Supporting Information

Regiodivergent and Stereoselective Hydrosilylation of 1,3-Disubstituted Allenes**

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Supporting Information

All reagents were used as received unless otherwise noted. Solvents were purified under nitrogen using a solvent purification system (Innovative Technology, Inc. Model # SPS-400-3 and PS-400-3). Tris(dibenzylideneacetone)-dipalladium (Pd2dba3) was purchased from Sigma Aldrich and was stored in a glovebox and on the benchtop. All reactions were conducted under an atmosphere of nitrogen with magnetic stirring in flame-dried or oven-dried (120 °C) glassware. All acyclic allenes were made according to literature precedent from the terminal alkyne and aldehyde.1 Cyclic allenes were made according to literature precedent from the respective ketone.2 Ligand 6 (IPr*OMe) was purchased from Strem and was stored in a glovebox. NHC Ligands 4 (IMes·HCl) and 5 (IPr·HCl) were purchased from Sigma-Aldrich and stored and weighed in a glovebox. Ligand DP-IPr was prepared according to literature procedure.3 Dimethylphenylsilane and dimethylbenzylsilane (purchased from Sigma-Aldrich) were used as received. A solution of tetra-n-butylammonium (TBAF, 1.0 M in THF) was purchased from Sigma-Aldrich and used as received. Cyclohexyllallene, propylsilane, and d-triethylsilane (97% d-purity) were purchased from Sigma-Aldrich and were used as received. 4'-Iodoacetophenone and N-iodosuccinimide were purchased from Sigma-Aldrich and used as received. 1H and 13C NMR spectra were obtained in CDCl3 at rt (25 °C), unless otherwise noted, on a Varian Mercury 400 MHz instrument, Varian Unity 500 MHz instrument, or Varian Unity 700 MHz instrument. Chemical shifts of 1H NMR spectra were recorded in parts per million (ppm) on the δ scale from an internal standard of residual chloroform (7.24 ppm). Chemical shifts of 13C NMR spectra were recorded in ppm from the central peak of CDCl3 (77.0 ppm) on the δ scale. High-resolution mass spectra (HRMS) were obtained on a VG-70-250-s spectrometer manufactured by Micromass Corp. (Manchester UK) at the University of Michigan Mass Spectrometry Laboratory. Regioisomeric ratios were determined on crude reaction mixtures using NMR or GC. GC analyses were carried out on an HP 6980 Series GC System with HP-5MS column (30 m x 0.252 mm x 0.25 µm). When noted, a Biotage purification system (model # SP1) was utilized with SNAP (10 g) silica columns. Reported regioselectivities were determined by GCMS analysis and confirmed by 1H NMR analysis by comparing the ratios of detectable alkenyl protons of the major and minor regioisomers in the crude reaction mixture. In cases where >98:2 regio- or stereoselectivity is reported, minor isomers were not detected by either GCMS or NMR based methods.

General Procedure I for the Ni(COD)2/IPr*OMe – promoted hydrosilylation of 1,3-disubstituted allenes:

THF (1.0 mL) was added to a solid mixture of IPr*OMe 6 (0.05 mmol) and Ni(COD)2 (0.05 mmol) at rt. After stirring for 10 min at rt the silane (0.5 mmol) was added. The reaction mixture was stirred for 10 min at rt followed by the addition of allene (0.5 mmol) in THF (3.0 mL) over 1 h by syringe pump. The reaction mixture was stirred at rt until TLC analysis indicated disappearance of the allene. The reaction mixture was filtered through silica gel eluting with 50% v/v EtOAc/hexanes. The solvent was removed in vacuo, and the crude residue was purified via flash column chromatography on silica gel to afford the desired product.

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The alke ne configuration of representative alkenylsilanes was determined by 1D NOE, where alkenyl protons for major isomers were determined to have the following observable correlation (confirming Z stereochemistry):

![Diagram of alkenylsilane configuration]

**General Procedure II for the Pd$_2$dba$_3$/IPr-HCl – promoted hydrosilylation of 1,3-disubstituted allenes**

THF (1.0 mL) was added to a solid mixture of IPr·HCl 5 (0.025 mmol), t-BuOK (0.025 mmol), and Pd$_2$dba$_3$ (0.0125 mmol) at rt. After stirring for 10 min at rt, the reaction mixture turned dark red and the silane (0.5 mmol) was added. The reaction mixture was stirred for 10 min at rt followed by addition of the allene (0.5 mmol) neat by syringe. The reaction mixture was stirred at rt for 2 h. The reaction mixture was filtered through silica gel eluting with 50% v/v EtOAc/hexanes. The solvent was removed *in vacuo*, and the crude residue was purified via flash column chromatography on silica gel to afford the desired product. Product stereochemistry is confirmed via determination of $^3$J(H-H) coupling across the alkene.

**General procedure III for the Ni(COD)$_2$/DP-IPr-promoted hydrosilylation of monosubstituted allenes affording alkenylsilane authentic standards:**

THF (1.0 mL) was added to a solid mixture of DP-IPr·HBF$_4$ (0.03 mmol), t-BuOK (0.03 mmol), and Ni(COD)$_2$ (0.03 mmol) at rt. After stirring for 10 min at rt, the silane (0.3 mmol) was added. The reaction mixture was stirred for 10 min at rt followed by the addition of allene (0.3 mmol) in THF (4.0 mL) over 2 h by syringe pump. The reaction mixture was stirred at rt until TLC analysis indicated disappearance of the allene. The reaction mixture was filtered through silica gel eluting with 50% v/v EtOAc/hexanes. The solvent was removed *in vacuo*, and the crude residue was purified via flash column chromatography on silica gel to afford the desired product.

**General procedure IV for the Pd$_2$dba$_3$/IMes –promoted hydrosilylation of monosubstituted allenes affording allylsilane authentic standards:**

THF (1.0 mL) was added to a solid mixture of IMes·HCl 4 (0.03 mmol), KO-t-Bu (0.03 mmol), and Pd$_2$dba$_3$ (0.015 mmol) at rt. After stirring for 10 min at rt, the reaction mixture turned bright red and triethylsilane (0.3 mmol) was added. The reaction mixture was stirred for 10 min at rt followed by dilution with THF (4.0 mL) and addition of the allene (0.3 mmol) neat by syringe. The reaction mixture was stirred at rt for 2 h. The
reaction mixture was filtered through silica gel eluting with 50% v/v EtOAc/hexanes. The solvent was removed in vacuo, and the crude residue was purified via flash column chromatography on silica gel to afford the desired product.

**General procedure V for the Ni(COD)$_2$/DP-IPr-promoted hydrosilylation crossover experiment:**

THF (1.0 mL) was added to a solid mixture of DP-IPr·HBF$_4$ (0.03 mmol), KO-t-Bu (0.03 mmol) and Ni(COD)$_2$ (0.03 mmol) at rt. After stirring for 10 min at rt, the Et$_3$SiD (0.3 mmol) and n-Pr$_3$SiH (0.3 mmol) and cyclohexylallene (0.3 mmol) were added in THF (4.0 mL) over 2 h by syringe pump. The reaction mixture was filtered through silica gel eluting with 50% v/v EtOAc/hexanes. The solvent was removed in vacuo, and the crude residue was directly analyzed by GCMS and GCFID.

**General procedure VI for the Pd$_2$dba$_3$/IMes –promoted hydrosilylation crossover experiment:**

THF (1.0 mL) was added to a solid mixture of IMes·HCl 4 (0.03 mmol), and Pd$_2$dba$_3$ (0.015 mmol) at rt. Then n-BuLi (0.03 mmol) was slowly added to the stirring solution. After stirring for 10 min at rt, the Et$_3$SiD (0.3 mmol) and n-Pr$_3$SiH (0.3 mmol) addition of cyclohexylallene (0.3 mmol) in THF (4.0 mL) over 2 h by syringe pump. The reaction mixture was filtered through silica gel eluting with 50% v/v EtOAc/hexanes. The solvent was removed in vacuo, and the crude residue was directly analyzed by GCMS and GCFID.

