Lewis Base-Catalyzed Additions of Trialkoxysilylalkynes to Carbonyl Compounds

Robert B. Lettan II and Karl A. Scheidt*

Department of Chemistry, Northwestern University,
2145 Sheridan Road, Evanston, Illinois 60208

Supporting Information

Table of Contents

General Information	S1-2
Synthesis and characterization of triethoxysilylalkynes 5a-f	S2-4
Synthesis and characterization of propargyl alcohols 6-30	S4-11
Control Experimentation	S11-
The function of 18-crown-6 in additions to ketones	S12-13
²⁹ Si NMR spectroscopy studies	S14
Synthesis and characterization of propargyl amine 32	S14-18
NMR spectra	S19-47

General Information. All reactions were carried out under a nitrogen atmosphere in flame-dried glassware with magnetic stirring. THF was purified by passage through a bed of activated alumina.¹ Reagents were purified prior to use unless otherwise stated following the guidelines of Perrin and Armarego.² Purification of reaction products was carried out by flash chromatography using EM Reagent silica gel 60 (230-400 mesh). Analytical thin layer chromatography was performed on EM Reagent 0.25 mm silica gel 60-F plates. Visualization

-
1. Pangborn, A. B.; Giardello, M. A.; Grubbs, R. H.; Rosen, R. K.; Timmers, F. J. *Organometal.* **1996**, *15*, 1518-1520.
 2. Perrin, D. D. and Armarego, W. L. *Purification of Laboratory Chemicals*; 3rd Ed., Pergamon Press, Oxford. 1988.

was accomplished with UV light and ceric ammonium nitrate stain or potassium permanganate stain followed by heating. Infrared spectra were recorded on a Perkin Elmer 1600 series FT-IR spectrometer. ^1H -NMR spectra were recorded on a Varian Inova 500 (500 MHz) or Mercury 400 (400 MHz) spectrometer and are reported in ppm using solvent as an internal standard (CDCl_3 at 7.26 ppm). Data are reported as (ap = apparent, s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, b = broad; coupling constant(s) in Hz; integration. Proton-decoupled ^{13}C -NMR spectra were recorded on a Varian Inova 500 (125 MHz) spectrometer and are reported in ppm using solvent as an internal standard (CDCl_3 at 77.0 ppm). GCMS experiments were carried out on a computer-interfaced Hewlett-Packard 6890 gas chromatograph equipped with a 5973 network mass selective detector. The column used was a 30 m HP-SMS capillary column with a 0.25 mm inner diameter and a 0.25 μL film thickness.

Benzyl propargylether was prepared according to the procedure of Sugimoto, Ishihara, and Murai³. Trisopropylsilyl propargylether was prepared using the procedure developed by Stüdemann, Ibrahim-Ouali, and Knochel⁴. Potassium ethoxide was opened and weighed out in a nitrogen filled drybox to prevent exposure to air and moisture. All triethoxysilylalkynes were stored at $-20\text{ }^\circ\text{C}$, and were stable to air exposure.

Representative Procedures for Triethoxysilylalkyne Formation:

Method A: To a purged with N_2 round-bottom flask equipped with a magnetic stir bar was added the 1-hexyne (20.37 mmol) by syringe, followed by addition of THF (40 mL) by syringe. The resulting solution was cooled to $-78\text{ }^\circ\text{C}$. To the cooled solution was added *n*-butyllithium (2.5 M in hexanes, 16.98 mmol) by syringe. The reaction was warmed to $0\text{ }^\circ\text{C}$ and stirred for 1-2 hours. In a separate purged with N_2 round-bottom flask equipped with a magnetic stir bar was added triethoxysilylchloride (25.46 mmol) by syringe, followed by addition of THF (50 mL) by syringe. The resulting solution was cooled to $-78\text{ }^\circ\text{C}$. To the cooled solution was added the freshly prepared lithium-alkyne/ THF solution dropwise by cannulation. The resulting reaction mixture was warmed slowly to ambient temperature over six hours, and stirred for an additional 10 hours at ambient temperature. The reaction was concentrated *in vacuo*. The concentrated

3. Sugimoto, T.; Ishihara, J.; Murai, A. *Synlett* **1999**, 5, 541-544.

4. Stüdemann, T.; Ibrahim-Ouali, M.; Knochel, P. *Tetrahedron* **1998**, 54, 1299-1316.

product was triturated with diethyl ether, filtered, and concentrated *in vacuo*. The resulting oil was purified by fractional distillation under reduced pressure to yield **5a** (16.5 mmol) as a colorless liquid.

Method B: To a round-bottom flask equipped with a magnetic stir bar was charged the 1-hexyne (107.60 mmol), diethyl ether (80 mL), and ethyl magnesium bromide (3.0 M in Et₂O, 89.67 mmol). A condenser was attached, and the solution was heated at reflux for 2 hours. The reaction mixture was cooled to room temperature, and tetraethylorthosilicate (161.4 mmol) was added. The reaction was again heated at reflux for 12 hours. The resulting mixture was filtered, and the distillate was concentrated *in vacuo*. The product was purified by fractional distillation under reduced pressure yield **5a** (70.4 mmol) as a colorless liquid.

Triethoxy (hex-1-ynyl)silane (5a): Purified by vacuum distillation, yielding 83% of **5a** as a colorless liquid. BP = 50-55 °C (0.4 torr); IR (film) 2972, 2931, 2887, 2183, 1389, 1167, 1101, 1081, 961, 790, 717 cm⁻¹; ¹H NMR (500 MHz, CDCl₃) δ 3.87 (q, J = 7.0 Hz, 6H); 2.26 (t, J = 7.0 Hz, 2H); 1.54-1.51 (m, 2H); 1.45-1.42 (m, 2H); 1.25 (t, J = 6.5 Hz, 9H); 0.91 (t, J = 7.5 Hz, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 107.64, 76.02, 59.1, 30.4, 22.1, 19.5, 18.2, 13.7; GCMS (EI): Mass calculated for C₁₂H₂₄O₃Si, 244.4. Found 229 [M-CH₃], 199 [M-OCH₂CH₃]. All spectral data are similar to that acquired by Takaki and coworkers.⁵

Triethoxy (3-methyl but-1-ynyl)silane (5b): Purified by vacuum distillation, yielding 81% of **5b** as a colorless liquid. BP = 75-80 °C (0.4 torr); IR (film) 2975, 2930, 2888, 2180, 1445, 1391, 1314, 1167, 1099, 1080, 970, 834, 791 cm⁻¹; ¹H NMR (500 MHz, CDCl₃) δ 3.86 (q, J = 7.0 Hz, 6H); 2.64-2.57 (m, 1H); 1.25 (t, J = 7.0 Hz, 9H); 1.19 (d, J = 7.0 Hz, 6H); ¹³C NMR (125 MHz, CDCl₃) δ 113.0, 74.8, 59.1, 22.7, 21.5, 18.2; GCMS (EI): Mass calculated for C₁₁H₂₂O₃Si, 230.4. Found 215 [M-CH₃], 187 [M-OCH₂CH₃].

