Supporting Information for:

Coupling Reactions of Bromoalkynes with Imidazoles Mediated by Copper Salts: Synthesis of Novel N-Alkynylimidazoles.

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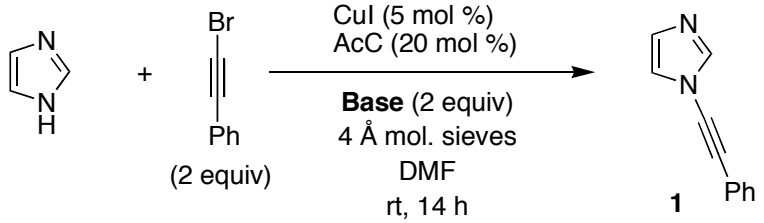
Table of Contents:

Table S1. Effects of bases and air on reactions performed in DMF as solvent.[a]



Entry	Base	Conditions	Yield[b]
1	Cs_2CO_3	Under Ar	26%
2	K_3PO_4	Under Ar	26%
3	K_2CO_3	Under Ar	26%
4	Cs_2CO_3	Open to air	26%
5	Cs_2CO_3 (1 equiv)	Under Ar	21%
6	Cs_2CO_3 (4 equiv)	Under Ar	23%

[a] Reactions carried out on 1 mmole scale in 2 mL of solvent. [b] Isolated yield after column chromatography.

Supplemental Experimental Section

General: All reactions were carried out under argon in oven-dried glassware with magnetic stirring. Unless otherwise noted, all materials were obtained from commercial suppliers and were used without further purification. CuI was purified by recrystallization[23] and Cs_2CO_3 was heated several times with a heat gun in the reaction flask under vacuum prior to use. THF, 1,4-dioxane and dimethoxyethane (DME) were distilled from sodium/benzophenone prior to use. Dimethylsulfoxide (DMSO) and toluene were distilled from CaH_2 prior to use. DMF was dried over 4Å molecular sieves overnight prior to use. Unless otherwise noted, organic extracts were dried with Na_2SO_4, filtered through a fritted glass funnel, and concentrated with a rotary evaporator (20–30 mmHg). R_f values are reported for analytical thin-layer chromatography (TLC) performed on 0.25 mm silica gel 60-F plates with UV light or $KMnO_4$ visualization.

Flash chromatography was performed with silica gel (230–400 mesh) using the mobile phase indicated. Melting points (open capillary) are uncorrected. Unless otherwise noted, ^{1}H and ^{13}C NMR spectra were determined in $CDCl_3$ on a spectrometer operating at 400 and 100 MHz, respectively, and are reported in ppm using solvent as internal standard (7.26 ppm for ^{1}H and 77.0 ppm for ^{13}C). All mass spectra were obtained in the positive mode by chemical ionization using methane as the ionizing gas.

General procedure for the bromoalkyne synthesis: To a solution of alkyne (10 mmol) in acetone (50 mL) was added NBS (3.56 g, 20 mmol) and $AgNO_3$ (170 mg, 1 mmol) at room temperature with magnetic stirring. After 4 hours, the solvent was carefully removed under reduced pressure, diluted with hexane and filtered. The filtrate was concentrated and purified by flash chromatography. This method proved to be suitable for the synthesis of 1-bromophenylacetylene,[1] 1-bromotriisopropylsilylacetylene,[1] 1-bromooctyne,[1] *tert*-butyldimethylsilyloxy-3-bromoprop-2-yne[2] and 2-methyl-2-(*tert*-butyldimethylsilyloxy)-4-bromobut-3-yne.[2]

Characterization data for *N*-alkynylimidazoles:

1-(2-triisopropylsilanylethynyl)-1*H*-imidazole 2: Following the general procedure described but without the additional heating under reflux (flash chromatography; 0–20% EtOAc/hexane), 131 mg of **2** (53%) was obtained as a colorless oil: ^{1}H NMR δ 7.71 (1H, s), 7.09 (1H, s), 6.98 (1H, s), 1.10-1.07 (21H, m); ^{13}C NMR δ 140.1, 128.8, 121.7, 91.6,

69.6, 18.4 (6C), 11.0 (3C); IR (neat) 2943, 2866, 2193, 1482, 1072 cm^{-1}; MS (*m/z*): 249 (M+1, 100%); HRMS calc for $C_{14}H_{25}N_2Si$ ($M+H^+$) 249.1791, found 249.1787.

1-octynyl-1*H*-imidazole 3: Following the general procedure described (flash chromatography; 0–25% EtOAc/hexane), 93 mg of **3** (53%) was obtained as a pale yellow oil: ^1H NMR δ 7.64 (1H, s), 7.03 (1H, s), 6.96 (1H, s), 2.32 (2H, t, *J* = 7.0 Hz), 1.54 (2H, quint, *J* = 7.2 Hz), 1.42-1.32 (2H, m), 1.31-1.21 (4H, m), 0.87 (3H, t, *J* = 6.8 Hz); ^{13}C NMR δ 139.9, 128.6, 121.7, 70.5, 69.7, 31.2, 28.4, 28.3, 22.4, 18.0, 13.9; IR (neat) 2931, 2860, 2274, 1490, 1296, 1239, 1103, 1036 cm^{-1}; MS (*m/z*): 177 (M+1, 100%); HRMS calc for $C_{11}H_{17}N_2$ ($M + H^+$) 177.1392, found 177.1395.

1-(3-(*tert*-butyldimethylsilanyloxy)-prop-1-ynyl)-1*H*-imidazole 4: Following the general procedure described (flash chromatography; 0–15% EtOAc/hexane), 52 mg of **4** (22%) was obtained as a white solid: mp 41.6–43.5 °C; ^1H NMR δ 7.71 (1H, s), 7.09 (1H, s), 7.02 (1H, s), 4.51 (2H, s), 0.91 (9H, s), 0.13 (6H, s); ^{13}C NMR δ 140.1, 129.1, 121.7, 73.8, 69.3, 51.4, 25.7 (3C), 18.3, –5.2 (2C); IR (KBr) 2930, 2857, 2270, 1613, 1496, 1459, 1280, 1225, 1190, 1130 cm^{-1}; MS (*m/z*): 237 (M+1, 100%); HRMS calc for $C_{12}H_{21}N_2OSi$ ($M + H^+$) 237.1423, found 237.1422.

1-(3-(*tert*-Butyldimethylsilanyloxy)-3-methylbut-1-ynyl)-1*H*-imidazole 5: Following the general procedure described (flash chromatography; 0–10% EtOAc/hexane), 149 mg of **5** (56%) was obtained as a pale yellow liquid: ^1H NMR δ 7.68 (1H, s), 7.07 (1H, s), 7.03 (1H, s), 1.53 (6H, s), 0.86 (9H, s), 0.15 (6H, s); ^{13}C NMR δ 139.8, 129.1, 121.5, 75.4, 72.1, 66.3, 32.7 (2C), 25.6 (3C), 17.9, -3.0 (2C); IR (neat) 2956, 2932, 2858, 2270,

1490, 1253, 1199, 1162, 1042, 1020 cm^{-1}; MS (*m/z*): 265 (M+1, 100%), 207 (9%), 133 (12%); HRMS calc for $C_{14}H_{25}N_2OSi$ ($M + H^+$) 265.1736, found 265.1739.

1-(2-phenylethynyl)-1*H*-benzimidazole 6: Following the general procedure described (flash chromatography; 0–20% EtOAc/hexane), 137 mg of **6** (63%) was obtained as a white solid: mp 46.1–48.2 °C; ^1H NMR δ 8.13 (1H, s), 7.85 (1H, d, *J* = 8.4 Hz), 7.65 (1H, d, *J* = 8.4 Hz), 7.59-7.57 (2H, m), 7.44-7.34 (5H, m); ^{13}C NMR δ 143.5, 141.7, 134.4, 131.8 (2C), 129.0, 128.6 (2C), 124.9, 124.1, 121.3, 120.7, 111.0, 76.3, 73.6; IR (KBr) 3102, 2253, 1486, 1455, 1399, 1291, 1242, 1163 cm^{-1}; MS (*m/z*): 219 (M+1, 100%); HRMS calc for $C_{15}H_{11}N_2$ ($M + H^+$) 219.022, found 219.022.

1-(2-triisopropylsilanylethynyl)-1*H*-benzimidazole 7: Following the general procedure described (flash chromatography; 0–10% EtOAc/hexane), 211 mg of **7** (71%) was obtained as a yellow oil: ^1H NMR δ 8.10 (1H, s), 7.81 (1H, d, *J* = 8.0 Hz), 7.56 (1H, d, *J* = 8.0 Hz), 7.42-7.33 (2H, m), 1.21-1.16 (21H, m); ^{13}C NMR δ 143.6, 141.7, 124.7, 123.9, 120.7, 110.9, 90.0, 72.9, 18.6 (6C), 11.1 (3C); IR (neat) 2943, 2865, 2190, 1498, 1456, 1277 cm^{-1}; MS (*m/z*): 299 (M+1, 100%); HRMS calc for $C_{18}H_{27}N_2Si$ ($M + H^+$) 299.1947, found 299.1944.

