

Electronic Supporting Information

Catalytic double hydroarylation of alkynes to 9,9-disubstituted 9,10-dihydroacridine derivatives by an electrophilic phenoxyphosphonium dication

James H. W. LaFortune, Julia M. Bayne, Timothy C. Johnstone, Louie Fan and Douglas W. Stephan*

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1. Materials and Methods

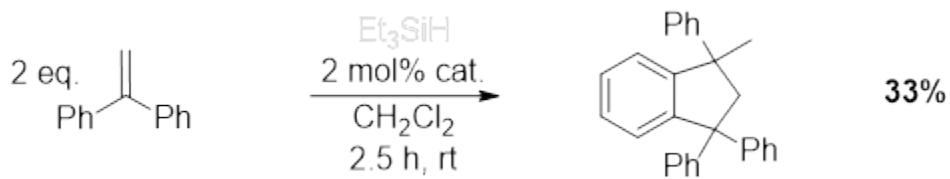
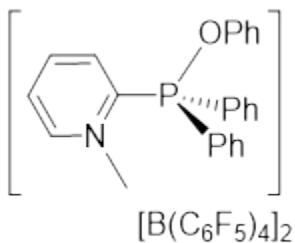
General Remarks

All manipulations were performed in a MB Unilab glove box produced by MBraun or using standard Schlenk techniques under an inert atmosphere of anhydrous N₂. All glassware was oven- or flame-dried and cooled under vacuum before use. Dry, oxygen-free solvents (dichloromethane and *n*-pentane) were prepared using an Innovative Technologies solvent purification system or deoxygenated and distilled over sodium benzophenone. Commercial reagents were purchased from Sigma-Aldrich, Strem Chemicals, TCI Chemicals, or Alfa Aesar, and were used without further purification unless indicated otherwise. Phosphonium salts [FP(C₆F₅)₃][B(C₆F₅)₄],¹ [(PhO)P(C₆F₅)₃][B(C₆F₅)₄],² [(PhO)P(2-(*N*-Mepy))Ph₂][B(C₆F₅)₄]₂,³ [FPPH₃][B(C₆F₅)₄],⁴ and starting materials [FP(2-(*N*-Mepy))Ph₂][B(C₆F₅)₄]₂,⁵ Ph₂NMe,⁶ (4-Tol)₂NMe,⁶ (4-(MeO)C₆H₄)₂NMe,⁷ (4-BrC₆H₄)₂NMe,⁸ and (4-Tol)₂NSiEt₃,⁹ were prepared according to literature procedures or modified literature procedures. NMR spectra were obtained on an Agilent DD2-700 MHz, an Agilent DD2-500 MHz, a Bruker AvanceIII-400 MHz, or a Varian Mercury-300 MHz spectrometer. ¹H, ¹³C, ³¹P, ¹⁹F, and ¹¹B NMR chemical shifts (δ /ppm) are referenced to Me₄Si, Me₄Si, H₃PO₄, CFCl₃, and BF₃•OEt₂, respectively. Assignments of individual resonances were performed using 2D NMR techniques (HMBC, HSQC, ¹H-¹H-COSY) when necessary. High-resolution mass spectra (HRMS) were obtained on an Agilent 6538 Q-TOF (ESI) or a JEOL AccuTOF (DART) mass spectrometer.

X-ray Diffraction Studies

Single crystals were coated with paratone oil, mounted on a cryoloop, and frozen under a stream of cold nitrogen. Data were collected on a Bruker Apex2 X-ray diffractometer at 150 (2) K for all crystals using graphite monochromated Mo-K α radiation (0.71073 Å). Data were collected using Bruker APEX-2 software and processed using SAINT. An empirical absorption correction was applied using SADABS. All structures were solved and refined by direct methods within the SHELXTL package. These data can be obtained free of charge from the Cambridge Crystallographic Data Centre.

2. Catalyst Reactivity



Friedel-Crafts Type Dimerization of 1,1-Diphenylethylene

In a 20 mL vial, a solution of [(PhO)P(2-(N-Mepy))Ph2][B(C6F5)4]2 (0.004 mmol, 0.02 eq.) was prepared in 1 mL CH2Cl2. 1,1-diphenylethylene (0.2 mmol, 1.0 eq.) was added at ambient temperature and the reaction mixture was left to stir for 2.5 h. The solution was then dried *in vacuo* and re-dissolved in 0.6 mL CDCl3 affording a pale green solution. Conversion was determined by ^1H NMR spectroscopy.

