

# Supporting Information for:

## Highly Practical and General Synthesis of Monodisperse Linear $\pi$ -Conjugated Oligoenynes and Oligoenediynes with Either *trans*- or *cis*-Olefin Configuration

Yuuki Takayama, Christophe Delas, Kenji Muraoka, Minoru Uemura, and Fumie Sato\*

*Department of Biomolecular Engineering, Tokyo Institute of Technology,  
4259 Nagatsuta-cho, Midori-ku, Yokohama, Kanagawa 226-8501, Japan*

fsato@bio.titech.ac.jp

**General.**  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectra were taken on a Varian Gemini-300 spectrometer at 300 and 75 MHz, respectively.  $\text{CDCl}_3$  was used as the solvent. Chemical shifts are reported in parts per million shift ( $\delta$  value) from  $\text{Me}_4\text{Si}$  ( $\delta$  0 ppm for  $^1\text{H}$ ) or based on the middle peak of the solvent ( $\text{CDCl}_3$ ) ( $\delta$  77.00 ppm for  $^{13}\text{C}$  NMR) as an internal standard. Signal patterns are indicated as br, broad; s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet. Coupling constants ( $J$ ) are given in hertz. Infrared (IR) spectra were recorded on a JASCO A-230 spectrometer and are reported in wave numbers ( $\text{cm}^{-1}$ ). Elemental analyses were performed on a Elementar Vario-EL. MALDI-TOF-MS spectra were obtained using a SHIMADZU MALDI-TOFMS AXIMA-CFR. 2,5-Dihydroxybenzoic acid (DHB) was used as matrix. UV/Vis spectra were obtained with HITACHI U-2000 Spectrophotometer. Melting points were measured with Yanaco MP-J3 Micro Melting Point Apparatus. All reactions were carried out under an argon atmosphere, using flame-dried glassware and were monitored by TLC (Merck, Kieselgel 60 F254); visualization was done with UV light (254 nm) /  $\text{KMnO}_4$  or Vanillin.

**Material.**  $\text{Ti}(\text{O}-i\text{-Pr})_4$  was distilled and stored under argon. Isopropylmagnesium chloride was prepared in  $\text{Et}_2\text{O}$  as 1.5 - 2.2 M solution from isopropyl chloride and magnesium turnings by the usual procedure, titrated and stocked under an argon atmosphere. Dry solvent ( $\text{Et}_2\text{O}$ , THF,  $\text{CH}_2\text{Cl}_2$ ) was purchased from Kanto Chemicals. Degassing of solvents and amines used for Pd-catalyzed reactions was accomplished by vigorously bubbling argon for at least 1 h. Chemicals were purified or dried in a standard manner.

**(Z)-4-Iodo-5-propyl-7-(trimethylsilyl)-4-hepten-6-yne (2a).** To a solution of 4-octyne (1.47 mL, 10.0 mmol) in  $\text{Et}_2\text{O}$  (30 mL) was added  $\text{Ti}(\text{O}-i\text{-Pr})_4$  (3.69 mL, 12.5 mmol). The reaction mixture was cooled to  $-78^\circ\text{C}$  and  $i\text{-PrMgCl}$  (16.7 mL, 1.50 M in  $\text{Et}_2\text{O}$ , 25.0 mmol) was added slowly. The reaction mixture was warmed to  $-50^\circ\text{C}$  over 1 h and stirred at that temperature for 4 h.

Ethynyltrimethylsilane (1.20 mL, 8.50 mmol) was added and the reaction mixture was stirred at  $-50^{\circ}\text{C}$  for 1 h. A solution of iodine (6.35 g, 25.0 mmol) in THF (10 mL) was added to the reaction mixture which was stirred at  $-50^{\circ}\text{C}$  for 30 min and at room temperature for an additional 30 min. The reaction mixture was worked up by a saturated solution of  $\text{Na}_2\text{S}_2\text{O}_3$  to ensure disappearance of excess of iodine. The aqueous layer was extracted with hexane and the combined organic layers were dried over  $\text{Na}_2\text{SO}_4$  and concentrated *in vacuo* to give a crude oil. The NMR spectrum of the crude reaction mixture was enough satisfactory to carry out the next step without purification. The crude oil (prepared from 8.50 mmol of ethynyltrimethylsilane) was stirred at room temperature in pyrrolidine (20 mL) for 1 h. The reaction mixture was diluted with hexane (30 mL) and quenched at  $0^{\circ}\text{C}$  by a saturated solution of  $\text{NH}_4\text{Cl}$ . The aqueous layer was extracted with hexane, the combined organic layers were washed with brine and dried over  $\text{Na}_2\text{SO}_4$  and concentrated *in vacuo* to give a crude oil. The crude product was chromatographed on silica gel (Wakogel C-200, hexane) to afford the expected compound (1.80 g, 63% from ethynyltrimethylsilane) as a yellowish oil.  $^1\text{H}$  NMR :  $\delta$  2.55 (t,  $J = 7.2$  Hz, 2H), 2.22 (t,  $J = 7.5$  Hz, 2H), 1.67-1.48 (m, 4H), 0.91 (t,  $J = 7.2$  Hz, 6H), 0.21 (s, 9H);  $^{13}\text{C}$  NMR :  $\delta$  131.16, 114.18, 109.23, 97.35, 42.60, 34.98, 23.09, 22.12, 13.78, 13.17, 0.00; IR (neat) 2960, 2871, 2144, 1457, 1248, 842, 759, 698  $\text{cm}^{-1}$ ; Anal. Calcd for  $\text{C}_{13}\text{H}_{23}\text{ISI}$ : C, 46.70; H, 6.93. Found: C, 46.36; H, 6.35.

**(Z)-1-Iodo-2-propyl-1,4-bis(trimethylsilyl)-1-buten-3-yne (2c).** To a stirred solution of 1-trimethylsilyl-1-pentyne (5.00 g, 35.7 mmol) and  $\text{Ti}(\text{O}-i\text{-Pr})_4$  (13.2 mL, 44.6 mmol) in 600 mL of  $\text{Et}_2\text{O}$  was added a 2.20 M solution of  $i\text{-PrMgCl}$  in ether (40.6 mL, 89.3 mmol) at  $-78^{\circ}\text{C}$  under argon to give a yellow homogeneous solution. The solution was warmed up to  $-50^{\circ}\text{C}$  over 30 min, during which period its color turned brown. After the solution was stirred at  $-50^{\circ}\text{C}$  for 2 h, ethynyltrimethylsilane (4.04 mL, 28.6 mmol) was introduced to the reaction mixture at  $-50^{\circ}\text{C}$ , and the solution was stirred at  $-50^{\circ}\text{C}$  for 3 h. Iodine (22.7 g, 89.3 mmol) was added as a solid to the reaction mixture at  $-50^{\circ}\text{C}$  and then the mixture was warmed up to room temperature. After being stirred for 2 h,  $\text{H}_2\text{O}$  (44.6 mL) was added. The resulting mixture was filtered through a pad of Celite and the organic layer was separated and washed with saturated aqueous solution of  $\text{Na}_2\text{S}_2\text{O}_3$  and brine, dried ( $\text{MgSO}_4$ ), and concentrated *in vacuo* to give a crude oil of 1,4-diiodo-2-propyl-1,4-bis(trimethylsilyl)buta-1,3-diene, which was subjected to the next reaction. The 1,4-diiodo-1,3-butadiene derivative was stirred at  $0^{\circ}\text{C}$  in pyrrolidine (50 mL) for one hour. The reaction mixture was diluted with hexane (50 mL) and quenched at  $0^{\circ}\text{C}$  by a saturated solution of  $\text{NH}_4\text{Cl}$ . The aqueous layer was extracted with hexane, the combined organic layers were washed with brine and dried over  $\text{MgSO}_4$  and concentrated *in vacuo* to give a crude oil. The crude product was chromatographed on silica gel (Wakogel C-200, hexane) to afford the title compound (6.63 g, 64% from ethynyltrimethylsilane) as a yellowish oil.  $^1\text{H}$  NMR :  $\delta$  0.226 (s, 9H), 0.295 (s, 9H), 0.921 (t,  $J = 7.4$  Hz, 3H), 1.55-1.68 (m, 2H), 2.27-2.33 (m, 2H);  $^{13}\text{C}$  NMR :  $\delta$  -0.308, 1.76, 13.44, 22.50, 39.02,

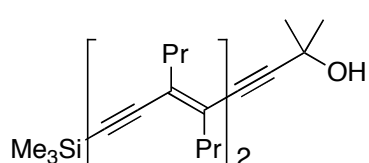
99.86, 109.54, 117.25, 144.19; IR (neat) 3676, 2960, 2146, 1539, 1250, 844, 760  $\text{cm}^{-1}$ ; Anal. Calcd for  $\text{C}_{13}\text{H}_{25}\text{ISi}_2$ : C, 42.85; H, 6.91. Found: C, 42.72; H, 6.81.

