Preparation of Asymmetrical Polyynes by a Solid-Supported Glaser-Hay Reaction

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Supporting Information

General. Solvents and reagents were obtained from either Sigma-Aldrich or Fisher Scientific and used without further purification, unless noted. Tritylchloride resin, 100-200 mesh, 1% DVB crosslinking, was purchased from Advanced Chemtech. Reactions were conducted under ambient atmosphere with non-distilled solvents. NMR data was acquired on a Varian Gemini 400 MHz. GC/MS analysis was conducted on an Agilent Technologies 6890N GC system interfaced with a 5973N mass selective detector. An Agilent J&W GC capillary column (30 m length, 0.32 mm diameter, 0.25 μm film) was employed with a splitless injection (250 °C inlet, 8.8 psi) with an initial 70 °C hold (2 min) and ramped for 15 min to 230 °C. Fluorescence data was measured using a PerkinElmer LS 55 Luminescence Spectrometer.

Immobilization of Alcohol onto Trityl Chloride Resin in Low Loading Conditions

To flame dried vial was added trityl chloride resin (200 mg, 0.36 mmol, 1 equiv.) and dichloromethane (5 mL). The resin was swelled at room temperature with gentle stirring for 15 min. Alcohol (25.0 μL, ~1.2 equiv.) was added to reaction, followed by triethylamine (10.0 μL, 0.072 mmol, 0.2 equiv). The mixture was stirred at room temperature for 16 h. The resin was transferred to a syringe filter and washed with DCM.
and MeOH (5 alternating rinses with 5 mL each). The resin was swelled in CH₂Cl₂ and
dried under vacuum for 45 min before further use. Resin loading was assessed via
cleavage of 15 mg resin in 2% TFA in DCM (200 µL) at room temperature for 1 hour.
After filtration of resin, loading was determined both by mass of cleaved product and by
GC/MS analysis of integrated alcohol peaks from a standard curve and the cleaved resin.

**Polyyne Extension Protocol**

Trimethylsilylacetylene (160 µL, 1.05 mmol, 15 equiv.) was added to a flame dried vial
containing the alcohol derivatized trityl resin (100 mg, 0.07 mmol, 1 equiv.), and
tetrahydrofuran (2.0 mL). The copper catalyst (20 mg, 1.06 mmol.) and
tetramethylethylenediamine (20 µL, 0.132 mmol.) were added to a separate flame-dried
vial then dissolved in tetrahydrofuran (2.0 mL). The catalyst mixture was then added to
the resin in one portion and stirred at 60 °C for 16 h. The resin was transferred to a
syringe filter and washed with DCM and MeOH (5 alternating rinses with 5 mL each).

**Regeneration of Terminal Alkyne**

The TMS group was then cleaved by incubation in 1M tetra-n-butylammonium fluoride
trihydrate in DCM (TBAF, 1 mL, 1 h). Then the reaction was again transferred to a
syringe filter and washed with DCM and MeOH (5 alternating rinses with 5 mL each)
and dried under vacuum for 45 minutes. Product was weighed and transferred to flame
dried vial for future use.
**Polyyne Capping**

Soluble alkyne (15 equiv.) was added to a flame dried vial containing the desired alcohol derivatized trityl resin and tetrahydrofuran (2 mL). The copper catalyst (20 mg, 1.06 mmol.) and tetramethylethylenediamine (20 µL, 0.132 mmol.) were added to a separate flame-dried vial then dissolved in tetrahydrofuran (2 mL). The catalyst mixture was then added to the resin in one portion and stirred at 60 °C for 16 h. The resin was transferred to a syringe filter and washed with DCM and MeOH (5 alternating rinses with 5 mL each). The product was then cleaved from the resin by treatment with 2% TFA (DCM, 1 h) and filtered into a vial. If necessary, a short silica plug was utilized to remove unreacted starting material (1:1 EtOAc/Hex).

**Analytical Data**

**Compound 6**: The solvent was removed *in vacuo* to give 6 as a solid (13 mg, 0.070 mmol, 99%) \(^1\)H NMR (400 MHz; CDCl\(_3\)): \(\delta\) 7.44 (d, \(J = 7.6\) Hz, 2H), 6.85 (d, \(J = 7.6\) Hz, 2H), 4.14 (s, 2H), 3.82 (s, 3H); GCMS (R\(_t\)=9.93 min) calculated for C\(_{12}\)H\(_{10}\)O\(_2\) 186.1, found 186.2.