1-octynyl-1*H*-benzimidazole 8: Following the general procedure described (flash chromatography; 0–5% EtOAc/hexane), 122 mg of **8** (54%) was obtained as a pale yellow oil: ^1H NMR δ 8.02 (1H, s), 7.78 (1H, d, *J* = 7.6 Hz), 7.53 (1H, d, *J* = 7.5 Hz), 7.36 (1H, td, *J* = 7.5, 1.1 Hz), 7.31 (1H, td, *J* = 7.6, 1.3 Hz), 2.45 (2H, t, *J* = 7.0 Hz), 1.63 (2H, quint, *J* = 7.2 Hz), 1.52-1.42 (2H, m), 1.38-1.26 (4H, m), 0.90 (3H, t, *J* = 6.9 Hz); ^{13}C NMR δ 143.8, 141.7, 134.6, 124.3, 123.5, 120.5, 110.7, 73.6, 68.0, 31.2, 28.5, 28.4,

22.4, 18.2, 14.0; IR (neat) 3115, 2954, 2931, 2274, 1494, 1401, 1300, 1256, 1089 cm^{-1}; MS (*m/z*): 227 (M+1, 100%); HRMS calc for $C_{15}H_{19}N_2$ ($M + H^+$) 227.1548, found 227.1552.

4-phenyl-1-(2-phenylethynyl)-1*H*-imidazole 9a: Following the general procedure described but without the additional heating under reflux (flash chromatography; 0–15% EtOAc/hexane), 154 mg of **9a** (63%) was obtained as a white solid: mp 115.4–117.1 °C; ^1H NMR δ 7.87-7.80 (3H, m), 7.56-7.52 (2H, m), 7.45-7.37 (6H, m), 7.33-7.28 (1H, m); ^{13}C NMR δ 141.9, 140.1, 132.6, 131.6 (2C), 128.9, 128.6 (2C), 128.5 (2C), 127.5, 125.1 (2C), 120.9, 116.6, 78.0, 70.6; IR (KBr) 3316, 3083, 2260, 1488, 1412, 1147, 1061, 1020 cm^{-1}; MS (*m/z*): 245 (M+1, 100%); HRMS calc for $C_{17}H_{13}N_2$ ($M + H^+$) 245.1079, found 245.1083.

5-phenyl-1-(2-phenylethynyl)-1*H*-imidazole 9b: Also isolated from the chromatography referred to above was 12 mg of **9b** (8%), which was obtained as a yellow oil: ^1H NMR δ 7.89 (1H, s), 7.74-7.70 (2H, m), 7.49-7.33 (8H, m), 7.20 (1H, s); ^{13}C NMR δ 141.1, 134.5, 131.4 (2C), 128.9, 128.6 (2C), 128.5 (2C), 128.5, 128.2, 127.4 (2C), 126.7, 121.2, 77.8, 73.1; IR (neat) 2926, 2264, 1469, 1441, 1294, 1200, 1155, 1105, 905 cm^{-1}; MS (*m/z*): 245 (M+1, 100%); HRMS calc for $C_{17}H_{13}N_2$ ($M + H^+$) 245.1079, found 245.1078.

4-phenyl-1-(2-triisopropylsilanylethynyl)-1*H*-imidazole 10a: Following the general procedure described (flash chromatography; 0–3% EtOAc/hexane), 291 mg of **10a** (90%) was obtained as a colorless liquid: ^1H NMR δ 7.80-7.76 (3H, m), 7.42-7.36 (3H, m), 7.29 (1H, tt, J = 7.4, 1.5 Hz), 1.15-1.13 (21H, m); ^{13}C NMR δ 141.7, 140.4, 132.7, 128.7

(2C), 127.6, 125.2 (2C), 116.9, 91.6, 70.1, 18.5 (6C), 11.2 (3C); IR (neat) 2944, 2866, 2195, 2163, 1609, 1493, 1462, 1026, 883 cm^{-1}; MS (*m/z*): 325 (M+1, 100%). HRMS calc for $C_{20}H_{29}N_2Si$ ($M + H^+$) 325.2100, found 325.2103.

4-phenyl-1-octynyl-1*H*-imidazole 11a: Following the general procedure described (flash chromatography; 0–5% EtOAc/hexane), 111 mg of **11a** (44%) was obtained as a white solid: Mp 54.0–56.0 °C; ^1H NMR δ 7.79 (2H, d, *J* = 7.2 Hz), 7.74 (1H, s), 7.39 (2H, t, *J* = 7.8 Hz), 7.34 (1H, s), 7.28 (1H, t, *J* = 7.4 Hz), 2.38 (2H, t, *J* = 7.2 Hz), 1.60 (2H, quint, *J* = 7.2 Hz), 1.45 (2H, quint, *J* = 7.0 Hz), 1.37-1.28 (4H, m), 0.93 (3H, t, *J* = 6.8 Hz); ^{13}C NMR δ 141.3, 140.1, 132.9, 128.5 (2C), 127.2, 125.0 (2C), 116.8, 70.8, 69.7, 31,2, 28.4, 28.2, 22.4, 18.0, 13.9; IR (KBr) 3116, 3085, 2952, 2931, 2855, 2271, 1492, 1463, 1372, 1265, 1218, 1066, 936, 825, 759, 725 cm^{-1}; MS (*m/z*): 253 (M+1, 100%); HRMS calc for $C_{17}H_{21}N_2$ ($M + H^+$) 253.1705, found 253.1707.

2-methyl-1-(2-phenylethynyl)-1*H*-imidazole 12: Following the general procedure described (flash chromatography; 0–30% EtOAc/hexane), 51 mg of **12** (28%) was obtained as a yellow oil: ^1H NMR δ 7.49-7.44 (2H, m), 7.35-7.31 (3H, m), 7.05 (1H, d, *J* = 1.6 Hz), 6.88 (1H, d, *J* = 1.6 Hz), 2.51 (3H, s); ^{13}C NMR δ 148.6, 131.4 (2C), 128.6, 128.3 (2C), 127.6, 121.2, 121.0, 78.0, 72.4, 13.1; IR (neat) 2266, 1547, 1502, 1423, 1286, 1184, 1153, 983 cm^{-1}; MS (*m/z*): 183 (M+1, 100%); HRMS calc for $C_{12}H_{11}N_2$ ($M + H^+$) 183.0922, found 183.0927.

4-methyl-1-(2-phenylethynyl)-1*H*-imidazole 13a: Following the general procedure described (flash chromatography; 0–30% EtOAc/hexane), 13 mg (18%) of a 3:2 mixture of **13a** and **13b** was obtained, along with 8 mg of pure **13a** (4%) isolated as a brownish

solid: Mp 74.5–76.4 °C; ^{1}H NMR δ 7.71 (1H, s), 7.50-7.46 (2H, m), 7.37-7.34 (3H, m), 6.89 (1H, s), 2.24 (3H, s); ^{13}C NMR δ 139.4, 138.5, 131.6 (2C), 128.8, 128.5 (2C), 121.3, 117.8, 78.4, 69.7, 13.4; IR (KBr) 2924, 2264, 1483, 1446, 1415, 1292, 1026, 756, 691 cm^{-1}; MS (*m/z*): 183 (M+1, 100%); HRMS calc for $C_{12}H_{11}N_2$ (M + H$^+$) 183.0922, found 183.0926.

5-methyl-1-(2-phenylethynyl)-1*H*-imidazole 13b: Also isolated from the chromatography referred to above was 13 mg of **13b** (7%) obtained as yellow oil: ^{1}H NMR (400 MHz, C_6D_6) δ 7.43 (1H, s), 7.36-7.31 (2H, m), 7.02-6.98 (3H, m), 6.75 (1H, s), 1.85 (3H, d, *J* = 1.2 Hz); ^{13}C NMR (100 MHz, C_6D_6) δ 139.0, 131.9 (2C), 130.1, 128.8, 128.7 (2C), 126.8, 122.0, 77.9, 72.8, 8.7; IR (neat) 3118, 3059, 2923, 2263, 2227, 1578, 1479, 1443, 1410, 1263, 1186, 1093 cm^{-1}; MS (*m/z*): 183 (M+1, 100%); HRMS calc for $C_{12}H_{11}N_2$ (M + H$^+$) 183.0922, found 183.0927.