**(Z)-2-Methyl-5,6-dipropyl-8-(trimethylsilyl)-5-octen-3,7-diyn-2-ol (4a).** To a solution of vinyl iodide derivative **2a** (5.98 mmol, 2.00 g) in pyrrolidine (20 mL) and triethylamine (10 mL), was added at room temperature  $\text{Pd}(\text{PPh}_3)_4$  (69.1 mg, 0.0598 mmol) and CuI (22.8 mg, 0.120 mmol). 3-Methyl-1-butyn-3-ol (1.45 mL, 15.0 mmol) was added drop by drop over 20 min period. After disappearance of the vinyl iodide derivative **2a** (TLC monitoring, *ca.* 2 days), the reaction mixture was diluted with hexane and quenched at 0 °C with a saturated solution of  $\text{NH}_4\text{Cl}$ . The aqueous layer was extracted with ether. The combined organic layers were washed with brine, dried over  $\text{Na}_2\text{SO}_4$  and concentrated *in vacuo*. The crude oil was chromatographed on silica gel (Wakogel C-200, hexane - ether) to afford compound **4a** (1.49 g, 86%) as yellow oil.  $^1\text{H}$  NMR :  $\delta$  2.14 (m, 4H), 2.08 (s, 1H, OH), 1.55 (s, 6H), 1.58-1.46 (m, 4H), 0.91 (t,  $J = 7.2$  Hz, 3H), 0.90 (t,  $J = 7.2$  Hz, 3H), 0.18 (s, 9H);  $^{13}\text{C}$  NMR :  $\delta$  129.50, 129.21, 105.86, 98.22 (2 peaks), 83.12, 65.62, 33.77, 33.68, 31.41, 21.59 (2 peaks), 13.70 (2 peaks), -0.05; IR (neat) 3375, 2960, 2871, 2135, 1456, 1377, 1164, 842, 759  $\text{cm}^{-1}$ ; Anal. Calcd for  $\text{C}_{19}\text{H}_{30}\text{OSi}$ : C, 74.42; H, 10.41. Found: C, 74.51; H, 10.66.

**(E)-4-Iodo-5-propyl-7-(trimethylsilyl)-4-hepten-6-yne (1a).** To a stirred solution of **2c** (1.79 g, 4.91 mmol) in THF (16 mL) was added *t*-BuLi (6.75 mL, 1.60 mol/L in pentane, 10.8 mmol) at -78 °C. After stirring for 30 min at this temperature, iodopropane (1.44 mL, 14.7 mmol) was added to the reaction mixture. The mixture was warmed up to room temperature and stirred for 5 h. After addition of a saturated solution of  $\text{NH}_4\text{Cl}$  at 0 °C, the mixture was extracted with hexane. The combined organic layers were washed with brine, dried over  $\text{MgSO}_4$ , and concentrated *in vacuo*. The residue was subjected to the iododesilylation without purification. To a stirred solution of the crude of (E)-5-propyl-4,7-bis(trimethylsilyl)-4-hepten-6-yne in  $\text{CH}_2\text{Cl}_2$  (25 mL) was added *N*-iodosuccinimide (1.66 g, 7.37 mmol). The reaction vessel was wrapped in aluminum foil, and the reaction mixture stirred for 1 h. After addition of a saturated aqueous solution of  $\text{Na}_2\text{S}_2\text{O}_3$ , the mixture was extracted with  $\text{CH}_2\text{Cl}_2$ . The combined organic layers were washed with water, brine, dried over  $\text{MgSO}_4$ , and concentrated *in vacuo* to give a crude oil which was purified by column chromatography (hexane) on silica gel (Wakogel C-200, hexane) to afford **1a** (1.05 g, 64%).  $^1\text{H}$  NMR :  $\delta$  0.186 (s, 9H), 0.918 (t,  $J = 8.0$  Hz, 3H), 0.946 (t,  $J = 8.0$  Hz, 3H), 1.48-1.65 (m, 4H), 2.29 (t,  $J = 7.5$  Hz, 2H), 2.85 (t,  $J = 7.2$  Hz, 2H);  $^{13}\text{C}$  NMR :  $\delta$  -0.248, 12.65, 13.43, 21.01, 22.45, 43.16, 45.65, 99.27, 101.75, 118.75, 128.36; IR (neat) 3447, 2140, 1458, 1250, 912, 842, 759  $\text{cm}^{-1}$ ; Anal. Calcd. For  $\text{C}_{13}\text{H}_{23}\text{ISi}$ : C, 46.70; H, 6.93. Found: C, 46.22; H, 7.33.

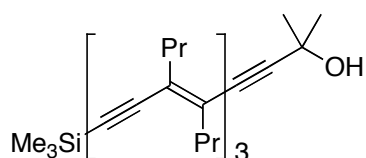
**(E)-2-Methyl-5,6-dipropyl-8-(trimethylsilyl)-5-octen-3,7-diyn-2-ol (5a).** A mixture of **1a** (0.815 g, 2.44 mmol), 3-methyl-1-butyn-3-ol (0.591 mL, 6.10 mmol),  $\text{Pd}(\text{PPh}_3)_4$  (141 mg, 0.122 mmol), CuI (46.5 mg, 0.244 mmol), and diethylamine (7.57 mL, 73.2 mmol) in THF (30 mL) was

stirred at room temperature for 12 h. Et<sub>2</sub>O and water were added to the mixture and the organic layer was separated, washed with brine, dried over MgSO<sub>4</sub>, and concentrated *in vacuo* to give a crude oil. The crude was purified by column chromatography on silica gel (Wakogel C-200, hexane – ether) to afford **5a** (0.474 g, 67%). <sup>1</sup>H NMR :  $\delta$  0.188 (s, 9H), 0.913 (t, *J* = 7.4 Hz, 6H), 1.56 (s, 6H), 1.45-1.62 (m, 4H), 1.90 (s, 1H), 2.30-2.40 (m, 4H); <sup>13</sup>C NMR :  $\delta$  -0.149, 13.48, 13.50, 21.44, 21.50, 31.41, 36.56, 36.86, 65.79, 81.48, 102.98, 103.22, 104.45, 129.60, 130.24; IR (neat) 3370, 2960, 2872, 2134, 1458, 1378, 1250, 1166, 953, 842, 759, 735 cm<sup>-1</sup>; Anal. Calcd for C<sub>18</sub>H<sub>30</sub>OSi: C, 74.42; H, 10.41. Found: C, 74.17; H, 10.13.



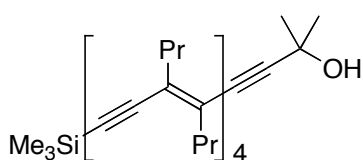
**General Procedure for the Removal of TMS Protecting Group and the Following Sonogashira Coupling Reaction in Scheme 3. (*E,E*)-2-Methyl-5,6,9,10-tetrapropyl-12-(trimethylsilyl)-5,9-dodecadien-3,7,11-triyn-2-ol (10-*C-trans*-oligoenyne).**

To a stirred solution of **5a** (0.914 g, 3.15 mmol) in THF (9 mL), MeOH (36 mL) and water (10 drops) was added K<sub>2</sub>CO<sub>3</sub> (87.0 mg, 0.630 mmol) and the mixture was stirred for 2 h. The reaction mixture was extracted with ether until the washing was colorless, washed with brine, dried over MgSO<sub>4</sub> and concentrated *in vacuo* to give a crude oil of the desilylated compound. The crude oil was dissolved in Et<sub>2</sub>O and filtered through a short pad of silica gel (ether) to afford the expected terminal acetylene derivative which was used for the next step without further purification. A solution of **1a** (2.10 g 6.29 mmol) in degassed THF (16 mL) was added to a mixture of Pd(PPh<sub>3</sub>)<sub>4</sub> (182 mg, 0.158 mmol), CuI (15.0 mg, 0.0787 mmol) and degassed Et<sub>3</sub>NH (9.76 mL, 94.4 mmol) in THF (3 mL) and to the resulting mixture was added a solution of the terminal acetylene derivative in THF (16 mL). The reaction mixture was stirred at room temperature for 24 h and extracted with ether, washed with brine, dried over MgSO<sub>4</sub> and concentrated *in vacuo* to an oil, which was chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane - ether) to afford the title compound (*R*<sub>f</sub> = 0.50 in hexane : AcOEt = 3 : 1, 0.851 g, 64%) as a yellow oil, the homo-coupling product of terminal acetylene (*R*<sub>f</sub> = 0.33 in hexane : AcOEt = 3 : 1, 0.109 g, 16%), and **1a** (*R*<sub>f</sub> = 0.76 in hexane : AcOEt = 3 : 1, 0.955 g, 91% recovered). <sup>1</sup>H NMR :  $\delta$  0.195 (s, 9H), 0.887-0.960 (m, 12H), 1.57 (s, 6H), 1.48-1.65 (m, 8H), 2.34-2.46 (m, 8H); <sup>13</sup>C NMR :  $\delta$  -0.141, 13.46 (2 peaks), 13.49, 13.51, 21.57, 21.61, 21.65 (2 peaks), 31.43, 36.86, 36.88, 37.02, 37.04, 65.81, 81.81, 97.93, 98.49, 102.88, 103.81, 104.89, 128.68, 129.16, 129.89, 131.06; IR (neat) 3375, 2959, 2872, 2129, 1458, 1250, 1165, 842 cm<sup>-1</sup>; UV/Vis (hexane):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 248 (10 100), 325 (28 400), 346 (24 700); MALDI-TOF-MS (DHB): 424.3 (Calc. for C<sub>28</sub>H<sub>44</sub>OSi: 424.3); Anal. Calcd for C<sub>28</sub>H<sub>44</sub>OSi: C, 79.18; H, 10.44. Found: C, 79.15; H, 10.78.



