932, 2862, 1758, 1684, 1453, 1364, 1095; $^1$H-NMR (400 MHz, CDCl$_3$) $\delta$ 7.27–7.18 (m, 5H), 7.03 (s, 1H), 4.47 (t, J = 8.4 Hz, 1H), 4.40 (ABq, $\Delta$ $\delta$ = 48.4 Hz, J = 12.0 Hz, 2H), 2.57–2.41 (m, 4H), 1.30 (m, 1H), 1.18 (s, 3H), 1.14 (m, 1H), 1.00 (s, 3H); $^{13}$C-NMR (100 MHz, CDCl$_3$) $\delta$ 149.37, 139.02, 134.86, 128.15, 127.55, 127.22, 122.28, 116.97, 81.91, 71.27, 41.47, 37.04, 36.72, 29.93, 29.30, 26.34, 23.45, 23.19, 21.09, 20.40, 10.11; HRMS (EI) calculated for C$_{24}$H$_{30}$O$_2$ 350.2246; found, 350.2250.
308.177; found, 308.1772.

Spectroscopic data of compound 2r: (colorless oil, $R_f = 0.28$, hexane/EtOAc=10/1); FT-IR (neat, cm$^{-1}$) 2928, 2866, 1452, 1389, 1072; $^1$H-NMR (400MHz, CDCl$_3$) $\delta$ 7.29–7.17 (m, 5H), 7.01 (s, 1H), 4.41 (ABq, $\Delta \delta = 58.8$Hz, $J = 12.4$Hz, 2H), 4.30 (t, $J = 8$Hz, 1H), 2.55–2.46 (m, 4H), 1.96 (m, 2H), 1.82–1.73 (m, 4H), 1.60 (m, 2H), 1.46 (q, $J = 6$Hz, 1H), 1.32 (m, 3H), 0.95 (m, 1H); $^{13}$C-NMR (100MHz, CDCl$_3$) $\delta$ 150.99, 138.93, 135.43, 128.26, 128.13, 127.53, 127.20, 123.83, 83.98, 71.33, 32.82, 29.81, 29.28, 28.11, 27.39, 26.05, 25.69, 24.62, 10.71; HRMS (EI) calculated for C$_{22}$H$_{26}$O$_2$: 322.1933; found, 322.1938.

Spectroscopic data of compound 2s: (colorless oil, $R_f = 0.24$, hexane/EtOAc=40/1); FT-IR (neat, cm$^{-1}$) 2933, 2857, 1688, 1559, 1470, 1361, 1249, 1082, 1010; $^1$H-NMR (400MHz, CDCl$_3$) $\delta$ 7.06 (s, 1H), 4.23 (s, 1H), 2.63–2.44 (m, 4H), 1.89 (m, 1H), 1.73 (m, 2H), 1.65–1.52 (m, 4H), 1.32 (t, $J = 4.4$Hz, 1H), 1.13 (m, 1H), 0.93 (s, 9H), 0.00 (s, 3H), -0.09 (s, 3H); $^{13}$C-NMR (100MHz, CDCl$_3$) $\delta$ 150.21, 135.04, 122.25, 116.51, 84.49, 46.39, 43.05, 35.42, 30.65, 26.13, 25.32, 24.93, 23.81, 23.44, 21.81, 20.62, 18.39, 17.85, -4.70, -4.83; HRMS (Cl) calculated for C$_{22}$H$_{37}$O$_2$Si: 361.2563; found, 361.2563.

Spectroscopic data of compound 2t: (colorless oil, $R_f = 0.35$, hexane/EtOAc=40/1); FT-IR (neat, cm$^{-1}$) 2929, 2856, 1755, 1250, 1094, 1077, 1015; $^1$H-NMR (400MHz, CDCl$_3$) $\delta$ 7.00 (s, 1H), 4.61 (t, $J = 8$Hz, 1H), 2.49 (m, 4H), 2.17 (m, 1H), 1.91 (m, 1H), 1.83–1.51 (m, 5H), 1.41 (q, $J = 4.4$Hz, 4H), 1.26 (m, 2H), 1.41 (t, $J = 4.4$Hz, 1H), 0.80 (s, 9H), -0.16 (d, $J = 2.8$Hz, 6H); $^{13}$C-NMR (100MHz, CDCl$_3$) $\delta$ 149.02, 134.86, 122.09, 118.38, 77.53, 30.11, 29.32, 25.74, 24.66, 23.45, 23.33, 22.90, 20.89, 20.34, 18.13, 9.38, -5.17, -5.47; HRMS (Cl) calculated for C$_{30}$H$_{33}$O$_2$Si: 333.2250; found, 323.2242.
3. $^1$H and $^{13}$C NMR Spectra of Compounds 2a-2t, 3m, and 4m

$^1$H-NMR Spectrum of Compound 2a

$^{13}$C-NMR Spectrum of Compound 2a
$^1$H-NMR Spectrum of Compound 2b

$^1$C-NMR Spectrum of Compound 2b
$^1$H-NMR Spectrum of Compound 2c

$^{13}$C-NMR Spectrum of Compound 2c
H-NMR Spectrum of Compound 2d

13C-NMR Spectrum of Compound 2d
H-NMR Spectrum of Compound 2f

$^1$H-NMR Spectrum of Compound 2f

$^{13}$C-NMR Spectrum of Compound 2f
\( ^{1}H\)-NMR Spectrum of Compound 2g

\( ^{13}C\)-NMR Spectrum of Compound 2g
$^1$H-NMR Spectrum of Compound 3h

$^{13}$C-NMR Spectrum of Compound 3h
**1H-NMR Spectrum of Compound 2i**

**13C-NMR Spectrum of Compound 2i**
$^1$H-NMR Spectrum of Compound 2j

$^{13}$C-NMR Spectrum of Compound 2j
**Supplementary Material (ESI) for Chemical Communications**

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**1H-NMR Spectrum of Compound 2k**

**13C-NMR Spectrum of Compound 2k**
Supplementary Material (ESI) for Chemical Communications
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1H-NMR Spectrum of Compound 2m

13C-NMR Spectrum of Compound 2m
H-NMR Spectrum of Compound 3m

C-NMR Spectrum of Compound 3m
$^1$H-NMR Spectrum of Compound 4m

$^1$C-NMR Spectrum of Compound 4m
H-NMR Spectrum of Compound 2n

13C-NMR Spectrum of Compound 2n
H-NMR Spectrum of Compound 2o

C-NMR Spectrum of Compound 2o
$^1$H-NMR Spectrum of Compound 2p

$^{13}$C-NMR Spectrum of Compound 2p
1H-NMR Spectrum of Compound 2q

13C-NMR Spectrum of Compound 2q
$^{1}H$-NMR Spectrum of Compound 2t

$^{13}C$-NMR Spectrum of Compound 2t