Triethoxy (3,3-dimethylbut-1-ynyl)silane (5c): Purified by vacuum distillation, yielding 91% of **5c** as a colorless liquid. BP = 90-97 °C (0.4 torr); IR (film) 2975, 2929, 2895, 2165, 1445, 1393, 1365, 1297, 1254, 1165, 1079, 966, 789 cm⁻¹; ¹H NMR (500 MHz, CDCl₃) δ 3.86 (q, J = 7.0 Hz, 6H); 1.26-1.24 (m, 18H); ¹³C NMR (125 MHz, CDCl₃) δ 115.9, 73.8, 59.1, 30.8 (x2), 18.2; GCMS (EI): Mass Calculated for C₁₂H₂₄O₃Si, 244.4. Found 229 [M-CH₃], 199 [M-OCH₂CH₃].

5. Takaki, K.; Kurioka, M.; Kamata, T.; Takehira, K.; Makioka, Y.; Fujiwara, Y. *J. Org. Chem.* **1998**, 63, 9265-9269.

Triethoxy (2-phenylethynyl)silane (5d): Purified by vacuum distillation, yielding 86% of **5d** as a colorless liquid. BP = 35-40 °C (0.4 torr); IR (film) 2974, 2928, 2888, 2166, 1487, 1443, 1391, 1164, 1099, 1082, 965, 841, 791, 758 cm⁻¹; ¹H NMR (500 MHz, CDCl₃) δ 7.52-7.50 (m, 2H), 7.35-7.29 (m, 3H), 3.94 (q, J = 7.0 Hz, 6H), 1.29 (t, J = 7.0 Hz, 9H); ¹³C NMR (125 MHz, CDCl₃) δ 132.6, 129.6, 128.5, 122.2, 104.35, 85.29, 59.3, 18.3; GCMS (EI): Mass calculated for C₁₄H₂₀O₃Si, 264.4. Found 264.

(3-(Benzyloxy)prop-1-ynyl) triethoxysilane (5e): Purified by vacuum distillation, yielding 79% of **5e** as a yellow liquid. BP = 105-112 °C (0.4 torr); IR (film) 2977, 2928, 2890, 2184, 1450, 1391, 1353, 1167, 1080, 1001, 969, 792, 726 cm⁻¹; ¹H NMR (500 MHz, CDCl₃) δ 7.36-7.35 (m, 5H) 4.62 (s, 2H), 4.21 (s, 2H), 3.90 (q, J = 7.0 Hz, 6H), 1.27 (t, J = 7.0 Hz, 9H); ¹³C NMR (125 MHz, CDCl₃) δ 137.4, 128.7, 128.4, 128.2, 101.1, 83.3, 71.9, 59.3, 57.8, 18.3; GCMS (EI): Mass calculated for C₁₅H₂₄O₄Si, 308.4. Found 202 [M-OBn].

(3-(Triisopropylsilyl)prop-1-ynyl) triethoxysilane (5f): Collected without purification, yielding 93% of **5f** as a colorless liquid; IR (film) 2970, 2940, 2868, 2189, 1465, 1389, 1167, 1101, 1009, 966, 883, 791 cm⁻¹; ¹H NMR (500MHz, CDCl₃) δ 4.40 (s, 2H), 3.86 (q, J = 7.0 Hz, 6H), 1.23 (t, J = 7.0 Hz, 9H), 1.12-1.06 (m, 21H); ¹³C NMR (125 MHz, CDCl₃) δ 104.2, 81.7, 59.2, 52.6, 18.2, 18.1, 12.2; GCMS (EI): Mass calculated for C₁₈H₃₈O₄Si₂, 374.7. Found 331 [M-OCH₂CH₃], 287 [M-2(OCH₂CH₃)], 245 [M-3(OCH₂CH₃)].

General Procedure for the Potassium Ethoxide Promoted Alkyne Additions:

A screw-capped tube was charged with potassium ethoxide (0.12 mmol) and 18-crown-6 ether⁶ (0.0637 mmol) in a nitrogen-filled drybox. The reaction tube was removed from the box and placed under a positive pressure of nitrogen. A solution of the triethoxysilylalkyne (0.637 mmol) in THF (2.5 mL) was added by cannulation to the tube and stirred for one hour. The reaction mixture was cooled to 0°C, after which the aldehyde (0.531 mmol) was added by syringe. The reaction was allowed to stir at 0 °C for 2-5 hours. Upon completed consumption of the electrophile (aldehyde/ketone) as judged by GC analysis, the reaction was quenched by the addition of 0.6 M HCl, and then warmed to room temperature. After stirring at room temperature for one hour, the reaction was poured over saturated aqueous sodium bicarbonate. The aqueous

6. 18-crown-6 ether only added to synthesize products **23-29**.

layer was washed with ethyl acetate (3x) and the combined organic extracts were dried over sodium sulfate, filtered, and concentrated *in vacuo*. The resulting residue was purified by flash column chromatography on silica gel.

1-(4'-methoxyphenyl)hept-2-yn-1-ol (6): Purified with 10% ethyl acetate/hexanes, yielding 84 mg (84%) of **6** as a yellow oil. $R_f = 0.20$ (10:90 ethyl acetate/hexanes); IR (film) 3441, 2958, 2933, 2868, 2361, 2336, 1611, 1511, 1462, 1300, 1249, 1173, 1032, 834 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.46 (m, 2H), 6.89 (m, 2H), 5.39 (s, 1H), 3.80 (s, 3H), 2.27 (q, $J = 7.0$ Hz, 2H), 1.55-1.52 (m, 2H), 1.45-1.41 (m, 2H), 0.92 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 159.8, 133.9, 128.3, 114.1, 87.7, 80.4, 64.6, 55.6, 30.9, 22.2, 18.8, 13.9; GCMS (EI): Mass calculated for $\text{C}_{14}\text{H}_{18}\text{O}_2$ 218.3. Found 218.