**(E)-Benzylidimethyl(pentadec-8-en-7-yl)silane (2a) ( Table 2, Entry 1)**

General procedure II was followed with Pd$_2$dba$_3$ (11.4 mg, 0.0125 mmol), IPr·HCl salt 5 (10.6 mg, 0.025 mmol), t-BuOK (2.8 mg, 0.025 mmol), benzylidimethylsilane (79 µL, 0.5 mmol), and pentadeca-1,7-diene (104 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (135 mg, 75% yield) (in >98:2 regiosel, >98:2 d.r.). $^1$H NMR (400 MHz, CDCl$_3$): 7.19 (t, $J = 7.6$ Hz, 2H), 7.04 (t, $J = 6.8$ Hz, 1H), 6.98 (t, $J = 7.6$ Hz, 2H), 5.22 (dt, $J = 15.5$, 6.8 Hz, 1H), 5.14 (dd, $J = 15.5$, 8.8 Hz, 1H), 2.07 (s, 2H), 1.98 (q, $J = 7.0$ Hz, 2H), 1.36 – 1.48 (m, 3H), 1.14 – 1.34 (m, 17H), 0.87 (t, $J = 6.6$ Hz, 6H), -0.10 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$): δ 140.5, 131.0, 129.0, 128.2, 128.1, 123.8, 32.9, 31.9, 31.8, 31.7, 30.0, 29.2, 29.2, 28.9, 28.7, 23.9, 22.7, 14.1, -5.10, -5.15; IR (thin film): ν 2954.8, 2924.4, 2855.0, 1703.5, 1600.0, 1493, 1452, 1057, 827.8, 697.7 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M]$^+$ calc for C$_{24}$H$_{42}$Si, 358.3056; found, 358.3068.

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**(E)-Dimethyl(pentadec-8-en-7-yl)(phenyl)silane (2b) (Table 2, Entry 2)**

![Diagram of (E)-Dimethyl(pentadec-8-en-7-yl)(phenyl)silane](image)

General procedure II was followed with Pd$_2$dba$_3$ (11.4 mg, 0.0125 mmol), IPr·HCl salt 5 (10.6 mg, 0.025 mmol), t-BuOK (2.8 mg, 0.025 mmol), dimethylphenylsilane (77 µL, 0.5 mmol), and pentadeca-1,7-diene (104 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (151 mg, 84% yield) (in >98:2 regiosel., >98:2 d.r.). $^1$H NMR (500 MHz, CDCl$_3$): δ 7.46 (m, 2H), 7.32 (m, 3H), 5.17 (dt, $J = 15.9, 6.2$ Hz, 1H), 5.11 (dd, $J = 15.9, 6.2$ Hz, 1H), 1.95 (q, $J = 6.5$ Hz, 2H), 1.60 (t, $J = 11.7$ Hz, 1H), 1.10 – 1.39 (m, 21H), 0.87 (t, $J = 6.8$ Hz, 3H), 0.83 (t, $J = 6.8$ Hz, 3H), 0.22 (s, 3H), 0.21 (s, 3H); $^{13}$C NMR (125 MHz, CDCl$_3$): δ 138.4, 134.1, 130.9, 129.0, 128.7, 127.5, 32.9, 32.4, 31.83, 31.80, 30.0, 29.2, 29.0, 28.9, 28.8, 22.70, 22.68, 14.12, 14.10, -4.25, -5.10; IR (thin film): ν 2954.0, 2925.1, 2857, 1709.7, 1465.4, 1427.5, 1249.4, 1117.7, 829.3, 698.2 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M]$^+$ calc for C$_{23}$H$_{40}$Si, 344.2899; found, 344.2907.

**(E)-(1,3-Dicyclohexylallyl)dimethyl(phenyl)silane. (2c) (Table 2, Entry 3)**

![Diagram of (E)-(1,3-Dicyclohexylallyl)dimethyl(phenyl)silane](image)

General procedure II was followed with Pd$_2$dba$_3$ (13.7 mg, 0.015 mmol), IPr·HCl salt 5 (12.8 mg, 0.03 mmol), t-BuOK (3.6 mg, 0.03 mmol), dimethylphenylsilane (46 µL, 0.3 mmol), and 1,3-dicyclohexylpropa-1,2-diene (61 mg, 0.3 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (98.7 mg, 58% yield) (in >98:2 regiosel., >98:2 d.r.). $^1$H NMR (400 MHz, CDCl$_3$): δ 7.54 – 7.46 (m, 2H), 7.37 – 7.29 (m, 3H), 5.31 – 5.21 (m, 1H), 5.13 (dd, $J = 15.2, 6.7$ Hz, 1H), 1.93 (m, $J = 10.6, 7.0$ Hz, 1H), 1.76 – 1.56 (m, 11H), 1.50 – 1.38 (m, 2H), 1.33 – 0.90 (m, 11H), 0.30 (d, $J = 2.0$ Hz, 3H), 0.27 (d, $J = 2.0$ Hz, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$): δ 139.43, 136.25, 133.96, 128.50, 127.43, 125.88, 41.11, 40.14, 38.69, 34.08, 33.64, 33.48, 31.48, 26.77, 26.74, 26.32, 26.26, 26.14, -2.64, -3.37; IR (thin film): ν 2917.9, 2847.5, 1446.9, 1426.0, 1245.3, 1109.7, 997.9, 966.1, 891.9, 851.1, 811.4, 767.3, 732.3, 697.5, 641.7 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M]$^+$ calc for C$_{23}$H$_{36}$Si, 340.2586; found, 340.2589.

**(E)-8-(dimethyl(phenyl)silyl)-2,2,3,3,11,11,12,12-octamethyl-4,10-dioxa-3,11-disilatridec-6-ene (2d) (Table 2, Entry 4)**

![Diagram of (E)-8-(dimethyl(phenyl)silyl)-2,2,3,3,11,11,12,12-octamethyl-4,10-dioxa-3,11-disilatridec-6-ene](image)

General procedure II was followed with Pd$_2$dba$_3$ (4.8 mg, 0.0052 mmol), IPr·HCl salt 5 (4.5 mg, 0.0105 mmol), t-BuOK (1.2 mg, 0.0105 mmol), dimethylphenylsilane (32 µL, 0.21 mmol), and 2,2,3,3,11,11,12,12-octamethyl-4,10-dioxa-3,11-disilatrideca-6,7-diene
(70 mg, 0.21 mmol). The crude residue was purified by flash chromatography (10% EtOAc:hexanes) affording a clear oil (60 mg, 64% yield). $^1$H NMR (500 MHz, CDCl$_3$): δ 7.52 (m, 2H), 7.35 (m, 3H), 5.63 (dd, $J$ = 15.0, 9.0 Hz, 1H), 5.40 (dt, $J$ = 15.0, 6.1 Hz, 1H), 4.12 (d, $J$ = 5.8 Hz, 2H), 2.00 (m, 1H), 0.912 (s, 9H), 0.872 (s, 9H), 0.322 (s, 3H), 0.309 (s, 3H), 0.063 (s, 6H), -0.0047 (s, 3H), -0.014 (s, 3H); $^{13}$C NMR (125 MHz, CDCl$_3$): δ 134.0, 133.0, 130.0, 128.8, 128.4, 127.5, 64.2, 63.9, 36.6, 26.0, 18.3, -3.7, -4.0, -5.11, -5.14, -5.40, -5.43; IR (thin film): ν 2953.5, 2926.2, 1704.1, 1462.4, 1250.7, 1089.8, 831.8 cm$^{-1}$; HRMS (ESI$^+$) (m/z): [M+Na]$^+$ calc for C$_{25}$H$_{48}$O$_2$Si$_3$, 487.2854; found, 487.2851.

