Supporting Information

Primary Alkyl Bis-Catecholato Silicates in Dual Photoredox/Nickel Catalysis: Aryl- and Heteroaryl-Alkyl Cross Coupling Reactions

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I. General informations

Unless otherwise noted, reactions were carried out under an argon atmosphere in oven-dried glassware. Methanol was distillated over CaH$_2$, THF and diethyl ether were distillated over sodium/benzophenone, triethylamine over potassium hydroxide. Catechol was purchased from commercial source and purified by crystallization from toluene followed by sublimation. Reagents and chemicals were purchased from commercial sources and used as received. Infrared (IR) spectra were recorded on a Bruker Tensor 27 (ATR diamond) spectrophotometer. Melting points were determined on a melting point apparatus SMP3 (Stuart scientific) and are uncorrected. $^1$H, $^{19}$F, $^{13}$C NMR spectra were recorded at room temperature at 400, 377 and 100 MHz respectively, on a Bruker AVANCE 400 spectrometer. $^{29}$Si NMR spectra were recorded at 119 MHz on a Bruker AVANCE III 600 spectrometer. Chemical shifts ($\delta$) are reported in ppm and coupling constants ($J$) are given in Hertz (Hz). Abbreviations used for peak multiplicity are: s (singlet); bs (broad singlet); d (doublet); t (triplet); q (quartet); quint (quintet); sept (septet); m (multiplet). Thin layer chromatographies (TLC) were performed on Merck silica gel 60 F 254 and revealed with a UV lamp ($\lambda = 254$ nm) and KMnO$_4$ staining. Flash Column Chromatographies were conducted on silica Geduran® Si 60 Å (40 – 63 µm). High resolution mass spectrometries were performed on a microTOF (ESI). Photocatalysts were synthesized as described.$^{[1],[2]}$ Silicates 1a-1f and 1k-1l were synthesized as described.$^{[3]}$
II. General procedures

1. General procedure A for silicate synthesis

To a stirred solution of catechol (2 eq.) in dry methanol (0.25 M) was added 18-C-6 (1 eq.). After dissolution of the crown ether, the trialkoxy organosilane (1 eq.) was added, followed by a solution of potassium methoxide in methanol (1 eq.). The reaction mixture was stirred for 3 hours and the solvent was removed under reduced pressure. The residue was dissolved in the minimum volume of acetone and diethyl ether was added until a cloudy solution was obtained (scraping on the edge of the flask could be done to induce crystallization). The flask was placed at -20°C overnight. The crystals were collected by filtration, washed with diethyl ether and dried under vacuum to afford [18-C-6] silicate.

2. General procedure B for photoredox/nickel cross-coupling dual catalysis

To a schlenk flask was added aryl or heteroaryl halide (1 eq., 0.3 mmol), silicate (1.5 eq., 0.45 mmol), Ir([dF(CF₃)ppy]₂(bpy)][PF₆] (2 mol %, 6 µmol, 6 mg), and 4,4’-di-tert-butyl-2,2’-bipyridine (3 mol %, 9 µmol, 2.4 mg). The schlenk flask was taken into a glovebox and Ni(COD)₂ (3 mol %, 9 µmol, 2.5 mg) was added. The schlenk flask was sealed with a rubber septum, removed from the glovebox, and evacuated / purged with vacuum / argon three times. Degassed DMF (3 mL) was introduced (followed by the aryl or heteroaryl halide if liquid) and the reaction mixture was irradiated with blue LEDs (477 nm) for 24 hours. The reaction mixture was diluted with diethyl ether (50 mL), washed with saturated NaHCO₃ (2 times), brine (2 times), dried over MgSO₄ and evaporated under reduced pressure. The residue was purified by flash column chromatography on silica gel to afford the coupling adduct 3.
III. Compound characterizations

Potassium [18-Crown-6] bis(catecholato)-benzylsilicate (1a)

![Chemical Structure of 1a]

Silicate 1a was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]

Potassium [18-Crown-6] bis(catecholato)-allylsilicate (1b)

![Chemical Structure of 1b]

Silicate 1b was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]

Potassium [18-Crown-6] bis(catecholato)-anilinomethylsilicate (1c)

![Chemical Structure of 1c]

Silicate 1c was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]
Potassium [18-Crown-6] bis(catecholato)-hexylsilicate (1d)

Silicate 1d was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.\[^3\]

Potassium [18-Crown-6] bis(catecholato)-isobutylsilicate (1e)

Silicate 1e was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.\[^3\]

Potassium [18-Crown-6] bis(catecholato)-2-cyanoethylsilicate (1f)

Silicate 1f was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.\[^3\]

Potassium [18-Crown-6] bis(catecholato)-3-cyanopropylsilicate (1g)
Following the general procedure A with 3-cyanopropyltriethoxysilane (5 mmol, 1.16 mL), catechol (10 mmol, 1.10 g), 18-Crown-6 (5 mmol, 1.32 g) and potassium methoxide (5 mmol, 1.4 mL of a 3.56 M solution in methanol) in 20 mL of dry methanol. The crude product was purified according the general procedure to afford 1g (2.76 g, 90%) as a white solid.

**M.p.** 167.6°C. **H NMR** (600 MHz, Methanol-d4): δ 6.69 (dd, J = 5.6, 3.5 Hz, 4H), 6.57 (dd, J = 5.7, 3.4 Hz, 4H), 3.54 (s, 24H), 2.29 (t, J = 7.2 Hz, 2H), 1.69 – 1.60 (m, 2H), 0.82 – 0.75 (m, 2H). **C NMR** (151 MHz, Methanol-d4): δ 150.9 (4 C), 121.6, 119.5 (4 C), 111.6 (4 C), 71.2 (12 C), 22.5, 20.2, 17.6. **C NMR** (119 MHz, Methanol-d4): δ -77.6. **IR** (neat): 3039, 2952, 2870, 2236, 1702, 1599, 1484, 1353, 1245, 1227, 1098, 1011, 953, 820, 737 cm⁻¹. **HRMS** calc. for [C16H14NO4Si]⁻ 312.0698; found 312.0699.

**Potassium [18-Crown-6] bis(catecholato)-3,3,3-trifluoropropylsilicate (1h)**

![Diagram](image)

Following the general procedure A with 3,3,3-trifluoropropyltrimethoxysilane (5 mmol, 956 µL), catechol (10 mmol, 1.10 g), 18-Crown-6 (5 mmol, 1.32 g) and potassium methoxide (5 mmol, 1.4 mL of a 3.56 M solution in methanol) in 20 mL of dry methanol. The crude product was purified according the general procedure to afford 1h (2.56 g, 80%) as a white solid.

**M.p.** 177.7°C. **H NMR** (600 MHz, Methanol-d4): δ 6.70 (dd, J = 5.6, 3.5 Hz, 4H), 6.59 (dd, J = 5.7, 3.4 Hz, 4H), 3.54 (s, 24H), 2.06 – 1.95 (m, 2H), 0.83 – 0.76 (m, 2H). **C NMR** (151 MHz, Methanol-d4): δ 150.8 (4 C), 130.6 (q, J = 275.6 Hz), 119.6 (4 C), 111.6 (4 C), 71.2 (12 C), 30.5 (q, J = 28.6 Hz), 9.6. **F NMR** (376 MHz, Methanol-d4): δ -70.5 (t, J = 11.1 Hz). **Si NMR** (119 MHz, Methanol-d4): δ -78.6. **IR** (neat): 3040, 2907, 2871, 1597, 1485, 1353, 1245, 1201, 1098, 1057, 820, 739 cm⁻¹. **HRMS** calc. for [C15H12F3O4Si]⁻ 341.0462; found 341.0460.
Potassium [18-Crown-6] bis(catecholato)-acetoxypropylsilicate (Ii)

Following the general procedure A with acetoxypropyltrimethoxysilane (10 mmol, 2.10 mL), catechol (20 mmol, 2.20 g), 18-Crown-6 (10 mmol, 2.64 g) and potassium methoxide (10 mmol, 2.8 mL of a 3.56 M solution in methanol) in 40 mL of dry methanol. The crude product was purified according the general procedure to afford Ii (5.88 g, 91%) as a white solid.

M.p. 160°C. $^1$H NMR (400 MHz, Methanol-d$_4$): $\delta$ 6.67 (dd, $J = 5.6$, 3.5 Hz, 4H), 6.58 (dd, $J = 5.6$, 3.4 Hz, 4H), 3.9 (t, $J = 7.1$ Hz, 2H), 3.5 (s, 24H), 1.9 (s, 3H), 1.7 – 1.5 (m, 2H), 0.7 – 0.6 (m, 2H). $^{13}$C NMR (101 MHz, Methanol-d$_4$): $\delta$ 173.1, 150.9 (4 C), 119.3 (4 C), 111.5 (4 C), 71.2 (12 C), 68.6, 24.9, 20.8, 13.9. $^{29}$Si NMR (119 MHz, Methanol-d$_4$): $\delta$ -76.6. IR (neat): 3016, 2950, 2882, 1735, 1597, 1486, 1351, 1242, 1105, 955, 819, 749, 725 cm$^{-1}$. HRMS calc. for [C$_{17}$H$_{17}$O$_6$Si]$^-$ 345.0800; found 345.0813.