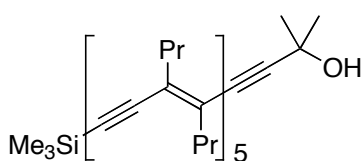
**(*E,E,E*)-2-Methyl-5,6,9,10,13,14-hexapropyl-16-(trimethylsilyl)-5,9,13-hexadecatrien-3,7,11,15-tetrayn-2-ol** (**14-C-*trans*-oligoenyne**). *trans*-Oligoenyne dimer (**10-C-*trans*-oligoenyne**)

(0.680 g, 1.60 mmol) was desilylated with  $K_2CO_3$  and cross-coupled with vinyl iodide **1a** (1.07 g, 3.20 mmol) in THF (20 mL) in the presence of  $Pd(PPh_3)_4$  (92.5 mg, 0.0801 mmol),  $CuI$  (7.62 mg, 0.0400 mmol), and  $Et_2NH$  (4.97 mL, 48.0 mmol) for 24 h as described in the general procedure. Column chromatography (Wakogel C-200, pretreated with 1%  $NEt_3$  in hexane and eluted with hexane - ether) afforded the title compound (0.651 g, 73%) as a yellow oil.  $^1H$  NMR :  $\delta$  0.199 (s, 9H), 0.84-1.04 (m, 18H), 1.57 (s, 6H), 1.48-1.64 (m, 12H), 2.27-2.50 (m, 12H);  $^{13}C$  NMR :  $\delta$  81.85, 98.36, 98.49, 98.58, 99.02, 102.89, 103.82, 104.87, 128.48, 128.99, 129.33, 129.36, 129.75, 130.94; IR (neat) 3370, 2959, 2928, 2871, 2126, 1458, 1249, 842  $cm^{-1}$ ; UV/Vis (hexane):  $\epsilon_{max}$  ( $\lambda$  [nm]) = 221 (24 700), 239 (21 700), 276(15 100), 359 (44 500), 385 (35 200); MALDI-TOF-MS (DHB): 558.3 (calc. for  $C_{28}H_{44}OSi$ : 558.4); Anal. Calcd. For  $C_{38}H_{58}OSi$ : C, 81.65; H, 10.46. Found: C, 81.20; H, 10.94.



**(*E,E,E,E*)-2-Methyl-5,6,9,10,13,14,17,18-octapropyl-20-(trimethylsilyl)-5,9,13,17-eicosatetra-en-3,7,11,15,19-pentayn-2-ol** (**18-C-*trans*-oligoenyne**). *trans*-Oligoenyne trimer (**14-C-*trans*-oligoenyne**)

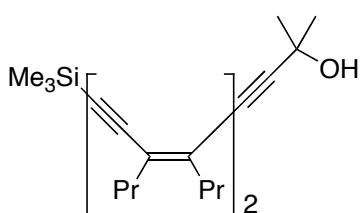
(0.471 g, 0.843 mmol) was desilylated with  $K_2CO_3$  and cross-coupled with vinyl iodide **1a** (0.563 g, 1.69 mmol) in THF (10 mL) in the presence of  $Pd(PPh_3)_4$  (48.7 mg, 0.0421 mmol),  $CuI$  (4.01 mg, 0.0211 mmol), and  $Et_2NH$  (2.62 mL, 25.3 mmol) for 24 h as described in the general procedure. Column chromatography (Wakogel C-200, pretreated with 1%  $NEt_3$  in hexane and eluted with hexane - ether) afforded the title compound (0.431 g, 74%) as a yellow solid. m.p. : 86  $^{\circ}C$ ;  $^1H$  NMR :  $\delta$  0.200 (s, 9H), 0.81-1.03 (m, 24H), 1.57 (s, 6H), 1.48-1.72 (m, 16H), 1.94 (s, 1H), 2.34-2.52 (m, 16H);  $^{13}C$  NMR :  $\delta$  -0.134, 13.50 (8 peaks), 21.60 (2 peaks), 21.67 (2 peaks), 21.80 (4 peaks), 31.45, 36.90, 36.93, 37.04, 37.09, 37.22 (2 peaks), 37.25 (2 peaks), 65.82, 81.89, 98.54, 98.66, 98.79, 99.20 (3 peaks), 103.01, 103.95, 105.00, 128.66, 129.19, 129.52, 129.54, 129.58, 129.62, 129.97, 131.15; IR (KBr) 3426, 2959, 2928, 2869, 2124, 1461, 1249, 842  $cm^{-1}$ ; UV/Vis (hexane):  $\epsilon_{max}$  ( $\lambda$  [nm]) = 268 (22 700), 386 (65 900); MALDI-TOF-MS (DHB): 692.3 (calc. for  $C_{48}H_{72}OSi$ : 692.54); Anal. Calcd for  $C_{48}H_{72}OSi$ : C, 83.17; H, 10.47. Found: C, 83.07; H, 10.80.



**(*E,E,E,E,E*)-2-Methyl-5,6,9,10,13,14,17,18,21,22-decapropyl-24-(trimethylsilyl)-5,9,13,17,21-tetracosapentaen-3,7,11,15,19,23-hexayn-2-ol** (**22-C-*trans*-oligoenyne**). *trans*-Oligoenyne tetramer (**18-C-*trans*-oligoenyne**)

(0.201 g, 0.290 mmol) was desilylated with  $K_2CO_3$  and cross-coupled with vinyl iodide **1a** (0.194 g, 0.580 mmol) in THF (3.6 mL) in the presence of  $Pd(PPh_3)_4$  (33.5 mg, 0.0290 mmol),  $CuI$  (2.76 mg, 0.0145 mmol), and  $Et_2NH$  (0.900 mL,

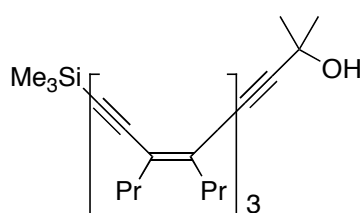
8.70 mmol) for 24 h as described in the general procedure. Column chromatography (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane - ether) afforded the title compound (0.170 g, 71%) as a yellow solid. m.p. : 118 °C; <sup>1</sup>H NMR :  $\delta$  0.200 (s, 9H), 0.87-1.02 (m, 30H), 1.57 (s, 6H), 1.47-1.68 (m, 20H), 2.35-2.50 (m, 20H); <sup>13</sup>C NMR :  $\delta$  -0.134, 13.51 (10 peaks), 21.60, 21.64, 21.68 (2 peaks), 21.81 (6 peaks), 31.45, 36.89, 36.93, 37.03, 37.09, 37.23 (3 peaks), 37.25 (3 peaks), 65.82, 81.89, 98.54, 98.66, 98.80, 99.21, 99.29 (3 peaks), 99.32, 102.60, 103.94, 104.99, 128.65, 129.18, 129.51, 129.54, 129.59 (3 peaks), 129.62, 129.96, 131.14; IR (KBr) 3409, 2959, 2927, 2870, 2127, 1458, 1249, 1164, 840 cm<sup>-1</sup>; UV/Vis (hexane):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 222 (34 400), 279 (22 600), 293 (25 700), 400 (67 700); MALDI-TOF-MS (DHB): 826.4 (calc. for C<sub>58</sub>H<sub>86</sub>OSi: 826.64); Anal. Calcd for C<sub>58</sub>H<sub>86</sub>OSi: C, 84.20; H, 10.48. Found: C, 84.41; H, 10.15.



**General Procedure for the Removal of TMS Protecting Group and the Following Sonogashira Coupling Reaction in Scheme 4. (Z,Z)-2-Methyl-5,6,9,10-tetrapropyl-12-(trimethylsilyl)-5,9-dodecadien-3,7,11-triyn-2-ol (10-C-cis-oligoenyne).**

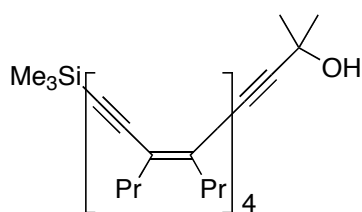
The silylacetylene derivative **4a** (0.872 g, 3.00 mmol) was dissolved in THF (8.5 mL), MeOH (34 mL) and water (10 drops). K<sub>2</sub>CO<sub>3</sub> (83.0 mg, 0.600 mmol) was added and the reaction mixture was stirred at room temperature. After disappearance of the silylacetylene derivative (TLC monitoring, *ca.* 2 h), the reaction mixture was extracted with ether until the washing was colorless, washed with brine, dried over MgSO<sub>4</sub> and concentrated *in vacuo* to give a crude oil of the desilylated compound. The crude oil was dissolved in Et<sub>2</sub>O and filtered through a short pad of silica gel (ether) to afford the expected terminal acetylene derivative which was used for the next step without further purification. To a solution of vinyl iodide derivative **2a** (1.30 g, 3.90 mmol) in pyrrolidine (20 mL), was added at room temperature Pd<sub>2</sub>(dba)<sub>3</sub> (68.7 mg, 0.0750 mmol) and dppb (64.0 mg, 0.150 mmol). After stirring for 15 min, CuI (14.3 mg, 0.0750 mmol) was added. A solution of the terminal acetylene derivative in pyrrolidine (10 mL) was added drop by drop over 20 min. After disappearance of the terminal acetylene derivative (TLC monitoring, *ca.* 2 days), the reaction mixture was diluted with hexane and quenched with a saturated solution of NH<sub>4</sub>Cl at 0 °C. The aqueous layer was extracted with ether. The combined organic layers were washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The crude oil was rapidly chromatographed on silica gel (Wakogel C-200, hexane - ether) to afford the title compound (*R*<sub>f</sub> = 0.53 in hexane : Et<sub>2</sub>O = 2 : 1, 0.731 g, 57%) as a yellow oil. and the homo-coupling product of terminal acetylene (*R*<sub>f</sub> = 0.38 in hexane : Et<sub>2</sub>O = 2 : 1, 0.188 g, 29%). <sup>1</sup>H NMR :  $\delta$  2.26-2.15 (m, 8H), 2.11 (s, 1H, OH), 1.66-1.51 (m, 8H), 1.53 (s, 6H), 0.91 (t, *J* = 7.2 Hz, 12H), 0.18 (s, 9H); <sup>13</sup>C NMR :  $\delta$  130.12, 129.28, 128.42, 121.94, 106.37, 98.46, 97.90, 95.02, 94.54, 83.49, 65.60, 34.31, 34.21, 34.18, 34.14, 31.52, 22.03, 21.97, 21.89, 21.86, 13.91 (4 peaks), 0.17; IR (neat) 3414, 2960, 2871, 2132, 1457, 1377, 1248, 1164, 956, 842, 759 cm<sup>-1</sup>; UV/Vis (hexane):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 262 (10 000), 274 (10 100), 323 (19

800), 343 (16 500); MALDI-TOF-MS (DHB): 424.3 (calc for  $C_{28}H_{44}OSi$ : 424.2); Anal. Calcd for  $C_{28}H_{44}OSi$ : C, 79.18; H, 10.44. Found: C, 79.05; H, 10.48.