1-(4'-methoxyphenyl)-4-methylpent-2-yn-1-ol (7): Purified with 10% ethyl acetate/hexanes, yielding 75 mg (75%) of **7** as a yellow oil. $R_f = 0.5$ (30:70 ethyl acetate/hexanes); IR (film) 3397, 2968, 2934, 2873, 2247, 1609, 1510, 1462, 1303, 1248, 1173, 1035, 991, 834 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.47 (m, 2H), 6.89 (m, 2H), 5.40 (s, 1H), 3.81 (s, 3H), 2.66-2.63 (m, 1H), 1.20 (d, $J = 7.0$ Hz, 6H); ^{13}C NMR (125 MHz, CDCl_3) δ 159.8, 133.9, 128.3, 114.1, 93.0, 79.5, 64.6, 55.6, 23.2, 20.8; GCMS (EI): Mass calculated for $\text{C}_{13}\text{H}_{16}\text{O}_2$ 204.3. Found 204.

1-(4'-methoxyphenyl)-4,4-dimethylpent-2-yn-1-ol (8): Purified with 10% ethyl acetate/hexanes, yielding 73 mg (73%) of **8** as a yellow oil. $R_f = 0.5$ (30:70 ethyl acetate/hexanes); IR (film) 3399, 2965, 2928, 2866, 2234, 1611, 1511, 1459, 1300, 1248, 1173, 1067, 1035, 989, 833 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.47 (m, 2H), 6.89 (m, 2H), 5.39 (s, 1H), 3.81 (s, 3H), 1.26 (s, 9H); ^{13}C NMR (125 MHz, CDCl_3) δ 160.0, 134.1, 128.4, 114.1, 96.1, 79.2, 64.5, 55.6, 31.2, 21.0, 14.3; GCMS (EI): Mass calculated for $\text{C}_{14}\text{H}_{18}\text{O}_2$ 218.3. Found 218.

1-(4'-methoxyphenyl)-3-phenylprop-2-yn-1-ol (9): Purified with 10% ethyl acetate/hexanes, yielding 77 mg (77%) of **9** as an orange oil. $R_f = 0.3$ (20:80 ethyl acetate/hexanes); IR (film) 3428, 3059, 2958, 2932, 2838, 2200, 2162, 1599, 1510, 1458, 1443, 1302, 1252, 1173, 1032, 963, 834, 758, 692 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.55 (m, 2H), 7.48-7.47 (m, 2H), 7.33-7.32 (m, 3H), 6.94-6.93 (m, 2H), 5.65 (s, 1H), 3.83 (s, 3H), 2.31 (bs, 1H); ^{13}C NMR (125 MHz, CDCl_3) δ 133.3, 132.0, 129.9, 128.8, 128.6, 128.4, 127.9, 122.8, 114.3, 89.2, 86.7, 65.0, 55.6; GCMS (EI): Mass calculated for $\text{C}_{16}\text{H}_{14}\text{O}_2$ 238.3. Found 238.

4-(benzyloxy)-1-(4'-methoxyphenyl)but-2-yn-1-ol (10): Purified with 10% ethyl acetate/hexanes, yielding 76 mg (76%) of **10** as a yellow oil. $R_f = 0.4$ (30:70 ethyl acetate/hexanes); IR (film) 3411, 3032, 2932, 2855, 1609, 1510, 1455, 1355, 1302, 1251, 1174, 1109, 1070, 1030, 837, 744, 699 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.48-7.46 (m, 3H), 7.36-7.33 (m, 4H), 6.92-6.90 (m, 2H), 5.47 (s, 1H), 4.61 (s, 2H), 4.27 (s, 2H), 3.81 (s, 3H), 2.55 (bs, 1H); ^{13}C NMR (125 MHz, CDCl_3) δ 159.9, 137.6, 133.1, 128.7, 128.3, 128.2, 114.2, 86.9, 82.7, 72.0, 64.4, 57.7, 55.6; GCMS (EI): Mass calculated for $\text{C}_{18}\text{H}_{18}\text{O}_3$ 282.3. Found 174 [M-OBn].

4-(Triisopropylsiloxy)-1-(4'-methoxyphenyl)but-2-yn-1-ol (11): Purified with 10% ethyl acetate/hexanes, yielding 76 mg (76%) of **11** as a yellow oil. $R_f = 0.8$ (30:70 ethyl acetate/hexanes); IR (film) 3422, 2943, 2866, 1601, 1510, 1464, 1251, 1173, 1126, 883, 685 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.46 (m, 2H), 6.89 (m, 2H), 5.45 (s, 1H), 4.47 (s, 2H), 3.81 (s, 3H), 1.15-1.04 (m, 21H); ^{13}C NMR (125 MHz, CDCl_3) δ 133.5, 132.7, 128.3, 114.1, 85.8, 84.6, 64.5, 55.6, 52.3, 18.2, 12.2; GCMS (EI): Mass calculated for $\text{C}_{20}\text{H}_{32}\text{O}_3\text{Si}$ 348.6. Found 349.

1-Phenylhept-2-yn-1-ol (12): Purified with 10% ethyl acetate/hexanes, yielding 74 mg (74%) of **12** as a yellow oil. $R_f = 0.3$ (10:90 ethyl acetate/hexanes); IR (film) 3447, 2959, 2933, 2868, 2235, 2202, 1643, 1450, 1314, 1266, 1175, 997, 912, 701 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.56-7.54 (m, 2H), 7.40-7.37 (m, 2H), 7.34-7.32 (m, 1H), 5.45 (s, 1H), 2.28 (t, $J = 7.0$ Hz, 2H), 1.55-1.51 (m, 2H), 1.46-1.41 (m, 2H), .93 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 141.5, 128.8, 128.4, 126.9, 87.9, 65.1, 30.9, 22.2, 18.8, 13.9; GCMS (EI): Mass calculated for $\text{C}_{13}\text{H}_{16}\text{O}$ 188.3. Found 188.

1-(2'-methoxyphenyl)hept-2-yn-1-ol (13): Purified with 10% ethyl acetate/hexanes, yielding 82 mg (82%) of **13** as a yellow oil. $R_f = 0.2$ (10:90 ethyl acetate/hexanes); IR (film) 3430, 2958, 2933, 2868, 1597, 1492, 1462, 1285, 1245, 1106, 1026, 754 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.62-7.60 (m, 1H), 7.31-7.29 (m, 1H), 7.01-6.98 (m, 1H), 6.92-6.90 (m, 1H), 5.73 (s, 1H), 3.89 (s, 1H), 2.98 (bs, 1H), 2.30 (t, $J = 7.0$ Hz, 2H), 1.56-1.52 (m, 2H), 1.47-1.42 (m, 2H), 0.93 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 157.0, 129.7, 129.6, 128.2, 121.0, 111.0, 87.4, 79.4, 61.4, 55.8, 31.0, 22.2, 18.8, 13.9; GCMS (EI): Mass calculated for $\text{C}_{14}\text{H}_{18}\text{O}_2$ 218.3. Found 218.