Potassium bis(catecholato)-acetoxypropylsilicate (Ii’)

Following the general procedure A with acetoxypropyltrimethoxysilane (5 mmol, 1.05 mL), catechol (10 mmol, 1.10 g) and potassium methoxide (5 mmol, 1.4 mL of a 3.56 M solution in methanol) in 20 mL of dry methanol. The crude product was purified according the general procedure to afford Ii’ (1.55 g, 62%*) as a white solid.

M.p. 160°C. $^1$H NMR (400 MHz, Methanol-d$_4$): $\delta$ 6.68 (dd, $J = 5.6$, 3.5 Hz, 4H), 6.56 (dd, $J = 5.6$, 3.5 Hz, 4H), 3.88 (t, $J = 7.0$ Hz, 2H), 1.92 (s, 3H), 1.66 – 1.56 (m, 2H), 0.7 – 0.65 (m, 2H). $^{13}$C NMR (101 MHz, Methanol-d$_4$): $\delta$ 173.3, 150.8 (4 C), 119.4 (4 C), 111.5 (4 C), 68.6,
24.9, 20.8, 13.7. IR (neat): 3016, 2950, 2882, 1735, 1597, 1486, 1351, 1242, 1105, 955, 819, 749, 725 cm⁻¹. HRMS calc. for [C₁₇H₁₇O₆Si]⁺ 345.0800; found 345.0813.


**Potassium [18-Crown-6] bis(catecholato)-acetoxymethylsilicate (1j)**

Following the general procedure A with acetoxyethyltriethoxysilane (5 mmol, 1.13 mL), catechol (10 mmol, 1.10 g), 18-Crown-6 (5 mmol, 1.32 g) and potassium methoxide (5 mmol, 1.4 mL of a 3.56 M solution in methanol) in 20 mL of dry methanol. The crude product was purified according the general procedure to afford 1j (2.92 g, 94%) as a white solid.

M.p. 110°C. ¹H NMR (600 MHz, Methanol-d₄): δ 6.68 (dd, J = 5.6, 3.4 Hz, 4H), 6.57 (dd, J = 5.8, 3.5 Hz, 4H), 3.82 (s, 2H), 3.53 (s, 24H), 1.83 (s, 3H). ¹³C NMR (151 MHz, Methanol-d₄): δ 174.1, 150.9 (4 C), 119.5 (4 C), 111.7 (4C), 71.2 (12 C), 58.1, 20.7. ²⁹Si NMR (119 MHz, Methanol-d₄): δ -85.8 (t, J = 5.7 Hz). IR (neat): 3028, 2901, 2868, 1719, 1599, 1487, 1348, 1243, 1102, 963, 830, 737 cm⁻¹. HRMS calc. for [C₁₅H₁₃O₆Si]⁺ 317.0487; found 317.0495.

**Potassium [18-Crown-6] bis(catecholato)-(3-glycidyloxypropyl)silicate (1k)**

Silicate 1k was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.^[3]
Potassium [18-Crown-6] bis(catecholato)-2-(7-oxabicyclo[4.1.0]hept-3-yl)ethyl)silicate (II)

Silicate II was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.\(^3\)

Potassium [18-Crown-6] bis(catecholato)-3-chloropropylsilicate (1m)

Following the general procedure A with 3-chloropropyltrimethoxysilane (5 mmol, 910 µL), catechol (10 mmol, 1.10 g), 18-Crown-6 (5 mmol, 1.32 g) and potassium methoxide (5 mmol, 1.4 mL of a 3.56 M solution in methanol) in 20 mL of dry methanol. The crude product was purified according the general procedure to afford 1m (2.96 g, 95%) as a white solid.

M.p. 147.7°C. \(^1\)H NMR (600 MHz, Methanol-\(d_4\)): \(\delta\) 6.68 (dd, \(J = 5.6, 3.4\) Hz, 4H), 6.56 (dd, \(J = 5.6, 3.4\) Hz, 4H), 3.53 (s, 24H), 3.37 (t, \(J = 7.2\) Hz, 2H), 1.80 – 1.69 (m, 2H), 0.79 – 0.69 (m, 2H). \(^{13}\)C NMR (151 MHz, Methanol-\(d_4\)): \(\delta\) 150.9 (4 C), 119.4 (4 C), 111.5 (4 C), 71.2 (12 C), 48.8, 29.6, 15.8. \(^{29}\)Si NMR (119 MHz, Methanol-\(d_4\)): \(\delta\) -76.9. IR (neat): 3044, 2894, 2872, 1598, 1485, 1351, 1243, 1104, 952, 817, 741 cm\(^{-1}\). HRMS (ESI-) calc. for [\(\text{C}_{15}\text{H}_{14}\text{ClO}_4\text{Si}\)]\(^-\) 321.0355; found 321.0367.

4’-(Benzyl)acetophenone (3aa)

Following general procedure B with benzylicsilicate 1a (0.45 mmol, 287 mg) and 4’-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column
chromatography (pentane/diethyl ether, 95/5) to afford 3aa as a colorless oil (56 mg, 88%). The spectroscopic data are in agreement with those reported in the literature.[4]

$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.89 (d, $J = 8.4$ Hz, 2H), 7.32 – 7.17 (m, 7H), 4.04 (s, 2H), 2.58 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 197.8, 146.8, 140.1, 135.3, 129.1 (2 C), 129.0 (2 C), 128.7 (4 C), 126.40, 41.9, 26.6. IR (neat): 2937, 1678, 1602, 1265 cm$^{-1}$.

4'-(Allyl)acetophenone (3ba)

Following general procedure B with allylsilicate 1b (0.45 mmol, 265 mg) and 4'-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 98/2) to afford 3ba as a colorless oil (41 mg, 86%). The spectroscopic data are in agreement with those reported in the literature.[5]

$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.90 (d, $J = 8.4$ Hz, 2H), 7.28 (d, $J = 8.4$ Hz, 2H), 5.95 (ddt, $J = 17.1$ Hz, 10.5 Hz, 6.7 Hz, 1H), 5.13 – 5.08 (m, 2H), 3.45 (d, $J = 6.7$ Hz, 2H), 2.59 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 197.8, 145.8, 136.3, 135.3, 128.8 (2 C), 128.6 (2 C), 116.7, 40.1, 26.6. IR (neat): 3050, 1680, 1604, 1356, 1266 cm$^{-1}$.

4'-((Anilinomethyl)acetophenone (3ca)

Following general procedure B with anilinomethylsilicate 1c (0.45 mmol, 294 mg) and 4'-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 80/20) to afford 3ca as a colorless oil (62 mg, 91%). The spectroscopic data are in agreement with those reported in the literature.[6]

$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.93 (d, $J = 8.4$ Hz, 2H), 7.47 (d, $J = 8.4$ Hz, 2H), 7.17 – 7.15 (m, 2H), 6.75 – 6.71 (m, 1H), 6.66 – 6.60 (m, 2H), 4.42 (s, 2H), 4.16 (s, 1H), 2.59 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 197.7, 147.7, 145.2, 136.2, 129.3 (2 C), 128.7 (2 C), 127.3 (2 C), 117.9, 112.9 (2 C), 47.9, 26.6. IR (neat): 3321, 1669, 1597, 1510 cm$^{-1}$.

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4’-(Hexyl)acetophenone (3da)

Following general procedure B with hexylsilicate 1d (0.45 mmol, 285 mg) and 4’-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1) to afford 3da as a colorless oil (53 mg, 85%). The spectroscopic data are in agreement with those reported in the literature.[7]

1H NMR (400 MHz, CDCl3): δ 7.87 (d, J = 8.2 Hz, 2H), 7.26 (d, J = 8.2 Hz, 2H), 2.68 – 2.64 (m, 2H), 2.58 (s, 3H), 1.67 – 1.58 (m, 2H), 1.38 – 1.26 (m, 6H), 0.88 (t, J = 6.8 Hz, 3H). 13C NMR (100 MHz, CDCl3): δ 198.0, 149.0, 135.1, 128.7 (2 C), 128.6 (2 C), 36.1, 31.8, 31.2, 29.0, 26.7, 22.7, 14.2. IR (neat): 2900, 1681, 1605, 1265 cm⁻¹.

4’-(Isobutyl)acetophenone (3ea)

Following general procedure B with isopropylsilicate 1e (0.45 mmol, 272 mg) and 4’-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 98/2) to afford 3ea as a colorless oil (39 mg, 75%). The spectroscopic data are in agreement with those reported in the literature.[8]

1H NMR (400 MHz, CDCl3): δ 7.87 (d, J = 8.3 Hz, 2H), 7.23 (d, J = 8.3 Hz, 2H), 2.58 (s, 3H), 2.53 (d, J = 7.2 Hz, 2H), 1.93 – 1.87 (m, 1H), 0.91 (d, J = 6.6 Hz, 6H). 13C NMR (100 MHz, CDCl3): δ 198.0, 147.7, 135.1, 129.4 (2 C), 128.4 (2 C), 45.5, 30.2, 29.7, 22.5 (2 C). IR (neat): 2909, 1680, 1605, 1265 cm⁻¹.