($Z$)-Benzylimethyl(tetradec-7-en-7-yl)silane (3a) (Table 2, Entry 5)

General procedure I was followed with Ni(COD)$_2$ (13.8 mg, 0.05 mmol), IPr*OMe 6 (47.2 mg, 0.05 mmol), benzimidethylsilane (79 µL, 0.5 mmol), and pentadeca-1,7-diene (104 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (159 mg, 89% yield) (in >98:2 regiosel., >98:2 d.r.). $^1$H NMR (400 MHz, CDCl$_3$): δ 7.19 (t, $J$ = 7.8 Hz, 2H), 7.05 (m, 1H), 7.00 (m, 2H), 5.97 (t, $J$ = 7.2 Hz, 1H), 2.20 (s, 2H), 2.01 – 2.08 (m, 2H), 1.93 – 1.99 (m, 3H), 1.15 – 1.36 (m, 18H), 0.88 (m, 6H), 0.080 (s, 6H); $^{13}$C NMR (100 MHz, CDCl$_3$): δ 144.0, 140.3, 137.4, 128.32, 128.27, 128.0, 123.9, 38.4, 32.3, 31.9, 31.8, 30.0, 29.4, 29.2, 29.1, 28.5, 26.7, 22.7, 22.6, 14.1, -1.7; IR (thin film): ν 2953.5, 2923.7, 2855.0, 1716.2, 1600.8, 1493.2, 1452.2, 1377.5, 1248.7, 1056.5, 826.3 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M$^+$] calc for C$_{24}$H$_{37}$Si, 358.3056; found, 358.3066.

($Z$)-Dimethyl(phenyl)(tetradec-7-en-7-yl)silane (3b) (Table 2, Entry 6)

General procedure I was followed with Ni(COD)$_2$ (13.8 mg, 0.05 mmol), IPr*OMe 6 (47.2 mg, 0.05 mmol), dimethylphenylsilane (77 µL, 0.5 mmol), and pentadeca-1,7-diene (104 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (147 mg, 85% yield) (in >98:2 regiosel., >98:2 d.r.). $^1$H NMR (400 MHz, CDCl$_3$): δ 7.52 (m, 2H), 7.33 (m, 3H), 6.04 (t, $J$ = 7.2 Hz, 2H), 1.08-1.36 (m, 18H), 0.87 (t, $J$ = 8.0 Hz, 2H), 0.83 (t, $J$ = 8.0 Hz, 3H), 0.369 (s, 6H); $^{13}$C NMR (100 MHz, CDCl$_3$): δ 144.8, 140.2, 136.9, 133.8, 128.6, 127.6, 38.6, 32.5, 31.9, 31.7, 31.0, 29.8, 29.4, 29.2, 28.9, 22.7, 22.6, 14.12, 14.06, -0.83; IR (thin film): 2954.0, 2923.6, 2855.0, 1708.5, 1610.1, 1465.0, 1427.5, 1248.5, 1110.7, 831.2 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M-CH$_3$]+ calc for C$_{22}$H$_{37}$Si, 329.2665; found, 329.2669.
(Z)-(1,3-Dicyclohexylprop-1-en-2-yl)dimethyl(phenyl)silane (3c) (Table 2, Entry 7)

General procedure I was followed with Ni(COD)$_2$ (13.8 mg, 0.05 mmol), IPr*OMe 6 (47.2 mg, 0.05 mmol), dimethylphenylsilane (77 µL, 0.5 mmol), and 1,3-dicyclohexylpropa-1,2-diene (102 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (110.7 mg, 65%) (in >98:2 regiosel., 96:4 d.r.). $^1$H NMR (500 MHz, CDCl$_3$): δ 7.50 - 7.57 (m, 2H), 7.30 – 7.36 (m, 3H), 5.75 (d, $J = 10.4$ Hz, 1H), 5.70 (d, $J = 10.4$ Hz, 0.06H, minor E-isomer), 1.99 - 2.05 (m, 1H), 1.97 (dd, $J = 6.8, 0.6$ Hz, 2H), 1.63 – 1.71 (m, 5H), 1.50 – 1.60 (m, 4H), 1.41 – 1.36 (m, 2H), 1.11 – 1.22 (m, 4H), 0.91 – 1.01 (m, 4H), 0.74 – 0.84 (m, 2H), 0.38 (s, 6H); $^{13}$C NMR (100 MHz, CDCl$_3$): δ 151.72, 140.51, 133.70, 132.89, 128.48, 127.50, 46.62, 41.24, 37.65, 33.11, 32.95, 26.77, 26.49, 25.92, 25.65, -0.81; IR (thin film): ν 2918.4, 2846.8, 1609.5, 1446.8, 1426.3, 1245.8, 1108.6, 903.4, 830.3, 768.4, 727.2, 698.0, 675.0 cm$^{-1}$; HRMS (ESI$^+$) (m/z): [M+Na$^+$] calc for C$_{23}$H$_{36}$Si, 340.2586; found, 340.2585.

(Z)-7-(benzyl(dimethylsilyl)-2,2,3,3,11,11,12,12-octamethyl-4,10-dioxa-3,11-disilatrideca-6-ene (3d) (Table 2, Entry 8)

General procedure I was followed with Ni(COD)$_2$ (2.9 mg, 0.00105 mmol), IPr*OMe 6 (9.8 mg, 0.00105 mmol), benzyldimethylsilane (33 µL, 0.21 mmol), and 2,2,3,3,11,11,12,12-octamethyl-4,10-dioxa-3,11-disilatrideca-6,7-diene (70 mg, 0.21 mmol). The crude residue was purified by flash column chromatography (10% EtOAc: hexanes) affording a clear oil (75 mg, 75% yield) (in >98:2 regiosel., 85:15 d.r.). $^1$H NMR (500 MHz): δ 7.18 (t, $J = 9.0$ Hz, 2H), 7.05 (t, $J = 9.0$ Hz, 1H), 6.97 (d, $J = 9.0$ Hz, 2H), 6.13 (t, $J = 7.4$, 1 H, major isomer), 5.90 (t, $J = 7.4$ Hz, 0.1H, minor E-isomer), 4.04 (d, $J = 9.4$ Hz, 2H), 3.42 (t, $J = 8.5$ Hz, 2H), 2.23 (t, $J = 7.4$ Hz, 2H), 2.16 (s, 2H), 0.88 (s, 10H), 0.86 (s, 10H), 0.098 (s, 6H), 0.035 (s, 6H), 0.0093 (s, 6H); $^{13}$C NMR (125 MHz, CDCl$_3$): δ 145.4, 143.9 (minor), 139.6, 139.4 (minor), 135.3, 128.3, 128.1, 124.2, 124.0 (minor), 63.9, 62.7, 40.9, 26.5, 26.02, 26.00, 18.4, -0.09, -1.9, -5.1, -5.2; IR (thin film): ν 2953.5, 2926.2, 2856.6, 1704.1, 1601.0, 1462.4, 1250.7, 1089.8, 831.8, 675.0 cm$^{-1}$; HRMS (ESI$^+$) (m/z): [M$^+$] calc for C$_{26}$H$_{50}$S$_2$O$_2$, 501.3011; found, 501.3009.

(Z)-Benzyl(cyclopentadec-1-en-1-yl)dimethylsilane (8) (Scheme 1)
General procedure I was followed with Ni(COD)$_2$ (6.6 mg, 0.024 mmol), IPr*OMe 6 (22.7 mg, 0.024 mmol), benzylidimethylsilane (37.9 µL, 0.24 mmol), and cyclopentadeca-1,2-diene (50 mg, 0.24 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (61 mg, 71% yield) (in >98:2 regiosel., >98:2 d.r.). $^1$H NMR (500 MHz, CDCl$_3$): $\delta$ 7.18 (t, $J = 9.9$ Hz, 2H), 7.04 (t, $J = 9.9$ Hz, 1H), 7.00 (d, $J = 9.9$ Hz, 2H), 5.94 (t, $J = 8.6$ Hz, 1H), 2.21 (s, 2H), 2.17 (m, 2H), 2.07 (m, 2H), 1.39 – 1.47 (m, 2H), 1.16 – 1.38 (m, 20H), 0.069 (s, 6H); $^{13}$C NMR (175 MHz, CDCl$_3$): 145.2, 140.3, 137.3, 128.3, 128.0, 123.9, 37.6, 31.2, 29.4, 20.7, 27.7, 27.6, 27.25, 27.20, 27.1, 26.9, 26.8, 26.7, 26.5, 26.0, -1.7; IR (thin film): $\nu$ 2925.9, 2855.4, 1493.2, 1451.4, 1248.6, 1151.4, 828.7 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M]$^+$ calc for C$_{24}$H$_{40}$Si, 356.2899; found, 356.2901.

