Cover page for Supporting Information

Title: Dearomatizing Anionic Cyclization and Novel Skeletal Rearrangement: High Yield Formation of Multiply Substituted Bicyclic or polycyclic Spirocyclopentadienes and Phenanthrene Derivatives from 4-Aryl 1-lithio-1,3-butadienes

Author: Lantao Liu, Zhihui Wang, Fei Zhao, and Zhenfeng Xi*

Affiliation: Beijing National Laboratory for Molecular Sciences (BNLMS), Institute of Chemistry, Chinese Academy of Sciences, Beijing 100080, China, and Key Laboratory of Bioorganic Chemistry and Molecular Engineering of Ministry of Education, College of Chemistry, Peking University, Beijing 100871, China, and State Key Laboratory of Organometallic Chemistry, Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences, Shanghai 200032, China

Contents:

- 1) General experimental condition and characterization data for all new starting materials and products. **S2-S39**
- 2) Copies of ^1H NMR and ^{13}C NMR spectra for all new compounds. **S40-S173**

General.

All reactions were conducted under a slightly positive pressure of dry, prepurified nitrogen using standard Schlenk line techniques. Unless otherwise noted, all starting materials were commercially available and were used without further purification. Diethyl ether and Toluene were refluxed and distilled from sodium benzophenone ketyl under a nitrogen atmosphere.

^1H and ^{13}C NMR spectra were recorded at 300 and 75.4 MHz, respectively, in CDCl_3 (contain 0.1% TMS) solution.

Preparation of starting materials 4-aryl-1-iodo-1,3-butadienes following the literature method. All 4-aryl-1-iodo-1,3-butadiene derivatives used as starting materials were synthesized following the reported procedure.¹ Analytical data for new compounds are listed as follows.

1a. Colorless liquid, isolated yield 60%. ^1H NMR (CDCl_3 , TMS): δ 0.54 (t, $J = 7.5$ Hz, 3H, CH_3), 0.86 (t, $J = 6.9$ Hz, 3H, CH_3), 0.95 (t, $J = 7.5$ Hz, 3H, CH_3), 1.24 (t, $J = 7.5$ Hz, 3H, CH_3), 1.43-2.83 (m, 8H, CH_2), 7.33-7.45 (m, 3H, CH), 7.52-7.55 (m, 1H, CH), 7.68-7.81 (m, 3H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 12.31 (1 CH_3), 13.28 (1 CH_3), 14.01 (1 CH_3), 14.12 (1 CH_3), 26.22 (1 CH_2), 26.51 (1 CH_2), 26.61 (1 CH_2), 34.51 (1 CH_2), 109.46 (1 quart C), 125.14 (1 CH), 125.23 (1 CH), 125.36 (1 CH), 125.41 (1 CH), 126.40 (1 CH), 126.72 (1 CH), 128.36 (1 CH), 131.65 (1 quart C), 133.51 (1 quart C), 136.08 (1 quart C), 139.62 (1 quart C), 145.23 (1 quart C), 148.79 (1 quart C). HRMS calcd. for $\text{C}_{22}\text{H}_{27}\text{I}$: 418.1158, found 418.1153.

1c. Colorless liquid, isolated yield 65%. ^1H NMR (CDCl_3 , TMS): δ 0.50 (t, $J = 7.2$ Hz, 3H, CH_3), 0.69-1.67 (m, 27H, CH_3 and CH_2), 2.08-2.35 (m, 4H, CH_2), 2.63-2.76 (m, 2H, CH_2), 7.32-7.51 (m, 4H, CH), 7.68-7.82 (m, 3H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 13.47 (1 CH_3), 13.99 (1 CH_3), 14.00 (1 CH_3), 14.09 (1 CH_3), 21.54 (1 CH_2), 22.67 (1 CH_2), 22.85 (1 CH_2), 23.59 (1 CH_2), 30.21 (1 CH_2), 30.68 (1 CH_2), 31.70 (1 CH_2), 31.93 (1 CH_2), 33.48 (1 CH_2), 33.84 (1 CH_2), 33.91 (1 CH_2), 40.63 (1 CH_2), 108.27 (1 quart C), 125.16 (1 CH), 125.26 (1 CH), 125.37 (1 CH), 125.48 (1 CH), 126.28 (1 CH), 126.67 (1 CH), 128.36 (1 CH), 131.67 (1 quart C), 133.56 (1 quart C), 135.19 (1 quart C), 140.12 (1 quart C), 144.76 (1 quart C), 148.69 (1 quart C). HRMS calcd. for $\text{C}_{30}\text{H}_{43}\text{I}$: 530.2410, found 530.2418.

1d. Colorless liquid, isolated yield 70%. ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.23 (t, $J = 7.5$ Hz, 3H, CH_3), 0.48 (t, $J = 7.5$ Hz, 1.5H, CH_3), 0.80-2.38 (m, 29H, CH_3 and CH_2), 7.09-8.16 (m, 10.5H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 11.93(1 CH_3), 12.48(1 CH_3), 14.28(2 CH_3), 21.82(1 CH_2), 22.20(1 CH_2), 22.28(1 CH_2), 22.85(1 CH_2), 29.03(1 CH_2), 29.32(1 CH_2), 29.36(1 CH_2), 29.45(1 CH_2), 32.13(1 CH_2), 32.35(1 CH_2), 32.78(1 CH_2), 35.63(1 CH_2), 36.31(1 CH_2), 36.69(1 CH_2), 42.19(1 CH_2), 42.43(1 CH_2), 101.06(1 quart C), 101.62(1 quart C), 124.10(1 CH), 124.63(1 CH), 124.85(1 CH), 124.88(1 CH), 124.94(1 CH), 125.15(1 CH), 125.64(1 CH),

125.94(1 CH), 125.98(1 CH), 126.37(1 CH), 126.82(1 CH), 128.16(1 CH), 128.23(1 CH), 129.34(1 CH), 130.14(1 quart C), 130.88(1 quart C), 131.37(1 quart C), 133.59(1 quart C), 133.67(1 quart C), 134.07(1 quart C), 140.24(1 quart C), 140.70(1 quart C), 143.88(1 quart C), 144.51(1 quart C), 147.26(1 quart C), 148.21(1 quart C). HRMS calcd. for C₂₄H₂₉I: 444.1314, found 444.1315.

6c. Colorless liquid, isolated yield 70%. ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.77-0.86 (m, 9H, CH₃), 0.96 (t, *J* = 7.2 Hz, 3H, CH₃), 1.06-1.54 (m, 16H, CH₂), 1.65-1.75 (m, 1H, CH₂), 1.94-2.04 (m, 1H, CH₂), 2.20-2.30 (m, 3H, CH₂), 2.35-2.51 (m, 3H, CH₂), 7.15-7.25 (m, 5H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 13.76 (1 CH₃), 14.03 (3 CH₃), 21.56 (1 CH₂), 22.67 (1 CH₂), 23.08 (1 CH₂), 23.50 (1 CH₂), 30.08 (1 CH₂), 31.17 (1 CH₂), 31.38 (1 CH₂), 31.47 (1 CH₂), 33.44 (1 CH₂), 33.58 (1 CH₂), 34.80 (1 CH₂), 40.61 (1 CH₂), 108.61 (1 quart C), 126.02 (1 CH), 127.29 (2 CH), 128.58 (2 CH), 136.56 (1 quart C), 142.52 (1 quart C), 143.26 (1 quart C), 148.08 (1 quart C). HRMS calcd. for C₂₆H₄₁I: 480.2253, found 480.2248.

6d. Colorless liquid, isolated yield 55%. ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.62 (t, *J* = 7.5 Hz, 3H, CH₃), 0.88 (t, *J* = 7.2 Hz, 3H, CH₃), 1.08-2.94 (m, 16H, CH₂), 7.11-7.26 (m, 5H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 12.77 (1 CH₃), 14.07 (1 CH₃), 21.86 (1 CH₂), 22.40 (1 CH₂), 28.84 (1 CH₂), 29.08 (1 CH₂), 32.09 (1 CH₂), 34.73 (1 CH₂), 35.64 (1 CH₂), 42.41 (1 CH₂),

100.56 (1 quart C), 126.01 (1 CH), 127.04 (2 CH), 128.81 (2 CH), 133.97 (1 quart C), 142.18 (1 quart C), 143.31 (1 quart C), 146.74 (1 quart C). HRMS calcd. for $C_{20}H_{27}I$: 394.1158, found 394.1161.

6f. Colorless liquid, isolated yield 67%. 1H NMR (300 MHz, $CDCl_3$, TMS): δ 0.78-0.94 (m, 9H, CH_3), 1.12 (t, $J = 7.5$ Hz, 3H, CH_3), 1.65-1.78 (m, 1H, CH_2), 1.99-2.09 (m, 1H, CH_2), 2.20-2.39 (m, 6H, CH_3 and CH_2), 2.42-2.56 (m, 3H, CH_2), 6.96-7.13 (m, 4H, CH). ^{13}C NMR (75 MHz, $CDCl_3$, TMS): δ 12.47 (1 CH_3), 13.56 (1 CH_3), 13.67 (1 CH_3), 13.75 (1 CH_3), 21.36 (1 CH_3), 26.09 (1 CH_2), 26.64 (1 CH_2), 27.39 (1 CH_2), 34.63 (1 CH_2), 109.62 (1 quart C), 125.57 (1 CH), 126.78 (1 CH), 127.15 (1 CH), 129.40 (1 CH), 136.56 (1 quart C), 137.66 (1 quart C), 142.46 (1 quart C), 142.86 (1 quart C), 148.28 (1 quart C). HRMS calcd. for $C_{19}H_{27}I$: 382.1158, found 382.1160.

6g. Colorless liquid, isolated yield 78%. 1H NMR (300 MHz, $CDCl_3$, TMS): δ 0.79-0.93 (m, 9H, CH_3), 1.11 (t, $J = 7.5$ Hz, 3H, CH_3), 1.66-1.79 (m, 1H, CH_2), 2.01-2.14 (m, 1H, CH_2), 2.19-2.39 (m, 6H, m, 6H, CH_3 and CH_2), 2.41-2.57 (m, 3H, CH_2), 7.02 (d, $J = 8.1$ Hz, 2H, CH), 7.12 (d, $J = 7.8$ Hz, 2H, CH). ^{13}C NMR (75 MHz, $CDCl_3$, TMS): δ 12.46 (1 CH_3), 13.59 (1 CH_3), 13.65 (1 CH_3), 13.81 (1 CH_3), 21.18 (1 CH_3), 26.11 (1 CH_2), 26.71 (1 CH_2), 27.40 (1 CH_2), 34.57

(1 CH₂), 109.67 (1 quart C), 127.98 (2 CH), 128.45 (2 CH), 135.54 (1 quart C), 137.48 (1 quart C), 139.96 (1 quart C), 142.40 (1 quart C), 148.24 (1 quart C). HRMS calcd. for C₁₉H₂₇I: 382.1158, found 382.1158.

6h. Colorless liquid, isolated yield 80%. ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.82-0.92 (m, 9H, CH₃), 1.11 (t, *J* = 7.5 Hz, 3H, CH₃), 1.68-1.80 (m, 1H, CH₂), 2.04-2.16 (m, 1H, CH₂), 2.21-2.52 (m, 6H, CH₂), 7.00 (d, *J* = 8.1 Hz, 2H, CH), 7.54 (d, *J* = 8.4 Hz, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 12.39 (1 CH₃), 13.47 (1 CH₃), 13.65 (1 CH₃), 13.85 (1 CH₃), 26.02 (1 CH₂), 26.47 (1 CH₂), 27.48 (1 CH₂), 34.54 (1 CH₂), 91.52 (1 quart C), 110.12 (1 quart C), 127.53 (1 quart C), 130.70 (2 CH), 136.40 (2 CH), 142.49 (1 quart C), 143.39 (1 quart C), 147.62 (1 quart C). HRMS calcd. for C₁₈H₂₄I₂: 493.9968, found 493.9960.

6i. Colorless liquid, isolated yield 76%. ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.80-0.93 (m, 9H, CH₃), 1.14 (t, *J* = 7.5 Hz, 3H, CH₃), 1.70-1.82 (m, 1H, CH₂), 2.04-2.16 (m, 1H, CH₂), 2.23-2.58 (m, 6H, CH₂), 7.36 (d, *J* = 8.4 Hz, 2H, CH), 7.48 (d, *J* = 8.4 Hz, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 12.38 (1 CH₃), 13.42 (1 CH₃), 13.66 (1 CH₃), 13.73 (1 CH₃), 25.96 (1 CH₂), 26.52 (1 CH₂), 27.57 (1 CH₂), 34.56 (1 CH₂), 110.26 (1 quart C), 124.24 (q, *J* = 3.8 Hz, 1 CF₃), 128.77 (1 quart C), 128.98 (4 CH), 136.41 (1 quart C), 144.06 (1 quart C), 146.84 (1 quart C).

C), 147.37 (1 quart C). HRMS calcd. for C₁₉H₂₄F₃I: 436.0875, found 436.0880.

Typical procedure for the preparation of spiro cyclopentadiene products 5a-n from dearomatizing anionic cyclization of 4-naphthyl 1-lithio-1,3-butadienes followed by reactions with electrophiles. To a diethyl ether (5 mL) solution of 4-naphthyl 1-iodo-1,3-butadiene **1** (0.5 mmol) at -78 °C was added *t*-BuLi (1.0 mmol, 1.5 M in pentane). The above reaction mixture was then stirred at -78 °C for 1h. Hydrolysis of the reaction mixture of **1a** with saturated aqueous NaHCO₃ afforded a mixture of two products **5a** and **5a'**, which were separated by using column chromatograph to give pure **5a** and pure **5a'** in 69% and 21% isolated yields, respectively.

When the above reaction mixture of **1** was further treated with an electrophile (0.6 mmol) instead of quench with saturated aqueous NaHCO₃, the reaction mixture was continuously stirred at -78 °C for another one hour and then quenched with aqueous NaHCO₃. The layers were separated and the aqueous phase was extracted three times with ether. The combined extracts were washed with brine and dried over MgSO₄. Evaporation under reduced pressure gave a crude product **5b-n**, which was purified by flash chromatography.

5a. Colorless liquid, isolated yield 69% (101 mg). ¹H NMR (CDCl₃, TMS): δ 0.74 (t, *J* = 7.5 Hz, 6H, CH₃), 1.10 (t, *J* = 7.5 Hz, 6H, CH₃), 1.90-2.14 (m, 4H, CH₂), 2.24-2.32 (m, 4H, CH₂), 3.50 (t, *J* = 2.7 Hz, 2H, CH₂), 5.06 (dt, *J* = 10.2, 2.1 Hz, 1H, CH), 6.02 (dt, *J* = 9.9, 3.3 Hz, 1H, CH), 6.60 (dd, *J* = 7.8, 1.2 Hz, 1H, CH), 6.90-6.96 (m, 1H, CH), 7.04-7.13 (m, 2H, CH). ¹³C

NMR (75 MHz, CDCl₃, TMS): δ 14.99 (2 CH₃), 15.07 (2 CH₃), 18.90 (2 CH₂), 19.48 (2 CH₂), 29.71 (1 CH₂), 62.76 (1 quart C), 123.83 (1 CH), 125.66 (1 CH), 125.76 (1 CH), 127.02 (1 CH), 128.47 (1 CH), 129.32 (1 CH), 134.18 (1 quart C), 134.93 (1 quart C), 141.62 (2 quart C), 150.65 (2 quart C). HRMS calcd. for C₂₂H₂₈: 292.2191, found 292.2193.

5a'. Colorless liquid, isolated yield 21% (30 mg). ¹H NMR (CDCl₃, TMS): δ 0.86 (t, J = 7.5 Hz, 6H, CH₃), 1.09 (t, J = 7.5 Hz, 6H, CH₃), 2.01-2.31 (m, 8H, CH₂), 2.44 (q, J = 2.1 Hz, 2H, CH₂), 6.05-6.11 (m, 1H, CH), 6.40-6.44 (m, 1H, CH), 6.67-6.70 (m, 1H, CH), 6.92-7.10 (m, 3H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.98 (2 CH₃), 15.01 (2 CH₃), 18.70 (2 CH₂), 19.39 (2 CH₂), 29.59 (1 CH₂), 59.23 (1 quart C), 125.76 (1 CH), 126.29 (1 CH), 126.70 (1 CH), 127.03 (1 CH), 127.34 (1 CH), 127.70 (1 CH), 134.09 (1 quart C), 135.71 (1 quart C), 140.28 (2 quart C), 150.38 (2 quart C). HRMS calcd. for C₂₂H₂₈: 292.2191, found 292.2188.

5b. Colorless liquid, isolated yield 88% (146 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.70 (t, J = 7.5 Hz, 3H, CH₃), 0.77 (t, J = 7.5 Hz, 3H, CH₃), 1.08-1.14 (m, 6H, CH₃), 1.85-2.69 (m, 10H, CH₂), 3.56-3.59 (m, 1H, CH), 5.00-5.08 (m, 3H, CH₂ and CH), 5.79-5.93 (m, 1H, CH), 5.97 (dd, J = 10.2, 3.6 Hz, 1H, CH), 6.57 (dd, J = 7.8, 1.5 Hz, 1H, CH), 6.90-6.96 (m, 1H, CH), 7.07-7.13 (m, 1H, CH), 7.23-7.26 (m, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.92 (1 CH₃), 15.05 (1 CH₃), 15.16 (1 CH₃), 15.24 (1 CH₃), 18.89 (1 CH₂), 18.91 (1 CH₂), 19.23 (1 CH₂),

19.33 (1 CH₂), 37.90 (1 CH₂), 43.82 (1 CH), 62.82 (1 quart C), 116.58 (1 CH₂), 125.57 (1 CH), 125.87 (1 CH), 127.03 (1 CH), 127.93 (1 CH), 127.98 (1 CH), 128.74 (1 CH), 134.75 (1 quart C), 136.27 (1 CH), 137.84 (1 quart C), 141.57 (1 quart C), 142.04 (1 quart C), 150.27 (1 quart C), 150.61 (1 quart C). HRMS calcd. for C₂₅H₃₂: 332.2504, found 332.2502.

5c. Colorless liquid, isolated yield 84% (160 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.63-0.79 (m, 6H, CH₃), 1.07-1.13 (m, 6H, CH₃), 1.82-2.04 (m, 4H, CH₂), 2.23-2.32 (m, 4H, CH₂), 2.80 (dd, *J* = 13.2, 9.6 Hz, 1H, CH₂), 3.27 (dd, *J* = 13.2, 4.8 Hz, 1H, CH₂), 3.77 (t, *J* = 4.5 Hz, 1H, CH), 4.98 (dd, *J* = 10.2, 1.5 Hz, 1H, CH), 5.80 (dd, *J* = 10.2, 3.6 Hz, 1H, CH), 6.58 (d, *J* = 7.8 Hz, 1H, CH), 6.95 (t, *J* = 7.2 Hz, 1H, CH), 7.10-7.31 (m, 7H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.86 (1 CH₃), 15.02 (1 CH₃), 15.12 (1 CH₃), 15.39 (1 CH₃), 18.87 (1 CH₂), 18.93 (1 CH₂), 19.16 (1 CH₂), 19.33 (1 CH₂), 40.13 (1 CH), 46.46 (1 CH₂), 62.94 (1 quart C), 125.70 (1 CH), 125.83 (1 CH), 126.02 (1 CH), 127.14 (1 CH), 127.54 (1 CH), 128.16 (2 CH), 128.24 (1 CH), 128.73 (1 CH), 129.52 (2 CH), 134.73 (1 quart C), 137.90 (1 quart C), 139.83 (1 quart C), 141.70 (1 quart C), 142.02 (1 quart C), 150.14 (1 quart C), 150.54 (1 quart C). HRMS calcd. for C₂₉H₃₄: 382.2661, found 382.2657.