4’-(2-Cyanoethyl)acetophenone (3fa)

Following general procedure B with 2-cyanoethylsilicate 1e (0.45 mmol, 271 mg) and 4’-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 1/1) to afford 3fa as a colorless oil (36 mg, 69%). The spectroscopic data are in agreement with those reported in the literature.[9]
$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.93 (d, $J = 8.4$ Hz, 2H), 7.33 (d, $J = 8.4$ Hz, 2H), 3.01 (t, $J = 7.3$ Hz, 2H), 2.65 (t, $J = 7.3$ Hz, 2H), 2.58 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 197.6, 143.3, 136.2, 129.0 (2 C), 128.6 (2 C), 118.7, 31.4, 26.6, 19.0. IR (neat): 2910, 2245, 1675, 1607, 1266 cm$^{-1}$.

$\text{4'}$-($3$-Cyanopropyl)acetophenone (3ga)

Following general procedure B with 2-cyanoethylsilicate 1g (0.45 mmol, 277 mg) and 4$'$-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 1/1) to afford 3ga as a colorless oil (48 mg, 85%). The spectroscopic data are in agreement with those reported in the literature.$^{[10]}$

$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.90 (d, $J = 8.4$ Hz, 2H), 7.28 (d, $J = 8.4$ Hz, 2H), 2.86 – 2.82 (m, 2H), 2.58 (s, 3H), 2.33 (t, $J = 7.0$ Hz, 2H), 2.0 (dd, $J = 7.5$ Hz, 7.0 Hz, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 197.6, 145.3, 135.6, 128.8 (2 C), 128.6 (2 C), 119.1, 34.3, 26.5, 26.5, 16.4. IR (neat): 2905, 2258, 1675, 1607, 1266 cm$^{-1}$.

$\text{4'}$-($3,3,3$-Trifluoropropyl)acetophenone (3ha)

Following general procedure B with 3,3,3-trifluoropropylsilicate 1h (0.45 mmol, 290 mg) and 4$'$-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1 then 95/5) to afford 3ha as a colorless oil (52 mg, 80%).

$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.91 (d, $J = 8.4$ Hz, 2H), 7.30 (d, $J = 8.4$ Hz, 2H), 2.95 – 2.91 (m, 2H), 2.59 (s, 3H), 2.47 – 2.35 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 197.6, 144.4, 135.8, 128.8 (2 C), 128.5 (2 C), 126.5 (q, $J = 275$ Hz), 35.1 (q, $J = 28$ Hz), 28.2 (q, $J = 3$ Hz), 26.5. $^{19}$F NMR (376 MHz, CDCl$_3$): $\delta$ -66.57. IR (neat): 2871, 1677, 1607, 1266 cm$^{-1}$.
4’-(Acetoxypropyl)acetophenone (3ia)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 4’-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1 then 95/5) to afford 3ia as a colorless oil (56 mg, 85%).

$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.88 (d, $J$ = 8.4 Hz, 2H), 7.27 (d, $J$ = 8.4 Hz, 2H), 4.08 (t, $J$ = 6.5 Hz, 2H), 2.76 – 2.72 (m, 2H), 2.57 (s, 3H), 2.04 (s, 3H), 2.01 – 1.94 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 197.7, 171.0, 147.0, 135.3, 128.6 (2 C), 128.6 (2 C), 63.5, 32.2, 26.5, 20.9. IR (neat): 2900, 1735, 1679, 1606, 1233 cm$^{-1}$. HRMS calc for [C$_{13}$H$_{16}$NaO$_3$]$^+$ 243.0992; found 243.0999.

4’-(Acetoxymethyl)acetophenone (3ja)

Following general procedure B with acetoxymethylsilicate 1j (0.45 mmol, 279 mg) and 4’-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1 then 95/5) to afford 3ja as a colorless oil (38 mg, 66%).

$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.94 (d, $J$ = 8.4 Hz, 2H), 7.43 (d, $J$ = 8.4 Hz, 2H), 5.15 (s, 2H), 2.59 (s, 3H), 2.12 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 197.6, 170.6, 141.2, 136.8, 128.6 (2 C), 127.9 (2 C), 65.4, 26.6, 20.9. IR (neat): 2905, 2855, 1736, 1681, 1264, 1224 cm$^{-1}$. HRMS calc for [C$_{11}$H$_{12}$NaO$_3$]$^+$ 215.0673; found 215.0679.

4’-(3-Glycidyloxypropyl)acetophenone (3ka)
Following general procedure B with 3-glycidyloxypropylsilicate 1k (0.45 mmol, 239 mg) and 4'-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford 3ka as a colorless oil (29 mg, 40%).

**1H NMR** (400 MHz, CDCl₃): δ 7.88 (d, J = 8.4 Hz, 2H), 7.28 (d, J = 8.4 Hz, 2H), 3.73 (dd, J = 11.5 Hz, 2.9 Hz, 1H), 3.57 – 3.42 (m, 2H), 3.36 (dd, J = 11.5 Hz, 5.9 Hz, 1H), 3.21 – 3.07 (m, 1H), 2.85 – 2.64 (m, 3H), 3.60 (dd, J = 5.0 Hz, 2.7 Hz, 1H), 2.58 (s, 3H), 1.92 (ddt, J = 12.7 Hz, 7.6 Hz, 6.3 Hz, 2H).

**13C NMR** (100 MHz, CDCl₃): δ 197.8, 147.7, 135.1, 128.5 (2 C), 128.5 (2 C), 71.6, 70.3, 50.8, 44.2, 32.3, 30.9, 26.5. IR (neat): 2905, 1678, 1605, 1266, 1106 cm⁻¹. HRMS calc for [C₁₄H₁₈NaO₃]⁺ 257.1148; found 257.1155.

4'-(2-(7-Oxabicyclo-[4.1.0]hept-3-yl)ethyl)acetophenone (3la)

Following general procedure B with 2-(7-oxabicyclo-[4.1.0]hept-3-yl)ethylsilicate 3l (0.45 mmol, 303 mg) and 4'-bromoacetophenone (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 80/20) to afford a 45/55 mixture of diastereoisomers of 3la as a colorless oil (48 mg, 65%).

**1H NMR** (400 MHz, CDCl₃): δ 7.88 – 7.85 (m, 4H), 7.26 – 7.21 (m, 4H), 3.20 – 3.14 (m, 4H), 2.69 – 2.66 (m, 4H), 2.60 (s, 6H), 2.25 – 1.99 (m, 4H), 1.89 – 1.51 (m, 10H), 1.44 – 1.37 (m, 2H), 1.25 – 0.95 (m, 2H).

**13C NMR** (100 MHz, CDCl₃): δ 197.8 (197.8), 148.4 (148.3), 135.0 (135.0), 128.5 (128.5), 128.5 (128.5), 53.0 (52.5), 51.8 (51.7), 38.1 (37.8), 33.3 (33.0), 32.1 (31.8), 30.6 (29.3), 27.0 (25.1), 26.5, 24.3 (23.5). IR (neat): 2935, 1671, 1604, 1568, 1298 cm⁻¹. HRMS calc for [C₁₆H₂₀NaO₂]⁺ 267.1365; found 267.1135.

4'-(3-Chloropropyl)acetophenone (3ma)

Following general procedure B with chloropropylsilicate 1m (0.45 mmol, 282 mg) and 4'-bromoacetophenone 2a (0.3 mmol, 60 mg). The crude product was purified by flash
column chromatography (pentane/diethyl ether, 80/20) to afford 3ma as a colorless oil (42 mg, 71%). The spectroscopic data are in agreement with those reported in the literature.[11]

$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.89 (d, $J$ = 8.4 Hz, 2H), 7.29 (d, $J$ = 8.4 Hz, 2H), 3.52 (t, $J$ = 6.4 Hz, 2H), 2.86 – 2.82 (m, 2H), 2.58 (s, 3H), 2.13 – 2.07 (m, 2H).

$^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 197.8, 146.5, 135.5, 128.8 (2 C), 128.7 (2 C), 44.1, 33.6, 32.8, 26.6. IR (neat): 2935, 1678, 1605, 1358, 1265 cm$^{-1}$.

HRMS calc. for [C$_{13}$H$_{16}$NaO$_3$]$^+$ 243.0992; found 243.0992.

3-(3-Acetylphenyl)propyl acetate (3ib)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 3'-bromoacetophenone 2b (0.3 mmol, 35 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3ib as a colorless oil (53 mg, 80%).

$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.80 – 7.71 (m, 2H), 7.40 – 7.34 (m, 2H), 4.08 (t, $J$ = 6.5 Hz, 2H), 2.76 – 2.72 (m, 2H), 2.59 (s, 3H), 2.04 (s, 3H), 2.01 – 1.94 (m, 2H).

$^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 198.2, 171.1, 141.7, 137.3, 133.2, 128.6, 128.0, 126.3, 63.6, 32.0, 30.0, 26.6, 20.9. IR (neat): 2941, 1734, 1684, 1601, 1232, 839 cm$^{-1}$. HRMS calc. for [C$_{13}$H$_{16}$NaO$_3$]$^+$ 243.0992; found 243.0992.

3-(4-(Trimethylsilyl)phenyl)propyl acetate (3ic)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and (4-bromophenyl)trimethylsilane 2c (0.3 mmol, 59 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3hic as a colorless oil (54 mg, 72%).