5-(4-fluorophenyl)-4-(4-pyridyl)-1-(2-triisopropylsilanyl)-1*H*-imidazole 14a: Following the general procedure described (flash chromatography; 0–30% EtOAc/hexane), 50 mg of 1**4a** (12%) was obtained as a yellow solid: mp 91.0–92.0 °C; ^{1}H NMR δ 8.48 (2H, br s), 7.89 (1H, s), 7.46-7.41 (4H, m), 7.18-7.14 (2H, m), 1.0-0.96 (21H, m); ^{13}C NMR δ 163.5 (d, *J* = 249.3 Hz , 149.8 (2C), 140.6, 140.0 (2C), 134.6, 132.3 (2C, d, *J* = 8.2 Hz), 131.4, 123.9 (d, *J* = 3.8 Hz), 120.9, 116.1 (2C, d, *J* = 21.6 Hz), 89.8, 74.0, 18.3 (6C), 11.0 (3C); IR (KBr) 3126, 2926, 2864, 2197, 2172, 1599, 1510, 1493, 1462, 1402, 1252 cm^{-1}; MS (*m/z*): 420 (M+1, 100%); HRMS calc for $C_{25}H_{31}N_3FSi$ (M + H$^+$) 420.2271, found 420.2272.

4-(4-fluorophenyl)-5-(4-pyridyl)-1-(2-triisopropylsilanyl)-1*H*-imidazole 14b: Also isolated from the chromatography referred to above was 13 mg of **14b** (3%) obtained as a yellow solid: mp 71–73 °C; ^{1}H NMR δ 8.66 (2H, s, br), 7.92 (1H, s), 7.49-7.45 (2H, m), 7.42 (2H, d, *J* = 5.2 Hz), 7.02-6.97 (2H, m), 1.05-1.01 (21H, m); IR (KBr) 3114, 2925, 2865, 2194, 1606, 1513, 1463, 1406, 1226, 1156, 1090, 1034 cm^{-1}; MS (*m/z*): 420 (M+1, 100%); HRMS calc for $C_{25}H_{31}N_3FSi$ (M + H$^+$) 420.2271, found 420.2267.

4-(4-fluorophenyl)-1-(2-triisopropylsilanylethynyl)-1*H*-imidazole 15a: Following the general procedure described (flash chromatography; 0–10% EtOAc/hexane), 246 mg of 1**5a** (72%) was obtained as an orange solid: mp = 29.5–30.7 °C; ^{1}H NMR δ 7.76 (1H, d, *J* = 1.2 Hz), 7.75-7.70 (2H, m), 7.32 (1H, d, *J* = 1.2 Hz), 7.08-7.03 (2H, m), 1.14-1.12 (21H, m); ^{13}C NMR δ 162.3 (d, *J* = 245.5 Hz), 140.8, 140.3, 128.9 (d, *J* = 2.9 Hz), 126.8 (2C, d, *J* = 8.2 Hz), 116.5, 115.5 (2C, d, *J* = 21.6 Hz), 91.5, 70.1, 18.5 (6C), 11.1 (3C); IR (KBr) 3145, 2945, 2893, 2866, 2195, 2164, 1564, 1501, 1463, 1397, 1232, 1156, 1028, 996 cm^{-1}; MS (*m/z*): 343 (M+1, 100%); HRMS calc for $C_{20}H_{28}FN_2Si$ (M + H$^+$) 343.2006, found 343.2003.

5-(4-fluorophenyl)-1-(2-triisopropylsilanylethynyl)-1*H*-imidazole 15b: Also isolated from the chromatography referred to above was 23 mg of **15b** (7%) obtained as a yellow liquid: ^{1}H NMR δ 7.83 (1H, s, br), 7.65-7.61 (2H, m), 7.12-7.06 (3H, m), 1.14-1.01 (21H, m); IR (neat) 3082, 2945, 2866, 2194, 2159, 1600, 1564, 1504, 1468, 1384, 1291, 1236, 1196, 1161, 1102, 1015cm^{-1}; MS (*m/z*): 343 (M+1, 100%); HRMS calc for $C_{20}H_{28}FN_2Si$ (M + H$^+$) 343.2006, found 343.2004.

References

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2. Marino, J. P.; Nguyen, H. N. *J. Org. Chem.* **2002**, *67*, 6841-6844.

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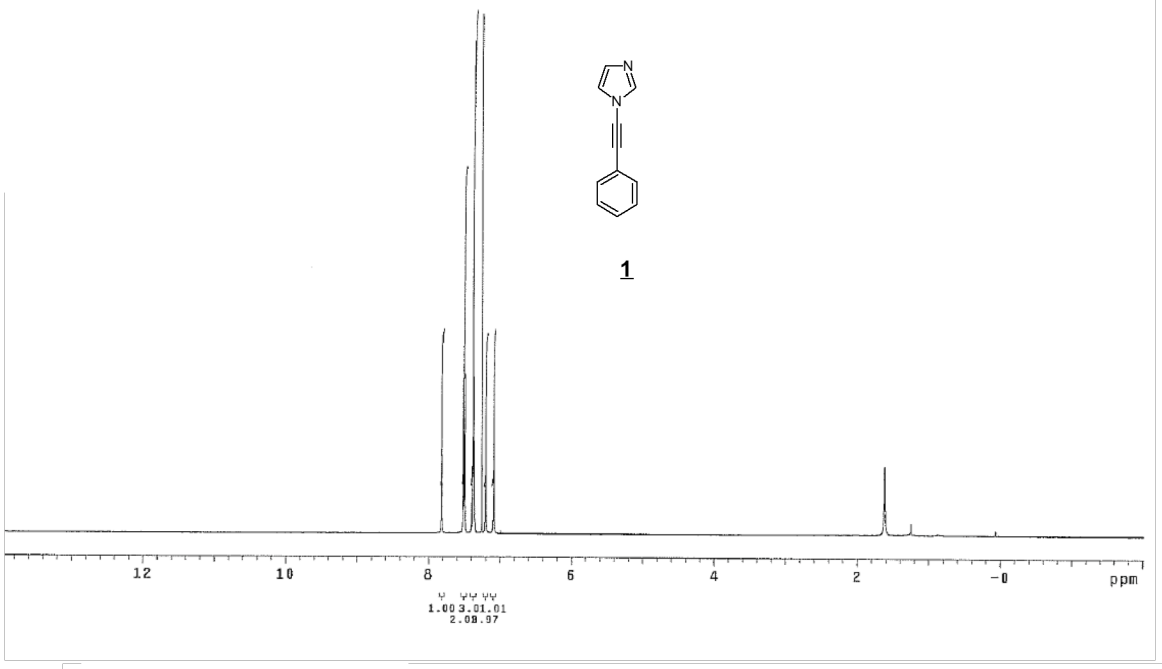

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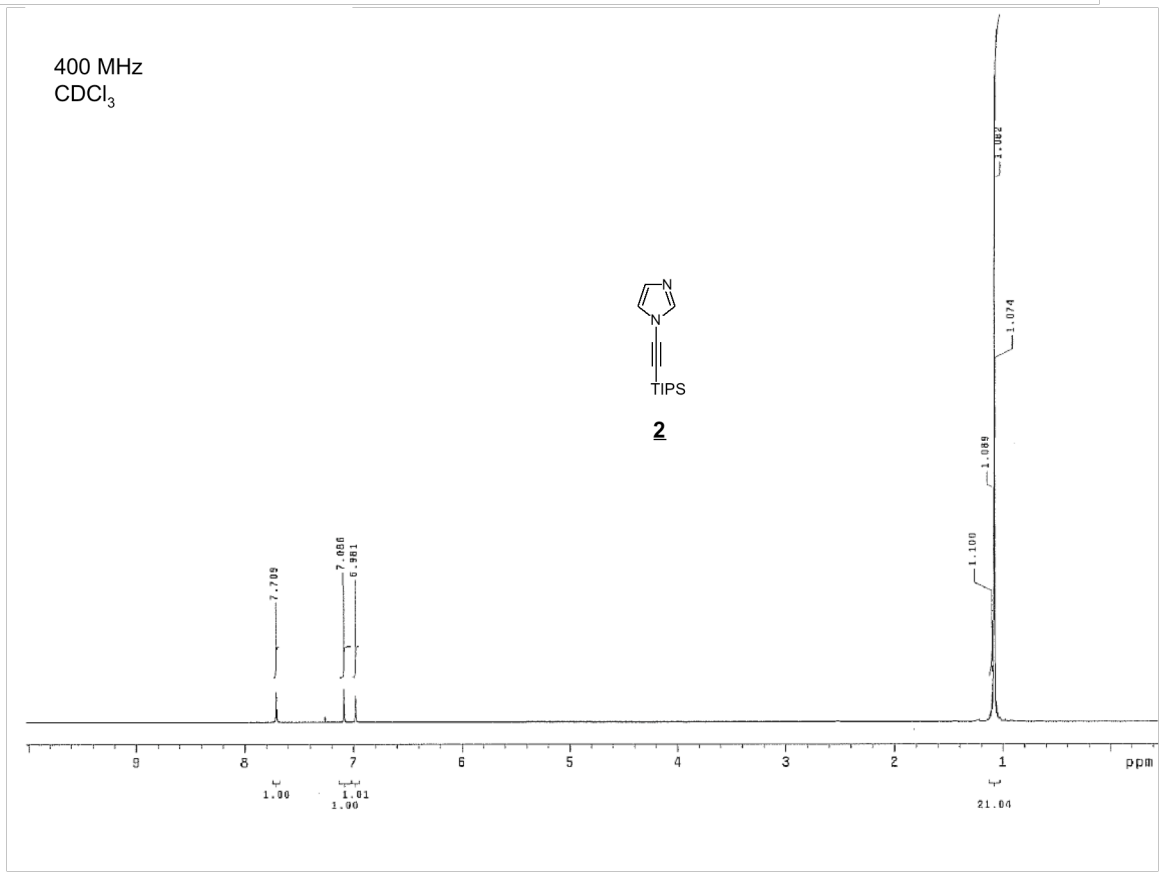