1-(naphthalen-1-yl)hept-2-yn-1-ol (14): Purified with 10% ethyl acetate/hexanes, yielding 76 mg (76%) of **14** as a yellow oil. $R_f = 0.2$ (10:90 ethyl acetate/hexanes); IR (film) 3368, 3050, 2957, 2932, 2866, 1597, 1510, 1459, 1379, 1260, 1164, 1134, 988, 781 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 8.33-8.32 (m, 1H), 7.89-7.83 (m, 3H), 7.56-7.46 (m, 3H), 6.12 (s, 1H), 2.37 (bs, 1H), 2.30 (t, $J = 7.0$ Hz, 2H), 1.57-1.52 (m, 2H), 1.46-1.42 (m, 2H), 0.93 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 136.5, 134.3, 130.8, 129.4, 128.9, 126.5, 126.1, 125.5, 124.7, 124.3, 88.6, 79.9, 63.3, 30.9, 22.3, 18.9, 13.9; GCMS (EI): Mass calculated for $\text{C}_{17}\text{H}_{18}\text{O}$ 238.3. Found 238.

1-(4'-Bromophenyl)hept-2-yn-1-ol (15): Purified with 10% ethyl acetate/hexanes, yielding 76 mg (76%) of **15** as a yellow oil. $R_f = 0.2$ (10:90 ethyl acetate/hexanes); IR (film) 3382, 2958, 2932, 2868, 2234, 2202, 1643, 1587, 1483, 1398, 1264, 1134, 1070, 1007, 844, 774, 741 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.50-7.48 (m, 2H), 7.41-7.40 (m, 2H), 5.40 (s, 1H), 2.64 (t, $J = 6.5$ Hz, 2H), 1.53-1.49 (m, 2H), 1.44-1.39 (m, 2H), 0.91 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 140.5, 131.8, 128.6, 122.4, 88.3, 79.7, 64.4, 30.8, 22.2, 18.7, 13.8; GCMS (EI): Mass calculated for $\text{C}_{13}\text{H}_{15}\text{OBr}$ 267.2. Found 185 [M-Br].

1-p-Tolylhept-2-yn-1-ol (16): Purified with 10% ethyl acetate/hexanes, yielding 80 mg (80%) of **16** as a yellow oil. $R_f = 0.2$ (10:90 ethyl acetate/hexanes); IR (film) 3368, 2958, 2930, 2863, 1513, 1458, 1429, 1379, 1179, 1132, 999, 820, 758 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.44 (m, 2H), 7.19 (m, 2H), 5.42 (s, 1H), 2.37 (s, 3H), 2.28 (t, $J = 7.0$ Hz, 2H), 1.56-1.53 (m, 2H), 1.46-1.42 (m, 2H), 0.93 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 138.8, 138.2, 129.5, 126.9, 87.6, 80.4, 64.9, 30.9, 22.3, 21.4, 18.8, 13.9; GCMS (EI): Mass calculated for $\text{C}_{14}\text{H}_{18}\text{O}$ 202.3. Found 202. All spectral data are similar to that acquired by Sheldon and coworkers.⁷

1-(furan-3-yl)hept-2-yn-1-ol (17): Purified with 10% ethyl acetate/hexanes, yielding 85 mg (85%) of **17** as a red oil. $R_f = 0.2$ (10:90 ethyl acetate/hexanes); IR (film) 3408, 2959, 2933, 2868, 1636, 1501, 1462, 1304, 1134, 1007, 932, 817, 739 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.40 (m, 1H), 6.42 (m, 1H), 6.34 (m, 1H), 5.44 (s, 1H), 2.47 (bs, 1H), 2.27 (t, $J = 7.0$ Hz, 2H), 1.56-1.50 (m, 2H), 1.47-1.41 (m, 2H), 0.92 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ

7. Brink, G.-J. T.; Arends, I. W. C. E.; Hoogenraad, M.; Verspui, G.; Sheldon, R. A. *Adv. Syn. Catal.* **2003**, 345, 1341-1352.

153.9, 143.1, 110.6, 107.7, 87.1, 77.7, 58.5, 30.7, 22.2, 18.7, 13.8; GCMS (EI): Mass calculated for $C_{11}H_{14}O_2$ 178.2. Found 178.

(E)-1-phenylnon-1-en-4-yn-3-ol (18): Purified with 10% ethyl acetate/hexanes, yielding 59 mg (59%) of **18** as a yellow oil. $R_f = 0.3$ (10:90 ethyl acetate/hexanes); IR (film) 3389, 3028, 2958, 2932, 2868, 2213, 1628, 1493, 1450, 1325, 1203, 1068, 966, 749, 694 cm^{-1} ; 1H NMR (500 MHz, $CDCl_3$) δ 7.43-7.41 (m, 2H), 7.35-7.32 (m, 2H), 7.29-7.26 (m, 1H), 6.77 (d, $J = 16.0$ Hz, 1H), 6.32 (dd, $J = 10.0$ Hz, 5.0 Hz, 1H), 5.06 (d, $J = 5.5$ Hz, 1H), 2.29 (t, $J = 7.0$ Hz, 2H), 2.08 (bs, 1H), 1.58-1.52 (m, 2H), 1.49-1.42 (m, 2H), 0.94 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 136.5, 131.7, 129.1, 128.8, 128.2, 127.0, 87.8, 79.4, 63.5, 30.9, 22.2, 18.7, 13.9; GCMS (EI): Mass calculated for $C_{15}H_{18}O$ 214.3. Found 213.

1-cyclohexylhept-2-yn-1-ol (19): Purified with 5% ethyl acetate/hexanes, yielding 56 mg (56%) of **19** as a colorless oil. $R_f = 0.5$ (30:70 ethyl acetate/hexanes); IR (film) 3368, 2927, 2853, 1451, 1379, 1328, 1140, 1080, 1011, 893 cm^{-1} ; 1H NMR (500 MHz, $CDCl_3$) δ 4.13 (d, $J = 5.5$ Hz, 1H), 1.84-1.82 (m, 2H), 1.77-1.72 (m, 3H), 1.52-1.46 (m, 3H), 1.44-1.38 (m, 2H), 1.28-1.20 (m, 3H), 1.18-1.10 (m, 2H), 0.91 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 86.5, 80.4, 67.7, 44.6, 31.1, 28.8, 28.3, 26.7, 26.2, 26.2, 22.2, 18.6, 13.8; GCMS (EI): Mass calculated for $C_{18}H_{22}O$ 194.3. Found 111 [$M-C_6H_{11}$].