**Compound 7**: The solvent was removed *in vacuo* to give 7 as a solid (10 mg, 0.049 mmol, 68%) \(^1\)H NMR (400 MHz; CDCl\(_3\)): \(\delta\) 7.44 (d, \(J = 7.6\) Hz, 2H), 6.86 (d, \(J = 7.6\) Hz, 2H), 4.38 (s, 2H), 3.82 (s, 3H); GCMS (R\(_t\)=11.02 min) calculated for C\(_{14}\)H\(_{10}\)O\(_2\) 210.2, found 210.3.

**Compound 8**: The solvent was removed *in vacuo* to give 8 as a solid (11 mg, 0.037 mmol, 67%) \(^1\)H NMR (400 MHz; CDCl\(_3\)): \(\delta\) 7.46 (d, \(J = 7.6\) Hz, 2H), 6.84 (d, \(J = 7.6\) Hz, 2H), 4.38 (s, 2H), 3.82 (s, 3H); GCMS (R\(_t\)= 18.39 min) calculated for C\(_{16}\)H\(_{10}\)O\(_2\) 234.3, found 234.2.

**Compound 9**: The solvent was removed *in vacuo* to give 9 as a solid (8 mg, 0.031 mmol, 44%) \(^1\)H NMR (400 MHz; CDCl\(_3\)): \(\delta\) 7.42 (d, \(J = 7.6\) Hz, 2H), 6.85 (d, \(J = 7.6\) Hz, 2H), 4.42 (s, 2H), 3.82 (s, 3H); GCMS (R\(_t\)=14.35 min) calculated for C\(_{18}\)H\(_{10}\)O\(_2\) 258.3, found 258.2.
**Compound 10**: The solvent was removed *in vacuo* to give 10 as a solid isolated as the TFA salt (7 mg, 0.031 mmol, 45%). $^1$H NMR (400 MHz; CD$_3$OD): δ 5.21 (s, 2H), 4.35 (s, 2H), 3.39 (s, 2H); GCMS ($R_t$ = 6.01 min) calculated for C$_6$H$_7$NO 109.1, found 109.1.

**Compound 11**: The solvent was removed *in vacuo* to give 11 as a solid isolated as the TFA salt (8 mg, 0.032 mmol, 46%). $^1$H NMR (400 MHz; CD$_3$OD): δ 3.97 (s, 2H), 3.75 (s, 2H), 2.70 (s, 2H); GCMS ($R_t$ = 7.03 min) calculated for C$_8$H$_7$NO 133.2, found 133.2.

**Compound 12**: The solvent was removed *in vacuo* to give 12 as a solid isolated as the TFA salt (9 mg, 0.032 mmol, 46%). $^1$H NMR (400 MHz; CD$_3$OD): δ 4.00 (s, 2H), 3.58 (s, 2H), 2.95 (s, 2H); GCMS ($R_t$ = 8.43 min) calculated for C$_{10}$H$_7$NO 157.2, found 157.2.

**Compound 13**: The solvent was removed *in vacuo* to give 13 as a solid isolated as the TFA salt (10 mg, 0.034 mmol, 48%). $^1$H NMR (400 MHz; CD$_3$OD): δ 4.00 (s, 2H), 3.55 (s, 2H), 2.98 (s, 2H); GCMS ($R_t$ = 9.15 min) calculated for C$_{12}$H$_7$NO 181.2, found 181.9.

**Compound 14**: The solvent was removed *in vacuo* to give 14 as a solid (8 mg, 0.068 mmol, 95%). $^1$H NMR (400 MHz; CDCl$_3$): δ 7.49 (t, J = 5.9, 2H), 7.34-7.26 (m, 3H), 4.45 (s, 2H), 1.94 (s, 1H); GCMS ($R_t$ = 9.20 min) calculated for C$_{11}$H$_8$O: 156.1, found 156.2.

**Compound 15**: The solvent was removed *in vacuo* to give 15 as a solid (8 mg, 0.044 mmol, 63%). $^1$H NMR (400 MHz; CDCl$_3$): δ 7.50 (t, J = 5.9, 2H), 7.38-7.28 (m, 3H), 4.45 (s, 2H), 1.94 (s, 1H); GCMS ($R_t$ = 15.06 min) calculated for C$_{13}$H$_8$O: 180.2, found 180.2.