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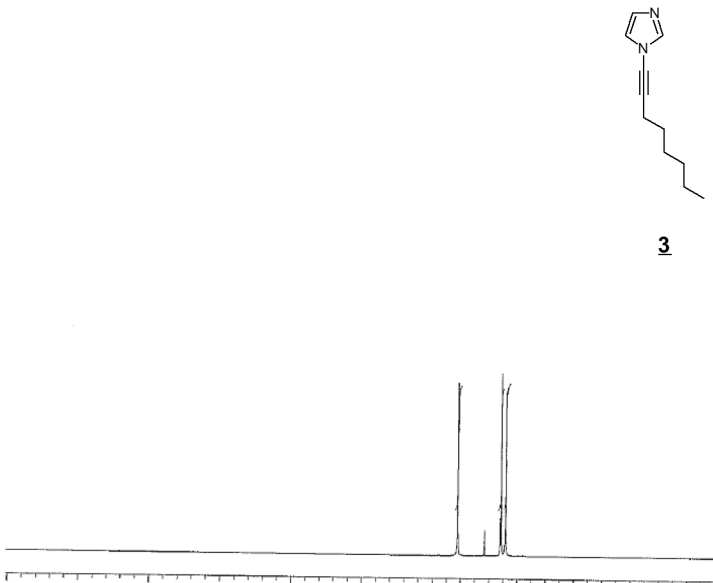

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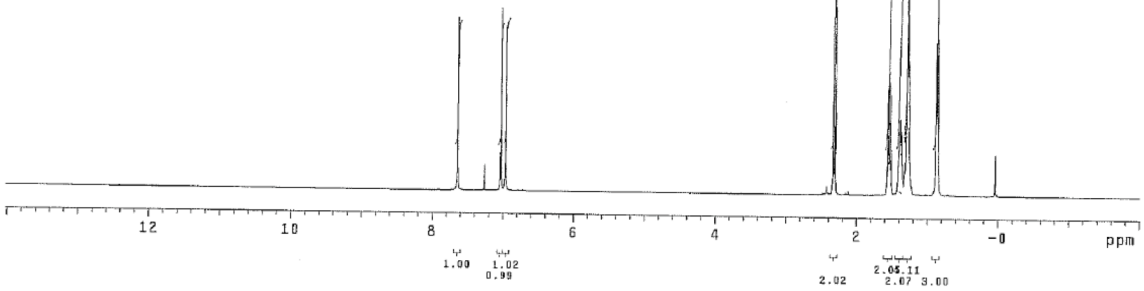

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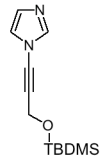

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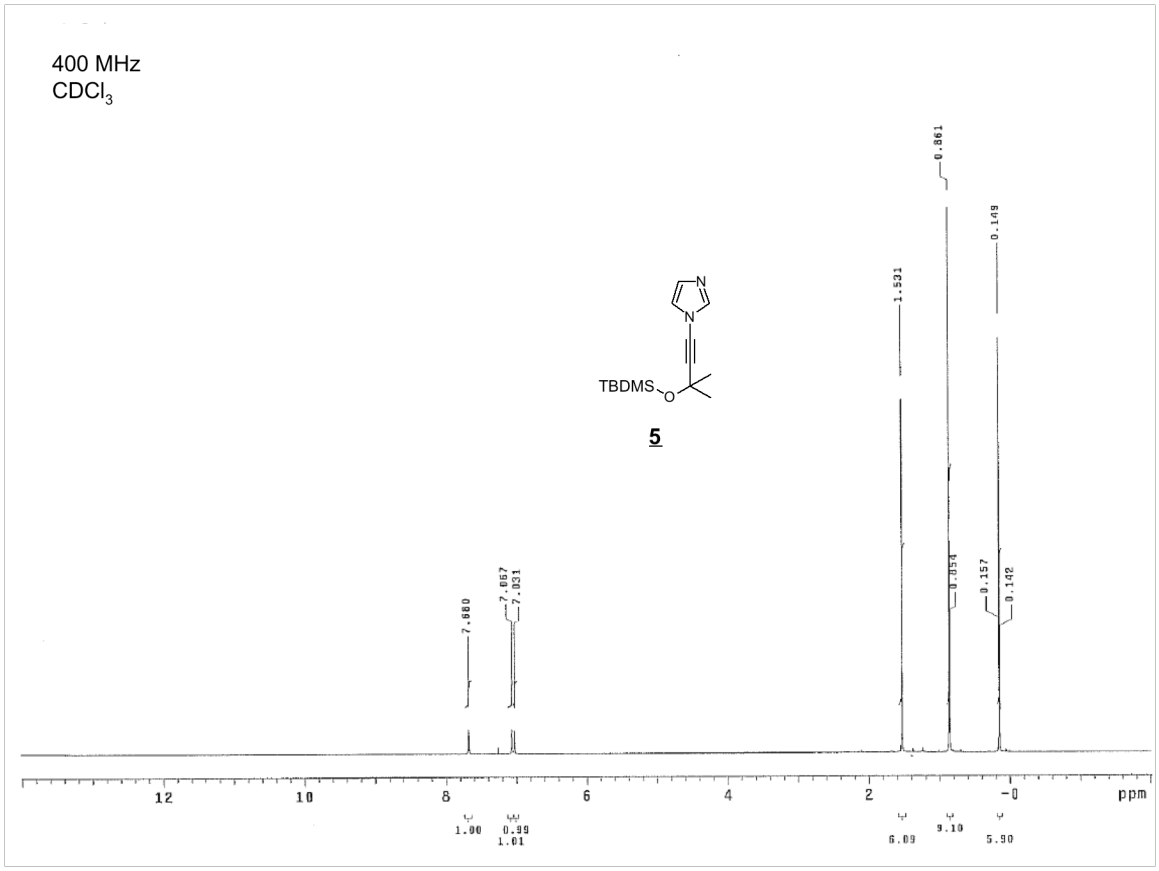
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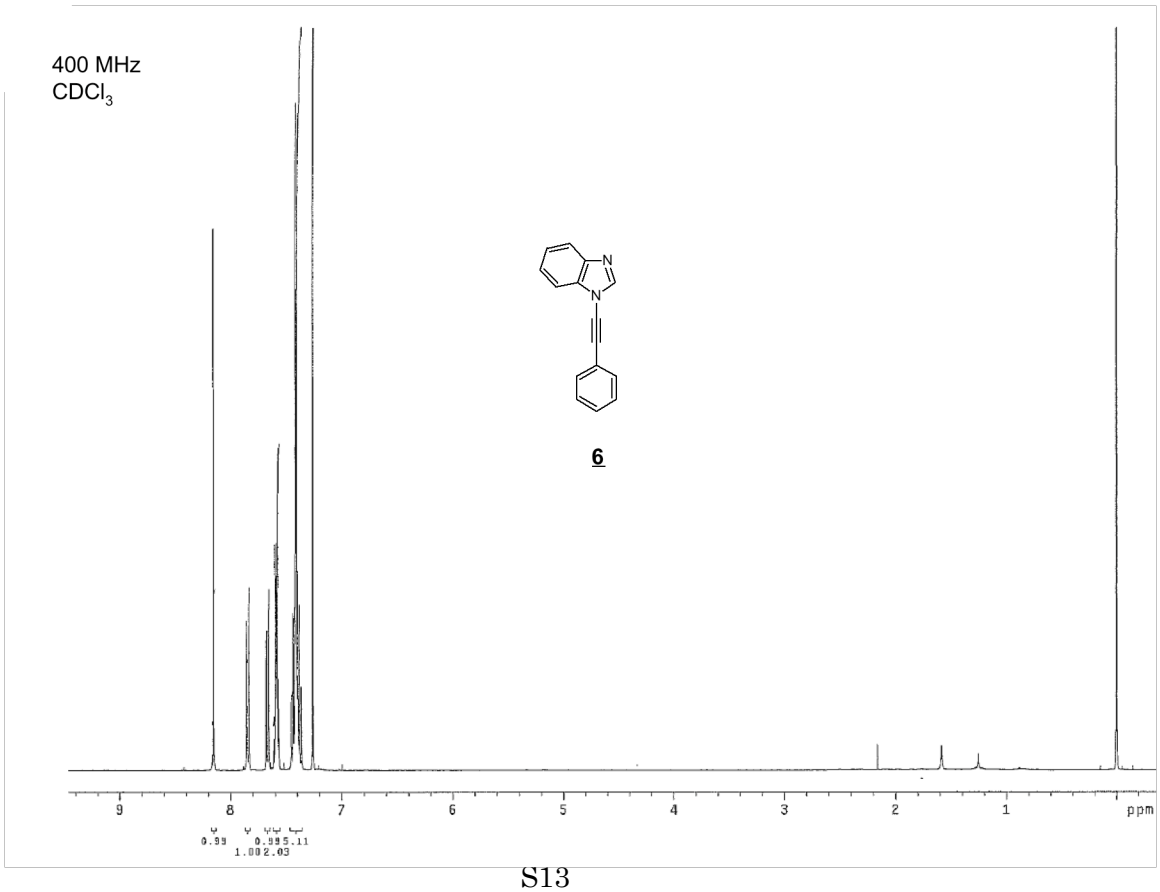
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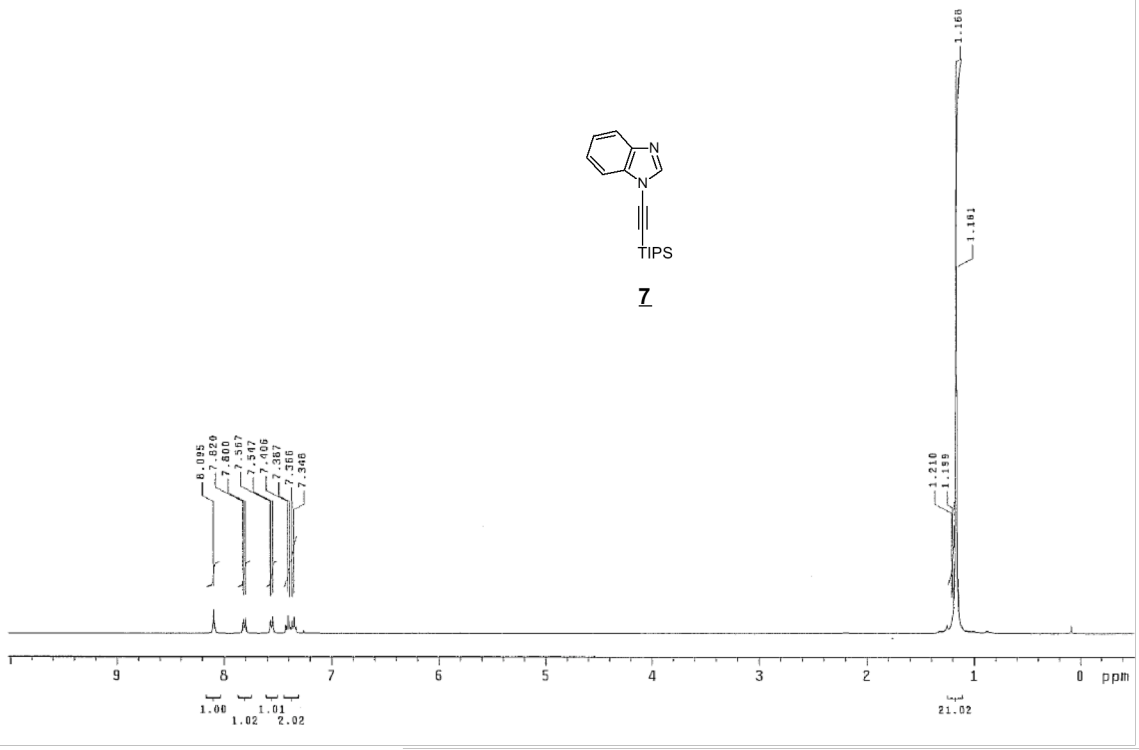