5d. Colorless liquid, isolated yield 66% (124 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.72 (t, *J* = 7.8 Hz, 3H, CH₃), 0.79 (t, *J* = 7.5 Hz, 3H, CH₃), 1.09-1.14 (m, 6H, CH₃), 1.35 (s, 9H, CH₃),

1.86-2.34 (m, 8H, CH₂), 5.12-5.16 (m, 2H, CH), 5.90 (dd, *J* = 9.9, 3.9 Hz, 1H, CH), 6.63 (dd, *J* = 8.1, 1.5 Hz, 1H, CH), 6.88 (dd, *J* = 7.5, 0.9 Hz, 1H, CH), 6.94-7.08 (m, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.97 (2 CH₃), 15.07 (1 CH₃), 15.33 (1 CH₃), 18.91 (3 CH₂), 19.30 (1 CH₂), 26.65 (3 CH₃), 45.34 (1 quart C), 47.77 (1 CH), 62.50 (1 quart C), 121.88 (1 CH), 126.19 (1 CH), 126.40 (1 CH), 127.19 (1 CH), 128.13 (1 CH), 131.56 (1 CH), 134.10 (1 quart C), 135.24 (1 quart C), 142.19 (1 quart C), 142.35 (1 quart C), 149.63 (1 quart C), 151.02 (1 quart C), 214.51 (1 quart C). IR (neat): ν (C=O) = 1710 cm⁻¹; HRMS calcd. for C₂₇H₃₆O: 376.2766, found 376.2771.

5e. Colorless liquid, isolated yield 58% (132 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.72 (t, *J* = 7.5 Hz, 3H, CH₃), 0.79 (t, *J* = 7.5 Hz, 3H, CH₃), 1.08-1.14 (m, 6H, CH₃), 1.72-2.34 (m, 23H CH₂ and CH), 5.12 (dd, *J* = 9.9, 2.1 Hz, 1H, CH), 5.17 (m, 1H, CH), 5.85 (dd, *J* = 9.9, 3.6 Hz, 1H, CH), 6.62 (dd, *J* = 7.8, 1.5 Hz, 1H, CH), 6.82-6.85 (m, 1H, CH), 6.93-7.06 (m, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.97 (2 CH₃), 15.06 (1 CH₃), 15.32 (1 CH₃), 18.89 (2 CH₂), 18.92 (1 CH₂), 19.30 (1 CH₂), 27.98 (3 CH), 36.54 (3 CH₂), 38.22 (3 CH₂), 46.92 (1 CH), 47.51 (1 quart C), 62.45 (1 quart C), 121.84 (1 CH), 126.12 (1 CH), 126.29 (1 CH), 127.12 (1 CH), 128.30 (1 CH), 131.27 (1 CH), 134.21 (1 quart C), 135.25 (1 quart C), 142.11 (1 quart C), 142.27 (1 quart C), 149.66 (1 quart C), 151.08 (1 quart C), 213.96 (1 quart C). IR (neat): ν (C=O) = 1706 cm⁻¹; HRMS calcd. for C₃₃H₄₂O: 454.3236, found 454.3238.

5f. Colorless liquid, isolated yield 60% (170 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.70-0.78 (m, 6H, CH_3), 0.86-1.00 (m, 6H, CH_3), 1.05-2.27 (m, 39H CH_2 and CH), 5.06-5.12 (m, 2H, CH), 5.84 (dd, $J = 10.2, 3.6$ Hz, 1H, CH), 5.57 (dd, $J = 7.8, 1.5$ Hz, 1H, CH), 6.80-7.05 (m, 3H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 13.84 (1 CH_3), 13.99 (1 CH_3), 14.08 (2 CH_3), 23.08 (1 CH_2), 23.12 (1 CH_2), 23.14 (2 CH_2), 25.89 (3 CH_2), 26.31 (1 CH_2), 28.03 (3 CH), 32.09 (1 CH_2), 32.52 (1 CH_2), 32.55 (1 CH_2), 32.61 (1 CH_2), 36.58 (3 CH_2), 38.30 (3 CH_2), 47.21 (1 CH), 47.46 (1 quart C), 62.65 (1 quart C), 121.62 (1 CH), 126.10 (1 CH), 126.30 (1 CH), 126.96 (1 CH), 128.32 (1 CH), 131.55 (1 CH), 134.22 (1 quart C), 135.44 (1 quart C), 141.21 (1 quart C), 141.29 (1 quart C), 148.63 (1 quart C), 149.94 (1 quart C), 213.55 (1 quart C). IR (neat): ν ($\text{C}=\text{O}$) = 1708 cm^{-1} ; HRMS calcd. for $\text{C}_{41}\text{H}_{58}\text{O}$: 566.4488, found 566.4481.

5g. Carbon dioxide was directly bubbled into the reaction mixture containing the dearomatized intermediate **3a** under a slightly positive pressure. Colorless solid, isolated yield 69% (116 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.37 (t, $J = 7.5$ Hz, 3H, CH_3), 0.94-1.15 (m, 9H, CH_3), 2.07-2.40 (m, 8H, CH_2), 4.07 (t, $J = 2.4$ Hz, 1H, CH), 6.13 (dd, $J = 9.9, 2.4$ Hz, 1H, CH), 6.51 (dd, $J = 9.9, 3.0$ Hz, 1H, CH), 6.77 (dd, $J = 7.5, 0.3$ Hz, 1H, CH), 6.95-7.13 (m, 3H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.04 (1 CH_3), 14.36 (1 CH_3), 14.40 (1 CH_3), 14.44 (1 CH_3), 18.20 (1 CH_2), 19.14 (1 CH_2), 19.70 (1 CH_2), 19.92 (1 CH_2), 45.40 (1 CH), 62.11 (1 quart

C), 124.77 (1 CH), 125.96 (1 CH), 126.86 (1 CH), 127.11 (1 CH), 127.67 (1 CH), 128.04 (1 CH), 132.98 (1 quart C), 134.24 (1 quart C), 140.62 (1 quart C), 145.60 (1 quart C), 145.62 (1 quart C), 149.26 (1 quart C), 177.27 (1 quart C). HRMS calcd. for $C_{23}H_{28}O_2$: 336.2089, found 336.2091.

5h. Colorless liquid, isolated yield 73% (133 mg). 1H NMR (300 MHz, $CDCl_3$, TMS): δ 0.10 (s, 9H, CH_3), 0.64 (t, $J = 7.5$ Hz, 3H, CH_3), 0.85 (t, $J = 7.8$ Hz, 3H, CH_3), 1.06-1.15 (m, 6H, CH_3), 1.86-2.34 (m, 8H, CH_2), 3.18 (t, $J = 3.3$ Hz, 1H, CH), 4.85 (dd, $J = 10.2, 2.4$ Hz, 1H, CH), 5.96 (dd, $J = 10.2, 3.6$ Hz, 1H, CH), 6.55 (dd, $J = 7.5, 1.2$ Hz, 1H, CH), 6.82-6.87 (m, 1H, CH), 6.97-7.06 (m, 2H, CH). ^{13}C NMR (75MHz, $CDCl_3$, TMS): δ -1.52 (3 CH_3), 14.78 (1 CH_3), 15.00 (1 CH_3), 15.18 (1 CH_3), 15.68 (1 CH_3), 18.84 (1 CH_2), 18.87 (1 CH_2), 19.26 (1 CH_2), 19.37 (1 CH_2), 33.00 (1 CH), 62.90 (1 quart C), 124.56 (1 CH), 125.35 (1 CH), 125.54 (1 CH), 125.85 (1 CH), 127.61 (1 CH), 127.77 (1 CH), 133.38 (1 quart C), 136.50 (1 quart C), 139.97 (1 quart C), 142.04 (1 quart C), 151.73 (1 quart C), 152.44 (1 quart C). HRMS calcd. for $C_{25}H_{36}Si$: 364.2586, found 364.2589.

5i. Colorless liquid, isolated yield 52% (109 mg). 1H NMR (300 MHz, $CDCl_3$, TMS): δ 0.10 (s, 9H, CH_3), 0.66 (t, $J = 7.2$ Hz, 3H, CH_3), 0.76 (t, $J = 7.2$ Hz, 3H, CH_3), 0.92-1.01 (m, 6H, CH_3), 1.43-2.26 (m, 16H, CH_2), 3.17 (t, $J = 2.7$ Hz, 1H, CH), 4.83 (dd, $J = 10.2, 2.1$ Hz, 1H, CH), 5.94 (dd, $J = 10.2, 3.6$ Hz, 1H, CH), 6.52-6.54 (m, 1H, CH), 6.81-6.86 (m, 1H, CH), 6.96-7.05 (m, 2H,

CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ -1.47 (3 CH_3), 14.43 (1 CH_3), 14.52 (2 CH_3), 14.83 (1 CH_3), 22.89 (1 CH_2), 23.45 (1 CH_2), 23.57 (1 CH_2), 23.94 (1 CH_2), 28.19 (1 CH_2), 28.28 (1 CH_2), 28.95 (1 CH_2), 29.02 (1 CH_2), 32.91 (1 CH), 63.09 (1 quart C), 124.56 (1 CH), 125.36 (1 CH), 125.41 (1 CH), 126.29 (1 CH), 127.55 (1 CH), 127.79 (1 CH), 133.60 (1 quart C), 136.41 (1 quart C), 138.80 (1 quart C), 141.20 (1 quart C), 150.78 (1 quart C), 151.62 (1 quart C). HRMS calcd. for $\text{C}_{29}\text{H}_{44}\text{Si}$: 420.3212, found 420.3200.

5j. Colorless liquid, isolated yield 25% (50 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.32 (t, J = 7.5 Hz, 3H, CH_3), 1.06-1.23 (m, 9H, CH_3), 2.09 (d, J = 2.7 Hz, 1H, OH), 2.22-2.60 (m, 8H, CH_2), 3.49 (br, 1H, CH), 4.57 (br, 1H, CH), 6.05 (dd, J = 9.6, 2.4 Hz, 1H, CH), 6.46 (dd, J = 9.9, 3.3 Hz, 1H, CH), 6.80, (dd, J = 7.5, 0.6 Hz, 1H, CH), 6.95-7.03 (m, 2H, CH), 7.08-7.13 (m, 1H, CH), 7.19-7.25 (m, 1H, CH), 7.30-7.36 (m, 4H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.55 (1 CH_3), 14.64 (1 CH_3), 15.02 (1 CH_3), 15.13 (1 CH_3), 18.44 (1 CH_2), 19.27 (1 CH_2), 20.04 (1 CH_2), 21.12 (1 CH_2), 48.04 (1 CH), 64.61 (1 quart C), 71.12 (1 CH), 125.66 (2 CH), 126.47 (1 CH), 126.64 (1 CH), 126.74 (1 CH), 126.86 (1 CH), 127.00 (1 CH), 127.46 (1 CH), 128.20 (2 CH), 128.49 (1 CH), 134.59 (1 quart C), 135.32 (1 quart C), 141.90 (1 quart C), 143.08 (1 quart C), 145.70 (1 quart C), 146.03 (1 quart C), 149.30 (1 quart C). HRMS calcd. for $\text{C}_{29}\text{H}_{34}\text{O}$: 398.2610, found 398.2604.

5j'. Colorless liquid, isolated yield 46% (92 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.61 (t, $J = 7.8$ Hz, 3H, CH_3), 0.86 (t, $J = 7.8$ Hz, 3H, CH_3), 1.07-1.15 (m, 6H, CH_3), 1.77-2.36 (m, 8H, CH_2), 3.92 (dd, $J = 5.4, 3.3$ Hz, 1H, CH), 5.16 (d, $J = 1.8$ Hz, 1H, CH), 5.20-5.31 (m, 1H, CH), 5.60 (dd, $J = 10.2, 3.3$ Hz, 1H, CH), 6.64 (dd, $J = 7.8, 1.2$ Hz, 1H, CH), 6.98-7.04 (m, 1H, CH), 7.15-7.20 (m, 1H, CH), 7.24-7.31 (m, 1H, CH), 7.35-7.47 (m, 5H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.84 (1 CH_3), 14.98 (1 CH_3), 15.16 (1 CH_3), 15.50 (1 CH_3), 18.90 (1 CH_2), 18.95 (1 CH_2), 19.13 (1 CH_2), 19.30 (1 CH_2), 46.20 (1 CH), 62.85 (1 quart C), 77.36 (1 CH), 121.94 (1 CH), 125.92 (2 CH), 126.41 (1 CH), 126.46 (1 CH), 127.08 (1 CH), 127.37 (1 CH), 127.67 (1 CH), 128.17 (2 CH), 132.90 (1 CH), 134.68 (1 quart C), 136.04 (1 quart C), 141.65 (1 quart C), 142.55 (1 quart C), 143.02 (1 quart C), 149.87 (1 quart C), 150.32 (1 quart C). HRMS calcd. for $\text{C}_{29}\text{H}_{34}\text{O}$: 398.2610, found 398.2616.

5k. Colorless liquid, isolated yield 82% (160 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.53 (t, $J = 7.5$ Hz, 3H, CH_3), 0.90 (t, $J = 7.5$ Hz, 3H, CH_3), 1.06-1.16 (m, 6H, CH_3), 1.27 (d, $J = 8.7$ Hz, 1H, OH), 1.47-1.87 (m, 12H, CH_2), 2.08-2.36 (m, 6H, CH_2), 3.55 (d, $J = 2.7$ Hz, 1H, CH), 5.13 (dd, $J = 10.2, 1.5$ Hz, 1H, CH), 6.09 (dd, $J = 10.5, 4.2$ Hz, 1H, CH), 6.61 (dd, $J = 7.8, 1.5$ Hz, 1H, CH), 6.93-6.98 (m, 1H, CH), 7.04-7.09 (m, 1H, CH), 7.25-7.55 (m, 1H, CH). ^{13}C NMR (75

MHz, CDCl₃, TMS): δ 14.67 (1 CH₃), 14.92 (1 CH₃), 15.26 (1 CH₃), 15.73 (1 CH₃), 18.86 (1 CH₂), 18.90 (1 CH₂), 18.92 (1 CH₂), 19.39 (1 CH₂), 21.77 (1 CH₂), 22.03 (1 CH₂), 25.79 (1 CH₂), 33.69 (1 CH₂), 35.98 (1 CH₂), 49.05 (1 CH), 63.47 (1 quart C), 75.00 (1 quart C), 125.15 (1 CH), 125.54 (1 CH), 125.99 (1 CH), 127.29 (1 CH), 130.12 (1 CH), 130.85 (1 CH), 134.55 (1 quart C), 135.99 (1 quart C), 140.50 (1 quart C), 143.51 (1 quart C), 149.86 (1 quart C), 150.92 (1 quart C). HRMS calcd. for C₂₈H₃₈O: 390.2923, found 390.2926.

51. Colorless liquid, isolated yield 65% (156 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.69-0.78 (m, 6H, CH₃), 1.05-1.23 (m, 4H, CH₂), 1.64-2.40 (m, 27H, CH₂ and CH), 5.10-5.14 (m, 2H, CH), 5.85 (dd, *J* = 9.6, 3.9 Hz, 1H, CH), 6.59 (dd, *J* = 7.5, 1.2 Hz, 1H, CH), 6.81-6.84 (m, 1H, CH), 6.93-7.05 (m, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.48 (1 CH₃), 14.58 (1 CH₃), 22.26 (1 CH₂), 22.63 (1 CH₂), 23.83 (2 CH₂), 24.44 (2 CH₂), 28.02 (1 CH₂ and 3 CH), 28.66 (1 CH₂), 36.58 (3 CH₂), 38.26 (3 CH₂), 47.15 (1 CH), 47.50 (1 quart C), 62.97 (1 quart C), 121.83 (1 CH), 126.13 (1 CH), 126.24 (1 CH), 127.01 (1 CH), 128.30 (1 CH), 131.07 (1 CH), 134.26 (1 quart C), 135.27 (1 quart C), 137.48 (1 quart C), 137.61 (1 quart C), 146.89 (1 quart C), 148.20 (1 quart C), 213.72 (1 quart C). IR (neat): ν (C=O) = 1708 cm⁻¹; HRMS calcd. for C₃₅H₄₄O: 480.3392, found 480.3401.

5m. Colorless liquid, isolated yield 85% (166 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.10 (s, 9H, CH_3), 0.67 (t, $J = 7.2$ Hz, 3H, CH_3), 0.77 (t, $J = 7.2$ Hz, 3H, CH_3), 0.94-1.05 (m, 2H, CH_2), 1.19-1.31 (m, 2H, CH_2), 1.63-2.14 (m, 8H, CH_2), 2.34-2.42 (m, 4H, CH_2), 3.17 (t, $J = 3.0$ Hz, 1H, CH), 4.85 (dd, $J = 10.2, 2.1$ Hz, 1H, CH), 5.94 (dd, $J = 10.2, 3.6$ Hz, 1H, CH), 6.50-6.53 (m, 1H, CH), 6.81-6.86 (m, 1H, CH), 6.96-7.05 (m, 2H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ -1.52 (3 CH_3), 14.43 (1 CH_3), 14.62 (1 CH_3), 22.04 (1 CH_2), 22.94 (1 CH_2), 23.88 (2 CH_2), 24.33 (1 CH_2), 24.38 (1 CH_2), 28.56 (1 CH_2), 28.68 (1 CH_2), 32.94 (1 CH), 63.38 (1 quart C), 124.46 (1 CH), 125.30 (1 CH), 125.48 (1 CH), 125.66 (1 CH), 127.47 (1 CH), 127.77 (1 CH), 133.36 (1 quart C), 135.15 (1 quart C), 136.43 (1 quart C), 137.49 (1 quart C), 148.95 (1 quart C), 149.72 (1 quart C). HRMS calcd. for $\text{C}_{27}\text{H}_{38}\text{Si}$: 390.2743, found 390.2752.

5n. Colorless liquid, isolated yield 71% (127 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.67-0.76 (m, 6H, CH_3), 1.04-1.25 (m, 4H, CH_2), 1.64-2.06 (m, 8H, CH_2), 2.39-2.65 (m, 6H, CH_2), 3.55-3.58 (m, 1H, CH), 5.00-5.07 (m, 3H, CH_2 and CH), 5.77-5.91 (m, 1H, CH), 5.95 (dd, $J = 10.2, 3.6$ Hz, 1H, CH), 6.53-6.56 (m, 1H, CH), 6.90-6.95 (m, 1H, CH), 7.07-7.12 (m, 1H, CH), 7.22-7.25 (m, 1H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.43 (1 CH_3), 14.58 (1 CH_3), 22.17 (1 CH_2), 22.49 (1 CH_2), 23.84 (1 CH_2), 23.86 (1 CH_2), 24.38 (1 CH_2), 24.40 (1 CH_2), 28.57 (1 CH_2), 28.66 (1 CH_2), 37.87 (1 CH), 43.80 (1 CH_2), 63.34 (1 quart C), 116.50 (1 CH_2), 125.50

(1 CH), 125.84 (1 CH), 126.94 (1 CH), 127.92 (1 CH), 128.02 (1 CH), 128.56 (1 CH), 134.73 (1 quart C), 136.32 (1 CH), 136.91 (1 quart C), 137.34 (1 quart C), 137.85 (1 quart C), 147.37 (1 quart C), 147.83 (1 quart C). HRMS calcd. for C₂₇H₃₄: 358.2660, found 358.2660.

Typical procedure for the preparation of spiro cyclopentadiene products 10a, 10a', 12a-l, and 13-20 from dearomatizing anionic cyclization of 4-phenyl 1-lithio-1,3-butadienes followed by reactions with electrophiles. To a diethyl ether (5 mL) solution of 4-phenyl 1-iodo-1,3-butadiene **6** (0.5 mmol) at -78 °C was added *t*-BuLi (1.0 mmol, 1.5 M in pentane). The above reaction mixture was firstly stirred at -78 °C for 1h. Hydrolysis of the reaction mixture of **6a** with saturated aqueous NaHCO₃ afforded **8a** in 95% isolated yield.¹ When the reaction temperature of **6** was allowed to warm up to 0 °C and kept at this temperature for 2h, hydrolysis of the reaction mixture of **6a** with saturated aqueous NaHCO₃ afforded a mixture of two products **10a** and **10a'**, which could be separated by using column chromatograph to give pure **10a** and pure **10'** in 40% and 36% isolated yields, respectively.

After the above reaction mixture of **6** was stirred at 0 °C for 2h, instead of quench with saturated aqueous NaHCO₃, the reaction mixture was further treated with an electrophile (0.6 mmol) at 0 °C for 2h. The reaction mixture was then quenched with aqueous NaHCO₃. The layers were separated and the aqueous phase was extracted three times with ether. The combined extracts were washed with brine and dried over MgSO₄. Evaporation under reduced pressure gave a crude product **12-20**, which was purified by flash chromatography.