**Compound 16**: The solvent was removed *in vacuo* to give 16 as a solid (9 mg, 0.044 mmol, 63%). $^1$H NMR (400 MHz; CDCl$_3$): δ 7.55 (t, J = 5.9, 2H), 7.40-7.30 (m, 3H), 4.45 (s, 2H), 1.94 (s, 1H); GCMS ($R_t$ = 10.08 min) calculated for C$_{15}$H$_8$O: 204.2, found 204.2.

**Compound 17**: The solvent was removed *in vacuo* to give 17 as a solid (9 mg, 0.039 mmol, 56%). $^1$H NMR (400 MHz; CDCl$_3$): δ 7.56 (t, J = 5.9, 2H), 7.44-7.38 (m, 3H), 4.45 (s, 2H), 1.94 (s, 1H); GCMS ($R_t$ = 9.90 min) calculated for C$_{17}$H$_8$O: 228.3, found 228.3.

**Compound 18**: The solvent was removed *in vacuo* to give 18 as a solid (8 mg, 0.058 mmol, 84%) $^1$H NMR (400 MHz; CDCl$_3$): δ 4.32 (s, 2H), 2.29 (t, J = 6.8 Hz, 3H), 1.52 (m, 2H), 1.42 (sextet, J = 7.2 Hz, 2H), 0.91 (t, J = 7.23 Hz, 3H); GCMS ($R_t$ = 7.29 min) calculated for C$_9$H$_{12}$O 136.1, found 136.0.

**Compound 19**: The solvent was removed *in vacuo* to give 19 as a solid (6 mg, 0.037 mmol, 53%). $^1$H NMR (400 MHz; CDCl$_3$): δ 4.32 (s, 2H), 2.30 (t, J = 6.8 Hz, 3H), 1.55 (m, 2H), 1.42 (sextet, J = 7.2 Hz, 2H), 0.93 (t, J = 7.23 Hz, 3H); GCMS ($R_t$ = 10.61 min) calculated for C$_{11}$H$_{12}$O 160.2, found 160.2.
**Compound 20:** The solvent was removed *in vacuo* to give 20 as a solid (5 mg, 0.027 mmol, 38%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 4.36 (s, 2H), 2.30 (t, J = 6.8 Hz, 2H), 1.55 (m, 2H), 1.42 (sextet, J = 7.2 Hz, 2H), 1.00 (t, J = 7.23 Hz, 3H); GCMS (R$_f$ = 10.28 min) calculated for C$_{13}$H$_{12}$O 184.2, found 184.2.

**Compound 21:** The solvent was removed *in vacuo* to give 21 as a solid (9 mg, 0.028 mmol, 41%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 4.38 (s, 2H), 2.35 (t, J = 6.8 Hz, 3H), 1.60 (m, 2H), 1.42 (sextet, J = 7.2 Hz, 2H), 1.02 (t, J = 7.23 Hz, 3H); GCMS (R$_f$ = 11.71 min) calculated for C$_{15}$H$_{12}$O 208.3, found 208.3.

**Compound 22:** The solvent was removed in vacuo to give compound 22 as a white solid (5 mg, 0.032 mmol, 99%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 4.36 (s, 4H); GCMS calculated for C$_6$H$_6$O 110.0, found 110.1.

**Compound 23:** The solvent was removed in vacuo to give compound 23 as a white solid (4 mg, 0.026 mmol, 82%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 4.36 (s, 4H); GCMS calculated for C$_8$H$_6$O 134.0, found 134.1.

**Compound 24:** The solvent was removed in vacuo to give compound 24 as a white solid (3 mg, 0.018 mmol, 57%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 4.38 (s, 4H); GCMS calculated for C$_{10}$H$_7$O 158.0, found 158.0.

**Compound 25:** The solvent was removed in vacuo to give compound 25 as a white solid (3 mg, 0.016 mmol, 49%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 4.35 (s, 4H); GCMS calculated for C$_{12}$H$_7$O 182.0, found 182.1.

**Compound 26:** The solvent was removed in vacuo to give compound 26 as a solid (2 mg, 0.019 mmol, 55%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 8.01 (d, J = 7.5 Hz, 1H), 7.65 (t, J = 7.4 Hz, 1H), 7.32 (t, J = 7.5 Hz, 1H), 6.91 (d, J = 7.4 Hz, 1H), 4.38 (s, 2H). GCMS calculated for C$_{10}$H$_7$NO 157.1, found 157.2.