$^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.46 (d, $J$ = 8.0 Hz, 2H), 7.19 (d, $J$ = 8.0 Hz, 2H), 4.10 (t, $J$ = 6.6 Hz, 2H), 2.71 – 2.67 (m, 2H), 2.06 (s, 3H), 1.99 – 1.91 (m, 2H), 0.27 (s, 9H).

$^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 171.1, 141.8, 137.7, 133.5 (2 C), 127.9 (2 C), 63.6, 32.1, 30.0, 20.9, -1.1 (3 C). IR (neat): 2936, 1739, 1601, 1233 cm$^{-1}$. HRMS calc. for [C$_{14}$H$_{22}$NaO$_2$Si]$^+$ 273.1281; found 273.1277.
3-(4-((Trimethylsilyl)ethynyl)phenyl)propyl acetate (3id)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and ((4-bromophenyl)ethynyl)trimethylsilane 2d (0.3 mmol, 76 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford 3id as a colorless oil (54 mg, 72%).

$^1$H NMR (400 MHz, CDCl$_3$): δ 7.38 (d, $J = 8.3$ Hz, 2H), 7.11 (d, $J = 8.3$ Hz, 2H), 4.06 (t, $J = 6.5$ Hz, 2H), 2.69 – 2.65 (m, 2H), 2.04 (s, 3H), 1.97 – 1.89 (m, 2H), 0.24 (s, 9H).

$^{13}$C NMR (100 MHz, CDCl$_3$): δ 171.0, 141.8, 132.0 (2 C), 128.3 (2 C), 120.8, 105.1, 93.6, 63.6, 32.21, 29.9, 20.9, 0.0 (3 C).

IR (neat): 2944, 2156, 1738, 1608, 1233, 839 cm$^{-1}$. HRMS calc. for [C$_{16}$H$_{22}$NaO$_2$Si]$^+$ 297.1281; found 297.1281.

3-(4-Fluorophenyl)propyl acetate (3ie)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 1-bromo-4-fluorobenzene 2e (0.3 mmol, 33 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 80/20) to afford 3ie as a colorless oil (45 mg, 75%).

$^1$H NMR (400 MHz, CDCl$_3$): δ 7.16 – 7.08 (m, 2H), 7.00 – 6.92 (m, 2H), 4.07 (t, $J = 6.5$ Hz, 2H), 2.68 – 2.64 (m, 2H), 2.05 (s, 3H), 1.95 – 1.89 (m, 2H).

$^{13}$C NMR (100 MHz, CDCl$_3$): δ 171.1, 161.3 (d, $J = 243.7$ Hz), 136.7 (d, $J = 3.2$ Hz), 129.7 (d, $J = 7.8$ Hz, 2 C), 115.1 (d, $J = 21.1$ Hz, 2 C), 63.6, 31.3, 30.3, 20.9.

$^{19}$F NMR (376 MHz, CDCl$_3$): δ -117.48. IR (neat): 2930, 1733, 1600, 1509, 1218, 1036 cm$^{-1}$. HRMS calc. for [C$_{11}$H$_{13}$FNaO$_2$]$^+$ 219.0797; found 219.0792.
3-(4-Chlorophenyl)propyl acetate (3if)

Following general procedure B with acetoxypropylsilicate 1I (0.45 mmol, 292 mg) and 1-bromo-4-chlorobenzene 2f (0.3 mmol, 58 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3if as a colorless oil (51 mg, 80%).

\[ ^1H\text{NMR} \ (400 \text{ MHz, CDCl}_3): \delta \ 7.25 \ (d, \ J = 8.6 \text{ Hz, 1H}), \ 7.11 \ (d, \ J = 8.6 \text{ Hz, 1H}), \ 4.07 \ (t, \ J = 6.5 \text{ Hz, 2H}), \ 2.68 - 2.64 \ (m, 2H), \ 2.05 \ (s, 3H), \ 1.97 - 1.89 \ (m, 2H). \]

\[ ^{13}C\text{NMR} \ (100 \text{ MHz, CDCl}_3): \delta \ 171.0, \ 139.6, \ 131.7, \ 129.7 \ (2 \text{ C}), \ 128.5 \ (2 \text{ C}), \ 63.6, \ 31.5, \ 30.1, \ 21.9. \]

\[ ^{1}IR \ (\text{neat}): \ 2936, \ 1736, \ 1597, \ 1231, \ 836 \text{ cm}^{-1}. \]

\[ ^{1}HRMS \ \text{calc. for} \ [\text{C}_{11}\text{H}_{13}\text{ClNaO}_2]^+ \ 235.0496; \ \text{found} \ 235.0505. \]

3-(4-Bromophenyl)propyl acetate (3ig)

Following general procedure B with acetoxypropylsilicate 1h (0.45 mmol, 292 mg) and 1,4-dibromobenzene 2g (0.3 mmol, 71 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3ig as a colorless oil (52 mg, 67%).

\[ ^1H\text{NMR} \ (400 \text{ MHz, CDCl}_3): \delta \ 7.40 \ (d, \ J = 8.4 \text{ Hz, 2H}), \ 7.06 \ (d, \ J = 8.4 \text{ Hz, 2H}), \ 4.07 \ (t, \ J = 6.6 \text{ Hz, 2H}), \ 2.66 - 2.62 \ (m, 2H), \ 2.05 \ (s, 3H), \ 1.97 - 1.89 \ (m, 2H). \]

\[ ^{13}C\text{NMR} \ (100 \text{ MHz, CDCl}_3): \delta \ 171.1, \ 140.1, \ 131.5 \ (2 \text{ C}), \ 130.1 \ (2 \text{ C}), \ 119.8, \ 63.6, \ 31.6, \ 30.0, \ 20.9. \]

\[ ^{1}IR \ (\text{neat}): \ 2940, \ 1735, \ 1591, \ 1299, \ 1231 \text{ cm}^{-1}. \]

\[ ^{1}HRMS \ \text{calc. for} \ [\text{C}_{11}\text{H}_{13}\text{BrNaO}_2]^+ \ 278.9991; \ \text{found} \ 278.9991. \]

3-(4-Bromophenyl)propyl acetate (3ig) and 3-(4-iodophenyl)propyl acetate (3ig’)

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Following general procedure B with acetoxypropylsilicate 1h (0.45 mmol, 292 mg) and 1-bromo-4-iodobenzene 2g (0.3 mmol, 85 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford a 10:1 mixture of 3ig and 3ig’ as a colorless oil (43 mg, 48%).

3-(4-Iodophenyl)propyl acetate (3ig’)

1H NMR (400 MHz, CDCl₃): δ 7.60 (d, J = 8.4 Hz, 2H), 6.95 (d, J = 8.4 Hz, 2H), 4.07 (t, J = 6.6 Hz, 2H), 2.66 – 2.63 (m, 2H), 2.05 (s, 3H), 1.96 – 1.86 (m, 2H). 13C NMR (100 MHz, CDCl₃): δ 171.1, 140.8, 137.5 (2 C), 130.5 (2 C), 119.8, 63.6, 31.7, 30.0, 20.9. IR (neat): 2940, 1735, 1591, 1299, 1231 cm⁻¹. HRMS calc. for [C₁₁H₁₃INaO₂]⁺ 326.9852; found 326.9847.

3-((p-Tolyl)propyl acetate (3ih)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 4-bromotoluene 2h (0.3 mmol, 51 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3ih as a colorless oil (42 mg, 73%).

1H NMR (400 MHz, CDCl₃): δ 7.12 – 7.07 (m, 4H), 4.09 (t, J = 6.6 Hz, 2H), 2.67 – 2.64 (m, 2H), 2.33 (s, 3H), 2.06 (s, 3H), 1.96 – 192 (m, 2H). 13C NMR (100 MHz, CDCl₃): δ 171.1, 138.1, 135.4, 129.1 (2 C), 128.2 (2 C), 63.8, 31.7, 30.3, 21.0 (2 C).* IR (neat): 2920, 1736, 1232, 1036 cm⁻¹. HRMS calc. for [C₁₂H₁₆NaO₂]⁺ 215.1043; found 215.1045.