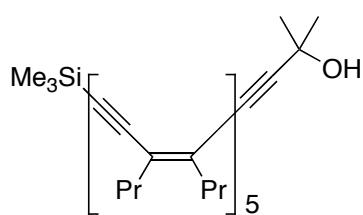
**(Z,Z,Z)-2-Methyl-5,6,9,10,13,14-hexapropyl-16-(trimethylsilyl)-5,9,13-hexadecatrien-3,7,11,15-tetrayn-2-ol (14-C-*cis*-oligoenyne).** *cis*-Oligoenyne dimer (**10-C-*cis*-oligoenyne**) (1.23 g, 2.90 mmol) was desilylated with  $K_2CO_3$  and cross-coupled with vinyl iodide **2a** (1.26 g, 3.76 mmol) in pyrrolidine (30 mL) in the presence of  $Pd_2(dba)_3$  (66.3

mg, 0.0724 mmol), dppb (61.8 mg, 0.145 mmol), and CuI (13.8 mg, 0.0724 mmol) as described in the general procedure. Rapid column chromatography (Wakogel C-200, hexane - ether) afforded the title compound (0.674 g, 42%) as a yellow oil.  $^1H$  NMR :  $\delta$  2.30-2.14 (m, 12H), 1.96 (s, 1H, OH), 1.66-1.48 (m, 12H), 1.53 (s, 6H), 0.96-0.84 (m, 18H), 0.17 (s, 9H);  $^{13}C$  NMR :  $\delta$  127.44, 128.02, 128.85, 128.96, 129.61, 130.41, 106.32, 98.33, 97.84, 95.65, 95.01, 94.80, 94.72, 83.49, 65.62, 34.41 (2 peaks), 34.32, 34.23, 34.15, 34.10, 31.47, 22.11, 22.06, 22.00, 21.96, 21.92, 21.88, 14.05, 13.96 (3 peaks), 13.91 (2 peaks), 0.17; IR (neat) 3420, 2960, 2871, 2133, 1457, 1377, 1248, 1163, 1110, 948, 842, 759  $cm^{-1}$ ; UV/Vis (hexane):  $\epsilon_{max}$  ( $\lambda$  [nm]) = 283 (20 100), 296 (22 300), 348 (24 700); MALDI-TOF-MS (DHB): 558.3 (calc. for  $C_{38}H_{58}OSi$ : 558.4); Anal. Calcd for  $C_{38}H_{58}OSi$ : C, 81.65; H, 10.46. Found: C, 81.86; H, 9.97.



**(Z,Z,Z,Z)-2-Methyl-5,6,9,10,13,14,17,18-octapropyl-20-(trimethylsilyl)-5,9,13,17-eicosatetra-en-3,7,11,15,19-pentayn-2-ol (18-C-*cis*-oligoenyne).** *cis*-Oligoenyne trimer (**14-C-*cis*-oligoenyne**) (0.585 g, 1.05 mmol) was desilylated with  $K_2CO_3$  and cross-coupled with vinyl iodide **2a** (0.455 g, 1.36 mmol) in pyrrolidine

(10 mL) in the presence of  $Pd_2(dba)_3$  (38.3 mg, 0.0419 mmol), dppb (35.7 mg, 0.0837 mmol), and CuI (7.97 mg, 0.0419 mmol) as described in the general procedure. Rapid column chromatography (Wakogel C-200, hexane - ether) afforded the title compound (0.366 g, 50%) as a yellow oil.  $^1H$  NMR :  $\delta$  2.30-2.10 (m, 16H), 2.05 (s, 1H, OH), 1.68-1.46 (m, 16H), 1.52 (s, 6H), 0.97-0.82 (m, 24H), 0.16 (s, 9H);  $^{13}C$  NMR :  $\delta$  130.63, 129.81, 129.22, 129.16, 128.50, 128.33, 127.69, 127.13, 106.47, 98.06, 97.67, 95.67, 94.29, 95.27, 95.20, 94.80, 94.66, 83.58, 65.62, 34.56, 34.49, 34.41 (2 peaks), 34.36 (2 peaks), 34.31, 34.17, 31.49, 22.15 (2 peaks), 22.07 (2 peaks), 21.99, 21.95, 21.92, 21.87, 14.06 (3 peaks), 13.99 (3 peaks), 13.94 (2 peaks), 0.17; IR (neat) 3420, 2959, 2871, 2132, 1457, 1377, 1248, 1110, 842  $cm^{-1}$ ; UV/Vis (hexane):  $\epsilon_{max}$  ( $\lambda$  [nm]) = 320 (39 500), 351 (31 000); MALDI-TOF-MS (DHB): 692.2 (calc. for  $C_{49}H_{72}OSi$ : 692.5); Anal. Calcd for  $C_{49}H_{72}OSi$ : C, 83.17; H, 10.47. Found: C, 83.19; H, 10.63.



**(*Z,Z,Z,Z,Z*)-2-Methyl-5,6,9,10,13,14,17,18,21,22-decapropyl-24-(trimethylsilyl)-5,9,13,17,21-tetracosapentaen-3,7,11,15,19,23-hexayn-2-ol (22-*C-cis*-oligoenyne).** *cis*-Oligoenyne tetramer (**18-*C-cis*-oligoenyne**) (0.260 g, 0.375 mmol) was desilylated with  $K_2CO_3$  and cross-coupled with vinyl iodide **2a** (0.163 g, 0.488 mmol) in

pyrrolidine (4 mL) in the presence of  $Pd_2(dba)_3$  (18.9 mg, 0.0206 mmol), dppb (17.6 mg, 0.0413 mmol), and CuI (3.93 mg, 0.0206 mmol) as described in the general procedure. Rapid column chromatography (Wakogel C-200, hexane - ether) afforded the title compound (0.148 g, 48%) as a yellow oil.  $^1H$  NMR :  $\delta$  2.28-2.12 (m, 20H), 2.00 (s, 1H, OH), 1.66-1.48 (m, 20H), 1.52 (s, 6H), 0.96-0.84 (m, 30H), 0.16 (s, 9H);  $^{13}C$  NMR :  $\delta$  130.64, 129.74, 129.41, 129.33, 128.87, 128.58, 128.26, 128.15, 127.65, 127.18, 106.51, 98.04, 97.74, 95.78, 95.49, 95.43, 95.35, 95.30, 95.26, 94.68, 94.55, 83.59, 65.61, 34.51 (4 peaks), 34.41 (2 peaks), 34.37, 34.26, 34.16 (2 peaks), 31.48, 22.15, 22.08 (5 peaks), 21.99, 21.96, 21.92, 21.87, 14.05, 14.00 (2 peaks), 13.98 (4 peaks), 13.93 (3 peaks), 0.16; IR (neat) 3419, 2960, 2871, 2132, 1457, 1377, 1361, 1248, 1110, 948, 842, 758  $cm^{-1}$ ; UV/Vis (hexane):  $\lambda_{max}$  ( $\epsilon$  [nm]) = 324 (17 500), 340 (17 600); Anal. Calcd. For  $C_{58}H_{86}OSi$ : C, 84.20; H, 10.48. Found: C, 84.04; H, 9.97.