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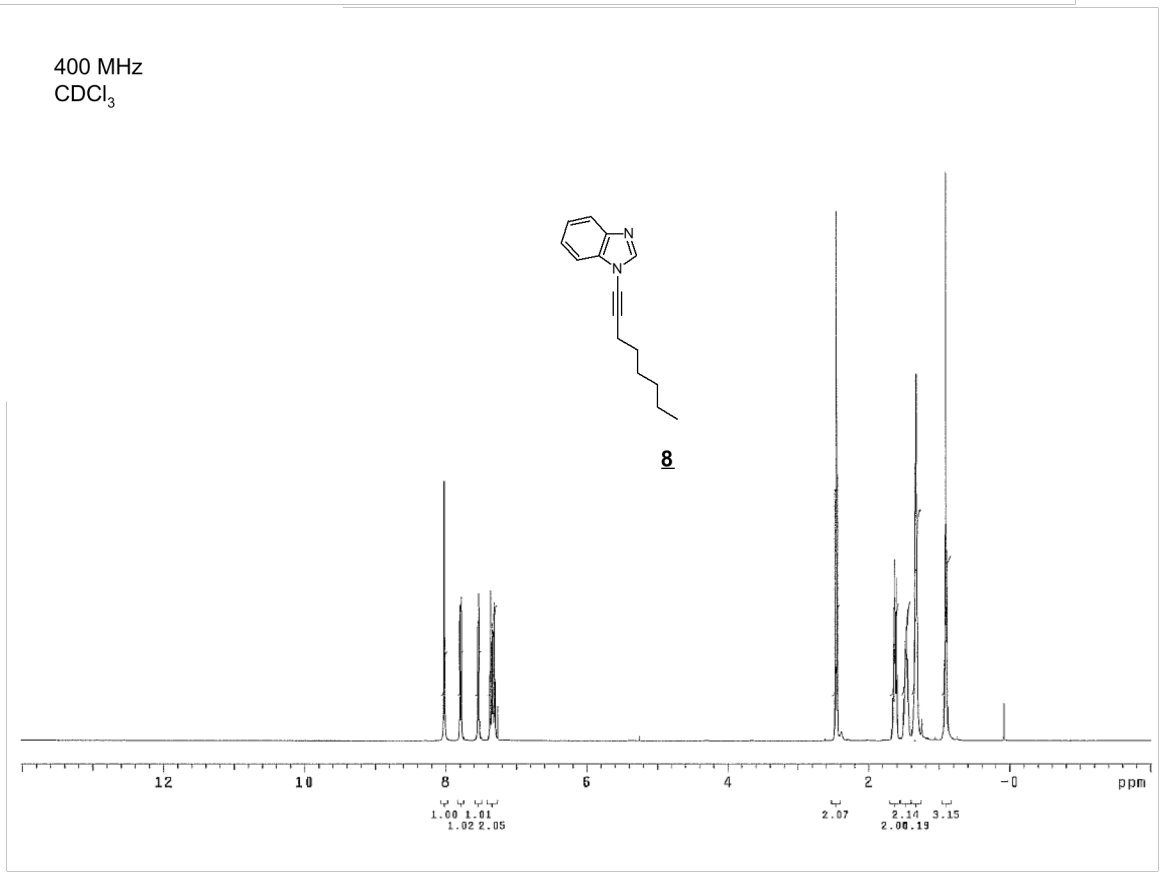

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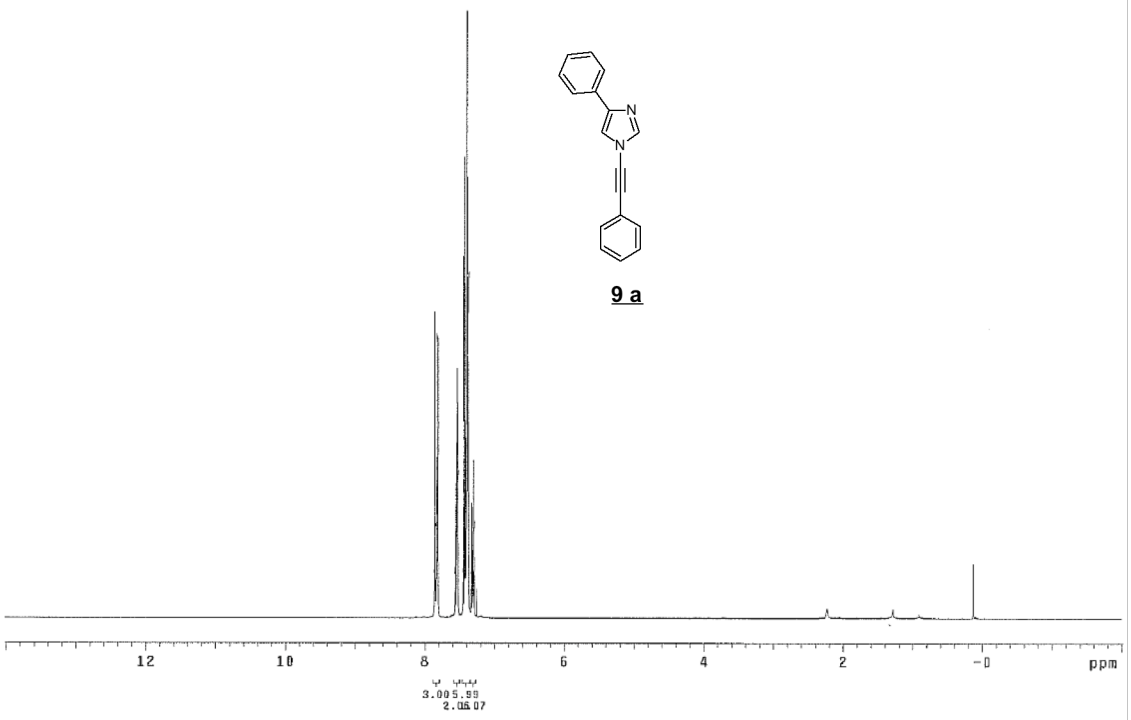