$^1$H NMR (700 MHz, CDCl$_3$): $\delta$ 7.19 (t, $J = 7.5$ Hz, 2H), 7.05 (t, $J = 7.5$ Hz, 1H), 6.98 (d, $J = 7.5$, 2H), 5.15 (m, 2H), 2.15 (m, 1H), 2.07 (s, 2H), 1.96 (m, 1H), 1.09 – 1.5 (m, 26H), -0.103 (s, 3H), -0.118 (s, 3H). $^1$H NMR (700 MHz, C$_6$D$_6$): 7.21 (m, 2H (overlapping signals)), 7.03-7.10 (m, 3H), 5.20 (dd, $J = 15.8$, 10.2 Hz, 1H), 5.15 (ddd, J = 15.8, 10.2, 4.0 Hz, 1H), 2.21 (m, 1H), 2.10 (s, 2H), 2.04 (m, 1H), 1.25 – 1.52 (m, 26H), -0.0039 (s, 6H); $^{13}$C NMR (175 MHz, CDCl$_3$): $\delta$ 140.5, 131.7, 129.1, 128.2, 128.1, 123.8, 31.9, 31.5, 29.0, 28.7, 28.2, 27.2, 27.1, 26.9, 26.8, 26.7, 25.4, 23.8, -5.2, -5.3; IR (thin film): $\nu$ 2926.0, 2856.4, 1599.8, 1451.8, 1257.8, 1152.4, 826.8 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M]$^+$ calc for C$_{24}$H$_{40}$Si, 356.2899; found, 356.2902.

$^{(E)}$-Benzyl(cyclopentadec-2-en-1-yl)dimethylsilane (9) (Scheme 1)

![Diagram](image)

General procedure II was followed with Pd$_2$dba$_3$ (5.5 mg, 0.006 mmol), IPr·HCl salt 5 (5.1 mg, 0.012 mmol), t-BuOK (1.3 mg, 0.012 mmol), benzylidimethylsilane (37.9 µL, 0.24 mmol), and cyclopentadeca-1,2-diene (50 mg, 0.24 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (57 mg, 66% yield) (in >98:2 regiosel., >98:2 d.r.). $^1$H NMR (500 MHz, CDCl$_3$); $\delta$ 7.18 (t, $J = 9.9$ Hz, 2H), 7.04 (t, $J = 9.9$ Hz, 1H), 7.00 (d, $J = 9.9$ Hz, 2H), 5.94 (t, $J = 8.6$ Hz, 1H), 2.21 (s, 2H), 2.17 (m, 2H), 2.07 (m, 2H), 1.39 – 1.47 (m, 2H), 1.16 – 1.38 (m, 20H), 0.069 (s, 6H); $^{13}$C NMR (175 MHz, CDCl$_3$): 145.2, 140.3, 137.3, 128.3, 128.0, 123.9, 37.6, 31.2, 29.4, 20.7, 27.7, 27.6, 27.25, 27.20, 27.1, 26.9, 26.8, 26.7, 26.5, 26.0, -1.7; IR (thin film): $\nu$ 2925.9, 2855.4, 1493.2, 1451.4, 1248.6, 1151.4, 828.7 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M]$^+$ calc for C$_{24}$H$_{40}$Si, 356.2899; found, 356.2902.

$^{(E)}$-(1-Cyclohexynon-2-en-1-yl)dimethyl(phenyl)silane and $^{(E)}$-(1-cyclohexynon-1-en-3-yl)dimethyl(phenyl)silane (10a & 11a) (Scheme 2)

![Diagram](image)

General procedure II was followed with Pd$_2$dba$_3$ (22.9 mg, 0.025 mmol), IPr·HCl salt 5 (21.3 mg, 0.05 mmol), t-BuOK (5.6 mg, 0.05 mmol), dimethylphenylsilane (77 µL, 0.5 mmol), and nona-1,2-dien-1-ylcyclohexane (103.2 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (137 mg, 80%
yield) (in 60:40 regiosel. 10a & 11a). \(^1\)H NMR (500 MHz, CDCl\(_3\)): \(\delta\) 7.53 (m, 4 H), 7.37 (m, 6H), 5.33 (dd, \(J = 15.7, 10.8\) Hz, 1H), 5.21 (dt, \(J = 16, 11\) Hz, 1H), 5.19 (dd, \(J = 16, 11\) Hz, 0.7 Hz), 5.14 (dd, \(J = 16, 9.2\) Hz, 0.7Hz), 2.02 (m, 2H), 1.94 (m, 1H), 1.57 – 1.76 (m, 11H), 1.10 – 1.38 (m, 26H), 0.936 (t, \(J = 10\) Hz, 3H), 0.90 (t, \(J = 10\) Hz, 3H), 0.33 (s, 3H), 0.30 (s, 3H), 0.29 (2H), 0.278 (s, 2H); \(^{13}\)C NMR (125 MHz, CDCl\(_3\)): \(\delta\) 139.5, 138.4, 135.1, 134.2, 134.0, 130.3, 128.7, 128.6, 128.55, 128.2, 127.5, 41.1, 40.3, 38.8, 34.2, 33.7, 33.6, 32.9, 32.4, 31.9, 31.8, 31.5, 30.0, 29.10, 29.06, 28.9, 28.8, 26.82, 26.80, 26.4, 26.2, 22.74, 22.71, 14.2, 14.1, -2.6, -3.3, -4.3, -5.1; IR (thin film); \(\nu\) 2925.4, 2852.1, 1725.7, 1448.5, 1427.5, 1249.4, 1117.9, 1061.8, 971.7, 828.9, 698.7, 418.6 cm\(^{-1}\); HRMS (EI\(^+\)) (m/z): [M]\(^+\) calc for \(C_{33}H_{38}Si\), 342.2743; found, 342.2749.

(Z)-Benzylidimethyl(2-methylundec-5-en-5-yl)silane and (Z)-benzylidimethyl(2-methylundec-4-en-5-yl)silane (12a & 13a) (Table 3, Entry 1)

General procedure I was followed with Ni(COD)\(_2\) (13.8 mg, 0.05 mmol), IPr*OMe 6 (47.2 mg, 0.05 mmol), benzylidimethylsilane (79 \(\mu\)L, 0.5 mmol), and 2-methylundecadiene (90.2 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (114 mg, 69% yield) (in 60:40 regiosel. of 12a:13a, 91:9 allyl:vinyl regiosel). \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.21 (t, \(J = 8.0\) Hz, 4H), 7.07 (t, \(J = 8.0\) Hz, 2H), 7.01 (d, \(J = 7.1\) Hz, 4H), 6.02 (t, \(J = 8.0\) Hz, 1H), 5.99 (t, \(J = 8.0\) Hz, 1H), 5.09 (m, 0.19H (minor allyl isomer)), 2.22 (s, 4H), 2.13 (m, 1H), 1.94 – 2.09 (m, 9H), 1.61 (m, 1H), 1.48 (m, 2H), 1.20 – 1.39 (m, 25H), 1.05 – 1.12 (m, 2H), 0.88 – 0.94 (m, 15H), 0.87 (s, 4H), 0.85 (s, 3H), 0.10 (s, 4H), 0.097 (s, 4H), 0.07 (s, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\), major signals from the 3 isomers are listed): \(\delta\) 146.2, 143.9, 142.9 140.4, 140.29, 140.27, 139.7, 134.9, 128.3, 128.0, 125.1, 123.9, 123.8, 45.3, 41.1, 40.5, 38.6, 37.2, 36.3, 32.3, 31.9, 31.8, 31.02, 30.1, 29.6, 29.4, 29.2, 29.1, 29.0, 28.3, 27.9, 26.8, 26.7, 26.5, 22.64, 22.60, 22.46, 14.1, -1.64, -1.7, -1.9; IR (thin film): \(\nu\) 2925.2, 2924.8, 1600.8, 1493.1, 1465.3, 1248.1, 1205.2, 1153.5, 1055.9 826.1 cm\(^{-1}\); HRMS (EI\(^+\)) (m/z): [M]\(^+\) calc for \(C_{33}H_{38}Si\), 330.2743; found, 330.2739.