**(*E,E,E,E,E*)-2-Methyl-24-phenyl-5,6,9,10,13,14,17,18,21,22-decapropyl-5,9,13,17,21-tetracosapentaen-3,7,11,15,19,23-hexayn-2-ol (6).** To a stirred solution of *trans*-oligoenyne pentamer (**22-*C-trans*-oligoenyne**) (92.9 mg, 0.112 mmol) in THF (0.3 mL), MeOH (1.2 mL) and water (1 drop) was added  $K_2CO_3$  (3.10 mg, 0.0225 mmol) and the mixture was stirred for 2 h at room temperature. The reaction mixture was extracted with ether until the washing was colorless, washed with brine, dried over  $MgSO_4$  and concentrated *in vacuo* to give a crude of the desilylated compound. The crude oil was dissolved in  $Et_2O$  and filtered through a short pad of silica gel (ether) to afford the expected terminal acetylene derivative which was used for the next step without further purification. To a stirred solution of iodobenzene (45.8 mg, 0.225 mmol) and  $Pd(PPh_3)_4$  (6.49 mg, 0.00561 mmol) in pyrrolidine (0.5 mL), under argon atmosphere, was added a solution of the desilylated 22-*C-trans*-oligoenyne in pyrrolidine (1.0 mL). After stirring at room temperature for 12 h, the mixture was hydrolysed with a saturated aqueous solution of  $NH_4Cl$  and extracted with ether. The organic extract was dried over  $MgSO_4$  and the solvent was removed *in vacuo*. The residue was chromatographed on silica gel (Wakogel C-200, pretreated with 1%  $NEt_3$  in hexane and eluted with hexane - ether) to afford the title compound (73.7 mg, 79%) as a deep-yellow solid. m.p. : 136  $^{\circ}C$ ;  $^1H$  NMR :  $\delta$  0.82-1.03 (m, 30H), 1.50-1.72 (m, 20H), 1.57 (s, 6H), 2.35-2.56 (m, 20H), 7.28-7.36 (m, 3H), 7.40-7.48 (m, 2H);  $^{13}C$  NMR :  $\delta$  13.46, 13.51 (9 peaks), 21.60, 21.68, 21.74, 21.83 (7 peaks), 31.43, 36.88, 37.09 (2 peaks), 37.17, 37.25 (6 peaks), 65.79, 81.86, 89.55, 98.53, 98.67, 98.78, 99.04, 99.10, 99.29 (2 peaks), 99.34, 99.37, 103.00, 123.77, 128.18, 128.40 (3 peaks), 128.66, 129.27, 129.50, 129.59 (2 peaks), 129.94, 130.03, 131.41 (2 peaks); IR (KBr) 3376, 2959, 2926, 2867, 1461, 1375, 1160, 838, 753, 688  $cm^{-1}$ ; UV/Vis (hexane):  $\lambda_{max}$  ( $\epsilon$  [nm]) = 303 (9400), 401 (25500); MALDI-

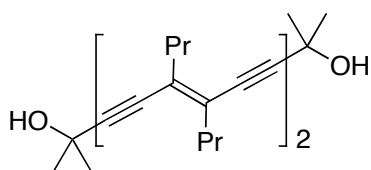


TOF-MS (DHB): 830.4 (calc. for C<sub>61</sub>H<sub>82</sub>O: 830.64); Anal. Calcd for C<sub>61</sub>H<sub>82</sub>O: C, 88.13; H, 9.94. Found: C, 87.71; H, 10.40.

**(E,E,E,E,E)-1-Phenyl-3,4,7,8,11,12,15,16,19,20-decapropyl-22-(p-tolyl)-3,7,11,15,19-docosa-pentaen-1,5,9,13,17,21-hexayne (7).** To a stirred solution of **6** (50.5 mg, 0.0607 mmol) in toluene (5 mL) was added ground NaOH (364 mg, 9.11 mmol), and the mixture was refluxed. When **6** disappeared on monitoring TLC analysis, the reaction was filtered, evaporated to afford a terminal acetylene derivative, which was subjected to the next Sonogashira coupling reaction. To a stirred solution of *p*-iodotoluene (26.5 mg, 0.121 mmol) and Pd(PPh<sub>3</sub>)<sub>4</sub> (7.02 mg, 0.00607 mmol) in pyrrolidine (0.5 mL), under argon atmosphere, was added a solution of the terminal acetylene in pyrrolidine (1.2 mL). After stirring at room temperature for 12 h, the mixture was hydrolysed with a saturated aqueous solution of NH<sub>4</sub>Cl and extracted with ether. The organic extract was dried over MgSO<sub>4</sub> and the solvent was removed *in vacuo*. The residue was chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane) to afford the title compound (36.5 mg, 70%) as an orange solid. m.p. : 131 °C; <sup>1</sup>H NMR :  $\delta$  0.89-1.03 (m, 30H), 1.57-1.72 (m, 20H), 2.36 (s, 3H), 2.42-2.59 (m, 20H), 7.09-7.16 (m, 2H), 7.28-7.36 (m, 5H), 7.40-7.47 (m, 2H); <sup>13</sup>C NMR :  $\delta$  13.53 (10 peaks), 21.75, 21.84 (10 peaks), 37.06, 37.10, 37.18, 37.22, 37.27 (6 peaks), 88.96, 89.57, 98.76, 98.89, 99.02, 99.06, 99.10, 99.24, 99.31, 99.37, 99.39, 99.43, 120.72, 123.79, 128.18, 128.41, 128.51, 128.67, 129.18, 129.25, 129.48, 129.56, 129.61, 129.62, 130.06, 131.32, 131.42, 132.14, 132.27, 138.37; IR (KBr) 2959, 2926, 2868, 1461, 1261, 1107, 811, 753, 690 cm<sup>-1</sup>; UV/Vis (hexane):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 312 (10000), 402 (21600); MALDI-TOF-MS (DHB): 862.4 (calc. for C<sub>65</sub>H<sub>82</sub>: 862.64); Anal. Calcd for C<sub>65</sub>H<sub>82</sub>: C, 90.43; H, 9.57. Found: C, 90.62; H, 9.62.

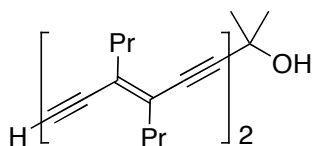
**(E,E,E,E,E,E,E,E,E,E)-2,47-Dimethyl-5,6,9,10,13,14,17,18,21,22,27,28,31,32,35,36,39,40,43,44-eicosapropyl-5,9,13,17,21,27,31,35,39,43-octatetracontadecaen-3,7,11,15,19,23,25,29,33,37,41,45-dodecayn-2,47-diol (8).** To a stirred solution of *trans*-oligoenyne pentamer (**22-C-trans-oligoenyne**) (47.8 mg, 0.0578 mmol) in THF (0.2 mL), MeOH (0.7 mL) and water (1 drop) was added K<sub>2</sub>CO<sub>3</sub> (1.60 mg, 0.0116 mmol) and the mixture was stirred for 2 h at room temperature. The reaction mixture was extracted with ether until the washing was colorless, washed with brine, dried over MgSO<sub>4</sub> and concentrated *in vacuo* to give a crude oil of a desilylated compound. The crude oil was dissolved in Et<sub>2</sub>O and filtered through a short pad of silica gel (ether) to afford the expected terminal acetylene derivative which was used for the next step without further purification. TMEDA (17.4  $\mu$ L, 0.116 mmol) and CuCl (8.01 mg, 0.0809 mmol) were added at room temperature to a solution of the desilylated compound of **22-C-trans-oligoenyne** in dry CH<sub>2</sub>Cl<sub>2</sub> (1 mL) and CH<sub>3</sub>Cl (0.5 mL). After stirring in air for 3 days, the reaction mixture was quenched with a saturated aqueous solution of NH<sub>4</sub>Cl and extracted with CH<sub>2</sub>Cl<sub>2</sub> until the washing was colorless. The organic phase was washed with brine and dried (MgSO<sub>4</sub>). Concentration *in vacuo*, purification by column

chromatography (Wako-gel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane - ether) gave the title compound (34.6 mg, 79%) as an orange solid. m.p. : 195 °C; <sup>1</sup>H NMR :  $\delta$  0.85-1.01 (m, 60H), 1.48-1.60 (m, 40H), 1.57 (s, 12H), 1.96 (s, 2H, -OH), 2.36-2.52 (m, 40H); <sup>13</sup>C NMR :  $\delta$  13.43, 13.48 (2 peaks), 13.52 (7 peaks), 21.60, 21.69, 21.75, 21.83 (7 peaks), 31.45, 36.88, 36.97, 37.09, 37.23 (3 peaks), 37.27 (4 peaks), 65.83, 81.89, 83.11, 84.82, 98.51, 98.71, 98.76, 99.23 (2 peaks), 99.42, 99.73, 101.25, 102.97, 128.14, 128.68, 129.32, 129.51, 129.56, 129.59, 129.81, 129.95, 130.27, 133.84; IR (KBr) 3357, 2958, 2926, 2867, 1459, 1375, 1160, 1111 cm<sup>-1</sup>; UV/Vis (hexane):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 278 (20400), 427 (68200); MALDI-TOF-MS (DHB): 1507.5 (calc. for C<sub>100</sub>H<sub>154</sub>O<sub>2</sub>: 1507.19); Anal. Calcd for C<sub>100</sub>H<sub>154</sub>O<sub>2</sub>: C, 87.59; H, 10.29. Found: C, 87.24; H, 9.89.



**General Procedure for the Acetylene-Acetylene Coupling Reaction in Schemes 6 and 7. (*E,E*)-2,15-Dimethyl-5,6,11,12-tetrapropyl-5,11-hexadecadien-3,7,9,13-tetra-yn-2,15-diol (12-C-*trans*-oligoenediynes).**

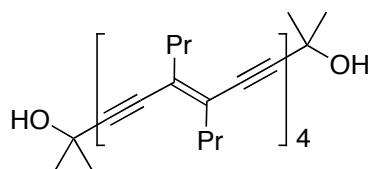
To a solution of desilylated product of **5a** (0.612 g, 2.81 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (10 mL) was added CuCl (0.389 g, 3.93 mmol) and TMEDA (0.847 mL, 5.61 mmol) at room temperature. After stirring under an atmosphere of pure O<sub>2</sub> until disappearance of the starting terminal acetylene by TLC monitoring (*ca.* 6~24 hr), the reaction mixture was diluted with CH<sub>2</sub>Cl<sub>2</sub> and H<sub>2</sub>O, and then the organic layer was extracted with CH<sub>2</sub>Cl<sub>2</sub>. The combined organic layers were washed with H<sub>2</sub>O and brine, dried over Mg<sub>2</sub>SO<sub>4</sub>, and concentrated *in vacuo*. The crude oil was rapidly chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-AcOEt) to afford the title compound (0.441 g, 72%) as a yellow solid. m.p. : 83–84 °C; <sup>1</sup>H NMR:  $\delta$  0.91 (t, *J* = 7.4 Hz, 6H), 0.92 (t, *J* = 7.4 Hz, 6H), 1.55 (s, 12H), 1.46-1.63 (m, 8H), 2.20 (s, 2H), 2.34-2.41 (m, 8H); <sup>13</sup>C NMR:  $\delta$  13.37, 13.42, 21.55 (x2), 31.30, 36.54, 37.06, 65.72, 81.22, 82.12, 83.52, 104.80, 128.47, 132.98; IR (KBr) 3339, 2960, 2928, 2869, 1457, 1375, 1247, 1227, 1165, 1140 cm<sup>-1</sup>; UV/Vis (CHCl<sub>3</sub>):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 287 (25 200), 295 (27 700), 313 (24 400), 322 (23 900), 344 (31 100), 369 (27 600); MALDI-TOF-MS (DHB): 434.2 (Calc. for C<sub>30</sub>H<sub>42</sub>O<sub>2</sub>: 434.3); Anal. Calcd for C<sub>30</sub>H<sub>42</sub>O<sub>2</sub>: C, 82.90; H, 9.74. Found: C, 83.11; H, 9.58.