1.01-1.08 (m, 12H, CH₃), 2.11-2.28 (m, 8H, CH₂), 2.32 (d, $J = 1.8$ Hz, 2H, CH₂), 4.84-4.87 (m, 1H, CH), 5.89-5.90 (m, 2H, CH), 5.96-6.01 (m, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 15.08 (2 CH₃), 15.50 (2 CH₃), 18.71 (2 CH₂), 18.89 (2 CH₂), 28.02 (1 CH₂), 56.50 (1 quart C), 122.53 (1 CH), 122.80 (1 CH), 126.29 (1 CH), 129.70 (1 CH), 140.61 (2 quart C), 148.70 (2 quart C). HRMS calcd. for C₁₈H₂₆: 242.2034, found 242.2034.

10a'. Colorless liquid, isolated yield 36% (44 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.99 (t, $J = 7.5$ Hz, 6H, CH₃), 1.05 (t, $J = 7.5$ Hz, 6H, CH₃), 2.12 (q, $J = 7.5$ Hz, 4H, CH₂), 2.23 (q, $J = 7.5$ Hz, 4H, CH₂), 2.73-2.76 (m, 2H, CH₂), 4.94-4.98 (m, 2H, CH), 5.87-5.92 (m, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 15.09 (2 CH₃), 15.56 (2 CH₃), 18.96 (2 CH₂), 19.17 (2 CH₂), 25.93 (1 CH), 60.57 (1 quart C), 124.49 (2 CH), 128.43 (2 CH), 141.64 (2 quart C), 148.09 (2 quart C). HRMS calcd. for C₁₈H₂₆: 242.2034, found 242.2034.

12a. Colorless liquid, isolated yield 26% (45 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 1.03-1.18 (m, 12H, CH₃), 1.94 (d, $J = 2.7$ Hz, 1H, OH), 2.19-2.62 (m, 8H, CH₂), 3.33 (br, 1H, CH), 4.35 (t, $J = 2.1$ Hz, 1H, CH), 5.12-5.15 (m, 1H, CH), 5.96-6.06 (m, 3H, CH), 7.17-7.33 (m, 5H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.63 (1 CH₃), 15.04 (1 CH₃), 15.18 (1 CH₃), 16.75 (1 CH₃), 18.86 (1 CH₂), 18.89 (1 CH₂), 19.23 (1 CH₂), 20.96 (1 CH₂), 48.39 (1 CH), 61.16 (1 quart C), 71.22 (1 CH), 124.26 (1 CH), 124.64 (1 CH), 125.64 (2 CH), 125.88 (1 CH), 126.73

(1 CH), 128.07 (2 CH), 129.48 (1 CH), 143.35 (1 quart C), 143.96 (1 quart C), 144.12 (1 quart C), 144.31 (1 quart C), 147.30 (1 quart C). HRMS calcd. for C₂₅H₃₂O: 348.2453, found 348.2454.

12a'. Colorless liquid, isolated yield 52% (90 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.90-0.96 (m, 6H, CH₃), 1.04 (t, *J* = 7.5 Hz, 6H, CH₃), 1.95-2.10 (m, 4H, CH₂), 2.22 (q, *J* = 7.5 Hz, 4H, CH₂), 3.25-3.28 (m, 1H, CH), 4.73 (dd, *J* = 5.1, 3.6 Hz, 1H, CH), 5.05-5.11 (m, 2H, CH), 5.74-5.84 (m, 2H, CH), 7.24-7.40 (m, 5H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 15.00 (1 CH₃), 15.06 (1 CH₃), 15.57 (1 CH₃), 15.76 (1 CH₃), 18.88 (1 CH₂), 18.96 (1 CH₂), 18.99 (2 CH₂), 43.26 (1 CH), 61.17 (1 quart C), 77.24 (1 CH), 124.43 (1 CH), 125.96 (1 CH), 126.37 (2 CH), 127.37 (1 CH), 128.13 (2 CH), 131.10 (1 CH), 131.21 (1 CH), 142.22 (1 quart C), 142.38 (1 quart C), 142.71 (1 quart C), 146.73 (1 quart C), 146.98 (1 quart C). HRMS calcd. for C₂₅H₃₂O: 348.2453, found 348.2457.

12b. Colorless liquid, isolated yield 23% (40 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 1.02-1.18 (m, 12H, CH₃), 2.17-2.62 (m, 8H, CH₂), 3.22 (d, *J* = 4.5 Hz, 1H, OH), 3.58 (br, 1H, CH), 4.26 (br, 1H, CH), 5.08 (d, *J* = 9.3 Hz, 1H, CH), 5.82-6.03 (m, 3H, CH), 7.09-7.13 (m, 1H, CH), 7.24 (d, *J* = 8.1 Hz, 1H, CH), 7.57-7.63 (m, 1H, CH), 8.49-8.51 (m, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.66 (1 CH₃), 15.12 (1 CH₃), 15.23 (1 CH₃), 16.57 (1 CH₃), 18.86 (1 CH₂), 18.93 (1 CH₂), 19.18 (1 CH₂), 21.05 (1 CH₂), 46.76 (1 CH), 60.90 (1 quart C), 71.54 (1

CH), 120.83 (1 CH), 121.84 (1 CH), 123.72 (1 CH), 124.25 (1 CH), 126.01 (1 CH), 130.03 (1 CH), 136.14 (1 CH), 142.93 (1 quart C), 143.81 (1 quart C), 145.32 (1 quart C), 147.13 (1 quart C), 148.32 (1 CH), 162.12 (1 quart C). HRMS calcd. for C₂₄H₃₁NO: 349.2406, found 349.2411.

12b'. Colorless liquid, isolated yield 43% (75 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.85 (t, *J* = 7.5 Hz, 3H, CH₃), 0.94 (t, *J* = 7.5 Hz, 3H, CH₃), 1.00-1.06 (m, 6H, CH₃), 1.82-2.24 (m, 8H, CH₂), 3.45-3.48 (m, 1H, CH), 4.82 (d, *J* = 4.2 Hz, 1H, CH), 5.04 (dd, *J* = 17.7, 10.2 Hz, 2H, CH), 5.81 (dd, *J* = 29.4, 10.2 Hz, 2H, CH), 7.17-7.21 (m, 1H, CH), 7.33 (d, *J* = 7.8 Hz, 1H, CH), 7.64-7.69 (m, 1H, CH), 8.56 (d, *J* = 4.8 Hz, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 15.01 (1 CH₃), 15.05 (1 CH₃), 15.58 (1 CH₃), 15.74 (1 CH₃), 18.76 (1 CH₂), 18.91 (1 CH₂), 18.98 (2 CH₂), 42.99 (1 CH), 61.15 (1 quart C), 75.85 (1 CH), 121.51 (1 CH), 122.36 (1 CH), 124.72 (1 CH), 125.51 (1 CH), 130.47 (1 CH), 131.06 (1 CH), 136.06 (1 CH), 142.11 (1 quart C), 142.50 (1 quart C), 146.80 (1 quart C), 147.27 (1 quart C), 148.28 (1 CH), 160.05 (1 quart C). HRMS calcd. for C₂₄H₃₁NO: 349.2406, found 349.2412.

12c. Colorless liquid, isolated yield 53% (113 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 1.03-1.17 (m, 12H, CH₃), 1.97 (d, *J* = 2.7 Hz, 1H, OH), 2.22-2.58 (m, 8H, CH₂), 3.27 (br, 1H, CH), 4.30 (br, 1H, CH), 5.12 (d, *J* = 9.6 Hz, 1H, CH), 5.86-6.05 (m, 3H, CH), 7.14 (d, *J* = 8.7 Hz, 2H, CH), 7.41 (d, *J* = 8.4 Hz, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.62 (1 CH₃),

15.06 (1 CH₃), 15.17 (1 CH₃), 16.73 (1 CH₃), 18.86 (1 CH₂), 18.87 (1 CH₂), 19.24 (1 CH₂), 20.92 (1 CH₂), 48.16 (1 CH), 61.04 (1 quart C), 70.89 (1 CH), 120.53 (1 quart C), 124.26 (1 CH), 124.87 (1 CH), 125.42 (1 CH), 127.50 (2 CH), 129.57 (1 CH), 131.09 (2 CH), 142.34 (1 quart C), 144.04 (1 quart C), 144.12 (1 quart C), 144.30 (1 quart C), 147.14 (1 quart C). HRMS calcd. for C₂₅H₃₁O⁷⁹Br: 426.1558, found 426.1557.

12c'. Colorless liquid, isolated yield 35% (74 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.85-1.06 (m, 12H, CH₃), 1.89 (q, *J* = 7.5 Hz, 2H, CH₂), 2.04 (q, *J* = 7.5 Hz, 2H, CH₂), 2.21 (q, *J* = 7.5 Hz, 4H, CH₂), 3.23-3.27 (m, 1H, CH), 4.71-4.73 (m, 1H, CH), 5.04-5.12 (m, 2H, CH), 5.72-5.81 (m, 2H, CH), 7.24 (d, *J* = 8.4 Hz, 2H, CH), 7.46 (d, *J* = 8.7 Hz, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.98 (1 CH₃), 15.03 (1 CH₃), 15.57 (1 CH₃), 15.77 (1 CH₃), 18.82 (1 CH₂), 18.93 (1 CH₂), 18.96 (2 CH₂), 43.14 (1 CH), 61.09 (1 quart C), 76.41 (1 CH), 121.15 (1 quart C), 123.94 (1 CH), 125.34 (1 CH), 128.13 (2 CH), 131.12 (2 CH), 131.45 (1 CH), 131.58 (1 CH), 141.15 (1 quart C), 142.36 (1 quart C), 142.85 (1 quart C), 146.58 (1 quart C), 146.85 (1 quart C). HRMS calcd. for C₂₅H₃₁O⁷⁹Br: 426.1558, found 426.1550.

12d. Colorless liquid, isolated yield 28% (51 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 1.04-1.18 (m, 12H, CH₃), 1.95 (br, 1H, OH), 2.20-2.62 (m, 8H, CH₂), 3.29 (br, 1H, CH), 4.34 (br,

1H, CH), 5.12 (d, $J = 9.0$ Hz, 1H, CH), 5.89-6.06 (m, 3H, CH), 6.95-7.02 (m, 2H, CH), 7.20-7.25 (m, 2H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.62 (1 CH_3), 15.05 (1 CH_3), 15.16 (1 CH_3), 16.71 (1 CH_3), 18.86 (1 CH_2), 18.89 (1 CH_2), 19.24 (1 CH_2), 20.93 (1 CH_2), 48.29 (1 CH), 61.11 (1 quart C), 70.84 (1 CH), 114.84 (d, $J = 21.1$ Hz, 2 CH), 124.28 (1 CH), 124.81 (1 CH), 125.58 (1 CH), 127.24 (d, $J = 8.1$ Hz, 2 CH), 129.63 (1 CH), 139.01 (d, $J = 3.1$ Hz, 2 quart C), 144.01 (1 quart C), 144.16 (1 quart C), 144.29 (1 quart C), 147.23 (1 quart C), 161.72 (d, $J = 244.2$ Hz, 2 quart C). HRMS calcd. for $\text{C}_{25}\text{H}_{31}\text{OF}$: 366.2359, found 366.2348.

12d'. Colorless liquid, isolated yield 44% (80 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.87-1.06 (m, 12H, CH_3), 1.91 (q, $J = 7.5$ Hz, 2H, CH_2), 2.05 (q, $J = 7.5$ Hz, 2H, CH_2), 2.18-2.29 (m, 5H, CH_2 and OH), 3.20-3.24 (m, 1H, CH), 4.70-4.71 (m, 1H, CH), 5.04-5.10 (m, 2H, CH), 5.73-5.81 (m, 2H, CH), 6.99-7.05 (m, 2H, CH), 7.29-7.34 (m, 2H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.99 (1 CH_3), 15.04 (1 CH_3), 15.57 (1 CH_3), 15.74 (1 CH_3), 18.86 (1 CH_2), 18.96 (1 CH_2), 18.99 (2 CH_2), 43.28 (1 CH), 61.15 (1 quart C), 76.57 (1 CH), 114.90 (d, $J = 21.8$ Hz, 2 CH), 124.18 (1 CH), 125.54 (1 CH), 127.97 (d, $J = 8.1$ Hz, 2 CH), 131.30 (1 CH), 131.48 (1 CH), 137.96 (d, $J = 3.1$ Hz, 2 quart C), 142.34 (1 quart C), 142.84 (1 quart C), 146.66 (1 quart C), 146.87 (1 quart C), 162.16 (d, $J = 244.2$ Hz, 2 quart C). HRMS calcd. for $\text{C}_{25}\text{H}_{31}\text{OF}$: 366.2359, found 366.2359.

12e. Colorless liquid, isolated yield 31% (59 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 1.03-1.17 (m, 12H, CH_3), 1.92 (d, $J = 2.7$ Hz, 1H, OH), 2.16-2.58 (m, 8H, CH_2), 3.29 (br, 1H, CH), 3.77 (s, 3H, CH_3), 4.32 (br, 1H, CH), 5.10 (d, $J = 9.0$ Hz, 1H, CH), 5.91-6.05 (m, 3H, CH), 6.83 (d, $J = 8.7$ Hz, 2H, CH), 7.18 (d, $J = 8.7$ Hz, 2H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.64 (1 CH_3), 15.06 (1 CH_3), 15.17 (1 CH_3), 16.73 (1 CH_3), 18.87 (1 CH_2), 18.89 (1 CH_2), 19.24 (1 CH_2), 20.97 (1 CH_2), 48.23 (1 CH), 55.22 (1 CH_3), 61.12 (1 quart C), 70.95 (1 CH), 113.45 (2 CH), 124.21 (1 CH), 124.56 (1 CH), 126.06 (1 CH), 126.77 (2 CH), 129.64 (1 CH), 135.50 (1 quart C), 143.81 (1 quart C), 144.02 (1 quart C), 144.29 (1 quart C), 147.35 (1 quart C), 158.41 (1 quart C). HRMS calcd. for $\text{C}_{26}\text{H}_{34}\text{O}_2$: 378.2559, found 378.2558.

12e'. Colorless liquid, isolated yield 50% (94 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.90-0.96 (m, 6H, CH_3), 1.04 (t, $J = 7.5$ Hz, 6H, CH_3), 1.93-2.09 (m, 4H, CH_2), 2.22 (q, $J = 7.5$ Hz, 4H, CH_2), 3.22-3.23 (m, 1H, CH), 3.80 (s, 3H, CH_3), 4.66 (d, $J = 5.7$ Hz, 1H, CH), 5.06 (dd, $J = 10.2, 1.5$ Hz, 2H, CH), 5.71-5.75 (m, 1H, CH), 5.84-5.89 (m, 1H, CH), 6.88 (d, $J = 8.7$ Hz, 2H, CH), 7.29 (d, $J = 8.4$ Hz, 2H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 15.02 (1 CH_3), 15.06 (1 CH_3), 15.57 (1 CH_3), 15.76 (1 CH_3), 18.87 (1 CH_2), 18.96 (1 CH_2), 18.98 (1 CH_2), 19.00 (1 CH_2), 43.26 (1 CH), 55.28 (1 CH_3), 61.20 (1 quart C), 77.13 (1 CH), 113.54 (2 CH), 124.78 (1

CH), 125.93 (1 CH), 127.54 (2 CH), 130.81 (1 CH), 131.00 (1 CH), 134.58 (1 quart C), 142.17 (1 quart C), 142.66 (1 quart C), 146.80 (1 quart C), 147.01 (1 quart C), 158.95 (1 quart C). HRMS calcd. for C₂₆H₃₄O₂: 378.2559, found 378.2558.

12f. Colorless liquid, isolated yield 48% (102 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 1.04-1.19 (m, 12H, CH₃), 1.98 (d, *J* = 2.7 Hz, 1H, OH), 2.20-2.63 (m, 8H, CH₂), 3.38 (br, 1H, CH), 4.40 (br, 1H, CH), 5.13 (d, *J* = 10.2 Hz, 1H, CH), 5.94-6.06 (m, 3H, CH), 7.22-7.58 (m, 9H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.64 (1 CH₃), 15.07 (1 CH₃), 15.19 (1 CH₃), 16.76 (1 CH₃), 18.87 (2 CH₂), 19.27 (1 CH₂), 20.97 (1 CH₂), 48.26 (1 CH), 61.11 (1 quart C), 71.16 (1 CH), 124.23 (1 CH), 124.70 (1 CH), 125.91 (1 CH), 126.13 (2 CH), 126.80 (2 CH), 127.03 (2 CH), 127.10 (1 CH), 128.71 (2 CH), 129.57 (1 CH), 139.64 (1 quart C), 141.00 (1 quart C), 142.43 (1 quart C), 143.95 (1 quart C), 144.13 (1 quart C), 144.29 (1 quart C), 147.30 (1 quart C). HRMS calcd. for C₃₁H₃₆O: 424.2766, found 424.2764.

12f'. Colorless liquid, isolated yield 21% (44 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.88-10.7 (m, 12H, CH₃), 1.95 (q, *J* = 7.5 Hz, 2H, CH₂), 2.06 (q, *J* = 7.5 Hz, 2H, CH₂), 2.17-2.26 (m, 4H, CH₂), 3.31-3.33 (m, 1H, CH), 4.80 (d, *J* = 5.1 Hz, 1H, CH), 5.07-5.12 (m, 2H, CH),

5.81-5.88 (m, 2H, CH), 7.31-7.60 (m, 9H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 15.00 (1 CH_3), 15.05 (1 CH_3), 15.58 (1 CH_3), 15.78 (1 CH_3), 18.87 (1 CH_2), 18.95 (1 CH_2), 18.99 (2 CH_2), 43.27 (1 CH), 61.18 (1 quart C), 76.99 (1 CH), 124.42 (1 CH), 125.81 (1 CH), 126.86 (4 CH), 127.07 (2 CH), 127.21 (1 CH), 128.77 (2 CH), 131.18 (1 CH), 131.26 (1 CH), 140.30 (1 quart C), 140.98 (1 quart C), 141.37 (1 quart C), 142.26 (1 quart C), 142.72 (1 quart C), 146.72 (1 quart C), 147.02 (1 quart C). HRMS calcd. for $\text{C}_{31}\text{H}_{34}$: 406.2660, found 406.2664.

12g. Colorless liquid, isolated yield 37% (62 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 1.01-1.13 (m, 12H, CH_3), 1.91 (d, $J = 3.6$ Hz, 1H, OH), 2.18-2.58 (m, 8H, CH_2), 3.53 (br, 1H, CH), 4.32 (br, 1H, CH), 5.10 (d, $J = 9.0$ Hz, 1H, CH), 6.00-6.08 (m, 3H, CH), 6.20-6.21 (m, 1H, CH), 6.28-6.30 (m, 1H, CH), 7.31 (t, $J = 0.9$ Hz, 1H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.68 (1 CH_3), 14.85 (1 CH_3), 15.14 (1 CH_3), 16.71 (1 CH_3), 18.82 (1 CH_2), 18.94 (1 CH_2), 19.03 (1 CH_2), 20.96 (1 CH_2), 44.83 (1 CH), 60.77 (1 quart C), 66.94 (1 CH), 106.04 (1 CH), 110.13 (1 CH), 124.28 (1 CH), 124.66 (1 CH), 126.20 (1 CH), 129.69 (1 CH), 141.48 (1 CH), 143.75 (1 quart C), 143.94 (1 quart C), 144.20 (1 quart C), 147.24 (1 quart C), 155.74 (1 quart C). HRMS calcd. for $\text{C}_{23}\text{H}_{30}\text{O}_2$: 338.2246, found 338.2247.

12g'. Colorless liquid, isolated yield 33% (56 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.96, (t, $J = 7.5$ Hz, 6H, CH_3), 1.05 (t, $J = 7.5$ Hz, 6H, CH_3), 2.02-2.11 (m, 4H, CH_2), 2.23 (q, $J =$

7.5 Hz, 4H, CH₂), 3.38-3.42 (m, 1H, CH), 4.67 (d, *J* = 1H, CH), 5.08-5.16 (m, 2H, CH), 5.72-5.76 (m, 1H, CH), 5.89-5.93 (m, 1H, CH), 6.29-6.35 (m, 2H, CH), 7.38 (t, *J* = 0.9 Hz, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 15.02 (1 CH₃), 15.07 (1 CH₃), 15.61 (1 CH₃), 15.68 (1 CH₃), 18.93 (1 CH₂), 18.97 (1 CH₂), 19.00 (1 CH₂), 19.02 (1 CH₂), 41.01 (1 CH), 61.14 (1 quart C), 71.63 (1 CH), 106.76 (1 CH), 110.18 (1 CH), 124.28 (1 CH), 125.44 (1 CH), 131.08 (1 CH), 131.58 (1 CH), 141.80 (1 CH), 142.31 (1 quart C), 142.80 (1 quart C), 146.64 (1 quart C), 146.91 (1 quart C), 155.34 (1 quart C). HRMS calcd. for C₂₃H₃₀O₂: 338.2246, found 338.2240.