*signal for both CH₃ (verified by HSQC)

3-(o-Tolyl)propyl acetate (3ii)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 2-bromotoluene 2i (0.3 mmol, 36 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford 3ii as a colorless oil (44 mg, 76%).
\[ ^1H\text{NMR}\ (400\text{ MHz, CDCl}_3):\ 7.17 – 7.11\ (m, 4H),\ 4.13\ (t,\ J = 6.5\text{ Hz, 2H}),\ 2.71 – 2.67\ (m,\ 2H),\ 2.33\ (s,\ 3H),\ 2.08\ (s,\ 3H),\ 1.97 – 1.90\ (m,\ 2H).\ \]
\[ ^13C\text{NMR}\ (100\text{ MHz, CDCl}_3):\ \delta\ 171.1,\ 139.4,\ 135.8,\ 128.7,\ 126.1,\ 126.0,\ 64.0,\ 29.5,\ 29.0,\ 20.9,\ 19.2.\ \]

3-(4-(Trifluoromethyl)phenyl)propyl acetate (3ij)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 4-bromobenzotrifluoride 2j (0.3 mmol, 41 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3ij as a colorless oil (70 mg, 94%).

\[ ^1H\text{NMR}\ (400\text{ MHz, CDCl}_3):\ \delta\ 7.54\ (d,\ J = 8.0\text{ Hz, 2H}),\ 7.29\ (d,\ J = 8.0\text{ Hz, 2H}),\ 4.09\ (t,\ J = 6.5\text{ Hz, 2H}),\ 2.77 – 2.73\ (m,\ 2H),\ 2.05\ (s,\ 3H),\ 1.99 – 1.94\ (m,\ 2H).\ \]

3-(2-(Trifluoromethyl)phenyl)propyl acetate (3ik)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 2-bromobenzotrifluoride 2k (0.3 mmol, 42 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford 3ik as a colorless oil (51 mg, 69%).

\[ ^1H\text{NMR}\ (400\text{ MHz, CDCl}_3):\ \delta\ 7.62\ (dd,\ J = 7.9, 1.3\text{ Hz, 1H}),\ 7.47\ (td,\ J = 7.6, 1.3\text{ Hz, 1H}),\ 7.36 – 7.27\ (m,\ 2H),\ 4.13\ (t,\ J = 6.4\text{ Hz, 2H}),\ 2.86\ (ddd,\ J = 9.7, 6.2, 1.3\text{ Hz, 2H}),\ 2.06\ (s,\ 3H),\ 2.01 – 1.91\ (m,\ 2H).\ \]

3-[(4-(Trifluoromethyl)phenyl)propyl acetate (3ij)

\[ ^1H\text{NMR}\ (400\text{ MHz, CDCl}_3):\ \delta\ 7.17 – 7.11\ (m, 4H),\ 4.13\ (t,\ J = 6.5\text{ Hz, 2H}),\ 2.71 – 2.67\ (m,\ 2H),\ 2.33\ (s,\ 3H),\ 2.08\ (s,\ 3H),\ 1.97 – 1.90\ (m,\ 2H).\ \]

\[ ^13C\text{NMR}\ (100\text{ MHz, CDCl}_3):\ \delta\ 171.1,\ 139.4,\ 135.8,\ 128.7,\ 126.1,\ 126.0,\ 64.0,\ 29.5,\ 29.0,\ 20.9,\ 19.2.\ \]

IR (neat): 2942, 1736, 1601, 1231 cm\(^{-1}\). HRMS calc. for [C\(_{12}\)H\(_{16}\)NaO\(_2")\]+ 215.1043; found 215.1035.

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 4-bromobenzotrifluoride 2j (0.3 mmol, 41 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3ij as a colorless oil (70 mg, 94%).

\[ ^1H\text{NMR}\ (400\text{ MHz, CDCl}_3):\ \delta\ 7.54\ (d,\ J = 8.0\text{ Hz, 2H}),\ 7.29\ (d,\ J = 8.0\text{ Hz, 2H}),\ 4.09\ (t,\ J = 6.5\text{ Hz, 2H}),\ 2.77 – 2.73\ (m,\ 2H),\ 2.05\ (s,\ 3H),\ 1.99 – 1.94\ (m,\ 2H).\ \]

\[ ^13C\text{NMR}\ (100\text{ MHz, CDCl}_3):\ \delta\ 171.1,\ 145.3,\ 128.7,\ 128.5\ (q,\ J = 32.3\text{ Hz, 2 C}),\ 125.4\ (q,\ J = 3.9\text{ Hz, 2 C}),\ 124.3\ (q,\ J = 270\text{ Hz}),\ 63.5,\ 32.1,\ 29.9,\ 21.9.\ \]

\[ ^19F\text{NMR}\ (376\text{ MHz, CDCl}_3):\ \delta\ -62.4.\ \]

IR (neat): 2922, 1737, 1584, 1232, 845 cm\(^{-1}\). HRMS calc. for [C\(_{12}\)H\(_{13}\)F\(_3\)NaO\(_2")\]+ 269.0760; found 269.0752.

3-[(2-(Trifluoromethyl)phenyl)propyl acetate (3ik)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 2-bromobenzotrifluoride 2k (0.3 mmol, 42 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford 3ik as a colorless oil (51 mg, 69%).

\[ ^1H\text{NMR}\ (400\text{ MHz, CDCl}_3):\ \delta\ 7.62\ (dd,\ J = 7.9, 1.3\text{ Hz, 1H}),\ 7.47\ (td,\ J = 7.6, 1.3\text{ Hz, 1H}),\ 7.36 – 7.27\ (m,\ 2H),\ 4.13\ (t,\ J = 6.4\text{ Hz, 2H}),\ 2.86\ (ddd,\ J = 9.7, 6.2, 1.3\text{ Hz, 2H}),\ 2.06\ (s,\ 3H),\ 2.01 – 1.91\ (m,\ 2H).\ \]

\[ ^13C\text{NMR}\ (100\text{ MHz, CDCl}_3):\ \delta\ 171.1,\ 140.1,\ 131.8\ (d,\ J = 0.8\text{ Hz}),\ 131.0,\ 128.6\ (q,\ J = 29.8\text{ Hz}),\ 126.2,\ 126.0\ (q,\ J = 5.8\text{ Hz}),\ 124.6\ (q,\ J = 5.8\text{ Hz}),\ 63.8,\ 30.4,\ 29.1\ (d,\ J = 1.7\text{ Hz}),\ 20.9.\ \]

\[ ^19F\text{NMR}\ (376\text{ MHz, CDCl}_3):\ \delta\ -59.7.\ \]

IR (neat): 2940, 1737, 1608, 1311, 1111, 1030 cm\(^{-1}\). HRMS calc. for [C\(_{12}\)H\(_{13}\)F\(_3\)LiO\(_2")\]+ 253.1022; found 253.1019.
4-Acetoxypropylphenylboronic pinacol ester (3ii)

Following general procedure B with acetoxypropylsilicate II (0.45 mmol, 292 mg) and 4-Bromophenylboronic acid pinacol ester (0.3 mmol, 85 mg). The crude product was purified by flash column chromatography (pentane/EtOAc, 90/10) to afford 3ii as a brown oil (49 mg, 53%).

\[^1H\text{NMR}\ (400\text{ MHz, CDCl}_3): \delta\ 7.74\ (d, J = 8.0\ Hz, 2H), 7.20\ (d, J = 8.0\ Hz, 2H), 4.08\ (t, J = 6.6\ Hz, 2H), 2.72 - 2.68\ (m, 2H), 2.05\ (s, 3H), 1.97 - 1.94\ (m, 2H), 1.34\ (s, 12H).\]

\[^13C\text{NMR}\ (100\text{ MHz, CDCl}_3): \delta\ 171.1, 144.6, 135.0\ (2\ C), 127.8\ (2\ C), 83.7\ (2\ C), 63.8, 32.4, 30.1, 24.9\ (4\ C), 21.0.\]

\[^11B\text{NMR}\ (128\text{ MHz, CDCl}_3): 30.6.\]

IR (neat): 2960, 1737, 1611, 1357, 1235, 657 cm\(^{-1}\). HRMS calc. for [C\(_{17}\)H\(_{25}\)BNaO\(_4\)]\(^+\) 327.1741; found 327.1754.

3-(4-Hydroxyphenyl)propyl acetate (3im)

Following general procedure B with acetoxypropylsilicate II (0.45 mmol, 292 mg) and 4-bromophenylboronic acid pinacol ester 2m (0.3 mmol, 85 mg). After 24h of reaction, the crude reaction mixture was filtered through a plug of celite, washing with THF (15 mL). The filtrate was concentrated by rotary evaporation. The resulting solution of DMF was diluted with THF (10 mL) and cooled to 0°C in an ice water bath. To the cold stirring solution was added 1M NaOH (1.5 mL, 5 equiv.) and 30% aq. H\(_2\)O\(_2\) (171 \(\mu\)l, 5 equiv.). After 30 min the mixture was diluted with water (10 mL) and diethyl ether (10 mL) and neutralized by addition of 1M HCl (2.5 mL). The organic layer was collected and washed with water (2 x 10 mL), brine (2 x 10 mL), dried over MgSO\(_4\) and evaporated under reduced pressure. The crude product was purified by flash column chromatography (pentane/EtOAc, 90/10) to afford 3im as a brown oil (41 mg, 69%). The spectroscopic data are in agreement with those reported in the literature.\(^{[12]}\)

\[^1H\text{NMR}\ (400\text{ MHz, CDCl}_3): \delta\ 7.04\ (d, J = 8.5\ Hz, 2H), 6.76\ (d, J = 8.5\ Hz, 2H), 5.19\ (s, 1H) 4.08\ (t, J = 6.6\ Hz, 2H), 2.63 - 2.59\ (m, 2H), 2.06\ (s, 3H), 1.95 - 1.89\ (m, 2H).\]

\[^13C\text{NMR}\]
(100 MHz, CDCl₃): δ 171.5, 153.9, 133.2, 129.4 (2 C), 115.3 (2 C), 63.9, 31.2, 30.4, 21.0. IR (neat): 3356, 2978, 1707, 1595, 1514, 1227, 1035 cm⁻¹.