**General Procedure for the Mono-Deprotection of Oligoenediynes in Schemes 6 and 7. (*E,E*)-2-Methyl-5,6,11,12-tetrapropyl-5,11-tetradecadien-3,7,9,13-tetra-yn-2-ol.**

To a stirred solution of *trans*-oligoenediynes dimer (12-C-*trans*-oligoenediynes) (0.370 g, 0.853 mmol) in toluene (8.5 mL) was added excess ground NaOH (1.71 g, 42.6 mmol), and the mixture was heated at 85~90 °C (bath temperature). When conversion of the starting material reached around 50% on monitoring TLC analysis, the reaction mixture was filtered and evaporated. The residue was chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-AcOEt) to afford the title compound (0.113 g, 35%) as a yellow solid, bis-deprotected product

(0.65 mg, 0.24%) and the starting diol (0.215 g, 58%). The yield based on the recovered starting material is calculated to be 83%.  $^1\text{H}$  NMR:  $\delta$  0.89-0.96 (m, 12H), 1.56 (s, 6H), 1.46-1.64 (m, 8H), 2.06 (s, 1H), 2.34-2.48 (m, 8H), 3.51 (s, 1H);  $^{13}\text{C}$  NMR:  $\delta$  13.33, 13.37, 13.39, 13.43, 21.44, 21.57 (x3), 31.32, 36.56 (x2), 37.05, 37.09, 65.76, 81.25, 82.02, 82.67, 82.73, 83.09, 83.78, 87.75, 104.86, 128.46, 130.38, 132.30, 133.15.

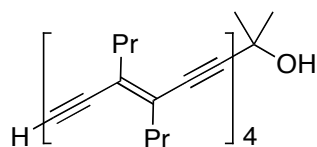


**(*E,E,E,E*)-2,27-Dimethyl-5,6,11,12,17,18,23,24-octa-propyl-**

**5,11,17,23-octacosatetraen-3,7,9,13,15,19,21,25-octayn-2,27-diol**

**(24-*C-trans*-oligoenediyn).**

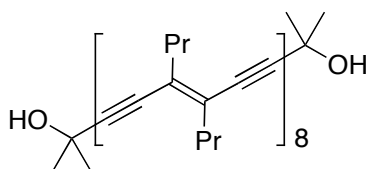
The reaction was carried out according to the general procedure using the mono-deprotected **12-*C-trans*-oligoenediyn** (0.595 g, 1.58 mmol), CuCl (0.219 g, 2.22 mmol), TMEDA (0.478 mL, 3.16 mmol) in  $\text{CH}_2\text{Cl}_2$  (5.3 mL) to give a crude residue, which was rapidly chromatographed on silica gel (Wakogel C-200, pretreated with 1%  $\text{NEt}_3$  in hexane and eluted with hexane-AcOEt) to afford the title compound (0.488 g, 82%) as a yellow solid. m.p. : 168-171  $^\circ\text{C}$ ;  $^1\text{H}$  NMR:  $\delta$  0.89-1.05 (m, 24H), 1.56 (s, 12H), 1.50-1.68 (m, 16H), 1.96 (s, 2H), 2.36-2.48 (m, 16H);  $^{13}\text{C}$  NMR:  $\delta$  13.39 (x3), 13.44, 21.58 (x2), 21.71 (x2), 31.32, 36.53, 36.93, 37.03, 37.13, 65.77, 81.23, 82.03, 83.33, 84.44, 84.76 (x2), 85.07, 105.03, 128.40, 132.20, 132.65, 133.38; IR (KBr) 3397, 2958, 2927, 2870, 1651, 1461, 1369, 1249, 993, 865, 845  $\text{cm}^{-1}$ ; UV/Vis ( $\text{CHCl}_3$ ):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 283 (45 300), 297 (43 300), 316 (38 100), 397 (76 900); MALDI-TOF-MS (DHB): 750.2 (calc. for  $\text{C}_{54}\text{H}_{70}\text{O}_2$ : 750.5); Anal. Calcd. For  $\text{C}_{54}\text{H}_{70}\text{O}_2$ : C, 86.35; H, 9.39. Found: C, 86.57; H, 9.35.



**(*E,E,E,E*)-2-Methyl-5,6,11,12,17,18,23,24-octa-propyl-5,11,17,23-**

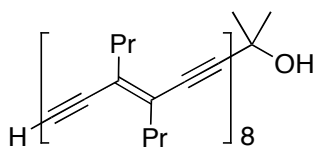
**hexacosatetraen-3,7,9,13,15,19,21,25-octayn-2-ol.**

The reaction was carried out according to the general procedure using *trans*-oligoenediyn tetramer (**24-*C-trans*-oligoenediyn**) (0.405 g, 0.540 mmol), NaOH (1.08 g, 27.0 mmol), in toluene (11 mL) to give a crude residue, which was rapidly chromatographed on silica gel (Wakogel C-200, pretreated with 1%  $\text{NEt}_3$  in hexane and eluted with hexane-AcOEt) to afford the title compound (0.144 g, 39%) as a yellow solid, bis-deprotected product (0.0323 g, 9%) and the starting diol (0.194 g, 48%). The yield based on the recovered starting material is calculated to be 74%.  $^1\text{H}$  NMR:  $\delta$  0.84-1.02 (m, 24H), 1.50-1.68 (m, 16H), 2.02 (s, 1H), 2.35-2.51 (m, 16H), 3.53 (s, 1H);  $^{13}\text{C}$  NMR:  $\delta$  13.34 (x2), 13.39 (x4), 13.44 (x2), 21.46, 21.58 (x3), 21.72 (x4), 31.32, 36.53 (x2), 36.95 (x2), 37.01 (x2), 37.11, 37.14, 65.77, 81.24, 82.04, 82.59, 82.62, 83.33, 83.55, 84.43, 84.50, 84.60 (x2), 84.71, 84.78 (x2), 85.07, 87.98, 105.03, 128.41, 130.25, 132.20, 132.36, 132.58, 132.68 (x2), 133.39.



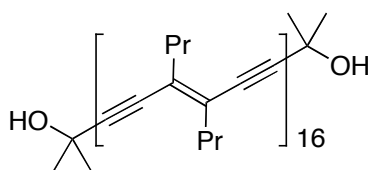
**(*E,E,E,E,E,E,E*)-2,51-Dimethyl-5,6,11,12,17,18,23,24,29,30,35,36,41,42,47,48-hexadeca-propyl-5,11,17,23,29,35,41,47-dopentacontaoctaen-3,7,9,13,15,19,21,25,27,31,33,37,39,43,45,49-hexadecayn-2,51-diol (48-C-*trans*-oligoenediynes).** The reaction

was carried out according to the general procedure using the mono-deprotected **24-C-*trans*-oligoenediynes** (0.266 g, 0.384 mmol), CuCl (0.0533 g, 0.538 mmol), TMEDA (0.116 mL, 0.769 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (6.9 mL) to give a crude residue, which was rapidly chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-CHCl<sub>3</sub>) to afford the title compound (0.221 g, 83%) as an orange solid. m.p. : >250 °C; <sup>1</sup>H NMR:  $\delta$  0.85-1.03 (m, 48H), 1.46-1.68 (m, 32 H), 1.57 (s, 12 H), 1.95 (s, 2 H), 2.32-2.54 (m, 32 H); <sup>13</sup>C NMR:  $\delta$  13.40 (x2), 13.46 (x6), 21.59 (x2), 21.74 (x6), 31.33, 36.55 (x2), 37.00 (x4), 37.16 (x2), 65.82, 81.27, 82.02, 83.33, 84.33, 84.41, 84.46, 84.60, 84.62, 84.64, 84.67, 84.80, 84.85, 84.90, 84.93, 85.12, 105.03, 128.42, 132.18, 132.50, 132.57, 132.61, 132.70, 132.75, 133.43; IR (KBr) 3426, 2958, 2927, 2868, 1706, 1658, 1462, 1260, 1108 cm<sup>-1</sup>; UV/Vis (CHCl<sub>3</sub>):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 281 (59 600), 297 (56 300), 316 (52 800), 425 (111 600); MALDI-TOF-MS (DHB): 1383.1 (calc. for C<sub>102</sub>H<sub>126</sub>O<sub>2</sub>: 1383.0); Anal. Calcd. For C<sub>102</sub>H<sub>126</sub>O<sub>2</sub>: C, 88.51; H, 9.18. Found: C, 88.38; H, 8.97.