12h. Colorless liquid, isolated yield 31% (55 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 1.01-1.59 (m, 12H, CH₃), 2.08 (d, *J* = 3.0 Hz, 1H, OH), 2.22-2.61 (m, 8H, CH₂), 3.48 (br, 1H, CH), 4.56 (br, 1H, CH), 5.13 (d, *J* = 9.3 Hz, 1H, CH), 6.00-6.08 (m, 3H, CH), 6.83-6.84 (m, 1H, CH), 6.95 (t, *J* = 4.5 Hz, 1H, CH), 7.19 (d, *J* = 5.1 Hz, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.67 (1 CH₃), 14.97 (1 CH₃), 15.15 (1 CH₃), 16.77 (1 CH₃), 18.83 (1 CH₂), 18.92 (1 CH₂), 19.12 (1 CH₂), 20.99 (1 CH₂), 48.33 (1 CH), 61.12 (1 quart C), 68.94 (1 CH), 122.51 (1 CH), 123.90 (1 CH), 124.48 (1 CH), 124.89 (1 CH), 125.92 (1 CH), 126.72 (1 CH), 129.45 (1 CH), 144.02 (1 quart C), 144.20 (2 quart C), 147.09 (1 quart C), 147.62 (1 quart C). HRMS calcd. for C₂₃H₃₀OS: 354.2017, found 354.2023.

12h'. Colorless liquid, isolated yield 29% (51 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ

0.90-1.09 (m, 12H, CH₃), 1.97-2.11 (m, 4H, CH₂), 2.17-2.28 (m, 4H, CH₂), 2.30 (br, 1H, OH), 3.30-3.34 (m, 1H, CH), 4.94 (d, *J* = 5.4 Hz, 1H, CH), 5.09-5.14 (m, 2H, CH), 5.76-5.81 (m, 1H, CH), 5.90-5.94 (m, 1H, CH), 6.96-6.99 (m, 2H, CH), 7.23-7.25 (m, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 15.01 (1 CH₃), 15.06 (1 CH₃), 15.61 (1 CH₃), 15.73 (1 CH₃), 18.91 (1 CH₂), 18.96 (1 CH₂), 18.99 (1 CH₂), 19.00 (1 CH₂), 43.52 (1 CH), 61.21 (1 quart C), 73.92 (1 CH), 123.95 (1 CH), 124.22 (1 CH), 124.37 (1 CH), 125.48 (1 CH), 126.59 (1 CH), 131.30 (1 CH), 131.63 (1 CH), 142.32 (1 quart C), 142.83 (1 quart C), 146.56 (2 quart C), 146.88 (1 quart C). HRMS calcd. for C₂₃H₃₀OS: 354.2017, found 354.2020.

12i'. Colorless liquid, isolated yield 52% (85 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.96-1.08 (m, 21H, CH₃), 1.67 (br, 1H, OH), 2.04-2.27 (m, 8H, CH₂), 3.21-3.29 (m, 2H, CH), 5.14 (dd, *J* = 27.3, 9.9 Hz, 2H, CH), 5.85 (dd, *J* = 53.7, 9.9 Hz, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 15.02 (1 CH₃), 15.10 (1 CH₃), 15.66 (1 CH₃), 15.76 (1 CH₃), 18.98 (2 CH₂), 19.02 (1 CH₂), 19.05 (1 CH₂), 26.99 (3 CH₃), 35.92 (1 quart C), 37.71 (1 CH), 60.62 (1 quart C), 81.74 (1 CH), 124.24 (1 CH), 129.67 (2 CH), 133.00 (1 CH), 142.30 (1 quart C), 142.86 (1 quart C), 146.74 (1 quart C), 146.77 (1 quart C). HRMS calcd. for C₂₃H₃₆O: 328.2766, found 328.2765.

12j'. Colorless liquid, isolated yield 75% (128 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.94-1.08 (m, 12H, CH₃), 1.47-1.66 (m, 10H, CH₂), 2.03-2.27 (m, 8H, CH₂), 2.84-2.87 (m, 1H, CH), 5.10 (dd, *J* = 10.5, 2.1 Hz, 2H, CH), 6.00 (dd, *J* = 10.5, 3.0 Hz, 2H, CH). ¹³C NMR (75

MHz, CDCl₃, TMS): δ 15.03 (1 CH₃), 15.15 (1 CH₃), 15.62 (1 CH₃), 15.71 (1 CH₃), 18.95 (1 CH₂), 18.97 (1 CH₂), 19.00 (1 CH₂), 19.02 (1 CH₂), 21.91 (2 CH₂), 25.84 (1 CH₂), 34.66 (2 CH₂), 45.99 (1 CH), 61.14 (1 quart C), 73.61 (1 quart C), 125.04 (2 CH),, 130.73 (2 CH), 141.94 (1 quart C), 142.60 (1 quart C), 146.63 (1 quart C), 147.43 (1 quart C). HRMS calcd. for C₂₄H₃₆O: 340.2766, found 340.2766.

12k'. Colorless liquid, isolated yield 50% (106 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.94-1.07 (m, 12H, CH₃), 2.03-2.26 (m, 8H, CH₂), 2.48 (s, 1H, OH), 4.16-4.19 (m, 1H, CH), 5.15 (dd, J = 10.2, 2.1 Hz, 2H, CH), 5.66 (dd, J = 10.5, 2.7 Hz, 2H, CH), 7.16-7.21 (m, 2H, CH), 7.29-7.34 (m, 4H, CH), 7.59-7.62 (m, 4H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.97 (1 CH₃), 15.08 (1 CH₃), 15.69 (1 CH₃), 15.77 (1 CH₃), 18.93 (1 CH₂), 18.95 (1 CH₂), 19.05 (1 CH₂), 19.12 (1 CH₂), 43.74 (1 CH), 61.10 (1 quart C), 78.79 (1 quart C), 124.74 (2 CH), 125.87 (4 CH), 126.52 (2 CH), 128.20 (4 CH), 132.88 (2 CH), 142.52 (1 quart C), 143.06 (1 quart C), 145.89 (2 quart C), 146.24 (1 quart C), 146.86 (1 quart C). HRMS calcd. for C₃₁H₃₆O: 424.2766, found 424.2777.

12l'. Colorless liquid, isolated yield 77% (163 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.85-1.26 (m, 12H, CH₃), 1.99-2.34 (m, 8H, CH₂), 3.34, (dd, J = 5.1, 2.7 Hz, 1H, CH), 4.30 (br, 1H, NH), 4.48 (d, J = 3.3 Hz, 1H, CH), 5.15-5.18 (m, 2H, CH), 5.62 (d, J = 10.5 Hz, 1H, CH),

5.92 (d, $J = 9.0$ Hz, 1H, CH), 6.44 (d, $J = 8.4$ Hz, 2H, CH), 6.58-6.63 (m, 1H, CH), 7.05 (t, $J = 7.5$ Hz, 2H, CH), 7.19-7.40 (m, 5H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 15.00 (1 CH_3), 15.13 (1 CH_3), 15.64 (1 CH_3), 16.05 (1 CH_3), 18.91 (1 CH_2), 18.95 (1 CH_2), 19.05 (1 CH_2), 19.43 (1 CH_2), 42.73 (1 CH), 60.70 (1 CH), 61.05 (1 quart C), 113.07 (2 CH), 116.98 (1 CH), 123.60 (1 CH), 126.82 (2 CH), 126.90 (1 CH), 128.18 (1 CH), 128.40 (2 CH), 129.06 (2 CH), 131.08 (1 CH), 131.93 (1 CH), 141.85 (1 quart C), 142.32 (1 quart C), 143.08 (1 quart C), 146.53 (1 quart C), 146.78 (1 quart C), 147.61 (1 quart C). HRMS calcd. for $\text{C}_{31}\text{H}_{37}\text{N}$: 423.2926, found 423.2871.

13. Colorless liquid, isolated yield 43% (87 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.86-1.00 (m, 12H, CH_3), 1.38-1.77 (m, 8H, CH_2), 1.96 (d, $J = 2.4$ Hz, 1H, OH), 2.10-2.56 (m, 8H, CH_2), 3.31 (br, 1H, CH), 4.35 (br, 1H, CH), 5.08 (d, $J = 9.3$ Hz, 1H, CH), 5.91-6.03 (m, 3H, CH), 7.18-7.34 (m, 5H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.59 (1 CH_3), 14.75 (1 CH_3), 14.85 (1 CH_3), 15.08 (1 CH_3), 23.32 (1 CH_2), 23.44 (1 CH_2), 23.74 (1 CH_2), 25.45 (1 CH_2), 28.32 (1 CH_2), 28.46 (1 CH_2), 28.94 (1 CH_2), 30.59 (1 CH_2), 48.65 (1 CH), 61.26 (1 quart C), 71.16 (1 CH), 124.18 (1 CH), 124.62 (1 CH), 125.59 (2 CH), 125.84 (1 CH), 126.69 (1 CH), 128.11 (2 CH), 129.5 (1 CH), 143.01 (1 quart C), 143.21 (1 quart C), 143.29 (1 quart C), 143.35 (1 quart C), 146.18 (1 quart C). HRMS calcd. for $\text{C}_{29}\text{H}_{40}\text{O}$: 404.3079, found 404.3074.

13'. Colorless liquid, isolated yield 30% (61 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ

0.79-0.95 (m, 12H, CH₃), 1.26-1.48 (m, 8H, CH₂), 1.92-2.21 (m, 8H, CH₂), 3.22-3.24 (m, 1H, CH), 4.70 (d, *J* = 5.4 Hz, 1H, CH), 5.06-5.10 (m, 2H, CH), 5.68-5.73 (m, 1H, CH), 5.78-5.82 (m, 1H, CH), 7.26-7.42 (m, 5H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.41 (2 CH₃), 14.69 (1 CH₃), 14.79 (1 CH₃), 23.42 (1 CH₂), 23.45 (1 CH₂), 23.74 (1 CH₂), 23.95 (1 CH₂), 28.30 (2 CH₂), 28.62 (1 CH₂), 28.68 (1 CH₂), 43.29 (1 CH), 61.18 (1 quart C), 77.21 (1 CH), 124.08 (1 CH), 126.01 (1 CH), 126.28 (2 CH), 127.40 (1 CH), 128.21 (2 CH), 131.61 (1 CH), 131.68 (1 CH), 141.15 (1 quart C), 141.74 (1 quart C), 142.49 (1 quart C), 145.69 (1 quart C), 145.74 (1 quart C). HRMS calcd. for C₂₉H₄₀O: 404.3079, found 404.3066.

14. Colorless liquid, isolated yield 86% (170 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.79-0.96 (m, 12H, CH₃), 1.29-2.00 (m, 18H, CH₂), 2.01-2.19 (m, 8H, CH₂), 2.82-2.85 (m, 1H, CH), 5.07 (dd, *J* = 10.5, 2.1 Hz, 2H, CH), 5.98 (dd, *J* = 10.2, 3.0 Hz, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.42 (1 CH₃), 14.44 (1 CH₃), 14.58 (1 CH₃), 14.86 (1 CH₃), 21.83 (2 CH₂), 23.46 (1 CH₂), 23.54 (1 CH₂), 23.78 (1 CH₂), 24.12 (1 CH₂), 25.84 (1 CH₂), 28.29 (1 CH₂), 28.36 (1 CH₂), 28.62 (1 CH₂), 28.73 (1 CH₂), 34.56 (2 CH₂), 46.22 (1 CH), 61.17 (1 quart C), 73.80 (1 quart C), 125.01 (2 CH), 130.92 (2 CH), 140.79 (1 quart C), 141.45 (1 quart C), 145.63 (1 quart C), 146.41 (1 quart C). HRMS calcd. for C₂₈H₄₄O: 396.3392, found 396.3410.

15. Colorless liquid, isolated yield 64% (153 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.78-1.02 (m, 12H, CH₃), 1.31-1.60 (m, 8H, CH₂), 1.92-2.29 (m, 8H, CH₂), 3.32 (dd, *J* = 5.4, 3.0

Hz, 1H, CH), 4.27 (br, 1H, NH), 4.48 (d, $J = 3.3$ Hz, 1H, CH), 5.15 (dd, $J = 10.2, 2.1$ Hz, 2H, CH), 5.59-5.63 (m, 1H, CH), 5.88-5.92 (m, 1H, CH), 6.44 (d, $J = 7.8$ Hz, 2H, CH), 6.61 (t, $J = 7.2$ Hz, 1H, CH), 7.06 (t, $J = 7.8$ Hz, 2H, CH), 7.24-7.42 (m, 5H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.41 (2 CH_3), 14.67 (1 CH_3), 14.85 (1 CH_3), 23.39 (1 CH_2), 23.41 (1 CH_2), 23.83 (1 CH_2), 23.92 (1 CH_2), 28.24 (1 CH_2), 28.38 (1 CH_2), 28.57 (1 CH_2), 28.91 (1 CH_2), 42.71 (1 CH), 60.88 (1 CH), 61.14 (1 quart C), 113.21 (2 CH), 116.99 (1 CH), 123.43 (1 CH), 126.86 (2 CH), 126.91 (1 CH), 128.11 (1 CH), 128.44 (2 CH), 129.01 (2 CH), 131.43 (1 CH), 132.21 (1 CH), 141.25 (1 quart C), 141.93 (1 quart C), 142.12 (1 quart C), 145.35 (1 quart C), 145.71 (1 quart C), 147.60 (1 quart C). HRMS calcd. for $\text{C}_{35}\text{H}_{45}\text{N}$: 479.3552, found 479.3553.

16. Colorless liquid, isolated yield 30% (69 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.78-0.88 (m, 12H, CH_3), 1.18-1.63 (m, 16H, CH_2), 1.88 (d, $J = 2.1$ Hz, 1H, OH), 2.12-2.51 (m, 8H, CH_2), 3.24 (br, 1H, CH), 4.27 (br, 1H, CH), 5.01 (d, $J = 9.0$ Hz, 1H, CH), 5.86-5.95 (m, 3H, CH), 7.10-7.26 (m, 5H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 13.86 (1 CH_3), 13.95 (1 CH_3), 14.02 (2 CH_3), 23.21 (1 CH_2), 23.36 (1 CH_2), 23.44 (1 CH_2), 23.52 (1 CH_2), 25.90 (1 CH_2), 25.95 (1 CH_2), 26.41 (1 CH_2), 27.94 (1 CH_2), 32.32 (2 CH_2), 32.74 (1 CH_2), 34.34 (1 CH_2), 48.68 (1 CH), 61.27 (1 quart C), 71.17 (1 CH), 124.23 (1 CH), 124.67 (1 CH), 125.62 (2 CH), 125.87 (1 CH), 126.69 (1 CH), 128.11 (2 CH), 129.63 (1 CH), 143.01 (1 quart C), 143.12 (1 quart C), 143.20 (1 quart C), 143.38 (1 quart C), 146.06 (1 quart C). HRMS calcd. for $\text{C}_{33}\text{H}_{48}\text{O}$: 460.3705, found 460.3705.

16'. Colorless liquid, isolated yield 36 % (83 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.80-0.94 (m, 12H, CH_3), 1.19-1.36 (m, 16H, CH_2), 1.98-2.18 (m, 8H, CH_2), 3.19-3.23 (m, 1H, CH), 4.68 (d, $J = 5.4$ Hz, 1H, CH), 5.07 (dd, $J = 10.2, 1.8$ Hz, 2H, CH), 5.66-5.71 (m, 1H, CH), 5.80-5.84 (m, 1H, CH), 7.23-7.39 (m, 5H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 13.89 (1 CH_3), 14.00 (2 CH_3), 14.05 (1 CH_3), 23.04 (1 CH_2), 23.05 (1 CH_2), 23.24 (1 CH_2), 23.29 (1 CH_2), 25.87 (1 CH_2), 25.89 (1 CH_2), 25.99 (1 CH_2), 26.14 (1 CH_2), 32.49 (2 CH_2), 32.74 (1 CH_2), 33.01 (1 CH_2), 43.27 (1 CH), 61.16 (1 quart C), 77.22 (1 CH), 124.09 (1 CH), 125.97 (1 CH), 126.25 (2 CH), 127.35 (1 CH), 128.16 (2 CH), 131.50 (1 CH), 131.64 (1 CH), 141.15 (1 quart C), 141.72 (1 quart C), 142.50 (1 quart C), 145.51 (1 quart C), 145.64 (1 quart C). HRMS calcd. for $\text{C}_{33}\text{H}_{46}$: 442.3600, found 442.3607.

17. Colorless liquid, isolated yield 70% (187 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.81-0.98 (m, 12H, CH_3), 1.18-1.53 (m, 16H, CH_2), 1.93-2.29 (m, 8H, CH_2), 3.30 (dd, $J = 5.7, 2.7$ Hz, 1H, CH), 4.26, (br, 1H, NH), 4.47 (d, $J = 3.6$ Hz, 1H, CH), 5.11-5.16 (m, 2H, CH), 5.60-5.64 (m, 1H, CH), 5.87-5.91 (m, 1H, CH), 6.43 (d, $J = 7.8$ Hz, 2H, CH), 6.62 (t, $J = 7.2$ Hz, 1H, CH), 7.06 (dd, $J = 8.1, 7.5$ Hz, 2H, CH), 7.24 (t, $J = 6.9$ Hz, 1H, CH), 7.31-7.42 (m, 4H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 13.91 (1 CH_3), 14.03 (1 CH_3), 14.05 (1 CH_3), 14.20 (1 CH_3), 23.09 (1 CH_2), 23.11 (1 CH_2), 23.32 (1 CH_2), 23.36 (1 CH_2), 25.89 (1 CH_2), 25.94 (1 CH_2), 26.03

(1 CH₂), 26.62 (1 CH₂), 32.47 (1 CH₂), 32.50 (1 CH₂), 32.88 (1 CH₂), 33.16 (1 CH₂), 42.72 (1 CH), 61.03 (1 CH), 61.19 (1 quart C), 113.23 (2 CH), 117.02 (1 CH), 123.54 (1 CH), 126.90 (2 CH), 126.92 (1 CH), 128.07 (1 CH), 128.44 (2 CH), 129.02 (2 CH), 131.45 (1 CH), 132.14 (1 CH), 141.31 (1 quart C), 141.99 (1 quart C), 142.10 (1 quart C), 145.23 (1 quart C), 145.74 (1 quart C), 147.69 (1 quart C). HRMS calcd. for C₃₉H₅₄N⁺: 536.4251, found 536.4245.

18. Colorless liquid, isolated yield 64% (117 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.80-0.86 (m, 6H, CH₃), 1.32-1.65 (m, 18H, CH₂), 1.96-2.07 (m, 4H, CH₂), 2.35 (br, 4H, CH₂), 2.84-2.85 (m, 1H, CH), 5.08 (dd, *J* = 10.5, 2.1 Hz, 2H, CH), 5.98 (dd, *J* = 10.5, 3.0 Hz, 2H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.46 (2 CH₃), 14.65 (2 CH₃), 21.86 (2 CH₂), 22.74 (1 CH₂), 23.08 (1 CH₂), 23.68 (1 CH₂), 23.70 (1 CH₂), 24.36 (1 CH₂), 24.46 (1 CH₂), 25.86 (1 CH₂), 28.30 (1 CH₂), 28.39 (1 CH₂), 34.60 (2 CH₂), 46.13 (1 CH), 61.44 (1 quart C), 73.70 (1 quart C), 125.14 (2 CH), 130.41 (2 CH), 137.19 (1 quart C), 137.89 (1 quart C), 143.73 (1 quart C), 144.49 (1 quart C). HRMS calcd. for C₂₆H₃₈O: 366.2923, found 366.2921.