2-methylnon-4-yn-3-ol (20): Purified with 5% ethyl acetate/hexanes, yielding 58 mg (58%) of **20** as a colorless oil. $R_f = 0.45$ (30:70 ethyl acetate/hexanes); IR (film) 3364, 2960, 2933, 2872, 1464, 1381, 1325, 1149, 959, 930, 735 cm^{-1} ; 1H NMR (500 MHz, $CDCl_3$) δ 4.14 (d, $J = 5.5$ Hz, 1H), 2.21 (t, $J = 7.0$ Hz, 2H), 1.81 (m, 2H), 1.48 (m, 2H), 1.40 (m, 2H), 0.97 (d, $J = 10.0$ Hz, 3H), 0.96 (d, $J = 10.0$, 3H), 0.90 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 86.4, 80.0, 68.4, 34.9, 31.0, 22.2, 18.6, 18.3, 17.6, 13.8; GCMS (EI): Mass calculated for $C_{10}H_{18}O$ 154.1. Found 111 [$M-CH(CH_3)_2$].

Methyl 4-(1-hydroxyhept-2-ynyl)benzoate (21): Purified with 10% ethyl acetate/hexanes, yielding 78 mg (78%) of **21** as a yellow oil. $R_f = 0.4$ (30:70 ethyl acetate/hexanes); IR (film) 3438, 2957, 2932, 2868, 1722, 1611, 1436, 1412, 1280, 1190, 1109, 1016, 868, 806, 751, 707 cm^{-1} ; 1H NMR (500 MHz, $CDCl_3$) δ 8.05-8.03 (m, 2H), 7.62-7.60 (m, 2H), 5.50 (s, 1H), 3.92 (s, 3H), 2.27 (t, $J = 7.0$ Hz, 2H), 1.54-1.51 (m, 2H), 1.44-1.39 (m, 2H), 0.91 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 167.1, 146.3, 130.1, 130.0, 126.7, 88.5, 79.6, 64.6, 52.4, 30.8, 22.2, 18.7, 13.8; GCMS (EI): Mass calculated for $C_{15}H_{18}O_3$ 246.3. Found 187 [$M-CO_2CH_3$].

2,2-Dimethylnon-4-yn-3-ol (22): Collected without purification, yielding 93 mg (93%) of **22** as a yellow oil. $R_f = 0.7$ (20:80 ethyl acetate/hexanes); IR (film) 3420, 2958, 2934, 2871, 1462, 1363, 1137, 1038, 1003 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 3.97 (s, 1H), 2.21 (t, $J = 6.5$ Hz, 2H), 1.50-1.47 (m, 2H), 1.42-1.39 (m, 2H), 0.96 (s, 9H), 0.90 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 86.4, 80.0, 71.8, 36.0, 31.0, 25.5, 22.1, 18.6, 13.8; GCMS (EI): Mass calculated for $\text{C}_{11}\text{H}_{20}\text{O}$ 168.3. Found 111 [$\text{M}-\text{C}(\text{CH}_3)_3$].

1,1-diphenylhept-2-yn-1-ol (23): Purified with 10% ethyl acetate/hexanes, yielding 73 mg (73%) of **23** as a yellow oil. $R_f = 0.4$ (10:90 ethyl acetate/hexanes); IR (film) 3458, 3061, 3028, 2958, 2932, 2862, 1597, 1489, 1450, 1329, 1204, 1141, 1004, 889, 754, 699, 643 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.66-7.64 (m, 4H), 7.37-7.34 (m, 4H), 7.30-7.27 (m, 2H), 2.79 (s, 1H), 2.38 (t, $J = 7.0$ Hz, 2H), 1.63-1.59 (m, 2H), 1.52-1.48 (m, 2H), 0.98 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 145.8, 128.4, 127.7, 126.3, 88.6, 83.3, 74.7, 31.0, 22.3, 18.9, 13.9; GCMS (EI): Mass calculated for $\text{C}_{19}\text{H}_{20}\text{O}$ 264.4. Found 264.

(E)-1,3-Diphenylnon-1-en-4-yn-3-ol (24): Purified with 5% ethyl acetate/hexanes, yielding 54 mg (54%) of **24** as a yellow oil. $R_f = 0.5$ (20:80 ethyl acetate/hexanes); IR (film) 3426, 3060, 3027, 2958, 2931, 2861, 1560, 1492, 1448, 1329, 1179, 1030, 965, 908, 747, 696 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.71-7.70 (m, 2H), 7.43-7.38 (m, 4H), 7.34-7.31 (m, 3H), 7.28-7.25 (m, 1H), 6.96 (d, $J = 16.0$ Hz, 1H), 6.40 (d, $J = 16.0$ Hz, 1H), 2.55 (bs, 1H), 2.39 (t, $J = 7.0$ Hz, 2H), 1.66-1.60 (m, 2H), 1.55-1.48 (m, 2H), 0.98 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 144.2, 136.6, 133.8, 129.0, 128.6, 128.1, 128.0, 127.1, 126.1, 88.9, 81.4, 73.3, 31.0, 22.3, 18.8, 13.9; GCMS (EI): Mass calculated for $\text{C}_{21}\text{H}_{22}\text{O}$ 290.4. Found 290.

2-Phenyloct-3-yn-2-ol (25): Purified with 10% ethyl acetate/hexanes, yielding 54 mg (54%) of **25** as a yellow oil. $R_f = 0.4$ (20:80 ethyl acetate/hexanes); IR (film) 3401, 2958, 2931, 2861, 2241, 1448, 1365, 1327, 1233, 1177, 1095, 1065, 918, 763, 699 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.67-7.65 (m, 2H), 7.37-7.34 (m, 2H), 7.30-7.27 (m, 1H), 2.28 (t, $J = 7.0$ Hz, 2H), 1.75 (s, 3H), 1.57-1.52 (m, 2H), 1.46-1.42 (m, 2H), 0.93 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 146.5, 128.4, 127.7, 125.2, 86.0, 84.0, 70.3, 33.8, 31.0, 22.2, 18.7, 13.9; GCMS (EI): Mass calculated for $\text{C}_{14}\text{H}_{18}\text{O}$ 202.3. Found 187 [$\text{M}-\text{CH}_3$].