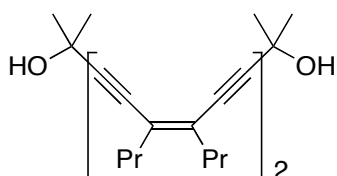
**(*E,E,E,E,E,E,E*)-2-Methyl-5,6,11,12,17,18,23,24,29,30,35,36,41,42,47,48-hexadecapropyl-5,11,17,23,29,35,41,47-pentacontaoctaen-3,7,9,13,15,19,21,25,27,31,33,37,39,43,45,49-hexadecayn-2-ol.** The

reaction was carried out according to the general procedure using *trans*-oligoenediynes octamer (**48-C-*trans*-oligoenediynes**) (225 mg, 0.163 mmol), NaOH (326 mg, 8.14 mmol), in toluene (3.3 mL) to give a crude residue, which was rapidly chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-CHCl<sub>3</sub>) to afford the title compound (92.8 mg, 43%) as an orange solid, bis-deprotected product (20.0 mg, 10%) and the starting diol (99.3 mg, 44%). The yield based on the recovered starting material is calculated to be 77%. <sup>1</sup>H NMR:  $\delta$  0.86-1.13 (m, 48H), 1.56 (s, 6H), 1.51-1.68 (m, 32H), 1.95 (s, 1H), 2.35-2.52 (m, 32H), 3.53 (s, 1H); <sup>13</sup>C NMR:  $\delta$  13.39 (overlap), 21.46, 21.58 (overlap), 21.73 (overlap), 31.33, 36.54 (overlap), 37.00 (overlap), 37.11 (overlap), 65.78, 81.25, 82.03, 82.59, 82.62, 83.32, 83.53, 84.41, 84.46, 84.65 (overlap), 84.85 (overlap), 84.93 (overlap), 85.00, 85.10, 87.99, 105.03, 128.41, 128.49, 128.65, 130.25, 131.58, 131.62, 132.17, 132.27, 132.41, 132.52, 132.58 (overlap), 132.65, 132.71, 133.40.



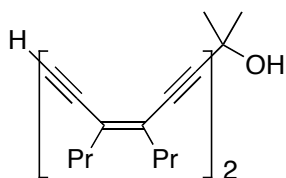
**(*E,E,E,E,E,E,E,E,E,E,E,E,E,E,E*)-2,99-Dimethyl-5,6,11,12,17,18,23,24,29,30,35,36,41,42,47,48,53,54,59,60,65,66,71,72,77,78,83,84,89,90,95,96-dotriacontapropyl-5,11,17,23,29,35,41,47,53,59,65,71,77,83,89,95-hectahexadecaen-3,7,9,13,15,19,21,25,27,31,33,37,39,43,45,49,51,55,57,61,63,67,69,73,75,79,81,85,87,91,93,97-dotriacontayn-2,99-diol (96-C-**

**trans-oligoenediynes**). The reaction was carried out according to the general procedure using the mono-deprotected **48-C-trans-oligoenediynes** (109 mg, 0.0823 mmol), CuCl (22.8 mg, 0.231 mmol), TMEDA (50 mL, 0.329 mmol) in CHCl<sub>3</sub> (4.0 mL) to give a crude residue, which was rapidly chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-CHCl<sub>3</sub>) to afford the title compound (74.4 mg, 68%) as an orange solid. m.p. : >250 °C; <sup>1</sup>H NMR:  $\delta$  0.86-0.98 (m, 96H), 1.57 (s, 12H), 1.49-1.66 (m, 64H), 1.94 (s, 2H), 2.38-2.50 (m, 64H); <sup>13</sup>C NMR:  $\delta$  13.60, 13.84 (overlap), 21.83, 21.92 (overlap), 31.32, 36.32 (overlap), 37.13 (overlap), 65.77, 81.30, 82.36, 82.51 (overlap), 82.98, 83.45 (overlap), 84.48, 105.03, 128.63, 132.00, 132.10, 132.14, 132.29, 132.36 (overlap), 132.53, 133.53; IR (KBr) 3443, 2958, 2925, 2854, 1739, 1461, 1261, 1100, 803 cm<sup>-1</sup>; UV/Vis (CHCl<sub>3</sub>):  $\epsilon_{\text{max}}$  ( $\lambda$  [nm]) = 271 (137 500), 316 (123 600), 429 (301 300); MALDI-TOF-MS (DHB): 2673.7 ([M + Na]<sup>+</sup>, calc. for C<sub>198</sub>H<sub>238</sub>O<sub>2</sub>Na<sup>+</sup> : 2673.0); Anal. Calcd. For C<sub>30</sub>H<sub>42</sub>O<sub>2</sub>: C, 89.74; H, 9.05. Found: C, 89.35; H, 9.37.



**(Z,Z)-2,15-Dimethyl-5,6,11,12-tetrapropyl-5,11-hexadeca-dien-3,7,9,13-tetrayn-2,15-diol (12-C-cis-oligoenediynes)**.

The reaction was carried out according to the general procedure using desilylated product of **4a** (0.870 g, 3.99 mmol), CuCl (0.553 g, 5.59 mmol), TMEDA (1.20 mL, 7.98 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (13.3 mL) to give a crude residue, which was rapidly chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-AcOEt) to afford the title compound (0.815 g, 94%) as a yellow oil. <sup>1</sup>H NMR:  $\delta$  0.90 (t, *J* = 7.2 Hz, 12 H), 1.56 (s, 12H), 1.46-1.60 (m, 8H), 2.12-2.22 (m, 8H), 2.96 (s, 2H); <sup>13</sup>C NMR:  $\delta$  13.83, 13.85, 21.77, 21.92, 31.34, 33.46, 33.96, 65.64, 77.81, 82.98, 84.21, 99.36, 128.09, 132.38; IR (neat) 3375, 2961, 2871, 1457, 1377, 1235, 1165, 950, 902 cm<sup>-1</sup>; UV/Vis (CHCl<sub>3</sub>):  $\epsilon_{\text{max}}$  ( $\lambda$  [nm]) = 262 (20 200), 299 (11 700), 320 (15 600), 342 (18 200), 364 (15 500); MALDI-TOF-MS (DHB): 434.3 (calc. for C<sub>30</sub>H<sub>42</sub>O<sub>2</sub>: 434.3); Anal. Calcd. For C<sub>30</sub>H<sub>42</sub>O<sub>2</sub>: C, 82.90; H, 9.74. Found: C, 82.43; H, 9.38.

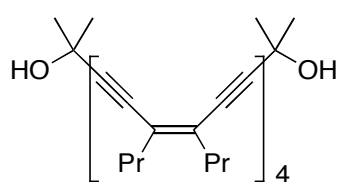


**(Z,Z)-2-Methyl-5,6,11,12-tetrapropyl-5,11-tetra-decadien-3,7,9,13-**

**tetrayn-2-ol**. To a stirred solution of *cis*-oligoenediynes dimer (**12-C-cis-oligoenediynes**) (60.0 mg, 0.138 mmol) in toluene (8 mL) was added excess ground NaOH (276 mg, 6.91 mmol), and the mixture was heated at 90 °C

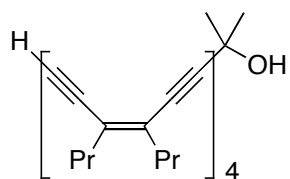
(bath temperature). When the starting diol was almost disappeared, the reaction mixture was filtered and evaporated. The residue was chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-AcOEt) to afford the title compound (42.1 mg, 81%) as a yellow oil. <sup>1</sup>H NMR:  $\delta$  0.91 (t, *J* = 7.2 Hz, 12H), 1.46-1.58 (m, 8H), 1.57 (s, 6H), 2.04 (s, 1H), 2.12-2.26 (m, 8H), 3.25 (s, 1H); <sup>13</sup>C NMR:  $\delta$  13.80 (x2), 13.86 (x2), 21.70, 21.82, 21.83, 21.97, 31.52,

33.43, 33.84, 33.93, 34.17, 65.73, 77.42, 77.92, 82.19, 83.03, 83.38, 84.09, 84.22, 98.99, 128.53, 129.67, 131.05, 132.48.



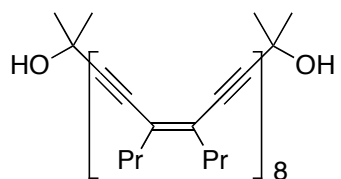
**(Z,Z,Z,Z)-2,27-Dimethyl-5,6,11,12,17,18,23,24-octapropyl-5,11,17,23-octacosatetraen-3,7,9,13,15,19,21,25-octayn-2,27-diol (24-C-*cis*-oligoenediyn).** The reaction was carried out according to the general

procedure using the mono-deprotected **12-C-*cis*-oligoenediyn** (30.0 mg, 0.0798 mmol), CuCl (11.1 mg, 0.112 mmol), TMEDA (24.1 mL, 0.160 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (1 mL) to give a crude residue, which was rapidly chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-AcOEt) to afford the title compound (24.7 mg, 83%) as a yellow oil. <sup>1</sup>H NMR:  $\delta$  0.88-0.96 (m, 24H), 1.59 (s, 12H), 1.50-1.70 (m, 16H), 2.02 (s, 2H), 2.15-2.28 (m, 16H); <sup>13</sup>C NMR:  $\delta$  13.77, 13.82, 13.85 (x2), 21.82, 21.87, 21.91, 21.98, 31.52, 33.47, 33.99, 34.31, 34.34, 65.76, 78.10, 79.36, 79.45, 82.92, 83.43, 84.39, 85.14, 99.37, 128.50, 130.93, 131.13, 132.65; IR (neat) 3420, 2962, 2871, 2178, 1457, 1378, 1164, 951, 756 cm<sup>-1</sup>; UV/Vis (CHCl<sub>3</sub>):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 266 (28 800), 316 (22 800), 360 (26 400), 390 (27 500); MALDI-TOF-MS (DHB): 750.2 (calc. for C<sub>54</sub>H<sub>70</sub>O<sub>2</sub>: 750.5); Anal. Calcd. For C<sub>54</sub>H<sub>70</sub>O<sub>2</sub>: C, 86.35; H, 9.39. Found: C, 86.30; H, 9.33.