(Z)-Benzylidimethyl(2-methylundec-4-en-4-yl)silane (12b) (Table 3, Entry 2).

General procedure I was followed with Ni(COD)\(_2\) (13.8 mg, 0.05 mmol), IPr*OMe 6 (47.2 mg, 0.05 mmol), benzylidimethylsilane (79 \(\mu\)L, 0.5 mmol), and 2-methylundecadiene (83.2 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (101.3 mg, 64%) (in 98:2 regiosel., \(>98:2\) d.r.). \(^1\)H NMR (500 MHz, CDCl\(_3\)): \(\delta\) 7.27 – 7.22 (m, 2H), 7.11 (t, \(J = 7.4\) Hz, 1H), 7.08 – 7.05 (m, 2H), 5.99 (t, \(J = 7.5\) Hz, 1H), 2.27 (s, 2H), 2.15 (q, \(J = 7.3\) Hz, 2H), 1.94 (d, \(J = 6.9\) Hz, 2H), 1.55 – 1.45 (m, 1H), 1.43 – 1.30 (m, 8H), 0.95 (t, \(J = 7.0\) Hz, 3H), 0.88 (d, \(J = 6.6\) Hz, 6H), 0.14 (s, \(J = 12.2\) Hz, 6H); \(^{13}\)C NMR (125 MHz, CDCl\(_3\)): \(\delta\) 145.62, 140.29, S8
136.17, 128.29, 128.07, 123.96, 48.37, 32.48, 31.88, 30.17, 28.18, 26.77, 22.69, 22.34, 14.12, -1.70. IR (cm⁻¹): ν 2951.5, 2921.7, 2851.0, 1601.2, 1492.6, 1461.3, 1451.2, 1363.5, 1247.3, 1204.7, 1153.3, 1055.9, 901.0, 825.2, 789.5, 759.3, 696.5 cm⁻¹; HRMS (EI⁺) (m/z): [M⁺] calc for C₂₁H₃₆Si, 316.2586; found, 316.2590.

(Z)-(1-Cyclohexylnon-2-en-2-yl)dimethyl(phenyl)silane (12c) (Table 3, Entry 3)

General procedure I was followed with Ni(COD)₂ (13.8 mg, 0.05 mmol), IPr*OMe 6 (47.2 mg, 0.05 mmol), dimethylphenylsilane (77 µL, 0.5 mmol), and nona-1,2-dien-1-ylcyclohexane (103 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (87.3 mg, 51%) (in >98:2 regiosel, >98:2 d.r.). ¹H NMR (500 MHz, CDCl₃): δ 7.57 – 7.52 (m, 2H), 7.37 – 7.32 (m, 3H), 6.00 (t, J = 7.5 Hz, 1H), 2.01 (d, J = 6.8 Hz, 2H), 1.96 (q, J = 7.4 Hz, 2H), 1.74 – 1.67 (m, 4H), 1.67 – 1.62 (m, 1H), 1.28 – 1.11 (m, 12H), 0.93 – 0.77 (m, 2H), 0.86 (t, J = 7.3 Hz, 3H), 0.40 (s, 6H); ¹³C NMR (125 MHz, CDCl₃): δ 146.12, 140.23, 134.89, 133.73, 128.52, 127.58, 46.90, 37.72, 33.19, 32.54, 31.70, 29.81, 28.96, 26.75, 26.47, 22.58, 14.05, -0.84; IR (thin film): ν 2918.3, 2848.9, 1609.0, 1447.8, 1426.7, 1246.4, 1109.0, 831.0, 812.4, 769.2, 726.6, 698.3, 669.5 cm⁻¹; HRMS (EI⁺) (m/z): [M⁺] calc for C₂₃H₄₈Si, 342.2743; found 342.2740.

(Z)-Benzyl(1-cyclohexylnon-2-en-2-yl)dimethylsilane (12d) (Table 3, Entry 4)

General procedure I was followed with Ni(COD)₂ (13.8 mg, 0.05 mmol), IPr*OMe 6 (47.2 mg, 0.05 mmol), benzylidemethylsilane (79 µL, 0.5 mmol), and nona-1,2-dien-1-ylcyclohexane (103 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (125 mg, 70%) (in >98:2 regiosel., >98:2 d.r.). ¹H NMR (500 MHz, CDCl₃): δ 7.25 – 7.19 (m, 2H), 7.09 (t, J = 7.4 Hz, 1H), 7.05 – 7.01 (m, 2H), 5.93 (t, J = 7.5 Hz, 1H), 2.23 (s, 2H), 2.11 (q, J = 7.4 Hz, 2H), 1.90 (d, J = 6.8 Hz, 2H), 1.73 – 1.63 (m, 5H), 1.41 – 1.27 (m, 8H), 1.21 – 1.12 (m, 3H), 1.11 – 1.04 (m, 1H), 0.92 (t, J = 7.0 Hz, 3H), 0.86 – 0.74 (m, 2H), 0.10 (s, J = 2.7 Hz, 6H); ¹³C NMR (125 MHz, CDCl₃): δ 145.51, 140.29, 135.36, 128.24, 128.05, 123.92, 46.79, 37.67, 33.21, 32.43, 31.82, 30.14, 29.18, 26.76, 26.74, 26.47, 22.66, 14.09, -1.70; IR (thin film): ν 2918.5, 2849.2, 1600.9, 1492.4, 1448.8, 1246.7, 1205.0, 1153.4, 1055.7, 900.8, 826.8, 789.5, 759.1, 696.3 cm⁻¹; HRMS (EI⁺) (m/z): [M⁺] calc for C₂₄H₄₀Si, 356.2899; found, 356.2894.
**(Z)**-Benzyl(2,2-dimethylundec-4-en-4-yl)dimethylsilane (12e) (Table 3, Entry 5)

![Chemical Structure](image)

General procedure I was followed with Ni(COD)$_2$ (13.8 mg, 0.05 mmol), IPr*OMe 6 (47.2 mg, 0.05 mmol), benzyl(dimethyl)silane (79 µL, 0.5 mmol), and 2,2-dimethylundec-3,4-diene (90.2 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (86.0 mg, 52%) (in >98:2 regiosel., >98:2 d.r.). $^1$H NMR (500 MHz, CDCl$_3$): $\delta$ 7.22 (t, $J = 7.6$ Hz, 2H), 7.08 (t, $J = 7.4$ Hz, 1H), 7.05 – 7.01 (m, 2H), 6.05 (t, $J = 7.6$ Hz, 1H), 2.26 (s, 2H), 2.17 (d, $J = 7.6$ Hz, 2H), 1.97 (s, 2H), 1.45 – 1.38 (m, 2H), 1.37 – 1.28 (m, 6H), 0.92 (t, $J = 7.0$ Hz, 3H), 0.87 (s, 9H), 0.10 (s, $J = 4.4$ Hz, 6H); $^{13}$C NMR (126 MHz, CDCl$_3$): $\delta$ 148.74, 140.56, 134.38, 128.32, 128.05, 123.90, 49.36, 32.99, 32.04, 31.85, 30.14, 29.87, 29.25, 26.90, 22.66, 14.11, -1.18. IR (cm$^{-1}$): $\nu$ 2949.6, 2853.0, 1600.2, 1492.4, 1451.1, 1361.0, 1247.7, 1203.8, 1153.8, 1056.5, 826.5, 790.3, 759.8, 696.5; HRMS (EI$^+$) (m/z): [M$^+$] calc for C$_{22}$H$_{38}$Si [M-H] + $^3$155.2508, found 315.2508.