2-Methyl-3-phenylnon-4-yn-3-ol (26): Purified with 5% ethyl acetate/hexanes, yielding 71 mg (71%) of **26** as a yellow oil. $R_f = 0.5$ (20:80 ethyl acetate/hexanes); IR (film) 3456, 3061, 3027, 2961, 2932, 2870, 1448, 1377, 1331, 1217, 1169, 1007, 758, 701 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.63-7.62 (m, 2H), 7.36-7.33 (m, 2H), 7.30-7.27 (m, 1H), 2.34 (t, $J = 7.0$ Hz, 2H), 2.09-2.05 (m, 1H), 1.61-1.56 (m, 2H), 1.51-1.47 (m, 2H), 1.08 (d, $J = 6.5$ Hz, 3H), 0.96 (t, $J = 7.0$ Hz, 3H), 0.81 (d, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 144.8, 128.0, 127.6, 126.5, 87.8, 81.4, 40.6, 31.1, 22.3, 18.7, 18.3, 17.8, 13.9; GCMS (EI): Mass calculated for $\text{C}_{16}\text{H}_{22}\text{O}$ 230.4. Found 187 [$\text{M}-\text{CH}(\text{CH}_3)_2$].

2,2-Dimethyl-3-phenylnon-4-yn-3-ol (27): Purified with 10% ethyl acetate/hexanes, yielding 85 mg (85%) of **27** as a yellow oil. $R_f = 0.6$ (10:90 ethyl acetate/hexanes); IR (film) 3479, 3060, 3026, 2958, 2932, 2870, 1677, 1599, 1483, 1447, 1387, 1362, 1325, 1218, 1180, 1040, 993, 903, 748, 703 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.65-7.64 (m, 2H), 7.35-7.32 (m, 2H), 7.30-7.28 (m, 1H), 2.33 (t, $J = 7.0$ Hz, 2H), 2.27 (bs, 1H), 1.62-1.56 (m, 2H), 1.54-1.48 (m, 2H), 1.04 (s, 9H), 0.98 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 143.8, 128.0, 127.4, 127.2, 86.6, 83.5, 39.7, 31.1, 25.8, 22.3, 18.7, 13.9; GCMS (EI): Mass calculated for $\text{C}_{17}\text{H}_{24}\text{O}$ 244.4. Found 187 [$\text{M}-\text{C}(\text{CH}_3)_3$].

1-(Hex-1-ynyl)cyclohexanol (28): Purified with 5% ethyl acetate/hexanes, yielding 64 mg (64%) of **28** as a colorless oil. $R_f = 0.4$ (20:80 ethyl acetate/hexanes); IR (film) 3392, 2932, 2858, 1449, 1330, 1179, 1063, 963 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 2.21 (t, $J = 7.0$ Hz, 2H), 1.87-1.85 (m, 2H), 1.67-1.65 (m, 2H), 1.57-1.46 (m, 8H), 1.43-1.39 (m, 2H), 0.91 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 146.7, 131.1, 43.8, 32.0, 31.0, 30.0, 28.9, 28.5, 26.8, 25.8; GCMS (EI): Mass calculated for $\text{C}_{12}\text{H}_{20}\text{O}$ 180.3. Found 180.

2,2,3-Trimethylnon-4-yn-3-ol (29): Purified with 10% ethyl acetate/hexanes, yielding 73 mg (73%) of **29** as a colorless oil. $R_f = 0.6$ (10:90 ethyl acetate/hexanes); IR (film) 3474, 2960, 2935, 2872, 1459, 1368, 1325, 1179, 1087, 1002, 910 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 2.19 (t, $J = 7.0$ Hz, 2H), 1.81 (bs, 1H), 1.49-1.45 (m, 2H), 1.42-1.38 (m, 5H), 1.02 (s, 9H), 0.90 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 84.4, 84.0, 74.2, 38.5, 31.1, 25.4, 25.3, 22.2, 18.5, 13.8; GCMS (EI): Mass calculated for $\text{C}_{12}\text{H}_{20}\text{O}$ 182.3. Found 125 [$\text{M}-\text{C}(\text{CH}_3)_3$].

Representative procedure for the other potassium alkoxide promoted reactions (table 1, entries 6 and 7, and Scheme 1):

A screw-capped reaction tube was charged with potassium hydride (0.125 mmol) and 18-crown-6 (0.125 mmol) in a nitrogen-filled drybox. The reaction tube was removed from the box and placed under a positive pressure of nitrogen. To the tube was added THF (0.6 mL), and cooled to 0 °C. A solution of *sec*-phenethyl alcohol (0.125 mmol) in THF (0.2 M) was added by cannulation to the test tube and let stir for one hour at 0 °C. A solution of **5a** (1.20 equiv) in THF (0.2 M) was added by cannulation to the test tube and let stir for one hour at 0 °C. To the reaction was added the aldehyde by syringe and was allowed to stir at 0°C for 2 hours. Upon completion by GC analysis, to the reaction was added 0.6 M HCl, and warmed to room temperature. After stirring at room temperature for one hour, the reaction was poured over saturated aqueous sodium bicarbonate. The aqueous layer was washed with ethyl acetate (3x) and the combined the organic extracts were dried over sodium sulfate, filtered, and concentrated *in vacuo*. The resulting residue was purified by flash column chromatography on silica gel.

To assess the necessity of the triethoxysilylalkyne system, two control experiments were run as illustrated above and described below. The only difference between the two control experiments was the addition or absence of tetraethylorthosilicate: A screw-capped tube was charged with potassium ethoxide (0.49 mmol) in a nitrogen-filled drybox. The reaction tube was removed from the box and placed under a positive pressure of nitrogen. To the tube was added THF (2.5 mL), 1-hexyne (0.49 mmol), tetraethylorthosilicate (0.49 mmol) if necessary, and benzaldehyde (0.49 mmol), each by syringe. The reaction was stirred for 5 hours at ambient temperature and then quenched by the addition of 0.6 M HCl. After stirring for 30 minutes, the reaction was poured over saturated aqueous sodium bicarbonate. The aqueous layer was washed with ethyl acetate (3x) and the combined organic extracts were dried over sodium sulfate, filtered, and concentrated *in vacuo*. Neither NMR (¹H, 500 MHz) and GC analysis of the unpurified reaction mixtures showed *any traces* of desired propargyl alcohol **12**.