**Compound 27:** The solvent was removed in vacuo to give compound 27 as a solid (2 mg, 0.011 mmol, 34%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 8.01 (d, J = 7.5 Hz, 1H), 7.65 (t, J = 7.4 Hz, 1H), 7.32 (t, J = 7.5 Hz, 1H), 6.91 (d, J = 7.4 Hz, 1H), 4.38 (s, 2H). GCMS calculated for C$_{12}$H$_7$NO 181.1, found 181.2.

**Compound 28:** The solvent was removed in vacuo to give compound 28 as a solid (2 mg, 0.009 mmol, 30%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 8.01 (d, J = 7.5 Hz, 1H), 7.65 (t, J = 7.4 Hz, 1H), 7.32 (t, J = 7.5 Hz, 1H), 6.91 (d, J = 7.4 Hz, 1H), 4.38 (s, 2H). GCMS calculated for C$_{14}$H$_7$NO 205.1, found 205.1.

**Compound 29:** The solvent was removed in vacuo to give compound 29 as a solid (2 mg, 0.008 mmol, 27%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 8.01 (d, J = 7.5 Hz, 1H), 7.65 (t, J = 7.4 Hz, 1H), 7.32 (t, J = 7.5 Hz, 1H), 6.91 (d, J = 7.4 Hz, 1H), 4.38 (s, 2H). GCMS calculated for C$_{16}$H$_7$NO 229.1, found 229.2.
Compound 30: The solvent was removed in vacuo to give 30 as a solid. (8 mg, 0.032 mmol, 73%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 7.53 (d, $J=$7.5 Hz, 2H), 7.30 (d, $J=$7.5 Hz, 2H), 7.40 (d, $J=$7.5 Hz, 2H), 6.95 (d, $J=$7.5 Hz, 2H), 4.65 (s, 2H), 3.96 (s, 3H); GCMS (R$_t$ =13.10 min) calculated for C$_{18}$H$_{14}$O$_2$ 262.1, found 262.1.

Compound 31: The solvent was removed in vacuo to give 31 as a solid. (6 mg, 0.024 mmol, 56%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 7.55 (d, $J=$7.4 Hz, 2H), 7.50 (d, $J=$7.4 Hz, 2H), 7.38 (d, $J=$ 7.4 Hz, 2H), 6.89 (d, $J=$ 7.4 Hz, 2H), 4.75 (s, 2H), 3.83 (s, 3H); GCMS (R$_t$ =16.89 min) calculated for C$_{20}$H$_{14}$O$_2$ 286.3, found 286.2.

Compound 32: The solvent was removed in vacuo to give 32 as a solid. (7 mg, 0.022 mmol, 52%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 7.98 (d, $J=$7.4 Hz, 2H), 7.58 (d, $J=$7.4 Hz, 2H), 7.50 (d, $J=$7.4 Hz, 2H), 6.95 (d, $J=$7.4 Hz, 2H), 4.75 (s, 2H), 3.85 (s, 3H); GCMS (R$_t$ =13.38 min) calculated for C$_{22}$H$_{14}$O$_2$ 310.4, found 310.3.

Compound 33: The solvent was removed in vacuo to give 33 as a solid. (8 mg, 0.023 mmol, 55%). $^1$H NMR (400 MHz; CDCl$_3$): $\delta$ 7.80 (d, $J=$7.5 Hz, 2H), 7.50 (d, $J=$7.5 Hz, 2H), 7.45 (d, $J=$7.5 Hz, 2H), 6.85 (d, $J=$7.5 Hz, 2H), 3.80 (s, 2H), 2.85 (s, 3H); GCMS (R$_t$ =11.43 min) calculated for C$_{24}$H$_{14}$O$_2$ 334.4, found 334.3.

Fluorescence Data

**Figure S1.** Fluorescence data for triyne compounds 7, 11, 15, and 19 at Ex 330 nm.
Figure S2. Fluorescence data for tetrayne compounds 8, 12, 16, and 20 at Ex 330 nm.

Figure S3. Fluorescence data for pentayne compounds 9, 13, 17, and 21 at Ex 330 nm.
Figure S4. Fluorescence data for anisole capped compounds 6-9 at Ex 330 nm.

Figure S4. Fluorescence data for amine capped compounds 10-13 at Ex 330 nm.
**Figure S5.** Fluorescence data for phenyl capped compounds 14-17 at Ex 330 nm.

**Figure S6.** Fluorescence data for hexyl capped compounds 18-21 at Ex 330 nm.
Figure S7. Representative $^1$H NMR demonstrating compound purity.