19. Colorless liquid, isolated yield 57% (97 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.95-1.08 (m, 12H, CH₃), 1.26 (t, *J* = 1.5 Hz, 3H, CH₃), 1.50 (br, 1H, OH), 1.64-1.88 (m, 8H, CH₂), 1.94-2.29 (m, 8H, CH₂), 2.95-2.99 (m, 1H, CH), 5.04 (dd, *J* = 9.9, 2.1 Hz, 1H, CH), 5.71-5.73 (m, 1H, CH), 5.86-5.90 (m, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.77 (1

CH₃), 14.96 (2 CH₃), 15.05 (1 CH₃), 17.97 (1 CH₃), 18.96 (1 CH₂), 19.00 (2 CH₂), 19.04 (1 CH₂), 23.87 (1 CH₂), 23.91 (1 CH₂), 38.20 (1 CH₂), 38.32 (1 CH₂), 46.80 (1 CH), 63.78 (1 quart C), 83.94 (1 quart C), 123.17 (1 CH), 124.80 (1 CH), 132.03 (1 CH), 136.48 (1 quart C), 142.96 (1 quart C), 143.64 (1 quart C), 145.61 (1 quart C), 146.16 (1 quart C). HRMS calcd. for C₂₄H₃₆O: 340.2766, found 340.2758.

20. Colorless liquid, isolated yield 30% (63 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 0.92-1.08 (m, 12H, CH₃), 1.57 (s, 3H, CH₃), 1.70-2.33 (m, 23H, CH₂ and CH), 4.36 (s, 1H, CH), 4.85 (dd, *J* = 2.7, 1.2 Hz, 1H, CH), 5.00-5.05 (m, 1H, CH), 5.71 (dd, *J* = 9.9, 3.3 Hz, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 15.06 (1 CH₃), 15.12 (1 CH₃), 15.65 (1 CH₃), 15.80 (1 CH₃), 18.60 (1 CH₂), 18.98 (1 CH₂), 19.00 (1 CH₂), 19.06 (1 CH₂), 22.45 (1 CH₃), 27.96 (3 CH), 36.58 (3 CH₂), 37.98 (3 CH₂), 47.36 (1 CH), 47.54 (1 quart C), 61.55 (1 quart C), 122.60 (1 CH), 125.90 (1 CH), 130.00 (1 CH), 130.30 (1 quart C), 141.93 (1 quart C), 142.18 (1 quart C), 146.60 (1 quart C), 147.90 (1 quart C), 213.74 (1 quart C). IR (neat): ν (C=O) = 1707 cm⁻¹; HRMS calcd. for C₃₀H₄₂O: 418.3236, found 418.3248.

Typical procedure for the preparation of tetrasubstituted phenanthrene products 21a-d from 4-naphthyl 1-lithio-1,3-butadienes. To a mixed solvent of diethyl ether (2.5 mL) and toluene (2.5 mL) or a toluene solution of 4-naphthyl 1-iodo-1,3-butadiene **1** (0.5 mmol) at -78 °C was added *t*-BuLi (1.0 mmol, 1.5 M in pentane). After being stirred at -78 °C for 1h, the above reaction mixture was heated up to 75 °C and kept at this temperature for 3h. The reaction was then cooled down to room temperature and was quenched with saturated aqueous NaHCO₃. The

layers were separated and the aqueous phase was extracted three times with ether. The combined extracts were washed with brine and dried over MgSO_4 . Evaporation under reduced pressure followed by flash chromatography afforded the title product. In case of the mixed solvent of diethyl ether (2.5 mL) and toluene (2.5 mL), tetrasubstituted phenanthrene products **21a-d** were obtained as the only products. In case of toluene as the solvent, in addition to **21a-d**, spiro cyclopnetadienes **50a-c** were also obtained. The tetrasubstituted phenanthrene product **22** and the spiro cyclopnetadiene **50** could be readily separated by column chromatography.

50a. Colorless liquid, isolated yield 19% (33 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.48 (t, $J = 7.8$ Hz, 3H, CH_3), 0.89-1.17 (m, 18H, CH_3), 1.17-1.78 (m, 2H, CH_2), 2.11-2.37 (m, 6H, CH_2), 3.31 (d, $J = 2.7$ Hz, 1H, CH), 5.06 (dd, $J = 10.5, 1.5$ Hz, 1H, CH), 6.11 (dd, $J = 10.5, 3.9$ Hz, 1H, CH), 6.59 (dd, $J = 7.5, 1.5$ Hz, 1H, CH), 6.89-6.95 (m, 1H, CH), 6.99-7.05 (m, 1H, CH), 7.30 (d, $J = 7.2$ Hz, 1H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.58 (1 CH_3), 14.93 (1 CH_3), 15.28 (1 CH_3), 15.86 (1 CH_3), 18.75 (1 CH_2), 18.90 (2 CH_2), 19.41 (1 CH_2), 29.16 (3 CH_3), 36.37 (1 quart C), 48.11 (1 CH), 63.60 (1 quart C), 124.33 (1 CH), 125.54 (1 CH), 127.14 (1 CH), 127.16 (1 CH), 129.37 (1 CH), 130.45 (1 CH), 135.75 (1 quart C), 136.32 (1 quart C), 139.91 (1 quart C), 143.38 (1 quart C), 150.10 (1 quart C), 151.19 (1 quart C); HRMS calcd. for $\text{C}_{26}\text{H}_{36}$: 348.2817, found 348.2824.

5ob. Colorless liquid, isolated yield 17% (34 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.61 (t, J = 6.6 Hz, 3H, CH_3), 0.75 (t, J = 7.2 Hz, 3H, CH_3), 0.82-1.75 (m, 26H, CH_3 and CH_2), 2.06-2.29 (m, 5H, CH_2), 3.30 (d, J = 3.6 Hz, 1H, CH), 5.02 (d, J = 10.2 Hz, 1H, CH), 6.10 (dd, J = 10.5, 3.9 Hz, 1H, CH), 6.57 (d, J = 7.5 Hz, 1H, CH), 6.91 (t, J = 7.2 Hz, 1H, CH), 7.02 (t, J = 7.8 Hz, 1H, CH), 7.29 (d, J = 7.8 Hz, 1H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 14.46 (2 CH_3), 14.57 (1 CH_3), 14.82 (1 CH_3), 22.73 (1 CH_2), 23.34 (1 CH_2), 23.69 (1 CH_2), 24.27 (1 CH_2), 28.24 (1 CH_2), 28.31 (1 CH_2), 28.44 (1 CH_2), 29.07 (1 CH_2), 29.16 (3 CH_3), 36.41 (1 quart C), 48.08 (1 CH), 63.76 (1 quart C), 124.32 (1 CH), 125.50 (1 CH), 127.07 (2 CH), 129.70 (1 CH), 130.44 (1 CH), 135.90 (1 quart C), 136.22 (1 quart C), 138.86 (1 quart C), 142.35 (1 quart C), 149.10 (1 quart C), 150.32 (1 quart C); HRMS calcd. for $\text{C}_{30}\text{H}_{44}$: 404.3443, found 404.3438.

5oc. Colorless liquid, isolated yield 19% (44 mg). ^1H NMR (300 MHz, CDCl_3 , TMS): δ 0.65 (t, J = 7.2 Hz, 3H, CH_3), 0.79 (t, J = 7.2 Hz, 3H, CH_3), 0.91-1.08 (m, 33H, CH_3 and CH_2), 2.04-2.32 (m, 6H, CH_2), 3.28 (d, J = 3.0 Hz, 1H, CH), 5.02 (dd, J = 7.2, 1.2 Hz, 1H, CH), 6.09 (dd, J = 3.9, 10.5 Hz, 1H, CH), 6.55 (dd, J = 7.8, 1.2 Hz, 1H, CH), 6.91 (t, J = 6.9 Hz, 1H, CH), 6.98-7.04 (m, 1H, CH), 7.25-7.30 (m, 1H, CH). ^{13}C NMR (75 MHz, CDCl_3 , TMS): δ 13.71 (1 CH_3), 13.93 (1 CH_3), 14.07 (1 CH_3), 14.10 (1 CH_3), 23.10 (1 CH_2), 23.13 (1 CH_2), 23.18 (1 CH_2), 23.22 (1 CH_2), 25.68 (1 CH_2), 25.87 (1 CH_2), 25.90 (1 CH_2), 26.64 (1 CH_2), 29.18 (3 CH_3), 31.66 (1 CH_2), 32.46 (1 CH_2), 32.74 (1 CH_2), 33.27 (1 CH_2), 36.43 (1 quart C), 48.08 (1 CH), 63.78 (1 quart C), 124.31 (1 CH), 125.55 (1 CH), 127.01 (1 CH), 127.03 (1 CH), 129.70 (1 CH), 130.42 (1 CH), 135.90 (1 quart C), 136.25 (1 quart C), 138.85 (1 quart C), 142.43 (1 quart C), 148.92 (1

quart C), 150.15 (1 quart C); HRMS calcd. for C₃₄H₅₂: 460.4069, found 460.4078.

21a. Colorless liquid, isolated yield 91% (132 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 1.21-1.28 (m, 6H, CH₃), 1.34 (t, *J* = 7.5 Hz, 3H, CH₃), 1.64 (t, *J* = 7.2 Hz, 3H, CH₃), 2.92 (q, *J* = 7.5 Hz, 2H, CH₂), 3.00 (q, *J* = 7.5 Hz, 2H, CH₂), 3.13 (q, *J* = 7.5 Hz, 2H, CH₂), 3.33-3.35 (m, 2H, CH₂), 7.49-7.52 (m, 2H, CH), 7.61 (d, *J* = 9.0 Hz, 1H, CH), 7.81-7.84 (m, 1H, CH), 7.92 (d, *J* = 9.0 Hz, 1H, CH), 8.62-8.65 (m, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 15.86 (1 CH₃), 15.88 (1 CH₃), 16.10 (1 CH₃), 16.31 (1 CH₃), 22.29 (1 CH₂), 22.53 (1 CH₂), 22.72 (1 CH₂), 25.27 (1 CH₂), 123.33 (1 CH), 124.60 (1 CH), 125.33 (1 CH), 125.92 (1 CH), 127.75 (1 CH), 128.02 (1 CH), 129.80 (1 quart C), 130.14 (1 quart C), 131.07 (1 quart C), 132.86 (1 quart C), 136.07 (1 quart C), 136.66 (1 quart C), 138.69 (1 quart C), 140.73 (1 quart C). HRMS calcd. for C₂₂H₂₆: 290.2034, found 290.2038.

21b.² Colorless liquid, isolated yield 92% (159 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 1.08-1.19 (m, 12H, CH₃), 1.52-1.67 (m, 4H, CH₂), 1.70-1.75 (m, 2H, CH₂), 1.96-2.04 (m, 2H, CH₂), 2.77-2.89 (m, 4H, CH₂), 2.99-3.05 (m, 2H, CH₂), 3.20 (br, 2H, CH₂), 7.48-7.51 (m, 2H, CH), 7.59 (d, *J* = 9.0 Hz, 1H, CH), 7.80-7.83 (m, 1H, CH), 7.88 (d, *J* = 9.0 Hz, 1H, CH), 8.49 (t, *J* = 3.0 Hz, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.46 (1 CH₃), 14.90 (1 CH₃), 15.09 (1 CH₃), 15.14 (1 CH₃), 24.66 (1 CH₂), 24.89 (1 CH₂), 25.00 (1 CH₂), 25.29 (1 CH₂), 31.80 (1 CH₂), 32.51 (2 CH₂), 35.06 (1 CH₂), 123.43 (1 CH), 124.53 (1 CH), 125.28 (1 CH), 125.76 (1

CH), 127.69 (1 CH), 127.96 (1 CH), 129.82 (1 quart C), 130.23 (1 quart C), 131.10 (1 quart C), 132.83 (1 quart C), 134.82 (1 quart C), 135.48 (1 quart C), 137.75 (1 quart C), 139.68 (1 quart C). HRMS calcd. for C₂₆H₃₄: 346.2660, found 346.2664. These data are in consistent with those reported.²

21c. Colorless liquid, isolated yield 83% (167 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 1.00-1.09 (m, 12H, CH₃), 1.45-1.71 (m, 14H, CH₂), 1.91-2.01 (m, 2H, CH₂), 2.80-2.93 (m, 4H, CH₂), 3.02-3.07 (m, 2H, CH₂), 3.25 (br, 2H, CH₂), 7.19-7.51 (m, 2H, CH), 7.58 (d, *J* = 9.0 Hz, 1H, CH), 7.78-7.83 (m 1H, CH), 7.88 (d, *J* = 9.0 Hz, 1H, CH), 8.53 (q, *J* = 3.6 Hz, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 13.93 (3 CH₃), 14.01 (1 CH₃), 23.22 (1 CH₂), 23.52 (1 CH₂), 23.61 (1 CH₂), 23.68 (1 CH₂), 29.30 (1 CH₂), 29.82 (1 CH₂), 29.89 (1 CH₂), 32.58 (1 CH₂), 33.56 (1 CH₂), 33.82 (1 CH₂), 33.85 (1 CH₂), 34.06 (1 CH₂), 123.45 (1 CH), 124.45 (1 CH), 125.26 (1 CH), 125.72 (1 CH), 127.84 (1 CH), 127.95 (1 CH), 129.79 (1 quart C), 130.25 (1 quart C), 131.12 (1 quart C), 132.84 (1 quart C), 134.84 (1 quart C), 135.52 (1 quart C), 137.80 (1 quart C), 139.71 (1 quart C); HRMS calcd. for C₃₀H₄₂: 402.3287, found 402.3286.

21d. Colorless liquid, isolated yield 90% (142 mg). ¹H NMR (300 MHz, CDCl₃, TMS): δ 1.08-1.20 (m, 6H, CH₃), 1.62-2.07 (m, 8H, CH₂), 2.96-3.17 (m, 8H, CH₂), 7.48-7.51 (m, 2H, CH), 7.58 (d, *J* = 9.0 Hz, 1H, CH), 7.80-7.83 (m, 1H, CH), 7.88 (d, *J* = 9.0 Hz, 1H, CH), 8.46 (t, *J* = 6.3 Hz, 1H, CH). ¹³C NMR (75 MHz, CDCl₃, TMS): δ 14.30 (1 CH₃), 14.83 (1 CH₃), 22.66 (1

CH₂), 22.99 (1 CH₂), 23.22 (1 CH₂), 23.76 (1 CH₂), 27.66 (1 CH₂), 27.70 (1 CH₂), 30.75 (1 CH₂), 34.71 (1 CH₂), 123.17 (1 CH), 124.56 (1 CH), 125.34 (1 CH), 125.78 (1 CH), 127.79 (1 CH), 127.92 (1 CH), 129.34 (1 quart C), 129.57 (1 quart C), 131.12 (1 quart C), 132.88 (1 quart C), 134.17 (1 quart C), 134.50 (1 quart C), 135.38 (1 quart C), 136.41 (1 quart C). HRMS calcd. for C₂₄H₂₈: 316.2191, found 316.2200.

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 IRNUC 32.785
 CTEMP 35.629
 SLVNT 36.313
 EXREF 36.692
 BF 42.189
 RGAIN 42.428
 76.589
 77.010
 77.438
 101.059
 101.619
 124.103
 124.630
 124.853
 124.877
 124.943
 125.149
 125.635
 125.940
 125.982
 126.369
 126.822
 126.822
 128.166
 128.232
 129.336
 130.135
 131.372
 133.589
 133.671
 134.075
 140.240
 140.701
 143.882
 144.509
 147.262
 148.209

D:\LLT\JOC\1D\SM\C1.als
 544-C6D6
 Fri Nov 10 10:04:20 2006
 13C
 BCM
 75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 256
 1.606 sec
 1.394 sec
 5.0 us
 1H
 22.3 c
 CDCL3
 0.00 ppm
 0.62 Hz
 25

1d

D:\LLT\PRBH\SM\H1.als
 544-C6D6
 Fri Nov 10 09:50:00 2006

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

1H
 NON
 300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 24
 5.449 sec
 1.551 sec
 5.8 us
 1H
 21.9 c
 CDCL3
 0.00 ppm
 0.09 Hz
 10

1d

D:\LLT\JOC\6C\C.als
 Thu Jan 11 11:17:45 2007
 13C
 BCM
 75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 512
 1.606 sec
 1.394 sec
 5.0 us
 1H
 24.2 C
 CDCL3
 0.00 ppm
 0.62 Hz
 27
 RGAIN

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 13.755
 14.027
 21.560
 22.673
 23.085
 23.497
 30.082
 31.170
 31.376
 31.467
 33.436
 33.585
 34.796
 40.615

76.590
 77.018
 77.438

108.608

126.023
 127.292
 128.586
 136.556
 142.523
 143.256
 148.077

6c

D:\LLT\JOC\6C\H.als
 Thu Jan 11 11:37:30 2007

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

1H
 NON
 300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 16
 5.449 sec
 1.551 sec
 5.8 us
 1H
 23.5 C
 CDCL3
 0.00 ppm
 0.09 Hz
 14

6c

D:\LLT\PREIBEN\C55.als
 COMNT Wed Dec 06 11:57:00 2006
 DATIM 13C
 EXMOD BCM
 OBFRO 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 224
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTMP 24.3 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 26

D:\LLT\PRELBEN\H4.als
 Wed Dec 06 11:37:49 2006

DFILE COMNT
 DATIM
 OBNUC 1H
 EXMOD NON
 OBFRQ 300.40 MHz
 OBSET 130.00 KHz
 OBFIN 1150.0 Hz
 POINT 32768
 FREQU 6013.2 Hz
 SCANS 24
 ACQTM 5.449 sec
 PD 1.551 sec
 PW1 5.8 us
 IRNUC 1H
 CTEMP 23.9 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.09 Hz
 RGAIN 15

D:\LLT\JOC\JTANJIAJI\C.als

COMNT
DATIM Wed Jan 03 12:52:18 2007
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 1416
ACQTM 1.606 sec
PD 1.394 sec
PW1 5.0 us
IRNUC 1H
CTEMP 23.5 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 27

0.000
12.470
13.566
13.673
13.747
21.362
26.093
26.645
27.387
34.631

76.598
77.018
77.438

109.622
125.570
126.781
127.152
129.402
136.556
137.660
142.457
142.860
148.283

6f

D:\LLT\JOC\JIANJIAJI\H1.als

Wed Jan 03 12:57:41 2007

1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
5.449 sec
1.551 sec
5.8 us
1H
22.9 C
CDCL3
0.00 ppm
0.62 Hz
14

DFILE
COMMT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

7.246
7.131
7.106
7.080
7.074
7.032
7.007
6.984
6.960
2.557
2.543
2.535
2.532
2.518
2.512
2.495
2.471
2.443
2.417
2.391
2.366
2.340
2.318
2.292
2.270
2.248
2.224
2.199
2.090
2.064
2.042
2.017
1.991
1.754
1.729
1.706
1.682
1.655
1.142
1.116
1.091
0.941
0.916
0.894
0.870
0.846
0.829
0.804
0.779
0.000

6f

D:\LLT\JOC\DUJIAJI\C.als

COMNT
DATIM Tue Jan 09 11:12:09 2007
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 800
ACQTM 1.606 sec
PD 1.394 sec
PW1 5.0 us
IRNUC 1H
CTEMP 24.1 C
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 26

0.000
12.461
13.590
13.648
13.813
21.181
26.109
26.711
27.395
34.574

76.598
77.018
77.438

109.671

127.976
128.454
135.542
137.479
139.959
142.399
148.242

6g

D:\LLT\JOC\DUJIAJI\H4.als

Tue Jan 09 10:31:14 2007

DFILE	COMNT	DATIM	OBNUC	EXMOD	OBFREQ	OBFSET	OBFIN	POINT	FREQU	SCANS	ACQTM	PD	PW1	IRNUC	CTEMP	SLVNT	EXREF	BF	RGAIN
			1H	NON	300.40 MHz	130.00 KHz	1150.0 Hz	32768	6013.2 Hz	24	5.449 sec	1.551 sec	5.8 us	1H	23.8 C	CDCL3	0.00 ppm	0.09 Hz	14

6g

D:\LLT\JOC\DUIDIAN\C3.als

COMNT
DATIM Wed Jan 10 13:02:14 2007
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 800
ACQTM 1.606 sec
PD 1.394 sec
PW1 5.0 us
IRNUC 1H
CTEMP 24.1 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 27

34.541
27.478
26.472
26.019
13.854
13.648
13.467
12.387
0.000

147.624
143.388
142.490
136.399
130.704
127.531

110.116

91.515

77.438
77.010
76.590

6h

D:\LLT\JOC\DUIDIAN\H2.als

Wed Jan 10 09:29:55 2007

DFILE COMNT DATIM OBNUC EXMOD OBFREQ OBSET OBFIN POINT FREQU SCANS ACQTM PD PW1 IRNUC CTEMP SLVNT EXREF BF RGAIN

0.000 0.818 0.843 0.855 0.868 0.880 0.891 0.904 0.917 1.086 1.111 1.136 1.704 1.729 1.752 1.778 2.065 2.091 2.113 2.138 2.206 2.231 2.251 2.276 2.300 2.309 2.323 2.334 2.348 2.359 2.384 2.409 2.434 2.457 2.482 2.498 2.523 6.983 7.010 7.255 7.529 7.557