Determination of the function of 18-crown-6 ether in tertiary propargyl alcohol formation:

Through initial studies it was apparent that 18-crown-6 ether was necessary as an additive along with potassium ethoxide to promote complete conversion of ketone starting materials in the addition of **5a**. To delineate the role of 18-crown-6 in these reactions, experiments were conducted to accurately measure the level of conversion as a function of amount of crown ether present. Gas chromatographic analysis using dodecane as an internal standard permitted the calculation of pinacolone conversion.

mol% KOEt	mol% 18-crown-6	% conversion
20	0	15
20	20	100
100	0	85

The data clearly indicate that the reaction proceeds to 85% with 100 mol% potassium ethoxide. More importantly, the use of *only* 20 mol% KOEt affords very low levels of conversion (15%). However, the addition of 20 mol% 18c6 to 20 mol% KOEt afford 100% conversion. One explanation to account for this data is that if the product tertiary propargyl potassium alkoxide (**32**) is responsible for catalytic turnover (i.e. undergoing addition to **5a** to form the reactive silicate). The function of 18-crown-6 presumably is to coordinate with potassium, thus generating a more nucleophilic propargyl anion that undergoes a more favored addition to the triethoxysilylalkyne. The crown ether is unnecessary in additions of **5a** to aldehydes due to the decreased steric bulk of the corresponding secondary propargyl potassium alkoxide.

Further evidence for the catalytic cycle above would be the observed generation of tetraethylorthosilicate both in reactions with catalytic and stoichiometric amounts of potassium ethoxide. The generation of the triethoxysilyl-protected propargyl alcohol is **only** observed under catalytic reaction conditions (via GC).

Pentavalent silicon studies using ^{29}Si NMR spectroscopy:

To a valved NMR tube was charged potassium ethoxide (1.0 equiv) and 18-crown-6 ether (1.0 equiv). To the tube was added tetrahydrofuran- d_8 and cooled to $-78\text{ }^\circ\text{C}$. To the tube was added a $-78\text{ }^\circ\text{C}$ solution of either tetraethylorthosilicate or **5a** (1 equiv) in tetrahydrofuran- d_8 by syringe. The reaction was then analyzed by ^{29}Si NMR spectroscopy at $-68\text{ }^\circ\text{C}$. Spectral data are similar to that acquired by Holmes and coworkers.⁸

Silane	^{29}Si NMR lit. ⁸ (δ)	^{29}Si NMR (δ)
$\text{Si}(\text{OEt})_4$	- 82.4	- 80.6
$\text{Si}(\text{OEt})_5^-$	-131.1	-130.0
$\text{PhSi}(\text{OEt})_3$	- 58.0	-
$\text{PhSi}(\text{OEt})_4^-$	- 117.3	-
$\text{H}_9\text{C}_4\text{—}\equiv\text{Si}(\text{OEt})_3$	-	- 74.6
$\text{H}_9\text{C}_4\text{—}\equiv\text{Si}(\text{OEt})_4^-$	-	- 125.6

Propargyl amine formation:

A screw-capped reaction tube was charged with potassium ethoxide (0.628 mmol) and 18-crown-6 ether (0.628 mmol) in a nitrogen-filled drybox. The reaction tube was removed from the box and placed under a positive pressure of nitrogen. To the tube was added THF by syringe (0.5 mL), and cooled to $0\text{ }^\circ\text{C}$. To the mixture was added a cooled to $0\text{ }^\circ\text{C}$ solution of **5a** (0.628 mmol) in THF (1 mL) by cannulation and let stir for 30 minutes. The reaction mixture was cooled to $-78\text{ }^\circ\text{C}$ after which a cooled to $-78\text{ }^\circ\text{C}$ solution of (*R*)-(benzylidene)-*t*-butanesulfinamide⁹ (**30**, 0.418 mmol) in THF (0.5 mL) was added by cannulation. The reaction

8. Comparable results seen in ^{29}Si NMR spectroscopy studies taken in toluene- d_8 : Swamy, K. C. K.; Chandrasekhar, V.; Harland, J. J.; Holmes, J. M.; Day, R. O.; Holmes, R. R. *J. Am. Chem. Soc.* **1990**, *112*, 2341-2348.
9. Ellman, J. A.; Cogan, D. A.; Liu, G. *J. Am. Chem. Soc.* **1997**, *119*, 9913-9914.

was allowed to stir at $-78\text{ }^{\circ}\text{C}$ for 5 hours. To the reaction was added saturated aqueous sodium bicarbonate, and warmed to room temperature. After stirring at room temperature for one hour, the reaction was extracted with ethyl acetate (3x). The combined the organic extracts were dried over sodium sulfate, filtered, and concentrated *in vacuo*. The resulting residue was purified by flash column chromatography on silica gel to yield **31**.

(*S*, *R*)-2-Methylpropane-2-sulfinic Acid (1-Phenylhept-2-ynyl) amide (31**):** Purified with 10% ethyl acetate/hexanes yielding 95% of **32** as a yellow oil; $R_{f(\text{major})} = 0.25$ (30:70 ethyl acetate/hexanes); $R_{f(\text{minor})} = 0.35$ (30:70 ethyl acetate/hexanes); IR (film) 3187, 3063, 3031, 2957, 2932, 2871, 2362, 2337, 1494, 1456, 1363, 1064, 699 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 7.52-7.51 (m, 2H), 7.38-7.31 (m, 3H), 5.26 (s, 1H), 3.40 (s, 1H), 2.25 (t, $J = 6.0$ Hz, 2H), 1.53-1.49 (m, 2H), 1.45-1.40 (m, 2H), 1.22 (s, 9H), 0.91 (t, $J = 7.0$, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 140.2, 129.0, 128.8, 128.6, 127.9, 87.9, 78.4, 56.0, 51.5, 30.9, 22.8, 22.1, 18.7, 13.8; GCMS (EI): Mass calculated for $\text{C}_{17}\text{H}_{25}\text{NOS}$ 291.2. Found 291.

General Method for Metal-alkyne additions to sulfonyl amide **30**:

Preparation of the lithium acetylide of 1-hexyne: To a nitrogen-filled flask under a positive pressure of nitrogen was added THF (0.5M) and 1-hexyne (1.0 equiv) by syringe, and cooled to $-78\text{ }^{\circ}\text{C}$. To the flask was added *n*-butyl lithium (1.5 M in THF, 1.0 equiv) slowly by syringe. The reaction was warmed to $0\text{ }^{\circ}\text{C}$, and let stir for 2 hours. The resulting solution was used in the general alkoxide promoted addition reaction procedure as written below.

Preparation of the grignard reagent of 1-hexyne: To a nitrogen-filled flask under a positive pressure of nitrogen was added THF (0.5M), 1-hexyne (1.0 equiv), and ethyl magnesium bromide (3.0 M in Et_2O , 1.0 equiv) by syringe. A condenser was attached, and the solution was heated at reflux for 2 hours. The resulting solution was used in the general alkoxide promoted addition reaction procedure as written below.