**(Z)**-Benzyl(1-cyclohexyl-5-phenylpent-2-en-2-yl)dimethylsilane (12f) (Table 3, Entry 6)

![Chemical Structure](image)

General procedure I was followed with Ni(COD)$_2$ (13.8 mg, mmol), IPr*OMe 6 (16.3 mg, 0.03 mmol), benzyl(dimethyl)silane (79 µL, 0.5 mmol), and (5-cyclohexylpenta-3,4-dien-1-yl)benzene (113 mg, 0.5 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (141 mg, 71% yield) (in 95:5 d.r., >98:2 regiosel.). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.27 (m, 2H), 7.16 (m, 4H), 7.04 (m, 1H), 6.95 (m, 3H), 5.93 (t, $J = 7.3$ Hz, 1H), 5.80 (t, $J = 7.3$ Hz, 0.05H), 2.65 (t, $J = 8.0$ Hz, 2H), 2.40 (q, $J = 8.0$ Hz, 2H), 2.15 (s, 2H), 2.04 (s, 2H), 1.86 (d, $J = 7.1$ Hz, 2H), 1.56 – 1.70 (m, 9H), 1.04 – 1.23 (m, 6H), 0.732 (m, 3H), 0.043 (s, 6H); $^{13}$C NMR (175 MHz, CDCl$_3$): $\delta$ 144.0, 141.9, 140.1, 136.5, 128.5, 128.3, 128.2, 128.1, 125.8, 124.0, 46.7, 37.6, 36.4, 34.3, 33.2, 26.7, 26.6, 26.4, 1.74; IR (thin film): $\nu$ 2949.6, 2853.0, 1600.2, 1492.4, 1451.1, 1361.0, 1247.7, 1203.8, 1153.8, 1056.5, 826.5, 790.3, 759.8, 696.5; HRMS (EI$^+$) (m/z): [M$^+$] calc for C$_{25}$H$_{33}$Si, 361.2359; found, 361.2359.

**(Z)**-Benzyl(4-(benzyloxy)-1-cyclohexylbut-2-en-2-yl)dimethylsilane (12g) (Table 3, Entry 7)

![Chemical Structure](image)

General procedure I was followed with Ni(COD)$_2$ (13.8 mg, 0.05 mmol), IPr*OMe 6 (47.2 mg, 0.05 mmol), benzyl(dimethyl)silane (79 mL, 0.5 mmol), and ((4-cyclohexylbuta-2,3-dien-1-yl)oxy)methyl)benzene (121 mg, 0.5 mmol). The crude residue was purified by flash chromatography (5% EtOAc: hexanes) affording a clear oil.
(130 mg, 66 % yield) (in >98:2 regiosel., 90:10 d.r.). $^1$H NMR (400 MHz, CDCl$_3$): 7.32 (d, $J = 4.5$ Hz, 4H), 7.27 (m, 1H), 7.17 (t, $J = 7.4$ Hz, 2H), 7.05 (t, $J = 7.4$ Hz, 1H), 6.93 (d, $J = 7.4$ Hz, 2H), 6.09 (t, $J = 6.9$ Hz, 1H), 4.46 (s, 2H), 3.93 (d, $J = 6.9$ Hz, 2H), 3.12 (d, $J = 6.5$ Hz, 2H), 1.63 – 1.70 (m, 6H), 1.11 (m, 4H), 0.796 (m, 2H), 0.030 (s, 6H); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 140.9, 140.5, 139.7, 138.2, 128.4, 128.3, 128.1, 128.0, 127.7, 124.1, 72.5, 69.4, 46.6, 37.3, 33.2, 26.6, 26.4, -1.8; IR (thin film): 2920.1, 2849.3, 1599.7, 1493.4, 1449.7, 1248.7, 1096.0, 1027.8 cm$^{-1}$; HRMS (APCI) (m/z): [M+H]$^+$ calc for C$_{23}$H$_{36}$OSi, 393.2608; found, 393.2627.

(1-Cyclohexylallyl-2-d) triethylsilane (14) (Scheme 3)

![Diagram](https://via.placeholder.com/150)

General procedure IV was followed with Pd$_2$dba$_3$ (13.7 mg, 0.015 mmol), IMes·HCl salt 4 (10.2 mg, 0.03 mmol), n-BuLi (12 mL, 0.03 mmol, 2.5 M in hexanes), triethylsilane (47.7 µL, 0.3 mmol), and cyclohexyllallene (36.6 mg, 0.3 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (50 mg, 70 % yield) (in >98:2 regiosel.). $^1$H NMR (700 MHz, CDCl$_3$): $\delta$ 4.83 (s, 1H), 4.77 (s, 1H), 1.65 – 1.74 (m, 3H), 1.44 – 1.63 (m, 2H), 0.986 – 1.27 (m, 6H), 0.93 (t, $J = 8.9$ Hz, 9H ), 0.561 (q, $J = 8.9$ Hz, 6H); $^{13}$C NMR (174 MHz, CDCl$_3$): d 112.6, 39.8, 38.3, 34.3, 31.6, 26.90, 26.89, 26.3, 7.7, 3.3; IR (thin film): n 2922.1, 1259.9, 1088.6, 799.9 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M]+ calc for C$_{15}$H$_{29}$DSi, 239.2180; found, 239.2185.

[3-(Triethylsilyl)-2-propen-1-yl]-cyclohexane (15) (Scheme 3)

![Diagram](https://via.placeholder.com/150)

General procedure IV was followed with Pd$_2$dba$_3$ (13.7 mg, 0.015 mmol), IMes·HCl salt 4 (10.2 mg, 0.03 mmol), t-BuOK (3.4 mg, 0.03 mmol), triethylsilane (48 µL, 0.3 mmol), and cyclohexyllallene (36.6 mg, 0.3 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (57 mg, 80% yield) (in >98:2 regiosel.). Spectral data matched that previously reported.$^4$

(1-Cyclohexylallyl)tripropylsilane (16) (Scheme 3)

![Diagram](https://via.placeholder.com/150)

General procedure IV was followed with Pd$_3$dba$_3$ (13.7 mg, 0.015 mmol), IMes·HCl salt 4 (10.2 mg, 0.03 mmol), t-BuOK (3.4 mg, 0.03 mmol), triethylsilane (48 µL, 0.3 mmol), triisopropylsilane (10 µL), t-BuOK (1.7 mg, 0.015 mmol), triethylsilane (48 µL, 0.3 mmol), triisopropylsilane (10 µL), and cyclohexyllallene (36.6 mg, 0.3 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (50 mg, 66 % yield) (in >98:2 regiosel., 90:10 d.r.). $^1$H NMR (400 MHz, CDCl$_3$): 7.32 (d, $J = 4.5$ Hz, 4H), 7.27 (m, 1H), 7.17 (t, $J = 7.4$ Hz, 2H), 7.05 (t, $J = 7.4$ Hz, 1H), 6.93 (d, $J = 7.4$ Hz, 2H), 6.09 (t, $J = 6.9$ Hz, 1H), 4.46 (s, 2H), 3.93 (d, $J = 6.9$ Hz, 2H), 3.12 (d, $J = 6.5$ Hz, 2H), 1.63 – 1.70 (m, 6H), 1.11 (m, 4H), 0.796 (m, 2H), 0.030 (s, 6H); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 140.9, 140.5, 139.7, 138.2, 128.4, 128.3, 128.1, 128.0, 127.7, 124.1, 72.5, 69.4, 46.6, 37.3, 33.2, 26.6, 26.4, -1.8; IR (thin film): 2920.1, 2849.3, 1599.7, 1493.4, 1449.7, 1248.7, 1096.0, 1027.8 cm$^{-1}$; HRMS (APCI) (m/z): [M+H]$^+$ calc for C$_{23}$H$_{36}$OSi, 393.2608; found, 393.2627.
and cyclohexylallene (36.6 mg, 0.3 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (49 mg, 58.56% yield) (in >98:2 regiosel.). $^1$H NMR (700 MHz, CDCl$_3$): 5.69 (dt, $J = 17.2$, 9.5 Hz, 1H), 4.83 (dd, $J = 10.5$, 2.7 Hz, 1H), 4.77 (dd, $J = 17.2$, 2.3 Hz, 1H), 1.66 (m, 3H), 1.58 - 1.60 (m, 1H), 1.50 – 1.57 (m, 3H), 1.41 – 1.48 (m, 1H), 1.27 – 1.37 (m, 6 H), 1.00 – 1.22 (m, 1H), 0.935 (t, $J = 8.0$ Hz, 9H), 0.513 – 0.569 (m, 6H); $^{13}$C NMR (175 MHz, CDCl$_3$): 138.6, 112.8, 40.5, 38.4, 34.3, 31.6, 26.9, 26.3, 18.8, 17.7, 15.3; IR (thin film): n 3073.1, 2954.5, 2924.1, 2867.7, 2661.8, 1623.3, 1450.1, 1331.9, 1203.2, 1067.5, 998.8, 894.7, 740.4 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M]$^+$ calc for C$_{18}$H$_{36}$Si, 280.2586; found, 280.2588.