3-(2-Hydroxyphenyl)propyl acetate (3in)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 2-bromophenylboronic acid pinacol ester 2m (0.3 mmol, 67 µl). After 24h of reaction, the crude reaction mixture was filtered through a plug of celite, washing with THF (15 mL). The filtrate was concentrated by rotary evaporation. The resulting solution of DMF was diluted with THF (10 mL) and cooled to 0°C in an ice water bath. To the cold stirring solution was added 1M NaOH (1.5 mL, 5 equiv.) and 30% aq. H₂O₂ (171 µl, 5 equiv.). After 30 min the mixture was diluted with water (10 mL) and diethyl ether (10 mL) and neutralized by addition of 1M HCl (2.5 mL). The organic layer was collected and washed with water (2 x 10 mL), brine (2 x 10 mL), dried over MgSO₄ and evaporated under reduced pressure. The crude product was purified by flash column chromatography (pentane/EtOAc, 90/10) to afford 3in as a colorless oil (34 mg, 58%). The spectroscopic data are in agreement with those reported in the literature.¹³

¹H NMR (400 MHz, CDCl₃): δ 7.12 – 7.06 (m, 2H), 6.88 – 6.84 (m, 1H), 6.77 – 6.75 (m, 1H), 5.43 (s, 1H) 4.12 (t, J = 6.5 Hz, 2H), 2.72 – 2.68 (m, 2H), 2.07 (s, 3H), 1.99 – 1.94 (m, 2H), 13C NMR (100 MHz, CDCl₃): δ 171.6, 153.7, 130.3, 127.4, 127.3, 120.7, 115.4, 64.2, 28.6, 26.3, 21.0. IR (neat): 3355, 2999, 1707, 1491, 1236, 1032 cm⁻¹.

3-(4-Methoxyphenyl)propyl acetate (3io)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 4-iodoanisole 2o (0.3 mmol, 70 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3io as a colorless oil (29 mg, 46%).

¹H NMR (400 MHz, CDCl₃): δ 7.10 (d, J = 8.7 Hz, 2H), 6.83 (d, J = 8.7 Hz, 2H), 4.07 (t, J = 6.6 Hz, 2H), 3.79 (s, 3H), 2.65 – 2.61 (m, 2H), 2.05 (s, 3H), 1.96 – 1.89 (m, 2H). ¹³C NMR
(100 MHz, CDCl₃): δ 171.2, 157.9, 133.2, 129.3 (2 C), 113.9 (2 C), 63.8, 55.3, 31.2, 30.4, 21.0. IR (neat): 2941, 1734, 1612, 1299, 1234 cm⁻¹. HRMS calc. for [C₁₂H₁₆NaO₃]⁺ 231.0992; found 231.0989.

3-(3-Methoxyphenyl)propyl acetate (3ip)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 3-bromoanisole 2p (0.3 mmol, 38 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3ip as a colorless oil (34 mg, 54%).

¹H NMR (400 MHz, CDCl₃): δ 7.22 – 7.18 (m, 1H), 6.79 – 6.74 (m, 3H), 4.09 (t, J = 6.6 Hz, 2H), 3.80 (s, 3H), 2.69 – 2.65 (m, 2H), 2.06 (s, 3H), 1.99 – 1.92 (m, 2H). ¹³C NMR (100 MHz, CDCl₃): δ 171.1, 159.7, 142.8, 129.4, 120.8, 114.2, 111.2, 63.8, 55.1, 32.2, 30.1, 21.0. IR (neat): 2941, 1734, 1600, 1594, 1234, 1035 cm⁻¹. HRMS calc. for [C₁₂H₁₆NaO₃]⁺ 231.0992; found 231.0989.

3-(3,5-Dimethoxyphenyl)propyl acetate (3iq)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 1-bromo-3,5-dimethoxybenzene 2q (0.3 mmol, 65 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3iq as a colorless oil (46 mg, 65%).

¹H NMR (400 MHz, CDCl₃): δ 6.37 – 6.29 (m, 3H), 4.09 (t, J = 6.6 Hz, 2H), 3.78 (s, 6H), 2.65 – 2.61 (m, 2H), 2.06 (s, 3H), 1.98 – 1.91 (m, 2H). ¹³C NMR (100 MHz, CDCl₃): δ 171.3, 161.0, 143.7, 106.6 (2 C), 98.1 (2 C), 63.9, 55.4 (2 C), 32.6, 30.1, 21.1. IR (neat): 1734, 1594, 1236, 1204, 1147, 1036 cm⁻¹. HRMS calc. for [C₁₃H₁₈NaO₄]⁺ 261.1097; found 261.1087.
4-Anilinomethyl-2-fluoropyridine (3cr)

Following general procedure B with anilinomethylsilicate 1c (0.45 mmol, 294 mg) and 4-bromo-2-fluoropyridine 2r (0.3 mmol, 31 μL). The crude product was purified by flash column chromatography (pentane/EtOAc, 80/20) to afford 3cr as a colorless oil (53 mg, 86%).

^1^H NMR (400 MHz, CDCl₃): δ 8.15 (d, J = 5.2 Hz, 1H), 7.20 – 7.16 (m, 3H), 6.94 (s, 1H), 6.78 – 6.74 (m, 1H), 6.58 – 6.56 (m, 2H), 4.41 (s, 2H), 4.41 (s, 1H (N-H)).

^13^C NMR (100 MHz, CDCl₃): δ 164.3 (d, J = 238.8 Hz), 155.5 (d, J = 7.5 Hz), 147.7 (d, J = 15.1 Hz) 147.1, 129.34, 119.7 (d, J = 3.9 Hz), 118.3, 112.8, 107.7 (d, J = 37.8 Hz), 46.8 (d, J = 3.2 Hz).

^19^F NMR (376 MHz, CDCl₃): δ -68.12.

IR (neat): 3345, 3060, 1602, 1264, 732 cm⁻¹.

HRMS calc. for [C₁₂H₁₂FN₂]⁺ 203.0979; found 203.0977.

2-Fluoro-4-hexylpyridine (3dr)

Following general procedure B with hexylsilicate 1d (0.45 mmol, 285 mg) and 4-bromo-2-fluoropyridine 2r (0.3 mmol, 31 μL). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1 then 95/5) to afford 3dr as a colorless oil (47 mg, 87%).

^1^H NMR (400 MHz, CDCl₃): δ 8.07 (d, J = 5.1 Hz, 1H), 6.98 (dt, J = 5.1, 1.7 Hz, 1H), 6.72 (t, J = 1.8 Hz, 1H), 2.68 – 2.56 (m, 2H), 1.68 – 1.56 (m, 2H), 1.30 - 1.28 (m, 6H), 0.87 (t, J = 6.8 Hz, 3H).

^13^C NMR (100 MHz, CDCl₃): δ 164.2 (d, J = 237.9 Hz), 158.0 (d, J = 7.8 Hz), 147.3 (d, J = 15.5 Hz), 121.7 (d, J = 4.2 Hz), 109.1 (d, J = 36.3 Hz), 35.2 (d, J = 2.7 Hz), 31.6, 30.1, 28.9, 22.6, 14.1.

^19^F NMR (376 MHz, CDCl₃): δ -69.4. IR (neat): 2955, 2925, 2857, 1612, 1567, 1481, 1465, 1410, 1276, 1146, 1096, 1072 cm⁻¹.

HRMS (ESI-) calc. for [C₁₂H₁₆FNNa]⁻ 204.1159; found 204.1166.

4-(2-Fluoropyridin-4-yl)butanenitrile (3gr)
Following general procedure B with cyanopropylsilicate \(^1\text{ig}\) (0.45 mmol, 277 mg) and 4-4-bromo-2-fluoropyridine \(^2\text{ir}\) (0.3 mmol, 31 \(\mu\)l). The crude product was purified by flash column chromatography (pentane/EtOAc, 80/20) to afford 3gr as a colorless oil (29 mg, 59%).

\(^1\text{H NMR\ (400 MHz, CDCl} _3\): \(\delta\) 8.15 (d, \(J = 5.1\) Hz, 1H), 7.04 – 7.01 (m, 1H), 6.78 – 6.74 (m, 1H), 2.85 – 2.81 (m, 2H), 2.39 – 2.36 (m, 2H), 2.05 – 1.98 (m, 2H). \(^{13}\text{C NMR\ (100 MHz, CDCl} _3\): \(\delta\) 164.2 (d, \(J = 239.0\) Hz), 154.6 (d, \(J = 7.7\) Hz), 147.9 (d, \(J = 15.3\) Hz), 121.5 (d, \(J = 4.0\) Hz), 118.7, 107.7 (d, \(J = 37.0\) Hz), 33.5 (d, \(J = 3.0\) Hz), 25.6, 16.5. \(^{19}\text{F NMR\ (376 MHz, CDCl} _3\): \(\delta\) -68.10. \(\text{IR\ (neat): \(3060, 1672, 1613, 1412, 1265, 731\) cm} ^{-1}\). \(\text{HRMS\ calc.\ for\ [C}_9\text{H}_{10}\text{FN}_2\]} ^+ 165.0823; found 165.0822

3-(2-Fluoropyridin-4-yl)propyl acetate (3ir)

Following general procedure B with acetoxypropylsilicate \(^1\text{ii}\) (0.45 mmol, 292 mg) and 4-bromo-2-fluoropyridine \(^2\text{ir}\) (0.3 mmol, 31 \(\mu\)l). The crude product was purified by flash column chromatography (pentane/EtOAc, 80/20) to afford 3ir as a colorless oil (48 mg, 81%).