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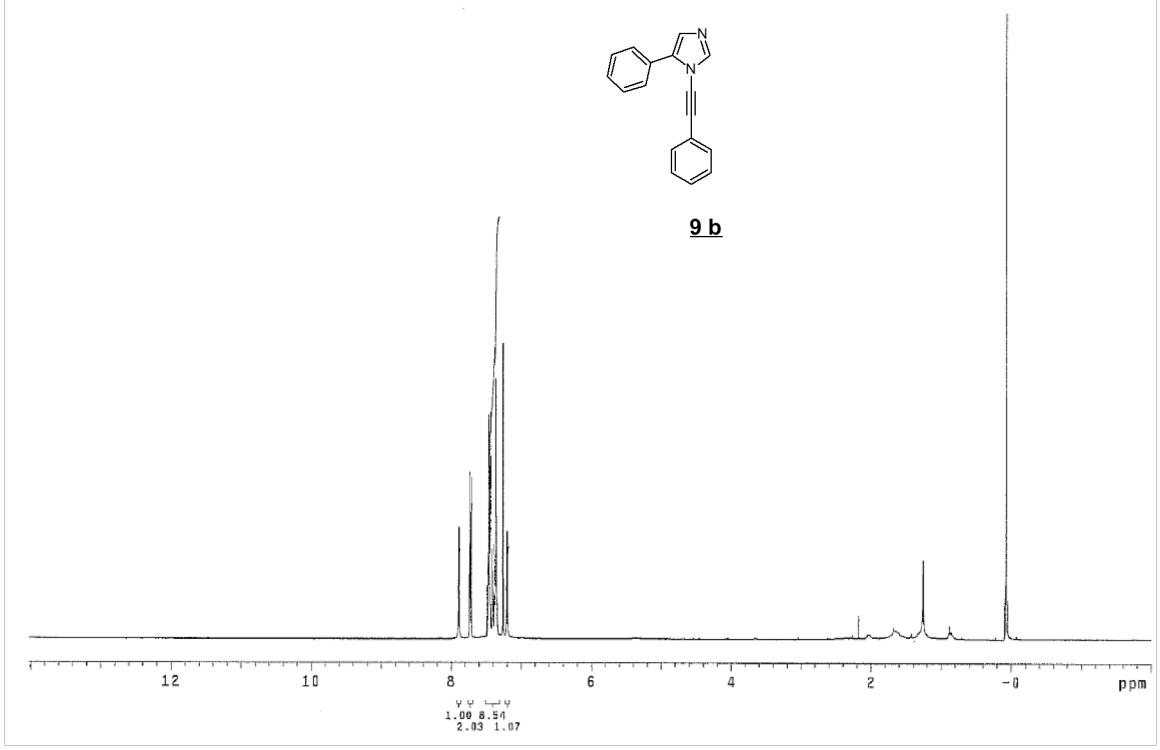

9 b

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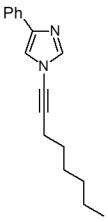
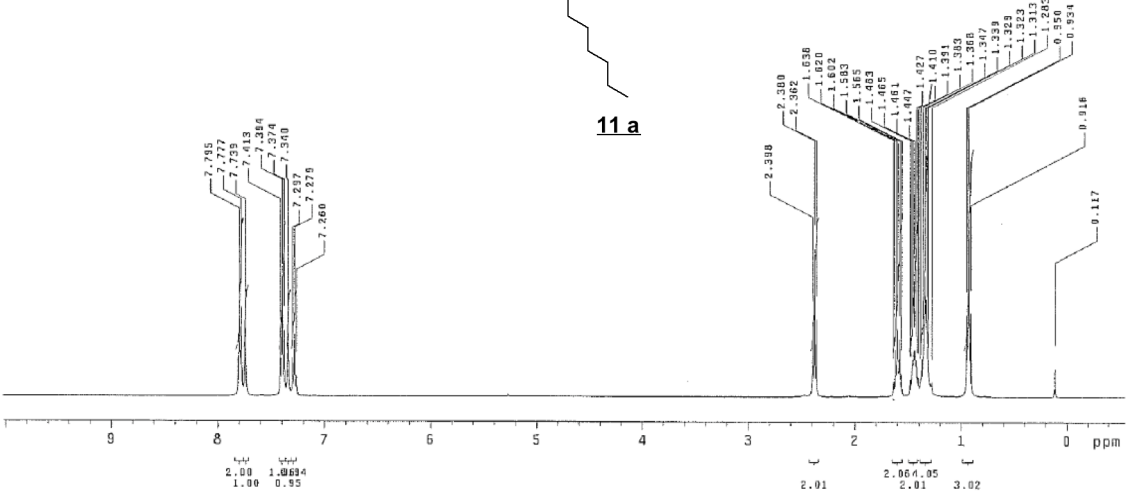
10 a