(3-Cyclohexylprop-1-en-2-yl-3-d)triethylsilane (18) (Scheme 3)

General procedure III was followed with Ni(COD)$_2$ (8.25 mg, 0.03 mmol), DP-IPr·HBF$_4$ (18.9 mg, 0.03 mmol), n-BuLi (12 mL, 0.03 mmol, 2.5 M in hexanes), d-triethylsilane (47.7 µL, 0.3 mmol), and cyclohexylallene (36.6 mg, 0.3 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (60 mg, 84% yield) (in >98:2 regiosel.). $^1$H NMR (700 MHz, CDCl$_3$): δ 5.56 (dd, $J = 3.3$, 1.1 Hz, 1H), 5.31 (d, $J = 3.3$ Hz, 1H), 1.94 (d, $J = 7$ Hz, 1H), 1.64 – 1.72 (m, 5H), 1.11-1.20 (m, 4H), 0.91 (t, $J = 8.0$ Hz, 9H), 0.77 – 0.83 (m, 2H), 0.58 (q, $J = 8.0$ Hz, 6H); $^{13}$C NMR (175 MHz, CDCl$_3$): δ 147.3, 126.5, 36.3, 33.43, 33.41, 26.7, 26.4, 7.3, 3.0; IR (thin film): n 2922.3, 2874.8, 2850.5, 1447.3, 1415.9, 1348.1, 1261.0, 1236.3, 1012.0, 923.5, 892.9 cm$^{-1}$; HRMS (EI) (m/z): [M]$^+$ calc for C$_{13}$H$_{24}$DSi, 210.1788; found, 210.1789.

[2-(Triethylsilyl)-2-propen-1-yl]-cyclohexane (19) (Scheme 3)

General procedure III was followed with Ni(COD)$_2$ (8.25 mg, 0.03 mmol), DP-IPr·HBF$_4$ (18.9 mg, 0.03 mmol), KO-t-Bu (3.4 mg, 0.03 mmol), triethylsilane (48 µL, 0.3 mmol), and cyclohexylallene (36.6 mg, 0.3 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (60 mg, 84% yield) (in >98:2 regiosel.). Spectral data matched that previously reported.$^4$

(3-Cyclohexylprop-1-en-2-yl)tripropylsilane (20) (Scheme 3)
General procedure III was followed with Ni(COD)$_2$ (8.25 mg, 0.03 mmol), DP-IPr-HBF$_4$ (18.9 mg, 0.03 mmol), t-BuOK (3.4 mg, 0.03 mmol), tripentysilane (µL, 0.3 mmol), and cyclohexylallene (36.6 mg, 0.3 mmol). The crude residue was purified by flash chromatography (100% hexanes) affording a clear oil (47 mg, 56 % yield) (in >98:2 regiosel.). $^1$H NMR (700 MHz, CDCl$_3$): δ 5.54 (m, 1H), 5.30 (d, $J$ = 3.4 Hz, 1H), 1.96 (d, $J$ = 5.9 Hz, 2H), 1.60-1.71 (m, 6H), 1.25-1.32 (m, 6H), 0.943 (t, $J$ = 8.0 Hz, 9 H), 0.77 – 0.84 (m, 2H), 0.55 (m, 6H); $^{13}$C NMR (175 MHz, CDCl$_3$): δ 148.0, 126.2, 45.1, 36.4, 33.5, 26.7, 26.4, 18.6, 17.4, 15.0; IR (thin film): ν 2922.4, 2954.2, 2867.7, 1449.6, 10654, 923, 806.5 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M-propyl]$^+$ calc for C$_{15}$H$_{29}$Si, 237.2039; found, 237.2041.

**Synthetic Manipulations of Alkenylsilane 12d:**

*(E)-Non-2-en-1-ylcyclohexane (28) (Scheme 4)*

Alkenylsilane 12d (70 mg, 0.196 mmol) in DMSO (50 µL) was added to a 6 mL dram vial with sir bar. TBAF (1.96 mL, 1.96 mmol, 1.0 M in THF) was then slowly added and the vessel was subsequently heated at 50 °C for 6 h when the reaction was judged complete by TLC analysis. The solvent was removed *in vacuo* and the crude material was purified by flash column chromatography (100 % hexanes) affording a clear oil (35.2 mg, 86 %) (in >98:2 regiosel, >98:2 d.r.). $^1$H NMR (500 MHz, CDCl$_3$): δ 5.38 (m, 2H), 1.98 (m, 2H), 1.88 (m, 2H), 1.614-1.78 (m, 6H), 1.14 – 1.42 (m, 15H), 0.894 (t, $J$ = 8.7 Hz, 6H); $^{13}$C NMR (175 MHz, CDCl$_3$): δ 131.4, 128.7, 40.7, 38.1, 33.1, 32.6, 31.7, 29.6, 28.8, 26.6, 26.3, 22.6, 14.1; IR (thin film): ν 2920.3, 2851.3, 1707.9, 1448.0, 1259.5, 966.2 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M]$^+$ calc for C$_{15}$H$_{29}$, 208.2191; found, 208.2189.

*(Z)-(2-Iodonon-2-en-1-yl)cyclohexane (29) (Scheme 4)*

Alkenylsilane 12d (70 mg, 0.196 mmol) in CH$_3$CN (1 mL) was added to a 6 mL dram vial equipped with a stir bar. The reaction vessel was cooled in an ice bath to 0 °C and then NIS (110 mg, 0.491 mmol) was added. The reaction was then removed from the ice bath and warmed to RT. After 12 h the reaction was judged complete by TLC analysis and sodium thiosulfate was added (2 mL) to quench the reaction. The solution was then extracted with EtOAc (3 X 2 mL) and washed with water (3 X 3 mL) and subsequently dried over anhydrous MgSO$_4$. The solvent was then removed in vacuo and the crude material was purified by flash column chromatography (100 % hexanes) affording a clear oil (50 mg, 77 %) (in >98:2 regiosel., 98:2 d.r.). $^1$H NMR (500 MHz, CDCl$_3$): δ 6.23 (t, $J$ = 8.0 Hz , 0.2H, minor E-isomer), 5.43 (t, $J$ = 7.2 Hz, 1H), 2.32 (d, $J$ = 7.5 Hz, 2H), 2.26 (d, $J$ = 7.0 Hz , 0.14H, minor E-isomer), 2.09 – 2.16 (m, 2H), 2.04 (q, $J$ = 7.0 Hz, 0.18H), 1.60 – 1.75 (m, 8H), 1.22 – 1.46 (m, 12H), 1.10-1.19 (m, 1H), 0.90 (t, $J$ = 7.2 Hz, 3H),
0.84 – 0.88 (m, 2H); $^{13}$C NMR ((175 MHz, CDCl$_3$): $\delta$ 135.8, 108.2, 52.6, 36.4, 36.3, 32.6, 31.7, 28.8, 28.4, 26.5, 26.2, 26.1, 22.6, 14.0; IR (thin film): v 2925.6, 2852.2, 1972.0, 1718.2, 1449.4, 1249.4, 1118.1, 827.3, 698.5 cm$^{-1}$; HRMS (EI$^+$) (m/z): [M]$^+$ calc for C$_{15}$H$_{27}$I, 334.1158; found, 334.1161.