\(^1\text{H NMR\ (400 MHz, CDCl} _3\): \(\delta\) 8.09 (d, \(J = 5.2\) Hz, 1H), 7.02 – 6.98 (m, 1H), 6.74 (s, 1H), 4.08 (t, \(J = 6.4\) Hz, 2H), 2.74 – 2.71 (m, 2H), 2.03 (s, 3H), 2.02 – 1.95 (m, 2H). \(^{13}\text{C NMR\ (100 MHz, CDCl} _3\): \(\delta\) 170.9, 164.1 (d, \(J = 238.5\) Hz), 156.2 (d, \(J = 7.7\) Hz), 147.5 (d, \(J = 15.4\) Hz), 121.5 (d, \(J = 3.9\) Hz), 109.1 (d, \(J = 36.9\) Hz), 63.2, 31.5 (d, \(J = 3.0\) Hz), 28.9, 20.8. \(^{19}\text{F NMR\ (376 MHz, CDCl} _3\): \(\delta\) -68.84. \(\text{IR\ (neat): \(2935, 1733, 1612, 1411, 1265, 731\) cm} ^{-1}\). \(\text{HRMS\ calc.\ for\ [C}_1\text{O}_1\text{H}_{12}\text{FLiNO}_2\]} ^+ 204.1007; found 204.1015.

4-(3-Chloropropyl)-2-fluoropyridine (3mr)
Following general procedure B with 3-chloropropylsilicate 1m (0.45 mmol, 281 mg) and 4-bromo-2-fluoropyridine 2r (0.3 mmol, 31 µL). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1 then 95/5) to afford 3mr as a colorless oil (42 mg, 81%).

$^1$H NMR (400 MHz, CDCl$_3$): δ 8.12 (d, $J = 5.1$ Hz, 1H), 7.02 (dt, $J = 5.0$, 1.6 Hz, 1H), 6.85 – 6.68 (m, 1H), 3.53 (t, $J = 6.3$ Hz, 2H), 2.83 (dd, $J = 8.4$, 6.8 Hz, 2H), 2.19 – 2.02 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ 164.1 (d, $J = 239.5$ Hz), 155.7 (d, $J = 7.7$ Hz), 147.6, 121.7, 109.3 (d, $J = 38.0$ Hz), 43.6, 32.5, 31.9 (d, $J = 2.8$ Hz). $^{19}$F NMR (376 MHz, CDCl$_3$): δ -68.6. IR (neat): 2926, 1613, 1558, 1411, 1275, 1148, 908, 728 cm$^{-1}$. HRMS (ESI-) calc. for [C$_8$H$_9$ClFNNa]$^+$ 196.0300; found 196.0306.7

3-(2-Methylpyridin-3-yl)propyl acetate (3is)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 3-bromo-2-methylpyridine 2s (0.3 mmol, 35 µL). The crude product was purified by flash column chromatography (pentane/diethyl ether, 50/50) to afford 3is as a colorless oil (39 mg, 67%).

$^1$H NMR (300 MHz, CDCl$_3$): δ 8.34 (d, $J = 3.5$ Hz, 1H), 7.40 (d, $J = 7.5$, 1H), 7.06 (dd, $J = 7.6$ Hz, $J = 3.5$ Hz, 1H), 4.10 (t, $J = 6.4$ Hz, 2H), 2.70 – 2.65 (m, 2H), 2.53 (s, 3H), 2.05 (s, 3H) 1.96 – 1.87 (m, 2H). $^{13}$C NMR (75 MHz, CDCl$_3$): δ 171.0, 156.5, 147.7, 136.3, 134.4, 121.3, 63.6, 29.0, 28.5, 22.0, 20.9. IR (neat): 2942, 1736, 1574, 1441, 1232, 1035, 729 cm$^{-1}$. HRMS calc. for [C$_{11}$H$_{15}$NNaO$_2$]$^+$ 216.0995; found 216.1003.

3-(5-(Trifluoromethyl)pyridin-2-yl)propyl acetate (3it)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 2-bromo-5-(trifluoromethyl)pyridine 2t (0.3 mmol, 67 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 80/20) to afford 3it as a colorless oil (30 mg, 40%).
**1H NMR** (400 MHz, CDCl₃): δ 8.80 (d, J = 0.8 Hz, 1H), 7.84 (dd, J = 8.1 Hz, J = 1.9 Hz, 1H), 7.30 (d, J = 8.1 Hz, 1H), 4.10 (t, J = 6.4 Hz, 2H), 2.97 – 2.94 (m, 2H), 2.16 – 2.09 (m, 2H), 2.04 (s, 3H). **13C NMR** (75 MHz, CDCl₃): δ 171.1, 165.0 (d, J = 1.3 Hz), 146.3 (q, J = 4.1 Hz), 133.5(q, J = 3.5 Hz), 124.4 (d, J = 30 Hz), 123.7 (d, J = 270 Hz), 122.6, 63.6, 34.6, 28.2, 20.9. **19F NMR** (376 MHz, CDCl₃): δ -62.3. **IR** (neat): 2940, 1737, 1608, 1326, 1232, 1125, 732 cm⁻¹. **HRMS** calc. for [C₁₁H₁₂F₃NNaO₂]⁺ 270.0712; found 270.0707.

Methyl 5-(3-acetoxypropyl)nicotinate (3iu)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 5-bromopyridine-3-carboxylate 2u (0.3 mmol, 65 mg). The crude product was purified by flash column chromatography (pentane/ethyl acetate, 60/40) to afford 3iu as a colorless oil (47 mg, 75%).

**1H NMR** (400 MHz, CDCl₃): δ 9.05 (d, J = 1.7 Hz, 1H), 8.61 (d, J = 1.9 Hz, 1H), 8.12 (dd, J = 1.9 Hz, 1.7 Hz, 1H), 4.09 (t, J = 6.4 Hz, 2H), 3.94 (s, 3H), 2.78 – 2.74 (m, 2H), 2.04 (s, 3H) 2.02 – 1.95 (m, 2H). **13C NMR** (100 MHz, CDCl₃): δ 171.0, 165.8, 153.4, 148.6, 136.8, 136.5, 125.8, 63.3, 52.4, 29.7, 29.2, 20.9. **IR** (neat): 2942, 1722, 1426, 1231, 1027, 765 cm⁻¹. **HRMS** calc. for [C₁₂H₁₅NNaO₄]⁺ 260.0893; found 260.0897.

3-(Quinolin-3-yl)propyl acetate (3iv)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 3-bromoquinoline 2v (0.3 mmol, 41 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3iv as a colorless oil (45 mg, 65%).

**1H NMR** (400 MHz, CDCl₃): δ 8.78 (d, J = 2.2 Hz, 1H), 8.07 (d, J = 8.5 Hz, 1H), 7.92 (d, J = 2.2 Hz, 1H), 7.76 (d, J = 8.2 Hz, 1H), 7.68 – 7.62 (m, 1H), 7.58 – 7.50 (m, 1H), 4.14 (t, J = 6.6 Hz, 2H), 2.90 – 2.85 (m, 2H), 2.10 – 2.06 (m, 2H), 2.05 (s, 3H). **13C NMR** (100 MHz, CDCl₃): δ 171.0, 151.9, 146.9, 134.2, 133.8, 129.2, 128.8, 128.0, 127.3, 126.7, 63.5, 29.8,
29.6, 20.9. IR (neat): 2938, 1732, 1605, 1494, 1365, 1232 cm\(^{-1}\). HRMS calc. for [C\(_{14}\)H\(_{16}\)NO\(_{2}\)]\(^{+}\) 230.1176; found 230.1183.

3-(Pyrimidin-5-yl)propyl acetate (3iw)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 5-bromopyrimidine 2w (0.3 mmol, 48 mg). The crude product was purified by flash column chromatography (pentane/ethyl acetate, 50/50) to afford 3iw as a colorless oil (18 mg, 33%).

\(^1\)H NMR (300 MHz, CDCl\(_3\)): \(\delta\) 9.09 (s, 1H), 8.60 (s, 2H), 4.12 (t, \(J = 6.3\) Hz, 2H), 2.73 – 2.68 (m, 2H), 2.05 (s, 3H), 2.03 – 1.94 (m, 2H). \(^{13}\)C NMR (75 MHz, CDCl\(_3\)): \(\delta\) 170.9, 156.9 (2 C), 156.7, 134.2, 63.1, 29.4, 27.0, 20.9. IR (neat): 2942, 1734, 1232, 1040, 697 cm\(^{-1}\). HRMS calc. for [C\(_{9}\)H\(_{12}\)N\(_{2}\)NaO\(_{2}\)]\(^{+}\) 203.0791; found 270.0797.

3-(1-Methyl-1H-indol-5-yl)propyl acetate (3ix)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 5-bromo-1-methyl-1H-indole 2x (0.3 mmol, 63 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3ix as a colorless oil (12 mg, 17%).