300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
8
5.449 sec
1.551 sec
5.8 us
1H
23.0 c
CDCL3
0.00 ppm
0.09 Hz
15

9.0000
2.9646
1.0141
1.0436
6.2809
1.9256
1.9298

6h

D:\LLT\JOC\SANFU\C3.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Sun Jan 07 21:30:56 2007

13C
BCM

75.45 MHz

124.00 KHz

1840.0 Hz

32768

20408.1 Hz

256

1.606 sec

1.394 sec

5.0 us

1H

24.3 C

CDCL3

0.00 ppm

0.62 Hz

27

6i

0.000
12.379
13.426
13.665
13.731
25.961
26.522
27.568
34.557

76.573
76.614
77.035
77.455

110.257
124.168
124.218
124.267
124.317
128.767
128.982
136.407
144.064
146.841
147.369

D:\LLT\JOC\SANFU\H2.als

Sun Jan 07 21:17:17 2007

DFILE COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSEF
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 FW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

1H
 NON
 300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 8
 5.449 sec
 1.551 sec
 5.8 us
 1H
 23.8 C
 CDCL3
 0.00 ppm
 0.09 Hz
 13

6i

D:\LLT\JOC\5a\c1.als
 COMNT LJH415DEPT
 DATIM Sun Dec 10 18:03:11 2006
 OBNUC 13C
 EXMOD BCM

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 272
 1.606 sec
 1.394 sec
 5.0 us
 1H
 24.7 c
 CDCL3
 0.00 ppm
 0.62 Hz
 27
 RGAIN

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 14.992
 15.074
 18.898
 19.483
 29.711

62.760
 76.598
 77.018
 77.438

123.831
 125.660
 125.759
 127.020
 128.471
 129.319
 134.182
 134.932
 141.624
 150.649

5a

D:\LLT\JOC\5a\H12.als
 Sun Dec 17 11:11:26 2006
 1H
 NON

300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 80
 5.449 sec
 1.551 sec
 5.8 us
 1H
 22.3 C
 CDCL3
 0.00 ppm
 0.09 Hz
 14

5a

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 0.720
 0.745
 0.771
 1.080
 1.105
 1.130
 1.926
 1.952
 1.974
 1.999
 2.022
 2.047
 2.072
 2.094
 2.119
 2.246
 2.269
 2.271
 2.293
 2.297
 2.319
 2.322
 3.487
 3.496
 3.505
 5.034
 5.041
 5.049
 5.068
 5.075
 5.082
 5.989
 6.001
 6.012
 6.022
 6.033
 6.592
 6.596
 6.618
 6.621
 6.935
 6.937
 7.040
 7.061
 7.065
 7.084
 7.088
 7.098
 7.101

D:\LLT\JOC\5a\C2.als
 Sun Dec 17 10:10:20 2006

COMNT
 DATIM
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 320
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 23.2 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 26

5a'

D:\LLT\JOC\5a\H2.als
 Mon Dec 18 09:58:46 2006

1H
 NON
 300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 24
 5.449 sec
 1.551 sec
 5.8 us
 1H
 22.6 C
 CDCL3
 0.00 ppm
 0.09 Hz
 20

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 0.837
 0.862
 0.887
 1.061
 1.086
 1.111
 1.111
 2.038
 2.063
 2.086
 2.111
 2.136
 2.182
 2.209
 2.216
 2.234
 2.242
 2.259
 2.267
 2.281
 2.292
 2.306
 2.435
 2.442
 2.449
 2.456
 6.061
 6.093
 6.408
 6.441
 6.672
 6.674
 6.676
 6.697
 6.700
 6.702
 6.918
 6.924
 6.943
 6.948
 6.967
 6.973
 7.000
 7.020
 7.025
 7.047
 7.051
 7.072
 7.075
 7.257

5a'

D:\LLT\JOC\5b\c.als
 WZHR648-C-NMR
 Mon Nov 14 20:17:03 2005
 13C
 BCM

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 936
 1.606 sec
 1.394 sec
 5.0 us
 1H
 20.7 c
 CDCL3
 0.00 ppm
 0.62 Hz
 25
 RGAIN

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

150.624
 150.278
 142.045
 141.575
 137.850
 136.284
 134.759
 128.751
 127.984
 127.943
 127.037
 125.883
 125.578
 116.586
 77.438
 77.010
 76.590
 62.834
 43.829
 37.912
 19.335
 19.236
 18.915
 18.898
 15.247
 15.173
 15.049
 14.926
 0.000

5b

WZHR648-H-NMR

5b

D:\WZH\R649\TURBOVEN600C3H\
 WZHR649-C-NMR
 DATIM Fri Dec 16 22:23:16 2005
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 1000
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 23.7 C
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 27

D:\WZH\R649\TURBOVEN600C3H\

WZHR649-H-NMR
Fri Dec 16 21:31:17 2005

1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
8
5.449 sec
1.551 sec
5.8 us
1H
CDCL3
22.7 c
0.00 ppm
0.09 Hz
15
RGAIN

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

5c

D:\WZH\R588\C-NMR.als
 COMNT WZHR588-C-NMR
 DATIM Sat Jun 11 21:50:09 2005
 OBNUC 13C
 EXMOD BCM

OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 1064
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 25.0 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 25

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 15.008
 15.107
 15.362
 18.939
 19.335
 26.686
 45.378
 47.801
 62.538
 76.614
 77.035
 77.463
 121.910
 126.221
 126.435
 127.226
 128.166
 131.594
 134.133
 135.270
 142.226
 142.382
 149.660
 151.053

214.546

PPM
 0
 50
 100
 150
 200

D:\WZH\R588\H-NMR1.als
 WZHR588-H-NMR
 Mon Jun 13 11:26:59 2005

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PUL
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 8
 5.449 sec
 1.551 sec
 5.8 us
 1H
 24.3 C
 CDCL3
 0.00 ppm
 0.09 Hz
 12

5d

D:\WZH\r589\c-nmr.als
 COMNT wzhr589-c-nmr
 DATIM Sat Jun 18 15:43:08 2005

OBNUC 13C
 EXMOD BCM

OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 600
 ACQTM 1.606 sec
 PD 1.394 sec
 PWI 5.0 us
 IRNUC 1H
 CTEMP 24.9 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 25

DFIE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PWI
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 15.016
 15.115
 15.371
 15.371
 18.939
 19.351
 28.030
 36.593
 38.274
 46.969
 47.562
 62.505
 76.622
 77.051
 77.471

121.894
 126.171
 126.336
 127.168
 128.355
 131.322
 134.264
 135.303
 142.160
 142.317
 149.709
 151.135

214.011

D:\WZH\589\h-nmr.als
 wzhr589-h-nmr
 Sat Jun 18 15:11:19 2005

DFILE COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 8
 5.449 sec
 1.551 sec
 5.8 us
 1H
 24.8 C
 CDCL3
 0.00 ppm
 0.09 Hz
 11

D:\LT\JOC\5F\C.als
 COMNT Sun Dec 31 11:39:14 2006
 DATIM 13C
 EXMOD BCM

OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 800
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 22.7 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 25

77.447
 77.018
 76.598
 62.653
 47.455
 47.216
 38.299
 36.585
 32.612
 32.554
 32.521
 32.093
 28.030
 26.307
 25.887
 23.143
 23.118
 23.077
 14.077
 13.994
 13.838
 0.000

149.940
 148.630
 141.286
 141.212
 135.435
 134.223
 131.553
 128.322
 126.962
 126.303
 126.097
 121.622

213.549

D:\LLT\JOC\5F\H.als
 Sun Dec 31 11:44:10 2006

DFILE COMNT
 DATIM 1H
 OBNUC NON
 EXMOD
 OBFRQ 300.40 MHz
 OBSET 130.00 KHz
 OBFIN 1150.0 Hz
 POINT 32768
 FREQU 6013.2 Hz
 SCANS 24
 ACQTM 5.449 sec
 PD 1.551 sec
 PWL 5.8 us
 IRNUC 1H
 CTEMP 22.2 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.09 Hz
 RGAIN 13

D:\LIT\JOC\5g\c.als
 WZHR653-2A8-2B3-C-NMR
 DATIM Wed Nov 30 21:48:29 2005
 OBNDC 13C
 EXMOD BCM

OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 1200
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 25.0 C
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 27

5g

0.000
 14.068
 14.390
 14.423
 14.464
 18.230
 19.162
 19.722
 19.945
 45.428
 62.134
 76.606
 77.026
 77.447

124.795
 125.982
 126.888
 127.135
 127.696
 128.067
 133.003
 134.264
 140.643
 145.621
 145.646
 149.289
 177.294

D:\WZH\R653\Clear H-NMR.als
 WZHR651-H-NMR
 Fri Dec 09 15:54:26 2005

DFILE
 CONNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

1H
 NON
 300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 64
 5.449 sec
 1.551 sec
 5.8 us
 1H
 22.9 c
 CDCL3
 0.00 ppm
 0.09 Hz
 19

5g

D:\WZH\R581\NOTMS\A6\C-NMR.
 COMNT WZHR581-C-NMR-NOTMS
 DATIM Fri Jun 10 15:09:03 2005
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 1040
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 25.0 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 27

5h

DFILE COMNT DATIM OBNUC EXMOD OBFRQ OBSET OBFIN POINT FREQU SCANS ACQTM PD PW1 IRNUC CTEMP SLVNT EXREF BF RGAIN

77.438
77.018
76.590
62.917

	75.45 MHz	
	124.00 KHz	
	1840.0 Hz	
	32768	
	20408.1 Hz	
	1064	
	1.606 sec	
	1.394 sec	
	5.0 us	
¹ H		25.1 °C
CDCl ₃		
	0.00 ppm	
	0.62 Hz	
	26

5h

D:\WZH\R581\TMS\H-NMR.als
 WZHR581-C-NMR-TMS
 Fri Jun 10 15:23:56 2005
 1H
 NON

300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 8
 5.449 sec
 1.551 sec
 5.8 us
 1H
 24.3 C
 CDCL3
 0.00 ppm
 0.09 Hz
 14

5h

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFREQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

WZHR574-C-NMR-NOTMS

D:\WZH\R574\NOTMS\C-NMR.als
COMNT WZHR574-C-NMR-NOTMS
DATIM Sat May 28 17:34:19 2005
OBNUC 13C
EXMOD BCM

OBFREQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 164
ACQTM 1.606 sec
PD 1.394 sec
PW1 5.0 us
IRNUC 1H
CTEMP 29.4 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 0.62 Hz
RGAIN 26

5i

DFILE D:\WZH\R574\CONTAIN\TMS\C-NM
 COMNT WZHR574-C-NMR-TMS
 DATIM Sat May 28 18:13:54 2005

OBNUC 13C
 EXMOD BCM

OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 344
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 29.4 C
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 26

5i

32.917
 29.027
 28.961
 28.285
 28.203
 23.950
 23.579
 23.464
 22.904
 14.843
 14.530
 14.439
 0.000
 -1.459

77.430
 77.010
 76.581
 63.098

151.638
 150.789
 141.212
 138.806
 136.416
 133.605
 127.795
 127.564
 126.295
 125.421
 125.372
 124.572

DFILE D:\WZH\R574\NOTMS\H-NMR.als
COMNT WZHR574-H-NMR-NOTMS
DATIM Sat May 28 17:24:14 2005
OBNUC 1H
EXMOD NON

OBFRQ 300.40 MHz
OBSET 130.00 KHz
OBFIN 1150.0 Hz
POINT 32768

FREQU 6013.2 Hz
SCANS 8

ACQTM 5.449 sec
PD 1.551 sec
PW1 5.8 us

IRNUC 1H
CTEMP 28.5 c

SLVNT CDCL3
EXREF 0.00 ppm
BF 0.09 Hz

RGAIN 11

5i

D:\WZH\R574\CONTAINMENTS\h-nm
 WZHR574-H-NMR-TMS
 Sat May 28 17:55:05 2005

DFILE COMNT
 DATIM
 OBNUC 1H
 EXMOD NON
 OBFRQ 300.40 MHz
 OBSET 130.00 KHz
 OBFIN 1150.0 Hz
 POINT 32768
 FREQU 6013.2 Hz
 SCANS 32
 ACQTM 5.449 sec
 PD 1.551 sec
 PW1 5.8 us
 IRNUC 1H
 CTEMP 28.6 C
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.09 Hz
 RGAIN 12

5i

D:\LLT\JOC\5j+J\PHCHO+Na\Cl

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFREQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Fri Dec 08 14:14:12 2006

13C
BCM
75.45 MHz
124.00 KHz
1840.0 Hz
32768
20408.1 Hz
400
1.606 sec
1.394 sec
5.0 us
1H
23.8 C
CDCL3
0.00 ppm
0.62 Hz
25

21.123
20.035
19.269
18.445
15.132
15.024
14.645
14.555
0.000

48.040

77.438
77.018
76.598
71.125
64.606

149.305
146.034
145.704
143.083
141.904
135.319
134.594
128.487
128.199
127.465
127.004
126.855
126.740
126.641
126.468
125.660

D:\LLT\JOC\5j+J\PHCHO+Na\H1

Fri Dec 08 14:28:36 2006

DFILE COMNT
 DAFIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

1H
 NON
 300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 16
 5.449 sec
 1.551 sec
 5.8 us
 1H
 23.1 C
 CDCL3
 0.00 ppm
 0.09 Hz
 15

D:\LLT\JOC\5j+J\PHCHO+Na\C2

DFILE COMNT
 DATIM Fri Dec 08 14:49:49 2006
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 264
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 23.7 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 27

19.302
 19.129
 18.948
 18.898
 15.503
 15.156
 14.975
 14.835
 0.000

46.203

62.851

77.438
 77.356
 77.018
 76.590

150.319
 149.866
 143.025
 142.547
 141.649
 136.045
 134.685
 132.905
 128.166
 127.671
 127.366
 127.078
 126.460
 126.410
 125.924
 121.943

5j'

D:\LLT\JOC\5j+J\PHCHO+Na\H2

DFILE COMNT DATIM OBNUC EXMOD OBFQ OBSE OBFIN POINT FREQU SCANS ACQTM PD PW1 IRNUC CTEMP SLVNT EXREF BF RGAIN
 Fri Dec 08 15:08:35 2006 1H NON 300.40 MHz 130.00 KHz 1150.0 Hz 32768 6013.2 Hz 24 5.449 sec 1.551 sec 5.8 us 1H 23.1 c CDCL3 0.00 ppm 0.09 Hz 15

7.475 7.469 7.451 7.445 7.429 7.409 7.385 7.380 7.360 7.307 7.283 7.244 7.180 7.176 7.011 6.653 6.648 6.626 6.627 5.616 5.593 5.582 5.202 5.196 5.162 2.330 2.304 2.278 2.273 2.252 2.248 2.188 2.163 1.890 1.873 1.846 1.821 1.154 1.129 1.117 1.103 1.092 1.067 1.091 0.866 0.840 0.640 0.615 0.589 0.000

D:\LLT\JOC\5K\C4.als
 Fri Nov 24 23:21:38 2006
 13C
 BCM

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 800
 1.606 sec
 1.394 sec
 5.0 us
 1H
 24.2 C
 CDCL3
 0.00 ppm
 0.62 Hz
 27
 RGAIN

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFREQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 14.670
 14.926
 15.255
 15.733
 18.865
 18.898
 18.923
 19.393
 21.766
 22.030
 25.788
 33.692
 35.983
 49.054
 63.469
 74.999
 76.614
 77.035
 77.455

125.149
 125.537
 125.990
 127.292
 130.119
 130.852
 134.553
 135.987
 140.495
 143.512
 149.866
 150.921

5k

D:\LLT\JOC\5K\H4.als
 Fri Nov 24 23:25:39 2006

DFILE COMNT
 DATIM
 OBNUC 1H
 EXMOD NON
 OBFRQ 300.40 MHz
 OBSET 130.00 KHz
 OBFIN 1150.0 Hz
 POINT 32768
 FREQU 6013.2 Hz
 SCANS 16
 ACQTM 5.449 sec
 PD 1.551 sec
 PW1 5.8 us
 IRNUC 1H
 CTEMP 23.7 C
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.09 Hz
 RGAIN 11

0.000
 0.507
 0.532
 0.557
 0.871
 0.896
 0.921
 1.056
 1.081
 1.106
 1.114
 1.139
 1.164
 1.504
 1.519
 1.528
 1.590
 1.601
 1.610
 1.617
 1.639
 1.658
 1.693
 1.715
 1.740
 1.765
 2.204
 2.212
 2.229
 2.237
 2.254
 2.283
 2.309
 2.314
 2.334
 2.339
 5.110
 5.115
 5.144
 5.149
 6.071
 6.085
 6.594
 6.599
 6.620
 6.625
 6.953
 6.956
 7.525
 7.528

D:\LLT\JOC\5L\C.als
 540
 Sat Nov 11 23:10:56 2006

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFREQ
 OBSSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 14.481
 14.579
 22.261
 22.632
 23.827
 24.445
 28.022
 28.656
 36.585
 38.258
 47.150
 47.497
 62.966
 76.614
 77.035
 77.455

121.828
 126.130
 126.245
 127.012
 128.306
 131.067
 134.256
 135.270
 137.479
 137.611
 146.891
 148.201

213.722

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 400
 1.606 sec
 1.394 sec
 5.0 us
 1H
 22.7 C
 CDCL3
 0.00 ppm
 0.62 Hz
 27

D:\LLT\JOC\5M\NO TMS\C2.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Tue Dec 26 23:12:40 2006

13C

BCM

75.45 MHz

124.00 KHz

1840.0 Hz

32768

20408.1 Hz

1168

1.606 sec

1.394 sec

5.0 us

1H

23.8 C

CDCL3

77.00 ppm

0.62 Hz

26

5m

D:\LLT\JOC\5M\New Folder\C.