Preparation of the potassium acetylide of 1-hexyne: To a flask was charged potassium hydride (1.0 equiv) and 18-crown-6 ether (1.0 equiv) in a nitrogen filled glove box. The flask was

removed from the box and placed under a positive pressure of nitrogen. To the flask was added THF (0.5 M) by syringe, and cooled to 0 °C. To the flask was added 1-hexyne by syringe, and let stir at 0 °C for 1 hour. The resulting solution was used in the general alkoxide promoted addition reaction procedure as written below.

General addition metal-acetylenes to **30:** A solution of M-hexyne (M = Li, K, MgBr) in THF was cooled to 0 °C. To the solution was added a cooled to 0 °C solution of **30**⁹ in THF, and let stir at 0 °C until completion. Reaction was quenched with saturated aqueous sodium bicarbonate, and warmed to room temperature. After stirring at room temperature for one hour, the reaction was extracted with ethyl acetate (3x). The combined the organic extracts were dried over sodium sulfate, filtered, and concentrated *in vacuo* to yield **31** as an unpurified mixture. Diastereomeric ratios were determined via NMR analysis of the unpurified products. Purification was done per above to determine yield.

M	time	temp.	% yield	diastereomeric ratio
Li	2 h	0 °C	99	7:1
MgBr	16 h	0 °C	74	3:1
K	16 h	0 °C	30	1:2
(EtO) ₃ Si	2 h	0 °C	88	1:10
Li	12 h	-78 °C	NR	-
MgBr	12 h	-78 °C	NR	-
K	12 h	-78 °C	NR	-
(EtO) ₃ Si	5 h	-78 °C	95	1:20

Determination of New Propargyl Amine Stereocenter:

Desulfonation and Boc-protection: To a flask containing **31** (0.351 mmol) was added MeOH (2 mL) and cooled to 0 °C. To the solution was added HCl (4 M in 1,4-dioxane, 1.40 mmol) slowly by syringe, and let stir at 0 °C for 20 minutes. The reaction was warmed to ambient temperature

and concentrated *in vacuo* to yield 1-phenylhept-2-yn-1-amine¹⁰ as a white solid. To the flask was added CH₂Cl₂ (1.0 mL) and triethylamine (0.527 mmol) by syringe, and cooled to 0 °C. To the reaction was added di-*tert*-butyl dicarbonate (0.421 mmol) and let stir 3 hours. The reaction was quenched with 0.6 M HCl (1mL), and partitioned. The organic layer was washed with 0.6 M HCl (x2) and brine (x2), dried over magnesium sulfate, and concentrated by evaporation to yield *tert*-butyl 1-phenylhept-2-ynylcarbamate¹¹ as a white solid.

Alkyne reduction: To a flask was charged Lindlar's catalyst¹² (50 mg) and purged first with N₂, then with H₂. To the flask was added ethyl acetate (1.0 mL) by syringe, and let stir under H₂ for 1 hour. To the mixture was added a solution of *tert*-butyl 1-phenylhept-2-ynylcarbamate (0.351 mmol) in ethyl acetate (1.0 mL) by syringe and let stir for 3 hours. To the reaction was added more Lindlar's catalyst (50 mg), purged with H₂, and let stir under H₂ for 12 hours. The reaction mixture was filtered over a thin layer of celite, and concentrated by evaporation. The product was purified by flash chromatography (5:95 EtOAc/Hexanes, R_f = 0.25) to yield *tert*-butyl (Z)-1-phenylhept-2-enylcarbamate as yellow oil.

Ozonolysis: To a flask containing *tert*-butyl (Z)-1-phenylhept-2-enylcarbamate (0.180 mmol) was added MeOH (2 mL) and CH₂Cl₂ (0.5 mL), cooled to -78 °C, and bubbled with ozone for 1 hour. The resulting solution was purged with N₂. To the purged reaction was added NaBH₄ (0.359 mmol), and stirred at -78 °C for 1 hour. The reaction was let warm slowly to ambient temperature while stirring for 8 hours. The solvent was removed *in vacuo*. The remaining residue was partitioned with 0.6 M HCl and CHCl₃ and the aqueous layer was extracted with CHCl₃ (3x). The combined organic layers were dried over sodium sulfate, and concentrated by evaporation. The product was purified by flash chromatography (50:50 EtOAc/Hexanes) to yield *tert*-butyl (R)-2-hydroxy-1-phenylethylcarbamate¹³ (**32**) as a white solid.

***tert*-Butyl (R)-2-hydroxy-1-phenylethylcarbamate (32)**: Purified with 50% diethyl ether/hexanes, yielding 73 mg (73%) of **32** as a colorless oil; [α]_D = -31.3 (*c* = 0.3, CHCl₃); R_f = 0.16 (50:50 diethyl ether/ hexanes); ¹H NMR (500 MHz, CDCl₃) δ 1.44 (s, 9H), 3.85-3.86 (m, 2H), 4.78 (m, 1H), 5.21 (d, *J* = 7.0 Hz, 1H) 7.29-7.38 (m, 5H); ¹³C NMR (125 MHz, CDCl₃) δ 156.5, 139.9, 129.0, 128.0, 126.8, 80.2, 67.3, 57.1, 28.5; Optical rotation data is in agreement

¹⁰ Barrow, J. C.; Ngo, P. L.; Pellicore, J. M.; Selnick, H. G.; Nantermet, P. G. *Tetrahedron Lett.* **2001**, 42, 2051-2054

¹¹ Barberis, C.; Voyer, N.; Roby, J.; Chénard, S.; Tremblay, M.; Labrie, P. *Tetrahedron* **2001**, 57, 2965-2972

¹² Lindlar, H.; Dubuis, R. *Org. Synth.* **V**, 880.

¹³ Clark, R. D.; Heathcock, C. H. *J. Org. Chem.* **1976**, 41, 1396-1403.

with Cox and Harwood¹⁴ and O'Brien and coworkers¹⁵. All NMR data corresponds to that acquired by Dondoni, Perrone, and Semola.¹⁶

¹⁴ Cox, G. G.; Harwood, L. M. *Tetrahedron Asymmetry* **1994**, 5, 1669-1672.

¹⁵ O'Brien, P. M.; Sliskovic, D. R.; Blankley, C. J.; Roth, B. D.; Wilson, M. W.; Hamelchle, K. L.; Krause, B. R.; Stanfield, R. L. *J. Med. Chem.* **1994**, 37, 1810-1822.

¹⁶ Dondoni, A.; Perrone, D.; Semola, T. *Synthesis* **1995**, 181-186.

Selected NMR Spectra