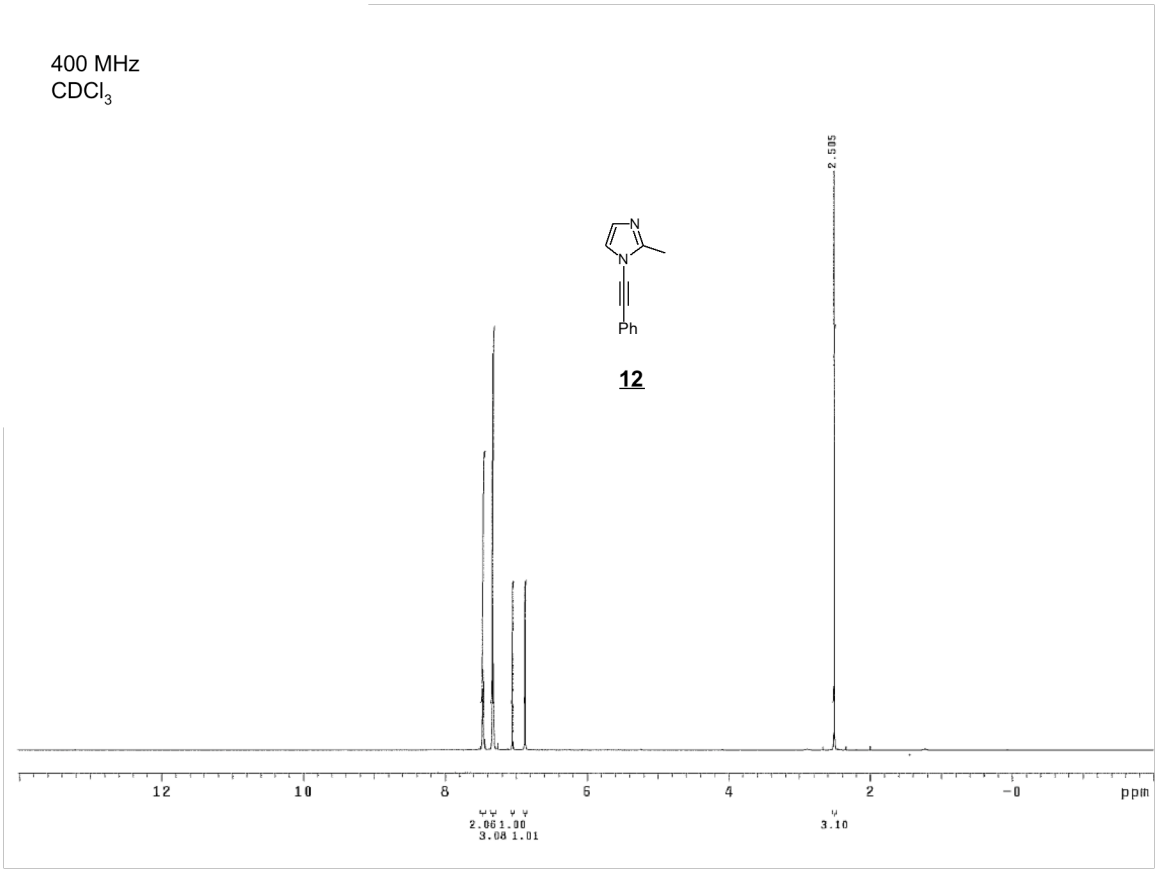
400 MHz
$CDCl_3$



11 a



400 MHz
$CDCl_3$



400 MHz
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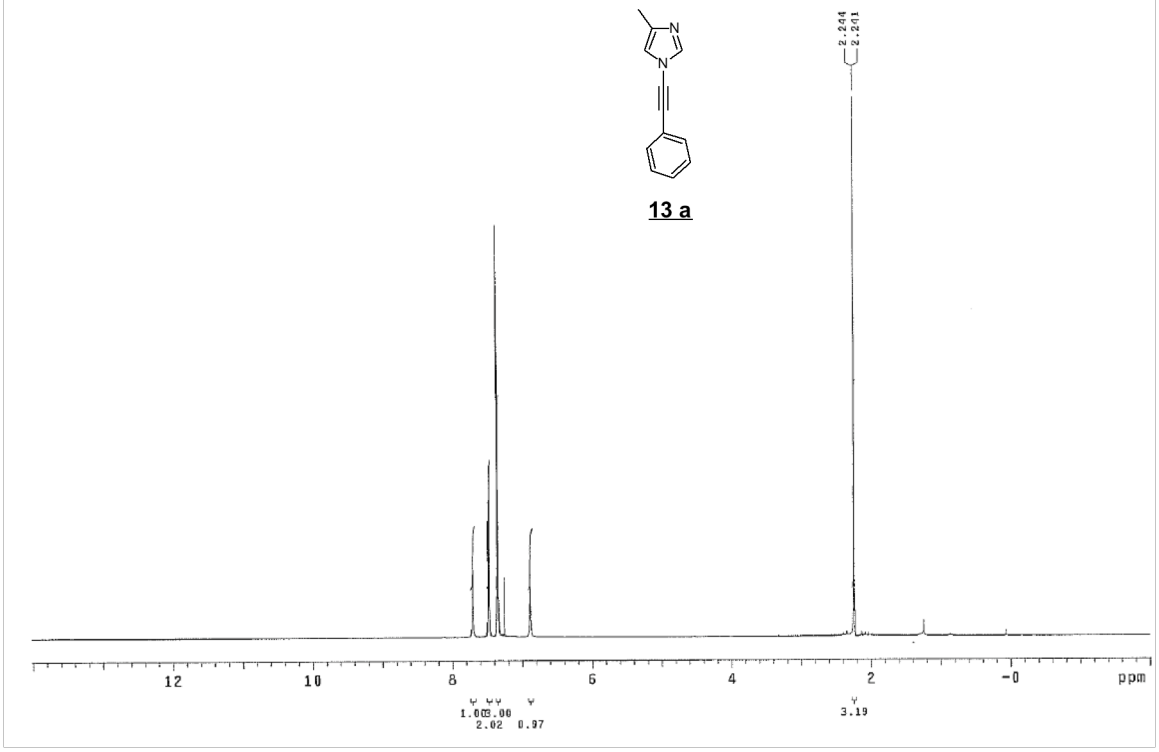
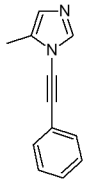
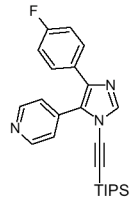