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PWL
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Wed Jan 10 09:17:52 2007

13C

BCM

75.45 MHz
124.00 KHz
1840.0 Hz
32768
20408.1 Hz
705
1.606 sec
1.394 sec
5.0 us
23.5 c
CDCL3
0.00 ppm
0.62 Hz
27

5m

DFILE D:\LLT\JOC\5M\NO TMS\h.als
 COMNT
 DATIM Tue Dec 26 19:53:30 2006
 OBNUC 1H
 EXMOD NON
 OBFRQ 300.40 MHz
 OBSET 130.00 KHz
 OBFIN 1150.0 Hz
 POINT 32768
 FREQU 6013.2 Hz
 SCANS 16
 ACQTM 5.449 sec
 PD 1.551 sec
 PW1 5.8 us
 IRNUC 1H
 CTEMP 23.2 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.09 Hz
 RGAIN 16

5m

[illegible]

D:\LIT\JOC\5N\C.als
 COMNT Wed Dec 27 11:02:06 2006
 OBNUC 13C
 EXMOD BCM

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 160
 1.606 sec
 1.394 sec
 5.0 us
 1H
 24.0 C
 CDCL3
 0.00 ppm
 0.62 Hz
 26

DFIL
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 14.431
 14.579
 22.170
 22.491
 23.843
 23.860
 24.379
 24.403
 28.574
 28.656
 37.870
 43.796

63.345
 76.581
 77.010
 77.430

116.504
 125.495
 125.842
 126.946
 127.918
 128.017
 128.561
 134.734
 136.317
 136.910
 137.339
 137.850
 147.369
 147.830

5n

D:\LIT\JOC\5N\H2.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PWL
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Wed Dec 27 11:46:54 2006
1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
80
5.449 sec
1.551 sec
5.8 us
1H
23.1 C
CDCL3
0.00 ppm
0.09 Hz
13

0.000
0.672
0.697
0.712
0.721
0.736
0.761
1.094
1.108
1.119
1.130
1.142
1.153
1.162
1.178
1.185
1.635
1.646
1.657
1.667
1.679
1.807
1.914
2.392
2.407
2.435
5.000
5.006
5.011
5.017
5.032
5.045
5.050
5.063
5.068
5.931
5.943
5.965
5.977
6.532
6.535
6.557
6.562
6.925
6.927
7.094
7.097
7.224
7.247
7.249

565

5n

D:\LLT\JOC\10\P2\CCS6S.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFREQ
OBSFET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Mon Jan 01 13:14:59 2007

13C

BCM

75.45 MHz

124.00 KHz

1840.0 Hz

32768

20408.1 Hz

880

1.606 sec

1.394 sec

5.0 us

1H

23.3 C

CDCL3

0.00 ppm

0.62 Hz

27

0.000

15.082

15.503

18.709

18.890

28.022

56.505

76.590

77.018

77.438

122.528

122.800

126.287

129.699

140.611

148.704

10a

D:\LLT\JOC\10\12\HHS6.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PWL
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Mon Jan 01 12:23:41 2007

1H
NON

300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
2
5.449 sec
1.551 sec
5.8 us
1H
22.5 c
CDCL3
0.00 ppm
0.09 Hz
15

10a

1.015
1.026
1.039
1.040
1.050
1.051
1.065
1.075
2.112
2.137
2.166
2.191
2.204
2.217
2.229
2.241
2.254
2.279
2.298
2.317
2.323

4.839
4.870
4.872
5.886
5.898
5.958
5.966
5.969
5.979
5.990
5.997
6.000
6.009
6.010
7.252
7.254

D:\LLT\JOC\10\P1\C-S2S3.als

DFILE
COMNT
DATIM Sun Dec 31 16:53:27 2006
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 400
ACQTM 1.606 sec
PD 1.394 sec
PWL 5.0 us
IRNUC 1H
CTEMP 23.3 C
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 26

0.000
15.082
15.560
18.956
19.170
25.936

60.568
76.598
77.018
77.447

124.490
128.429
141.641
148.086

10a'

D:\LLT\JOC\10\PI\H-S2S3-2.a
 COMNT Sun Dec 31 16:56:38 2006
 DATIM 1H
 OBNUC 1H
 EXMOD NON

300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 16
 5.449 sec
 1.551 sec
 5.8 us
 1H
 22.7 c
 CDCL3
 0.00 ppm
 0.09 Hz
 14

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

10a'

D:\LLT\PhCHO+Ph\Cl.als
 Sat Aug 26 22:33:20 2006

COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

13C
 BCM
 75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 344
 1.606 sec
 1.394 sec
 5.0 us
 1H
 23.5 c
 CDCL3
 0.00 ppm
 0.62 Hz
 27

0.000
 14.629
 15.041
 15.181
 16.747
 18.865
 18.890
 19.228
 20.958

48.387

61.161

71.216
 76.606
 77.026
 77.455

124.259
 124.638
 125.644
 125.883
 126.732
 128.075
 129.484
 143.355
 143.957
 144.121
 144.311
 147.303

12a

D:\LLT\PhCHO+Ph\H1.als
Sat Aug 26 22:14:29 2006

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFREQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PWL
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
16
5.449 sec
1.551 sec
5.8 us
1H
22.6 c
CDCL3
0.00 ppm
0.09 Hz
13

12a

D:\LLT\PhCHO+Ph\C22.als
 Sat Jan 13 17:08:45 2007
 13C
 BCM

0.000
 15.000
 15.057
 15.568
 15.758
 18.882
 18.956
 18.989

43.260

61.178

76.614
 77.035
 77.241
 77.455

124.432
 125.957
 126.369
 127.374
 128.133
 131.100
 131.207
 142.226
 142.382
 142.712
 146.734
 146.981

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 568
 1.606 sec
 1.394 sec
 5.0 us
 1H
 25.3 c
 CDCL3
 0.00 ppm
 0.62 Hz
 26
 RGAIN

12a'

D:\LLT\PYCAR+PH\Cl.als
 Fri Oct 27 16:45:40 2006

COMNT
 DATIM
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 480
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 23.2 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 27

12b

D:\LLT\PYCAR+PH\H1.als
 Fri Oct 27 16:48:30 2006

DFILE	COMMT	DATIM	OBNUC	EXMOD	OBFQ	OBSET	OBFIN	POINT	FREQU	SCANS	ACQTM	PD	PW1	IRNUC	CTEMP	SLVNT	EXREF	BF	RGAIN
			1H	NON	300.40 MHz	130.00 KHz	1150.0 Hz	32768	6013.2 Hz	16	5.449 sec	1.551 sec	5.8 us	1H	22.7 C	CDCL3	0.00 ppm	0.09 Hz	14

0.000	1.023	1.033	1.048	1.058	1.066	1.073	1.083	1.091	1.116	1.125	1.150	1.175	2.212	2.225	2.236	2.246	2.250	2.258	2.270	2.276	2.295	2.302	2.319	2.342	2.367	2.384	2.405	2.430	2.456	2.545	2.569	3.225	3.576	4.263	5.067	5.098	5.850	5.855	5.979	6.010	7.116	7.231	7.258	7.599	7.605	8.493	8.496	8.509	8.511
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

12.2681

8.0000

0.9674

0.8661

0.8411

0.8508

2.8776

1.0015

1.1665

1.0229

0.9091

12b

PPM

0

2

4

6

8

D:\LLT\PYCAR+PH\C2.als
 COMNT Fri Oct 27 13:03:33 2006
 DATIM 13C
 EXMOD BCM

OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 424
 ACQTM 1.606 sec
 PD 1.394 sec
 PWL 5.0 us
 IRNUC 1H
 CTEMP 22.7 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 27

18.980
 18.915
 18.758
 15.742
 15.585
 15.049
 15.008
 0.000

42.988

61.153

77.480
 77.059
 76.631
 75.848

160.053
 148.275
 147.270
 146.800
 142.498
 142.111
 136.061
 131.058
 130.473
 125.512
 124.721
 122.355
 121.506

12b'

D:\LIT\2BrPhCHO+Ph\C.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFREQ
OBSSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PWL
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

0.000
14.621
15.057
15.173
16.731
18.857
18.873
19.236
20.917

48.156

61.038

70.895
76.614
77.043
77.463

120.534
124.259
124.869
125.421
127.498
129.567
131.091
142.341
144.039
144.121
144.303
147.138

Fri Sep 22 15:37:31 2006

13C
BCM

75.45 MHz
124.00 KHz
1840.0 Hz
32768
20408.1 Hz
216
1.606 sec
1.394 sec
5.0 us
1H
23.3 C
CDCL3
0.00 ppm
0.62 Hz
26

12c

D:\LLT\2BrPhCHO+Ph\H1.als

Fri Sep 22 15:42:26 2006

1H
NON

300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
16
5.449 sec
1.551 sec
5.8 us
22.7 c
CDCL3
0.00 ppm
0.09 Hz
12

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PWL
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

0.000
1.028
1.034
1.053
1.059
1.078
1.084
1.103
1.122
1.147
1.172
1.260
1.964
1.973
2.217
2.233
2.242
2.258
2.267
2.292
2.314
2.350
2.372
2.396
2.430
2.456
2.481
2.504
2.512
2.537
2.558
2.583
3.272
4.299
5.100
5.132
5.856
5.890
5.922
5.936
5.948
5.968
6.007
6.021
6.037
6.053
7.120
7.149
7.395
7.423

12c

D:\LLT\2BrPhCHO+Ph\C2.als

COMNT
DATIM Fri Sep 22 15:57:42 2006
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 256
ACQTM 1.606 sec
PD 1.394 sec
PWL 5.0 us
IRNUC 1H
CTEMP 23.2 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 26

12c'

0.000
14.983
15.033
15.568
15.766
18.824
18.931
18.964

43.145

61.087

76.408
76.606
77.026
77.455

121.152
123.946
125.339
128.133
131.116
131.454
131.578
141.146
142.366
142.852
146.577
146.849

D:\LLT\2BrPhCHO+Ph\H2.als

Fri Sep 22 16:13:27 2006

1H
NON

300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
8
5.449 sec
1.551 sec
5.8 us
1H
22.5 c
CDCL3
0.00 ppm
0.09 Hz
12

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PWL
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

0.000
0.853
0.865
0.875
0.890
0.910
0.915
0.935
0.960
1.009
1.013
1.035
1.039
1.060
1.855
1.880
1.906
1.931
2.004
2.029
2.055
2.080
2.174
2.199
2.225
2.250
3.238
3.246
3.254
4.713
4.729
5.036
5.043
5.050
5.074
5.077
5.080
5.102
5.110
5.118
5.718
5.728
5.751
5.764
5.775
5.798
5.808
7.221
7.249
7.448
7.477

12c'

D:\LLT\4FPhCHO+Ph\C11.als

DFILE
COMNT
DATIM Wed Jan 17 14:58:38 2007
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQ 20408.1 Hz
SCANS 800
ACQTM 1.606 sec
PD 1.394 sec
PW1 5.0 us
IRNUC 1H
CTEMP 25.9 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 26

0.000
14.621
15.049
15.156
16.714
18.865
18.890
19.244
20.934
48.288
61.112
70.845
76.606
77.026
77.455

114.699
114.979
124.276
124.811
125.578
127.193
127.300
129.633
138.987
139.028
144.006
144.163
144.295
147.229
160.110
163.349

PPM
0
50
100
150
200

12d

D:\LLT\4FPCHO+Ph\H11.als

Wed Jan 17 15:05:53 2007

1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
32
5.449 sec
1.551 sec
5.8 us
1H
25.1 C
CDCL3
0.00 ppm
0.09 Hz
14

DFILE COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

12d

D:\LIT\4FPhCHO+Ph\C22.als

COMNT
DATIM Tue Jan 16 00:37:10 2007
OBNUC ¹³C
EXMOD BCM
OBFREQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 400
ACQTM 1.606 sec
PD 1.394 sec
PW1 5.0 us
IRNUC 1H
CTEMP 24.5 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 26

12d'

D:\LLT\4FPPhCHO+Ph\H2.als

Sat Sep 30 08:15:44 2006

1H

NON

300.40 MHz

130.00 KHz

1150.0 Hz

32768

6013.2 Hz

16

5.449 sec

1.551 sec

5.8 us

1H

22.5 c

CDCL3

0.00 ppm

0.09 Hz

11

DFILE COMNT
DATIM
OBNUC
EXMOD
OBFRQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

12d

D:\LLT\4-M3OPhCHO+Ph\Cl.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFREQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PWL
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Sat Oct 14 14:05:52 2006

13C

BCM

75.45 MHz

124.00 KHz

1840.0 Hz

32768

20408.1 Hz

800

1.606 sec

1.394 sec

5.0 us

1H

23.3 c

CDCL3

0.00 ppm

0.62 Hz

26

0.000
14.645
15.057
15.173
16.731
18.873
18.890
19.244
20.967

48.230
55.219
61.120
70.952
76.647
77.068
77.488

113.454
124.210
124.564
126.056
126.773
129.641
135.501
143.808
144.023
144.286
147.352
158.412

12e

[illegible]

12e

D:\LLT\4-M3OPhCHO+Ph\C22.a1

DFILE
COMNT
DATIM Sat Oct 14 18:53:32 2006
OBNUC 13C
EXMOD BCM
OBFREQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 584
ACQTM 1.606 sec
PD 1.394 sec
PW1 5.0 us
IRNUC 1H
CTEMP 22.9 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 25

19.005
18.980
18.964
18.873
15.758
15.568
15.066
15.016
0.000

43.260

55.285

61.202

77.455
77.133
77.035
76.614

113.537

124.778
125.932
127.539
130.811
131.001
134.586
142.168
142.663
146.800
147.006
158.948

12e'

D:\LLT\4-M3OPhCHO+Ph\H22.a1

DFILE
COMNT
DATIM Sat Oct 14 18:22:42 2006
OBNUC 1H
EXMOD NON
OBFRQ 300.40 MHz
OBSET 130.00 KHz
OBFIN 1150.0 Hz
POINT 32768
FREQU 6013.2 Hz
SCANS 16
ACQTM 5.449 sec
PD 1.551 sec
PW1 5.8 us
IRNUC 1H
CTEMP 22.7 C
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.09 Hz
RGAIN 13

7.305
7.277
6.903
6.874
5.886
5.880
5.856
5.850
5.841
5.754
5.747
5.737
5.717
5.708
5.082
5.077
5.047
5.042
4.671
4.652
3.805
3.234
3.226
3.217
2.256
2.231
2.206
2.181
2.092
2.067
2.041
2.016
2.010
1.983
1.958
1.933
1.066
1.041
1.016
0.965
0.948
0.940
0.923
0.915
0.898
0.000

12e'

D:\LLT\4PhPhCHO+Ph\c11.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

0.000
14.645
15.074
15.189
16.755
18.873
19.269
20.975

48.263

61.112
71.158
76.606
77.026
77.447

124.234
124.704
125.907
126.130
126.798
127.028
127.102
128.710
129.567
139.638
140.998
142.432
143.948
144.130
144.286
147.303

Sat Oct 07 16:12:32 2006

13C
BCM

75.45 MHz

124.00 KHz

1840.0 Hz

32768

20408.1 Hz

320

1.606 sec

1.394 sec

5.0 us

1H

22.6 c

CDCL3

0.00 ppm

0.62 Hz

27

12f

D:\LLT\4PhPhCHO+Ph\c222.als

DFILE COMNT
 DATIM Tue Jan 16 16:54:17 2007
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 480
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 25.1 c
 SLVNT CDCl3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 27

18.989
 18.948
 18.873
 15.783
 15.577
 15.049
 15.000
 0.000

43.269

61.178

77.447
 77.026
 76.993
 76.606

147.023
 146.726
 142.720
 142.259
 141.369
 140.981
 140.297
 131.265
 131.182
 128.767
 127.210
 127.070
 126.855
 125.809
 124.416

12f

D:\LLT\4PhPhCHO+Ph\H2.als

Sat Sep 23 18:14:44 2006

1H
NON

300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
221
5.449 sec
1.551 sec
5.8 us
1H
22.1 C
CDCL3
0.00 ppm
0.09 Hz
14

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFREQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

D:\LLT\FUNANQUAN+Ph\Cl.als

COMNT
DATIM Wed Oct 11 20:30:54 2006
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 240
ACQTM 1.606 sec
PD 1.394 sec
PW1 5.0 us
IRNUC 1H
CTEMP 22.5 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 26

12g

D:\LLT\FUNANQUAN+Ph\H1.als

Wed Oct 11 20:33:55 2006

DFILE COMNT
 DATIM
 OBNUC 1H
 EXMOD NON
 OBFRQ 300.40 MHz
 OBSET 130.00 KHz
 OBFIN 1150.0 Hz
 POINT 32768
 FREQU 6013.2 Hz
 SCANS 16
 ACQTM 5.449 sec
 PD 1.551 sec
 PWL 5.8 us
 IRNUC 1H
 CTEMP 22.3 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.09 Hz
 RGAIN 13

12g

D:\LLT\FUNANQUAN+Ph\C2.als

Wed Oct 11 19:54:40 2006

DFILE COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PWL
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 15.016
 15.074
 15.610
 15.676
 18.931
 18.972
 18.997
 19.022
 41.010
 61.145
 71.628
 76.647
 77.068
 77.488
 106.762
 110.182
 124.276
 125.446
 131.083
 131.586
 141.806
 142.308
 142.803
 146.635
 146.907
 155.338

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 624
 1.606 sec
 1.394 sec
 5.0 us
 1H
 22.6 c
 CDCl3
 0.00 ppm
 0.62 Hz
 25

12g'

D:\LLT\FUNANQUAN+Ph\H2.als

Wed Oct 11 20:08:26 2006

1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
16
5.449 sec
1.551 sec
5.8 us
1H
22.1 c
CDCl3
0.00 ppm
0.09 Hz
11

12g

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

0.000
0.940
0.965
0.990
1.027
1.052
1.077
2.024
2.042
2.049
2.066
2.074
2.092
2.117
2.195
2.220
2.245
2.270
3.393
3.402
3.411
4.662
4.680
5.085
5.091
5.118
5.124
5.149
5.156
5.162
5.176
5.721
5.726
5.751
5.759
5.896
5.921
5.925
5.930
6.289
6.292
6.300
6.302
6.338
6.344
6.349
6.355
7.382
7.385
7.388

D:\LLT\SAIFENQUAN+Ph\Cl.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Wed Oct 11 21:06:26 2006

13C

BCM

75.45 MHz

124.00 KHz

1840.0 Hz

32768

20408.1 Hz

400

1.606 sec

1.394 sec

5.0 us

1H

22.5 c

CDCL3

0.00 ppm

0.62 Hz

27

20.991
19.121
18.923
18.832
16.772
15.148
14.967
14.670
0.000

48.329

77.455
77.414
77.026
76.606
68.941
61.120

147.624
147.088
144.204
144.171
144.023
129.451
129.418
126.715
125.916
124.894
124.482
124.449
123.905
122.512

12h

D:\LLT\SAIFENQUAN+Ph\H1.als

Wed Oct 11 21:20:00 2006

1H
NON

300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
16
5.449 sec
1.551 sec
5.8 us
1H
21.9 c
CDCL3
0.00 ppm
0.09 Hz
14

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

0.000
1.012
1.037
1.059
1.069
1.082
1.094
1.109
1.137
1.162
2.080
2.091
2.220
2.237
2.245
2.262
2.270
2.289
2.315
2.341
2.364
2.389
2.413
2.437
2.462
2.486
2.511
2.537
2.562
2.584
3.477
4.558
5.117
5.147
6.005
6.012
6.042
6.051
6.073
6.082
6.831
6.834
6.838
6.843
6.846
6.935
6.950
6.964
7.181
7.199

12.0000

7.6568

0.9784

0.7487

0.7857

0.7387

2.7594

0.7867
0.8188
1.0096

PPM

0
2
4
6
8

12h

D:\LLT\SAIFENQUAN+Ph\C2.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Wed Oct 11 21:41:37 2006

13C
BCM

75.45 MHz

124.00 KHz

1840.0 Hz

32768

20408.1 Hz

280

1.606 sec

1.394 sec

5.0 us

1H

22.5 c

CDCL3

0.00 ppm

0.62 Hz

27

12h'

D:\LLT\SAIFENQUAN+Ph\H2.als

Wed Oct 11 21:54:49 2006

1H
NON

300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
16
5.449 sec
1.551 sec
5.8 us
1H
22.1 c
CDCL3
0.00 ppm
0.09 Hz
12

12h'

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

D:\LT\Ph+Piva\C.als
 Fri Sep 15 21:50:52 2006
 13C
 BCM

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 408
 1.606 sec
 1.394 sec
 5.0 us
 1H
 22.9 C
 CDCL3
 0.00 ppm
 0.62 Hz
 25

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFREQ
 OBSSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

12i'

D:\LLT\Ph+Piva\H.als
 Fri Sep 15 21:28:59 2006
 1H
 300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 8
 5.449 sec
 1.551 sec
 5.8 us
 1H
 21.9 C
 CDCL3
 0.00 ppm
 0.09 Hz
 9

12i

D:\LLT\Ph+CHONE\C.als
 COMNT Tue Sep 12 12:53:12 2006
 DATIM 13C
 OBNUC BCM
 EXMOD
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 552
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 23.3 c
 SLVNT CDCl3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 27

12j'

D:\LLT\Ph+CHONE\H.als
 Tue Sep 12 13:25:30 2006
 1H
 NON

300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 8
 5.449 sec
 1.551 sec
 5.8 us
 1H
 22.7 C
 CDCL3
 0.00 ppm
 0.09 Hz
 12
 RGAIN

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

6.021
 6.011
 5.986
 5.977
 5.129
 5.121
 5.094
 5.086
 2.877
 2.867
 2.859
 2.850
 2.840
 2.273
 2.249
 2.223
 2.198
 2.165
 2.139
 2.114
 2.083
 2.057
 2.032
 1.666
 1.624
 1.594
 1.471
 1.082
 1.057
 1.032
 1.000
 0.995
 0.975
 0.970
 0.950
 0.945
 0.000

12j

D:\LLT\Ph2CO=Ph\C2.als
Sat Jan 13 23:45:39 2007

COMNT
DATIM
OBNUC 13C
EXMOD BCM
OBFRO 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 240
ACQTM 1.606 sec
PD 1.394 sec
PWL 5.0 us
IRNUC 1H
CTEMP 25.1 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 27

19.121
19.046
18.948
18.931
15.774
15.692
15.082
14.967
0.000

43.738

61.095

78.790
77.438
77.018
76.590

146.866
146.240
145.893
143.058
142.523
132.880
128.199
126.517
125.874
124.745

12k'