**(Z,Z,Z,Z)-2-Methyl-5,6,11,12,17,18,23,24-octapropyl-5,11,17,23-hexacosatetraen-3,7,9,13,15,19,21,25-octayn-2-ol.** To a stirred solution

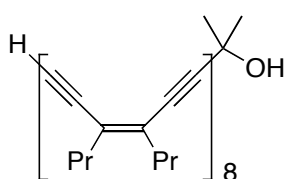
of *cis*-oligoenediyn tetramer (**24-C-*cis*-oligoenediyn**) (78.7 mg, 0.105 mmol) in toluene (2 mL) was added excess ground NaOH (210 mg, 5.25 mmol), and the mixture was heated at 90 °C (bath temperature). When the starting diol was almost disappeared, the reaction mixture was filtered and evaporated. The residue was chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-AcOEt) to afford the title compound (59.8 mg, 82%) as a yellow oil. <sup>1</sup>H NMR:  $\delta$  0.80-0.97 (m, 24H), 1.58 (s, 6H), 1.46-1.62 (m, 16H), 1.98 (br, 1H), 2.12-2.24 (m, 16H), 3.29 (s, 1H); <sup>13</sup>C NMR:  $\delta$  13.72 (x5), 13.77 (x3), 21.64, 21.76, 21.82 (x3), 21.86 (x2), 21.92, 31.46, 33.37, 33.68, 33.89, 34.11 (x3), 34.25 (x2), 78.03, 78.33, 79.31 (x2), 79.39, 82.46 (x2), 82.83, 83.26, 83.56, 83.89, 84.17, 84.31, 84.36, 85.02, 99.27, 128.46, 129.62, 130.85, 130.97, 131.26 (x2), 131.38, 132.54.



**(Z,Z,Z,Z,Z,Z,Z,Z)-2,51-Dimethyl-5,6,11,12,17,18,23,24,29,30,35,36,41,42,47,48-hexadeca-propyl-5,11,17,23,29,35,41,47-dopentaconta-octaen-3,7,9,13,15,19,21,25,27,31,33,37,39,43,45,49-hexadecayn-2,51-diol (48-C-*cis*-oligoenediyn).** The reaction was

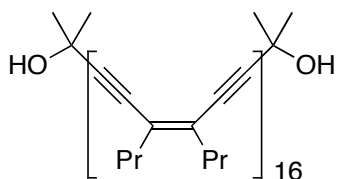
carried out according to the general procedure using the mono-deprotected **24-C-*cis*-oligoenediyn** (25.5 mg, 0.0368 mmol), CuCl (5.10 mg, 0.0516 mmol), TMEDA (11.1 mL, 0.0737 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (0.8 mL) to give a crude residue, which was rapidly chromatographed on silica gel (Wakogel C-200,

pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-CHCl<sub>3</sub>) to afford the title compound (21.1 mg, 83%) as an orange solid. m.p. : 117 °C; <sup>1</sup>H NMR:  $\delta$  0.84-0.96 (m, 48H), 1.56 (s, 12H), 1.46-1.66 (m, 32H), 1.99 (br, 2H), 2.12-2.25 (m, 32H); <sup>13</sup>C NMR:  $\delta$  13.71 (x5), 13.75 (x3), 21.72, 21.76, 21.80 (x5), 21.88, 31.41, 33.37, 33.85, 34.11 (x3), 34.19 (x3), 65.60, 78.02, 79.28, 79.30, 79.35, 79.38, 79.44, 79.48, 82.84, 83.32, 84.33 (x4), 84.40, 84.95, 99.14, 128.47, 130.92, 130.98, 131.10, 131.21, 131.30, 131.43, 132.48; IR (KBr) 3381, 2961, 2871, 1457, 1378, 1108 cm<sup>-1</sup>; UV/Vis (CHCl<sub>3</sub>):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 266 (61 000), 316 (50 800), 417 (85 000); MALDI-TOF-MS (DHB): 1383.7 (calc. for C<sub>102</sub>H<sub>126</sub>O<sub>2</sub>: 1383.0); Anal. Calcd. For C<sub>102</sub>H<sub>126</sub>O<sub>2</sub>: C, 88.51; H, 9.18. Found: C, 88.24; H, 8.89.



**(Z,Z,Z,Z,Z,Z,Z,Z)-2-Methyl-5,6,11,12,17,18,23,24,29,30,35,36,41,42,47,48-hexadecapropyl-5,11,17,23,29,35,41,47-pentacontaoctaen-3,7,9,13,15,19,21,25,27,31,33,37,39,43,45,49-hexadecayn-2-ol.**

The reaction was carried out according to the general procedure using **48-C-cis-oligoenediyn** (30.0 mg, 0.0217 mmol), NaOH (43.4 mg, 1.09 mmol), in toluene (0.4 mL) to give a crude residue, which was rapidly chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-CHCl<sub>3</sub>) to afford the title compound (14.4 mg, 50%) as an orange solid, bis-protected product (1.04 mg, 4%) and the starting diol (10.4 mg, 35%). The yield based on the recovered starting material is calculated to be 77%. <sup>1</sup>H NMR:  $\delta$  0.86-0.96 (m, 48H), 1.59 (s, 6H), 1.48-1.62 (m, 32H), 1.98 (br, 1H), 2.14-2.26 (m, 16H), 3.29 (s, 1H); <sup>13</sup>C NMR:  $\delta$  13.80 (overlap), 13.84 (overlap), 21.70, 21.81 (overlap), 21.89 (overlap), 31.50, 33.44, 33.76, 33.94, 34.21 (overlap), 34.29 (overlap), 78.11, 78.40, 79.25, 79.34, 79.40, 79.42 (overlap), 79.47 (overlap), 79.51, 79.52, 79.56, 82.38, 82.95, 83.43, 83.69, 83.99, 84.33, 89.35 (overlap), 84.40 (overlap), 84.44 (overlap), 84.50 (overlap), 85.02, 99.19, 128.58, 129.75, 130.98, 131.07, 131.16 (overlap), 131.19, 131.26, 131.33 (overlap), 131.35, 131.41 (overlap), 131.44, 131.51, 132.52.



**(Z,Z,Z,Z,Z,Z,Z,Z,Z,Z,Z,Z,Z,Z,Z,Z)-2,99-Dimethyl-5,6,11,12,17,18,23,24,29,30,35,36,41,42,47,48,53,54,59,60,65,66,71,72,77,78,83,84,89,90,95,96-dotriacontapropyl-5,11,17,23,29,35,41,47,53,59,65,71,77,83,89,95-hectahexadecaen-3,7,9,13,15,19,21,25,27,31,33,37,39,43,45,49,51,55,57,61,63,67,69,73,75,79,81,85,87,91,93,97-dotriacontayn-2,99-**

**diol (96-C-cis-oligoenediyn).** The reaction was carried out according to the general procedure using the mono-deprotected **48-C-cis-oligoenediyn** (20.0 mg, 0.0151 mmol), CuCl (4.19 mg, 0.0423 mmol), TMEDA (9.12 mL, 0.0604 mmol) in CHCl<sub>3</sub> (0.3 mL) to give a crude residue, which was rapidly chromatographed on silica gel (Wakogel C-200, pretreated with 1% NEt<sub>3</sub> in hexane and eluted with hexane-CHCl<sub>3</sub>) to afford the title compound (12.4 mg, 62%) as an orange solid. m.p. : >150 °C (decoloration from orange to red); <sup>1</sup>H NMR:  $\delta$  0.88-0.98 (m, 96H), 1.59 (s, 12H), 1.48-1.62 (m, 64H), 1.99 (br, 2H), 2.16-2.27 (m, 64H); <sup>13</sup>C NMR:  $\delta$  13.62 (overlap), 13.84 (overlap),

21.93 (overlap), 31.53, 33.47, 33.97, 34.26 (overlap), 65.79, 79.52 (overlap), 82.99, 83.46, 84.84 (overlap), 85.05, 99.20, 128.65, 131.11, 131.20, 131.37 (overlap), 132.54; IR (KBr) 3369, 2959, 2928, 2871, 1457, 1378, 1109  $\text{cm}^{-1}$ ; UV/Vis ( $\text{CHCl}_3$ ):  $\lambda_{\text{max}}$  ( $\epsilon$  [nm]) = 316 (101 600), 417 (175 900); MALDI-TOF-MS (DHB): 2672.5 ( $[M + \text{Na}]^+$ , calc. for  $\text{C}_{198}\text{H}_{238}\text{O}_2\text{Na}^+$ : 2673.0); Anal. Calcd for  $\text{C}_{198}\text{H}_{238}\text{O}_2$ : C, 89.74 ; H, 9.05. Found: C, 89.88; H, 9.30.