400 MHz
C_6D_6



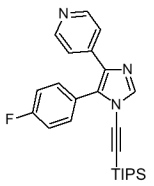
13 b

400 MHz
$CDCl_3$



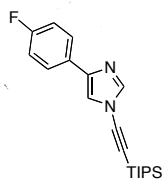
14 a

400 MHz
$CDCl_3$



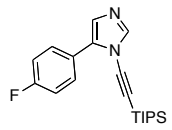
14 b

400 MHz
$CDCl_3$



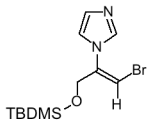
15 a

400 MHz
$CDCl_3$

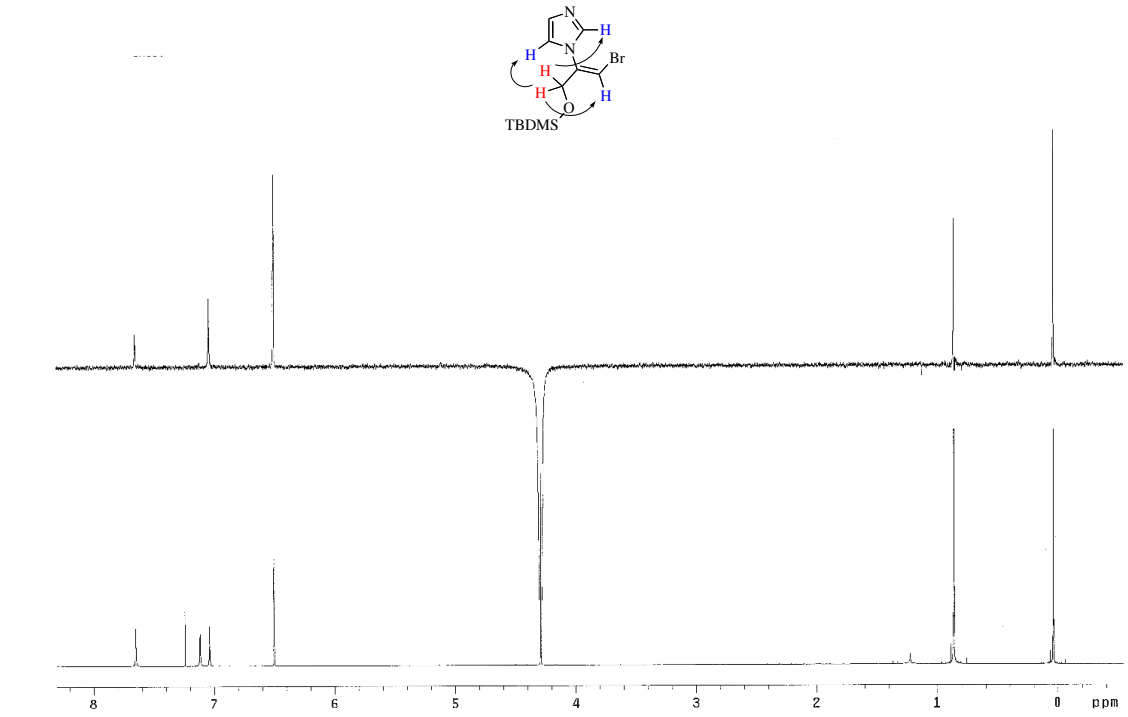


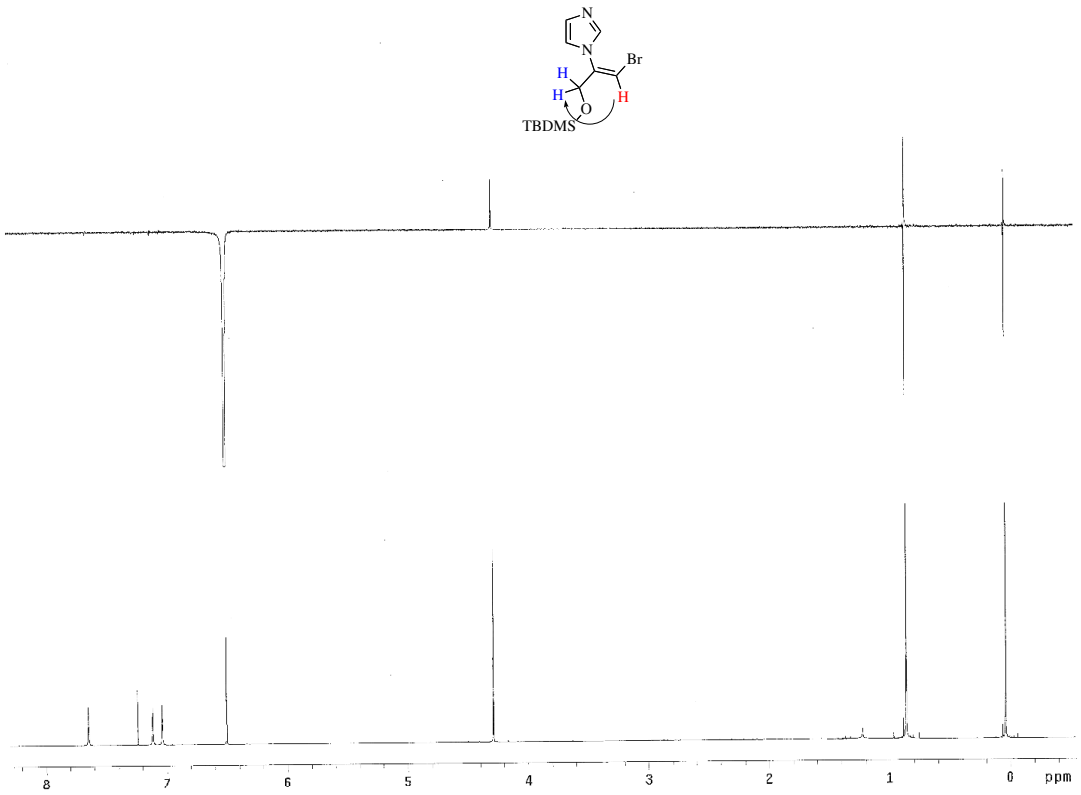
15 b

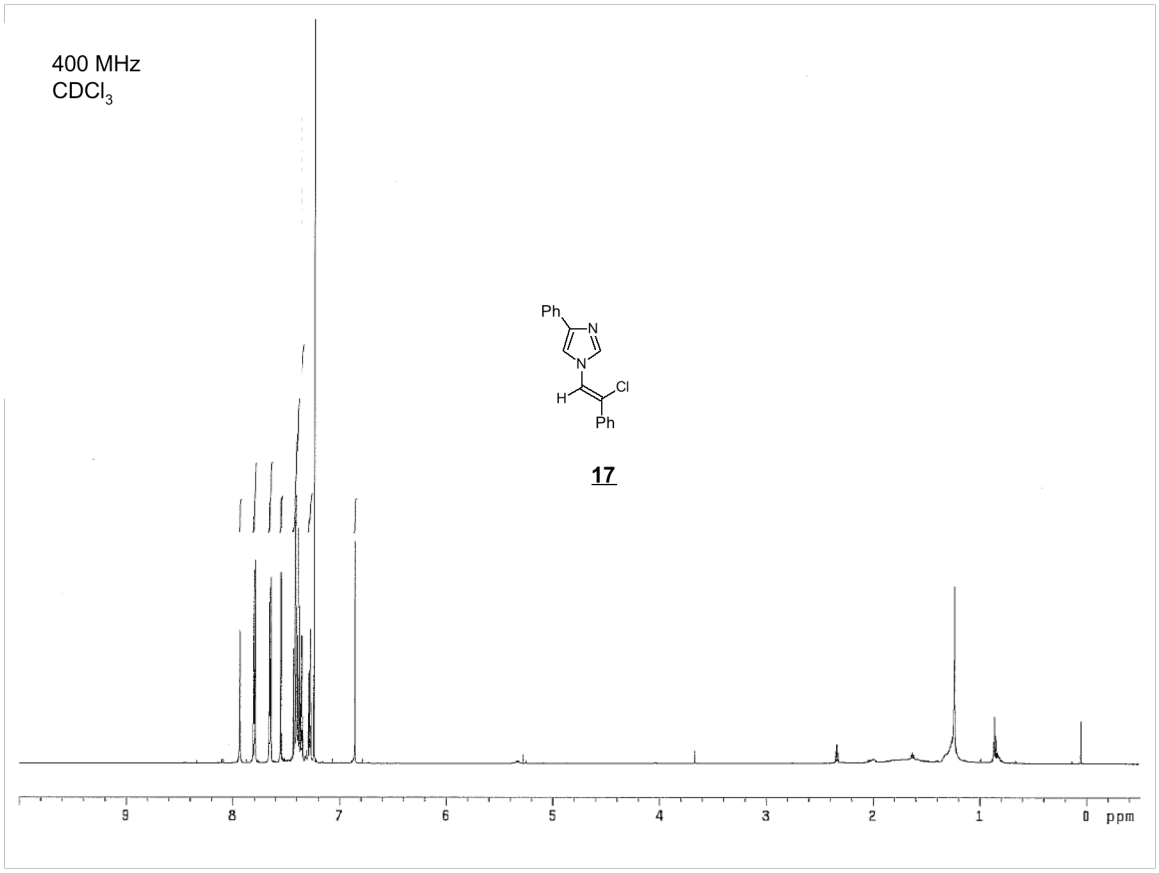
400 MHz
$CDCl_3$



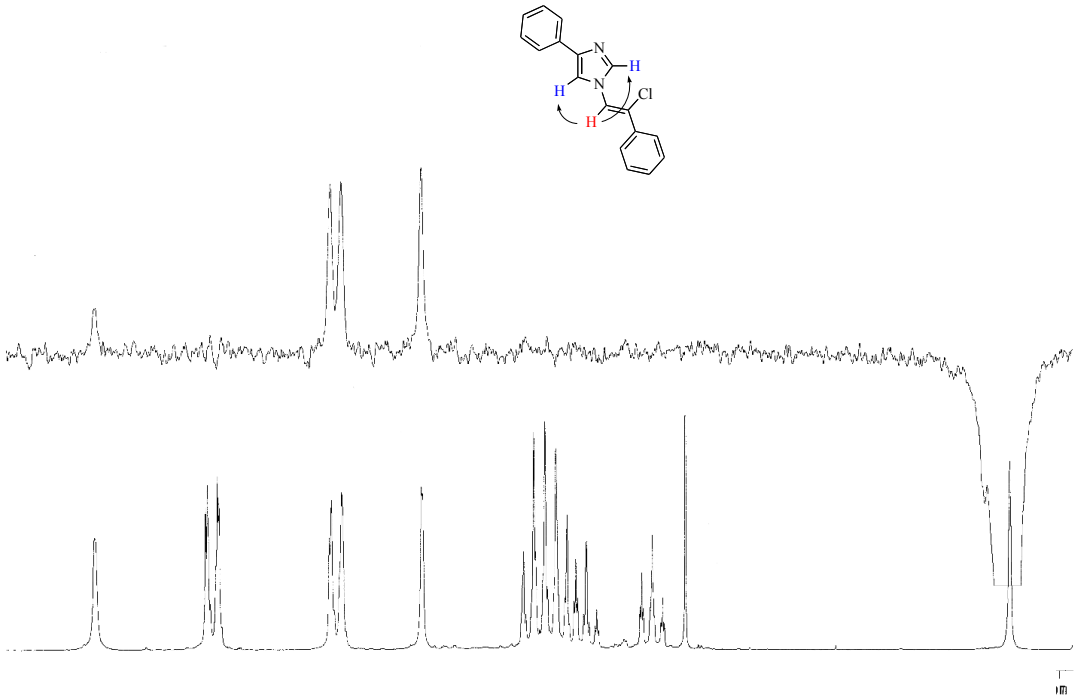
16

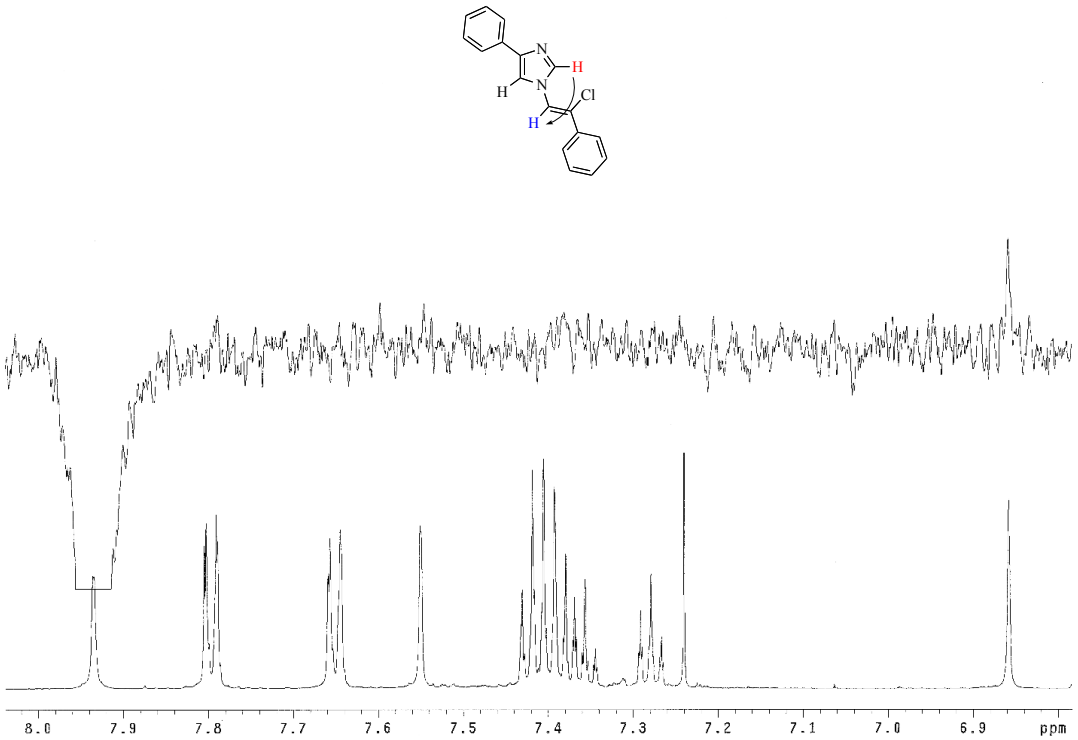

N
H
H
N
Br
H
H
H
O
TBDMS
8
7
6
5
4
3
2
1
0
ppm


N
N
Br
H
H
H
O
TBDMS
8
7
6
5
4
3
2
1
0
ppm



17


N
H
H
N
Cl
H


N
H
H
N
Cl
H
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
ppm