D:\LLT\Ph2CO=Ph\H2.als
 Sun Sep 03 00:13:36 2006

DFILE COMNT
 DATIM
 OBNUC 1H
 EXMOD NON
 OBFREQ 300.40 MHz
 OBSET 130.00 KHz
 OBFIN 1150.0 Hz
 POINT 32768
 FREQU 6013.2 Hz
 SCANS 8
 ACQTM 5.449 sec
 PD 1.551 sec
 PW1 5.8 us
 IRNUC 1H
 CTEMP 23.0 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.09 Hz
 RGAIN 12

12k'

D:\LLT\Ph+YAAN\C.als
Sat Sep 16 16:01:17 2006

DFILE COMNT
DATIM
OBNUC 13C
EXMOD BCM
OBFRQ 75.45 MHz
OBSET 124.00 KHz
OBFIN 1840.0 Hz
POINT 32768
FREQU 20408.1 Hz
SCANS 800
ACQTM 1.606 sec
PD 1.394 sec
PW1 5.0 us
IRNUC 1H
CTEMP 23.2 C
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.62 Hz
RGAIN 25

19.434
19.055
18.948
18.915
16.046
15.643
15.132
15.000
0.000

42.733

61.054
60.700

77.455
77.026
76.606

147.608
146.783
146.528
143.083
142.325
141.855
131.932
131.083
129.064
128.405
128.182
126.896
126.822
123.600
116.982
113.067

121'

D:\LLT\Ph+YAAN\H.als
Sat Sep 16 16:10:29 2006

DFILE COMNT
DATIM
OBNUC 1H
EXMOD NON
OBFRQ 300.40 MHz
OBSET 130.00 KHz
OBFIN 1150.0 Hz
POINT 32768
FREQU 6013.2 Hz
SCANS 16
ACQTM 5.449 sec
PD 1.551 sec
PW1 5.8 us
IRNUC 1H
CTEMP 22.3 C
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.09 Hz
RGAIN 10

0.850
0.875
0.906
0.931
0.956
1.029
1.053
1.078
1.101
1.146
1.171
1.196
1.993
2.018
2.043
2.193
2.218
2.226
2.243
2.252
2.266
2.278
2.289
2.303
2.314
2.339
2.339
3.347
4.305
4.481
4.492
5.149
5.153
5.184
5.911
6.419
6.447
6.602
6.604
6.604
7.028
7.053
7.078
7.210
7.233
7.235
7.283
7.308
7.333
7.373
7.399

12i

D:\LLT\4Pr\PhCHO\Cl.als
 Fri Oct 20 21:40:49 2006
 13C
 BCM

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 400
 1.606 sec
 1.394 sec
 5.0 us
 1H
 21.5 c
 CDCl3
 0.00 ppm
 0.62 Hz
 25
 RGAIN

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 14.588
 14.753
 14.851
 15.082
 23.324
 23.439
 23.736
 25.450
 28.318
 28.458
 28.945
 30.593
 48.650
 61.260
 71.158
 76.622
 77.051
 77.471

124.177
 124.622
 125.594
 125.842
 126.690
 128.108
 129.575
 143.009
 143.207
 143.289
 143.355
 146.182

DTFILE	COMINT	DATIM	OBNUC	EXMOD	OBFRQ	OBSET	OBFIN	POINT	FREQU	SCANS	ACQTM	PD	PWL	IRNUC	CTEMP	SLVNT	EXREF	BF	RGAIN																														
0.000	0.859	0.882	0.907	0.941	0.946	0.953	0.965	0.970	0.977	0.989	0.995	1.001	1.384	1.409	1.436	1.461	1.485	1.509	1.956	1.964	2.148	2.170	2.176	2.194	2.200	2.224	2.245	2.253	2.274	2.290	2.314	2.323	2.459	2.480	3.314	4.353	5.071	5.102	5.946	5.977	5.986	7.197	7.219	7.225	7.232	7.262	7.289	7.310	7.335

13

D:\LLT\4Pr\PhCHO\C2S.als
 Sat Oct 21 20:10:00 2006

COMNT
 DATIM
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 480
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 21.6 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 25

13'

D:\LLT\4Pr\PhCHO\H21.als

Sat Oct 21 19:43:26 2006

1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
56
5.449 sec
1.551 sec
5.8 us
1H
21.3 c
CDCl3
0.00 ppm
0.62 Hz
15

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

13'

D:\LLT\4Pr\CHONE\Cl.als
 Sat Oct 21 15:51:12 2006

COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 738
 1.606 sec
 1.394 sec
 5.0 us
 1H
 21.5 c
 CDCL3
 0.00 ppm
 0.62 Hz
 25

14

0.000
 14.423
 14.439
 14.579
 14.860
 21.832
 23.464
 23.538
 23.785
 24.123
 25.846
 28.294
 28.359
 28.623
 28.730
 34.557
 46.219
 61.169
 73.796
 76.631
 77.051
 77.471

125.009
 130.918
 140.792
 141.451
 145.630
 146.413

PPM

D:\LLT\4Pr\PhCH=NPh\Cl.als

Fri Oct 20 20:31:04 2006

13C

BCM

75.45 MHz

124.00 KHz

1840.0 Hz

32768

20408.1 Hz

400

1.606 sec

1.394 sec

5.0 us

1H

21.8 c

CDCL3

0.00 ppm

0.62 Hz

27

DFILE COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

0.000
14.406
14.670
14.851
23.390
23.406
23.835
23.917
28.236
28.384
28.574
28.912
42.708

60.881
61.145

76.590
77.018
77.438

113.207
116.990
123.435
126.855
126.913
128.108
128.438
129.015
131.429
132.212
141.253
141.929
142.119
145.349
145.712
147.599

15

D:\LLT\4Pr\PhCH=NPh\H1.als

Fri Oct 20 20:38:38 2006

1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
16
5.449 sec
1.551 sec
5.8 us
1H
21.3 c
CDCl3
0.00 ppm
0.09 Hz
12

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

0.000
0.784
0.808
0.833
0.902
0.927
0.951
0.974
0.997
1.021
1.310
1.336
1.360
1.384
1.409
1.434
1.458
1.482
1.524
1.550
1.576
1.926
1.953
1.980
1.980
2.141
2.181
2.194
2.208
2.234
2.262
2.287
4.479
4.490
5.130
5.137
5.164
5.171
6.429
6.455
6.613
7.034
7.061
7.086
7.237
7.261
7.309
7.335
7.359
7.393
7.417

15

D:\LLT\4BU\PhCHO\Cl.als
 Sat Nov 04 17:05:03 2006
 13C
 BCM

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 400
 1.606 sec
 1.394 sec
 5.0 us
 1H
 23.3 c
 CDCL3
 0.00 ppm
 0.62 Hz
 27

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 13.862
 13.953
 14.019
 23.208
 23.365
 23.439
 23.522
 25.895
 25.953
 26.414
 27.939
 32.324
 32.744
 34.343
 48.675
 61.268
 71.175
 76.622
 77.043
 77.471

124.234
 124.671
 125.619
 125.874
 126.690
 128.108
 129.633
 143.009
 143.116
 143.198
 143.380
 146.058

16

D:\LLT\4BU\PhCHO\H1.als
 Sat Nov 04 16:40:12 2006
 1H
 NON

300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 16
 5.449 sec
 1.551 sec
 5.8 us
 1H
 22.3 c
 CDCl3
 0.00 ppm
 0.09 Hz
 10

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 0.780
 0.803
 0.833
 0.858
 0.880
 1.181
 1.204
 1.224
 1.258
 1.282
 1.304
 1.313
 1.325
 1.882
 1.889
 2.117
 2.133
 2.163
 2.182
 2.197
 2.209
 2.225
 2.257
 2.350
 2.370
 2.381
 2.410
 2.430
 3.235
 4.272
 4.996
 5.027
 5.864
 5.902
 5.910
 5.919
 5.933
 5.941
 7.096
 7.117
 7.124
 7.137
 7.146
 7.169
 7.189
 7.209
 7.230
 7.255
 7.258

16

D:\LLT\4BU\PhCHO\C222.als

Wed Jan 17 12:10:30 2007

13C

BCM

75.45 MHz

124.00 KHz

1840.0 Hz

32768

20408.1 Hz

320

1.606 sec

1.394 sec

5.0 us

1H

24.7 c

CDCL3

0.00 ppm

0.62 Hz

26

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

16'

D:\LLT\4BU\PhCHO\H22.als
 Sat Nov 04 17:12:45 2006
 1H
 NON

300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 8
 5.449 sec
 1.551 sec
 5.8 us
 1H
 22.6 c
 CDCl3
 0.00 ppm
 0.09 Hz
 10

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

7.389
 7.369
 7.362
 7.348
 7.321
 7.293
 7.285
 7.275
 7.265
 7.252
 7.243
 5.806
 5.089
 5.083
 5.055
 5.049
 4.687
 4.669
 3.211
 2.185
 2.173
 2.162
 2.148
 2.078
 2.054
 2.028
 2.006
 1.977
 1.365
 1.354
 1.348
 1.341
 1.326
 1.313
 1.288
 1.281
 1.269
 1.259
 1.239
 1.216
 1.190
 0.939
 0.927
 0.918
 0.896
 0.862
 0.838
 0.815
 0.797
 0.000

16'

D:\LLT\4BU\YAN\Cl.als
 Thu Jan 18 13:38:23 2007
 13C
 BCM

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 440
 1.606 sec
 1.394 sec
 5.0 us
 1H
 25.9 C
 CDCl3
 0.00 ppm
 0.62 Hz
 28

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SILVNT
 EXREF
 BF
 RGAIN

0.000
 13.912
 14.027
 14.052
 14.200
 23.093
 23.110
 23.324
 23.365
 25.887
 25.945
 26.027
 26.620
 32.472
 32.497
 32.884
 33.164
 42.725
 61.029
 61.194
 76.598
 77.018
 77.438

113.232
 117.023
 123.542
 126.896
 126.921
 128.067
 128.446
 129.023
 131.454
 132.138
 141.311
 141.987
 142.102
 145.234
 145.737
 147.690

17

D:\LLT\4BU\YAAN\H2.als
 Thu Jan 18 13:40:33 2007

1H
 NON
 300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 8
 5.449 sec
 1.551 sec
 5.8 us
 1H
 25.6 c
 CDCl3
 0.00 ppm
 0.09 Hz
 13
 RGAIN

17

```

D:\LLT\PRBCHONE\c2.als
DFILE
COMMT
DATIM
OBNUC
EXMOD
Tue Jan 16 22:15:52 2007
13C
BCM

```

18

D:\LLT\PRBCHONE\H.als
 Wed Dec 20 15:14:44 2006
 1H
 300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 24
 5.449 sec
 1.551 sec
 5.8 us
 1H
 23.2 c
 CDCL3
 0.00 ppm
 0.09 Hz
 14

DFIL
 COMNT
 DATM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 0.801
 0.814
 0.826
 0.838
 0.850
 0.862
 1.321
 1.345
 1.370
 1.396
 1.422
 1.447
 1.533
 1.589
 1.610
 1.630
 1.647
 1.964
 1.991
 2.017
 2.045
 2.071
 2.349
 2.838
 2.845
 2.855
 5.061
 5.068
 5.096
 5.103
 5.963
 5.974
 5.998
 6.008

18

D:\LLT\2MePh=CypONE\LLTC.al

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQ
SCANS
ACQTM
PD
PWI
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Sun Jan 07 16:35:32 2007

13C

BCM

75.45 MHz
124.00 KHz
1840.0 Hz
32768
20408.1 Hz
1216
1.606 sec
1.394 sec
5.0 us
1H
23.8 c
CDCl3
0.00 ppm
0.62 Hz
26

19

0.000
14.769
14.959
15.049
17.967
18.964
18.997
19.038
23.868
23.909
38.200
38.315
46.796

63.782
76.606
77.026
77.455
83.941

123.171
124.803
132.031
136.481
142.959
143.643
145.613
146.157

D:\LLT\2MePh=CypONE\LLTH.al

Sun Jan 07 16:41:12 2007

1H

NON

300.40 MHz

130.00 KHz

1150.0 Hz

32768

6013.2 Hz

24

5.449 sec

1.551 sec

5.8 us

1H

CDCL3

23.2 C

0.00 ppm

0.09 Hz

13

DFILE COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PWI
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

0.000
0.952
0.971
0.978
0.997
1.003
1.022
1.029
1.055
1.080
1.257
1.262
1.266
1.734
1.754
1.848
1.875
1.987
1.994
2.009
2.034
2.041
2.066
2.091
2.113
2.138
2.146
2.171
2.193
2.218
2.238
2.243
2.262
2.268
2.288
2.293
2.972
5.017
5.024
5.050
5.057
5.713
5.718
5.723
5.728
5.856
5.862
5.866
5.900
7.261

12.0000

2.9994

1.1448

8.0134

8.0759

0.9877

0.9463

0.8998

0.9707

PPM

0

2

4

6

8

19

D:\LLT\3MePh +AdCOCl\lltc2.

DFILE COMNT
 DATIM Fri Jan 05 20:52:51 2007
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 3728
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 23.2 C
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 25

20

D:\LLT\3NePh +AdCOCL\11th.a

Fri Jan 05 20:55:48 2007

1H
NON

300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
16
5.449 sec
1.551 sec
5.8 us
1H
22.7 c
CDCl3
0.00 ppm
0.09 Hz
14

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

0.000
0.922
0.947
0.968
0.972
0.992
1.017
1.029
1.055
1.080
1.569
1.700
1.741
1.767
1.767
1.809
1.876
1.917
1.967
2.010
2.035
2.061
2.088
2.099
2.168
2.192
2.203
2.217
2.228
2.242
2.253
2.267
2.279
2.282
2.303
4.356
4.845
4.850
4.854
4.859
5.003
5.010
5.016
5.036
5.042
5.049
5.689
5.701
5.722
5.733
7.260

20

D:\LLT\JILI\J2H75\C.als
 Sun Dec 17 17:32:16 2006
 13C
 BCM

OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 200
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 23.3 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 26

5a

D:\LLT\JILL\J2H75\H1.als

Sun Dec 17 17:12:18 2006

1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
5.449 sec
1.551 sec
5.8 us
22.4 C
CDCl3
0.00 ppm
0.09 Hz
14

5a

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

D:\LLT\FelPr\JP1\C11.als

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PWL
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Sat Dec 23 10:29:31 2006
13C
BCM
75.45 MHz
124.00 KHz
1840.0 Hz
32768
20408.1 Hz
216
1.606 sec
1.394 sec
5.0 us
1H
24.3 c
CDCL3
0.00 ppm
0.62 Hz
27

0.000
14.464
14.571
14.818
22.730
23.390
23.695
24.272
28.236
28.310
28.442
29.068
29.159
36.412
48.082
63.766
76.590
77.010
77.438
124.325
125.504
127.070
129.699
130.440
135.896
136.218
138.863
142.350
149.099
150.319

5ob

D:\LLT\FelPr\JP1\H11.als

Sat Dec 23 10:49:31 2006

1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
24
5.449 sec
1.551 sec
5.8 us
1H
23.7 c
CDCl3
0.00 ppm
0.09 Hz
13

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRQ
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

7.305
7.279
7.015
6.909
6.582
6.557
5.042
5.008
3.308
3.295
2.293
2.286
2.270
2.258
2.240
2.213
2.187
2.160
2.135
1.587
1.561
1.537
1.514
1.487
1.464
1.439
1.415
1.154
1.152
1.124
1.062
1.025
1.006
0.981
0.964
0.940
0.938
0.915
0.897
0.866
0.837
0.817
0.778
0.754
0.730
0.670
0.628
0.609
0.587
0.000

5ob

D:\LLT\4BUNA\BU+Na\JIBENP1\

DFILE COMNT
 DATIM Sat Dec 23 22:30:25 2006
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 160
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 24.9 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 26

5oc

544-0000

D:\LLT\FE1ET\Cl.als
544-C6D6
Fri Nov 10 12:23:09 2006

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFREQ
OBSSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

75.45 MHz
124.00 KHz
1840.0 Hz
32768
20408.1 Hz
800
1.606 sec
1.394 sec
5.0 us
1H
23.0 C
CDCL3
0.00 ppm
0.62 Hz
27

0.000
15.857
15.882
16.096
16.310
22.294
22.533
22.722
25.269

76.581
77.010
77.430

123.328
124.597
125.331
125.916
127.754
128.026
129.806
130.144
131.075
132.863
136.069
136.663
138.690
140.734

21a

D:\LT\FE1ET\H1.als
544-C6D6
Fri Nov 10 10:26:47 2006

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBFRO
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

1H
NON
300.40 MHz
130.00 KHz
1150.0 Hz
32768
6013.2 Hz
24
5.449 sec
1.551 sec
5.8 us
1H
22.1 C
CDCL3
0.00 ppm
0.09 Hz
14

21a

LJH412HTMS

D:\LLT\FeiPr\C1.als
COMNT LJH412HTMS
DATIM Thu Nov 02 21:28:25 2006
OBNUC 13C
EXMOD BCM

75.45 MHz
124.00 KHz
1840.0 Hz
32768
20408.1 Hz
1176
1.606 sec
1.394 sec
5.0 us
1H
23.0 c
CDCL3
77.00 ppm
0.62 Hz
26

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFRO
OBSET
OBFIN
POINT
FREQU
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

14.462
14.899
15.089
15.138
24.666
24.888
25.004
25.292
25.292
31.803
32.512
35.058

76.571
77.000
77.420

123.433
124.530
125.279
125.758
127.694
127.958
129.821
130.233
131.098
132.829
134.815
135.483
137.749
139.686

21b

D:\LLT\FeiPr\FEIPRH.als
 Fri Apr 07 16:15:45 2006
 1H
 NON

300.40 MHz
 130.00 KHz
 1150.0 Hz
 32768
 6013.2 Hz
 8
 5.449 sec
 1.551 sec
 5.8 us
 1H
 21.4 c
 CDCl3
 0.00 ppm
 0.09 Hz
 12

21b

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRO
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

COMNT
 DATIM Fri Nov 17 10:33:05 2006
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75.45 MHz
 OBSET 124.00 KHz
 OBFIN 1840.0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 720
 ACQTM 1.606 sec
 PD 1.394 sec
 PW1 5.0 us
 IRNUC 1H
 CTEMP 25.6 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.62 Hz
 RGAIN 26

21c

D:\LLT\4BUNA\BU+Na\FEI\H2.a

COMNT
DATIM Thu Nov 16 14:58:00 2006
OBNUC 1H
EXMOD NON
OBFRO 300.40 MHz
OBSET 130.00 KHz
OBFIN 1150.0 Hz
POINT 32768
FREQU 6013.2 Hz
SCANS 24
ACQTM 5.449 sec
PD 1.551 sec
PW1 5.8 us
IRNUC 1H
CTEMP 25.5 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.09 Hz
RGAIN 13

21c

D:\LLT\PRBH\FEI\C.als
 Sat Nov 11 15:01:15 2006
 13C
 BCM

75.45 MHz
 124.00 KHz
 1840.0 Hz
 32768
 20408.1 Hz
 392
 1.606 sec
 1.394 sec
 5.0 us
 1H
 22.7 c
 CDCL3
 0.00 ppm
 0.62 Hz
 25

DFILE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSET
 OBFIN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SLVNT
 EXREF
 BF
 RGAIN

0.000
 14.299
 14.835
 22.656
 22.994
 23.225
 23.761
 27.667
 27.700
 30.750
 34.714

76.573
 77.002
 77.422

123.171
 124.556
 125.339
 125.776
 127.787
 127.918
 129.344
 129.575
 131.124
 132.880
 134.174
 134.495
 135.377
 136.407

D:\LLT\PRBH\FEI\HS.als
 COMNT
 DATIM Sat Nov 11 14:39:24 2006
 OBNUC 1H
 EXMOD NON

OBFRQ 300.40 MHz
 OBSET 130.00 KHz
 OBFIN 1150.0 Hz
 POINT 32768
 FREQU 6013.2 Hz
 SCANS 16
 ACQTM 5.449 sec
 PD 1.551 sec
 PW1 5.8 us
 IRNUC 1H
 CTEMP 21.9 C
 SLVNT CDCl3
 EXREF 0.00 ppm
 BF 0.09 Hz
 RGAIN 13

21d

3.167
 3.035
 3.009
 2.980
 2.956
 2.075
 2.047
 2.020
 1.992
 1.858
 1.694
 1.669
 1.641
 1.616
 1.201
 1.177
 1.153
 1.132
 1.107
 1.083
 0.000

8.472
 8.440
 7.895
 7.865
 7.827
 7.808
 7.796
 7.594
 7.564
 7.514
 7.503
 7.493
 7.484