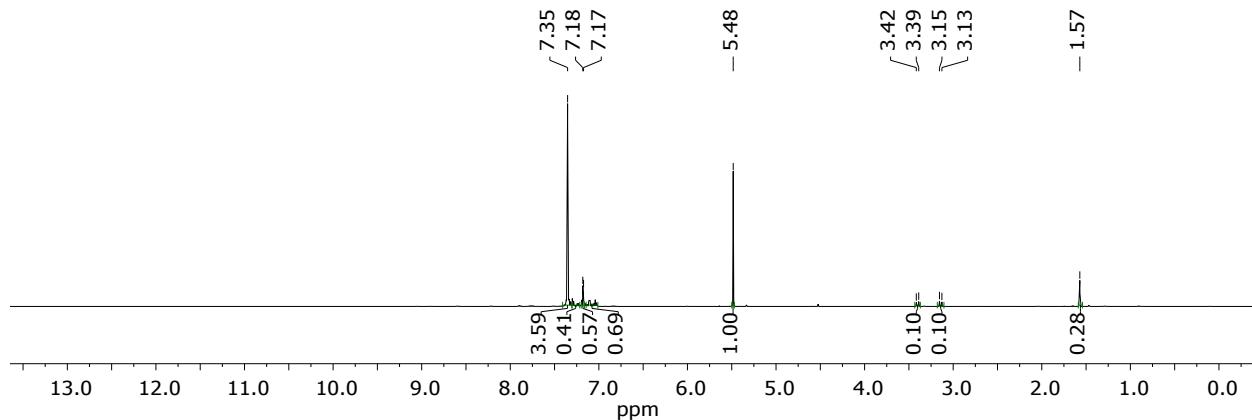
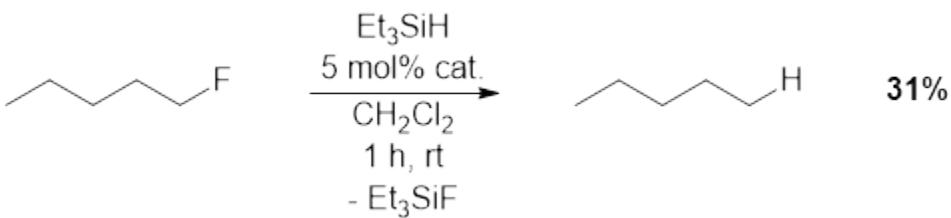


Figure 1. ^1H (CD2Cl2) NMR spectrum of dimerization catalysis, $t = 2.5$ h.

Hydrodefluorination of 1-Fluoropentane



In a 20 mL vial, a solution of [(PhO)P(2-(*N*-Mepy))Ph₂][B(C₆F₅)₄] (0.002 mmol, 0.05 eq.) was prepared in 0.6 mL CH₂Cl₂. Triethylsilane (Et₃SiH, 0.04 mmol, 1.0 eq.) was added at ambient temperature, the reaction was briefly stirred, and then 1-fluoropentane was added (0.04 mmol, 1.0 eq.). The reaction mixture was transferred to an NMR tube and left at ambient temperature for 1 h, before being monitored by ¹⁹F NMR spectroscopy. Conversion was determined from the proportion of Si-F bonds formed relative to C-F bonds remaining.

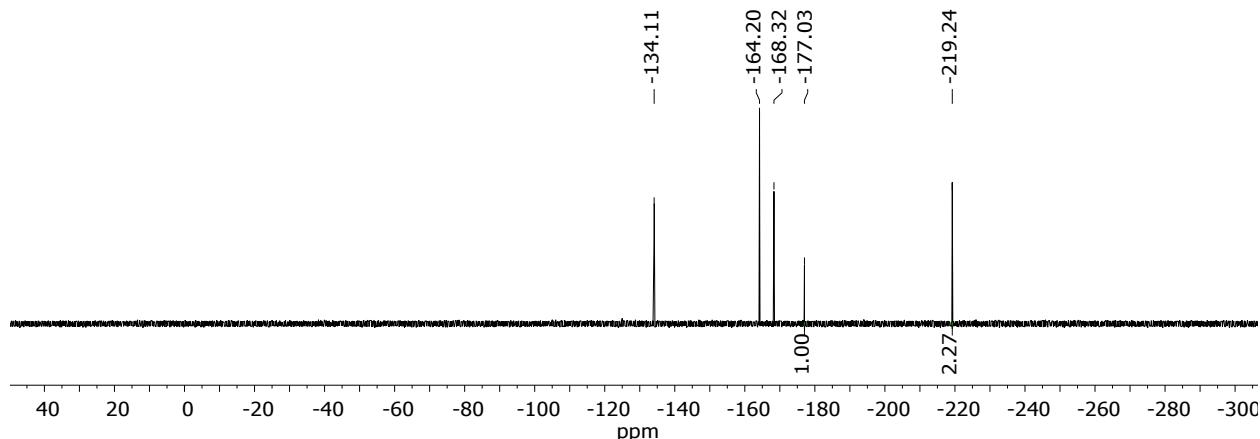
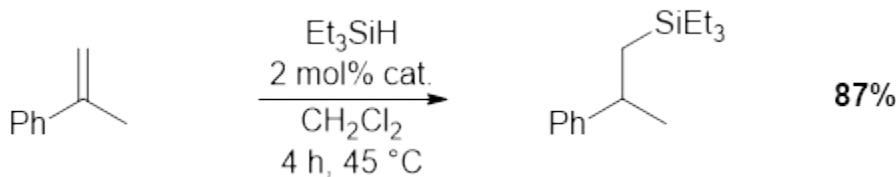


Figure 2. ¹⁹F (CD₂Cl₂) NMR spectrum for the hydrodefluorination of 1-fluoropentane.