\(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.47 – 7.42 (m, 1H), 7.28 (s, 1H), 7.09 – 7.04 (m, 2H), 6.44 (d, \(J = 3.1\) Hz, 1H), 4.13 (t, \(J = 6.6\) Hz, 2H), 3.80 (s, 3H), 2.84 – 2.79 (m, 2H), 2.10 – 2.05 (m, 3H), 2.04 – 2.00 (m, 2H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 171.2, 135.5, 132.0, 129.0, 128.7, 122.4, 120.1, 109.1, 100.5, 64.0, 32.8, 32.2, 31.0, 21.0. IR (neat): 2912, 1732, 1615, 1239, 1101, 1036, 718 cm\(^{-1}\). HRMS calc. for [C\(_{14}\)H\(_{17}\)NNaO\(_{2}\)]\(^{+}\) 254.11151; found 254.1153.
3-(Benzofuran-5-yl)propyl acetate (3iy)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 5-bromobenzofuran 2y (0.3 mmol, 38 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford 3iy as a colorless oil (48 mg, 73%).

$^1$H NMR (400 MHz, CDCl$_3$): δ 7.60 (d, $J = 2.2$ Hz, 1H), 7.41 (m, 2H), 7.12 (dd, $J = 8.4$ Hz, 1.7 Hz, 1H), 6.71 (dd, $J = 2.2$ Hz, 0.9 Hz, 1H), 4.10 (t, $J = 6.6$ Hz, 2H), 2.80 – 2.77 (m, 2H), 2.06 (s, 3H) 2.03 – 1.96 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ 171.1, 153.6, 145.2, 135.6, 127.6, 124.8, 120.5, 111.1, 106.3, 63.8, 32.0, 30.8, 21.0. IR (neat): 2948, 1733, 1467, 1234, 1030, 734 cm$^{-1}$. HRMS calc. for [C$_{13}$H$_{14}$NaO$_3$]$^+$ 241.0835; found 241.0841.

3-(Thiophen-3-yl)propyl acetate (3iz)

Following general procedure B with acetoxypropylsilicate 1i (0.45 mmol, 292 mg) and 3-bromothiophene 2z (0.3 mmol, 29 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford 3iz as a colorless oil (28 mg, 50%).

$^1$H NMR (400 MHz, CDCl$_3$): δ 7.13 (dd, $J = 5.2$ Hz, 1.2 Hz, 1H), 6.92 (dd, $J = 5.1$ Hz, 3.4 Hz, 1H), 6.80 (s, 1H), 4.12 (t, $J = 6.4$ Hz, 2H), 2.95 – 2.90 (m, 2H), 2.06 (s, 3H), 2.04 – 1.99 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ 171.1, 143.9, 126.8, 124.5, 123.2, 63.5, 30.5, 26.3, 20.9. IR (neat): 2942, 1734, 1232, 1040, 697 cm$^{-1}$. HRMS calc. for [C$_9$H$_{12}$SLiO$_2$]$^+$ 191.0713; found 191.0710.
IV. $^1$H, $^{13}$C, $^{11}$B, $^{19}$F and $^{29}$Si NMR spectra

$^1$H spectrum of 1g

$^{13}$C spectrum of 1g
$^{29}\text{Si}$ spectrum of $1g$

![Si spectrum of 1g](image)

$^1\text{H}$ spectrum of $1h$

![H spectrum of 1h](image)
$^{13}$C spectrum of $1h$

![13C Spectrum](image1)

$^{29}$Si spectrum of $1h$

![29Si Spectrum](image2)
$^{19}$F spectrum of 1h

$^1$H spectrum of 1i
$^{13}$C spectrum of 1i

![13C spectrum of 1i](image)

$^{29}$Si spectrum of 1i

![$^{29}$Si spectrum of 1i](image)
$^1$H spectrum of li’

ii’

$^{13}$C spectrum of li’

ii

S34
$^{1}H$ spectrum of 1j

![1H spectrum of 1j](image)

$^{13}C$ spectrum of 1j

![13C spectrum of 1j](image)
$^{29}$Si spectrum of 1j

1H spectrum of 1m
$^{13}$C spectrum of 1m

$^{29}$Si spectrum of 1m
$^1$H spectrum of 3aa

$^{13}$C spectrum of 3aa

S38
$^1$H spectrum of 3ba

$^{13}$C spectrum of 3ba
$^1$H spectrum of 3ca

3ca

$^{13}$C spectrum of 3ca

3ca
$^1$H spectrum of 3da

$^{13}$C spectrum of 3da
$^1$H spectrum of 3ea

$^{13}$C spectrum of 3ea
$^1$H spectrum of 3fa

$^{13}$C spectrum of 3fa
$^1$H spectrum of 3ga

$^{13}$C spectrum of 3ga

S44
$^1$H spectrum of 3ha

3ha

$^{13}$C spectrum of 3ha

3ha
$^{19}$F spectrum of 3ha

$^1$H spectrum of 3ia

S46
$^{13}$C spectrum of 3ia

3ia

$^1$H spectrum of 3ja

3ja
$^{13}$C spectrum of 3ja

$^1$H spectrum of 3ka
$^{13}$C spectrum of 3ka

3ka

$^1$H spectrum of 3la

3la
$^{13}$C spectrum of 3ma

$^{1}$H spectrum of 3ib
$^{13}$C spectrum of 3ib

$^1$H spectrum of 3ic
$^{13}$C spectrum of 3ic

$^1$H spectrum of 3id
$^{13}\text{C}$ spectrum of 3id

![Carbon spectrum of 3id](image)

3id

$^1\text{H}$ spectrum of 3ie

![Hydrogen spectrum of 3ie](image)

3ie
$^{13}$C spectrum of 3ie

![13C spectrum of 3ie](image)

$^{19}$F spectrum of 3ie

![19F spectrum of 3ie](image)
$^1$H spectrum of 3if

![1H spectrum of 3if](image)

$^{13}$C spectrum of 3if

![13C spectrum of 3if](image)
$^1$H spectrum of 3ig

3ig

$^{13}$C spectrum of 3ig

3ig
$^1$H spectrum of 3ig and 3ig$^\prime$

3ig + 3ig$^\prime$

$^{13}$C spectrum of 3ig and 3ig$^\prime$

3ig + 3ig$^\prime$
$^1$H spectrum of 3ih

$^{13}$C spectrum of 3ih
$^1$H spectrum of 3ii

$^{13}$C spectrum of 3ii
$^1$H spectrum of 3ij

$^{13}$C spectrum of 3ij
$^{19}\text{F}$ spectrum of 3ij

$^{1}\text{H}$ spectrum of 3ik
$^{13}$C spectrum of 3ik

![Spectrum](image)

$^{19}$F spectrum of 3ik

![Spectrum](image)
$^1$H spectrum of 3il

$^{13}$C spectrum of 3il
$^{13}$C spectrum of 3im

![$^{13}$C spectrum of 3im]

$^1$H spectrum of 3in

![$^1$H spectrum of 3in]
$^{13}$C spectrum of 3in

![Carbon Spectrum of 3in](image)

$^1$H spectrum of 3io

![Proton Spectrum of 3io](image)
$^{13}$C spectrum of 3io

3io

$^1$H spectrum of 3ip

3ip
$^{13}$C spectrum of 3ip

$^1$H spectrum of 3iq
$^{13}$C spectrum of 3iq

$^1$H spectrum of 3cr
$^{13}$C spectrum of 3cr

![13C spectrum of 3cr](image)

$^{19}$F spectrum of 3cr

![19F spectrum of 3cr](image)
$^1$H spectrum of 3dr

3dr

$^{13}$C spectrum of 3dr

3dr
$^{19}\text{F}$ spectrum of 3dr

3dr

$^{1}\text{H}$ spectrum of 3gr

3gr
$^{13}\text{C}$ spectrum of 3gr

$^{19}\text{F}$ spectrum of 3gr
$^1$H spectrum of 3ir

$^{13}$C spectrum of 3ir
$^{19}$F spectrum of 3ir

![19F spectrum of 3ir](image)

$^1$H spectrum of 3mr

![1H spectrum of 3mr](image)
$^{13}$C spectrum of 3mr

$^{19}$F spectrum of 3mr
$^1$H spectrum of 3is

$^{13}$C spectrum of 3is

S78
$^1$H spectrum of 3it

![$^1$H spectrum of 3it](image)

$^{13}$C spectrum of 3it

![$^{13}$C spectrum of 3it](image)
$^{19}$F spectrum of 3it

$^{1}$H spectrum of 3iu
$^{13}$C spectrum of 3iu

![$^{13}$C spectrum of 3iu](image)

3iu

$^1$H spectrum of 3iv

![$^1$H spectrum of 3iv](image)

3iv
$^{13}$C spectrum of 3iv

\[ \text{3iv} \]

$^1$H spectrum of 3iw

\[ \text{3iw} \]
$^{13}$C spectrum of 3iw

![Carbon spectrum](image)

3iw

$^1$H spectrum of 3ix

![Hydrogen spectrum](image)

3ix
\(^{13}\)C spectrum of 3ix

\[ \text{3ix} \]

\(^1\)H spectrum of 3iy

\[ \text{3iy} \]
$^{13}$C spectrum of 3iy

3iy

$^1$H spectrum of 3iz

3iz

S85
$^{13}$C spectrum of 3iz
V. References