(Z)-1-(4-(1-Cyclohexyl-2-en-2-yl)phenyl)ethan-1-one (30) (Scheme 4)

Alkenylsilane 12d (125 mg, 0.7 mmol) in THF (1 mL) was added to a flame-dried 6 mL dram vial with a stir bar. TBAF (2.1 mL, 2.1 mmol, 1.0 M in THF) was then slowly added followed by addition of 4'-idoacetophenone (172 mg, 0.7 mmol) and Pd$_2$dba$_3$ (16 mg, 0.0175 mmol). The reaction vessel was then heated at 50 °C for 30 min when the reaction was judged complete by TLC analysis. DCM (1 mL) was added to the vial and the solution was filtered with 50 % EtOAc:hexanes and the solvent was removed in vacuo. The crude material was purified by flash column chromatography (5 – 15 % EtOAc:hexanes) affording a clear oil (180 mg, 79 %) (in >98:2 regiosel., >98:2 d.r.). $^1$H NMR (500 MHz, CDCl$_3$): $\delta$ 7.90 (d, $J = 8.2$, 2H), 7.21 (d, $J = 8.2$ 2H), 5.43 (t, $J = 7.2$ Hz, 1H), 2.59 (s, 3H), 2.31 (d, $J = 7.5$ Hz, 2H), 1.89 (q, $J = 7.0$ Hz, 2H), 1.54 – 1.67 (m, 6H), 1.14 – 1.34 (m, 10H), 1.00 – 1.11 (m, 5H), 0.824 (t, $J = 7.5$ Hz, 5H); $^{13}$C NMR (175 MHz, CDCl$_3$): $\delta$ 197.9, 147.0, 138.3, 135.2, 130.0, 128.6, 128.1, 147.2, 35.4, 33.1, 31.6, 30.0, 28.9, 28.9, 26.6, 26.1, 22.6, 14.0; IR (thin film): v 2925.3, 1682.0, 1604.1, 1358.0, 1263.3, 1120.1, 833.1 cm$^{-1}$; HRMS (ESI$^+$) (m/z): [M+H]$^+$ calc for C$_{23}$H$_{34}$O, 327.2682; found, 327.2682.

Analysis of the crossover experiment:

For detailed experimental crossover studies including an excel spreadsheet for calculating ratios of isotopic products, please see Montgomery et. al. 2014 (reference 5). Pure samples of products derived from Et$_3$SiH (MW 238), Et$_3$SiD (MW 239), and Pr$_3$SiH (MW 280) were independently prepared and GCMS analysis was performed. Based on the similarity of the molecular ion minus ethyl regions (M-Et = 209) of the Et$_3$SiH and Et$_3$SiD derived product, the molecular ion region of the Pr$_3$SiD derived product was assumed to appear as the molecular ion (M = 280) region of the Pr$_3$SiH-derived product, shifted by one mass unit. Relative peak heights in the molecular ion minus ethyl region of the spectra of each pure compound were normalized, with a value of 1 assigned to the base peak. In the crude product of an experiment that employed 0.5 equiv each of Et$_3$SiD and Pr$_3$SiH, the ratio of Et$_3$Si products to Pr$_3$Si products was determined by GC. From the crude GCMS, the relative intensity of the products were normalized, with the value of 1 assigned to the base peak. The ratio of the Et$_3$Si-(H) product to Et$_3$Si-(D) product was
determined as follows:

\[
\begin{align*}
\text{intensity of 209 peak in crossover experiment} &= [X] \cdot \text{rel. height of 209 peak for Et}_3\text{Si-(H) product} + [Y] \cdot \text{rel. height of 209 peak for Et}_3\text{Si-(D) product} \\
\text{intensity of 210 peak in crossover experiment} &= [X] \cdot \text{rel. height of 210 peak for Et}_3\text{Si-(H) product} + [Y] \cdot \text{rel. height of 210 peak for Et}_3\text{Si-(D) product}
\end{align*}
\]

\[
X = \frac{\text{1/100 x relative % of Et}_3\text{Si-(H) product}}{\text{1/100 x relative % of Et}_3\text{Si-(D) product}} = 1 - X
\]

In the above equation, after substitution of \([1-X]\) for \([Y]\), the experimental values were inserted and the equation was solved for \([X]\). The ratio of Pr\(_3\)Si-(H) product to the intensity of 280 peak in crossover experiment and Pr\(_3\)Si-(D) products was determined in a similar fashion. Merging the GCFID ratios of Et\(_3\)Si products to Pr\(_3\)Si products with the data calculated from the above equation, an overall ratio of the products were obtained.

Triethylsilyl : tripropylsilyl product ratios were determined by GC-FID detection and are corrected for molecular weight to provide molar ratios. GCMS chromatograms and MS spectra for authentic samples and crossover experiments are included as pages S17-S26.

Ratio of Ethyl:Propyl products (nickel crossover): [72:28]
Ratio of Ethyl:Propyl products (palladium crossover): [38:62]
Pd crossover experiment

<table>
<thead>
<tr>
<th>Authentic H Sample</th>
<th>Authentic D Sample</th>
<th>Crossover Experiment</th>
<th>Calculation Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ion 280</td>
<td>Ion 281</td>
<td>Ion 280</td>
<td>Ion 281</td>
</tr>
<tr>
<td>53264</td>
<td>12224</td>
<td>154</td>
<td>7333</td>
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<tr>
<td></td>
<td></td>
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<td>1956</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% H: 96 %</td>
<td>% D: 4 %</td>
</tr>
</tbody>
</table>
Authentic Standards Chromatograms:

File: C:\msdchem\DATA\Zach\zm-iv-143.D
Operator: zm
Acquired: 17 Mar 2015 13:36 using AcqMethod RYANRAMP.M
Instrument: GC
Sample Name: zm-iv-143
Misc Info: vinyl-ethylysilane-H
Vial Number: 68
$\text{Si(}n\text{-Pr)}_3$
SiEt₃

Cy

H

TIC: zm-il-263.Drdata.ms

Scan 1193 (9.907 min): zm-il-263.Drdata.ms

m/z ->

204 205 206 207 208 209 210 211 212 213 214 215

Abundance

350000
300000
250000
200000
150000
100000
50000

Time ->


Abundance

1.2e+07
1.1e+07
1e+07
900000
800000
700000
600000
500000
400000
300000
200000
100000
Nickel Crossover Experiment:

Area Ratios

ret. time 9.8 min: 69 %
ret. time 11.9 min: 31 %
Nickel Crossover Experiment:

File: C:\msdchem\1\DATA\Zach\ZM-V-221NI.D
Operator: zm
Acquired: 20 Mar 2015 15:42 using AcqMethod RYANRAMP.M
Instrument: GC
Sample Name: ZM-V-221NI
Misc Info:
Vial Number: 75

[Graph showing chromatogram with peaks at m/z 280.90 and 281.00]
Palladium Crossover Experiment:

Area Ratios
ret. time 9.9 min: 34 %
ret. time 11.8 min: 66 %
Palladium Crossover Experiment:
References:

2a, Table 2, Entry 1
**2b, Table 2, Entry 2**

- **n-Hex**
  - **SiMe₂Ph**
  - **n-Hex**
2c, Table 2, Entry 3
2d, Table 2, Entry 4
3a, Table 2, Entry 5
3b, Table 2, Entry 6
3c, Table 2, Entry 7
3c, Table 2, Entry 8
85:15 (Z:E)
Scheme 1 in CDCl$_3$ and C$_6$D$_6$. 

9. Scheme 1 in CDCl$_3$.
Scheme 1
in CDCl₃

Scheme 1
in C₆D₆
10a + 11a, Scheme 2
(60:40 rr.)
12a + 13a, Table 3, Entry 1
(50:50) mixture + 9% allylsilane
SiMe$_2$Bn

$i$-Pr $\rightarrow$ n-Hex

12b, Table 3, Entry 2

SiMe$_2$Bn

$i$-Pr $\rightarrow$ n-Hex

12b, Table 3, Entry 2
12c, Table 3, Entry 3
SiMe₂Bn
Cy\(\_\_\_\_\_n\)-Hex

12d, Table 3, Entry 4
12e, Table 3, Entry 5
SiMe₂Bn
Cy
Ph

12f, Table 3, Entry 6
12g, Table 3, Entry 7 (90:10) (Z:E)
14, Scheme 3
Scheme 3
Scheme 3

20, Scheme 3
Cy $\rightarrow n$-Hex

28, Scheme 4
30, Scheme 4