Hydrosilylation of α -Methylstyrene



In a 20 mL vial, a solution of [(PhO)P(2-(*N*-Mepy))Ph₂][B(C₆F₅)₄] (0.001 mmol, 0.02 eq.) was prepared in 0.6 mL CH₂Cl₂. Triethylsilane (Et₃SiH, 0.05 mmol, 1.0 eq.) was added at ambient temperature, the reaction mixture was briefly stirred, and then α -methylstyrene (0.05 mmol, 1.0

eq.) was added. The mixture was transferred to an NMR tube and heated at 45 °C for 4 h. The solution was then dried *in vacuo* and re-dissolved in 0.6 mL CDCl₃ affording a colourless solution. Conversion was determined by ¹H NMR spectroscopy.

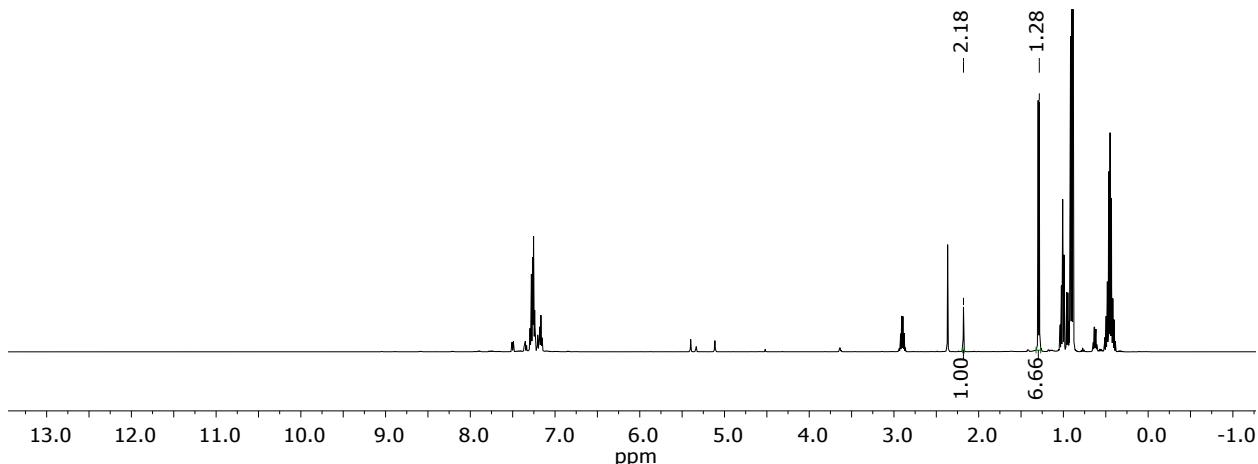
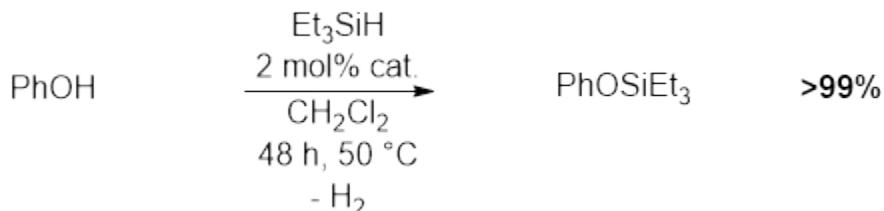


Figure 3. ¹H (CD₂Cl₂) NMR spectrum of hydrosilylation catalysis.

Dehydrocoupling of Phenol with Et₃SiH



In a 20 mL vial, a solution of [(PhO)P(2-(*N*-Mepy))Ph₂][B(C₆F₅)₄] (0.001 mmol., 0.02 eq.) was prepared in 0.6 mL CH₂Cl₂. Triethylsilane (Et₃SiH, 0.05 mmol, 1.0 eq.) was added at ambient temperature, the reaction mixture was briefly stirred, and then added to a vial containing phenol (0.05 mmol, 1.0 eq.). The mixture was transferred to an NMR tube and heated at 50 °C for 48 h. The solution was then dried *in vacuo* and re-dissolved in 0.6 mL CDCl₃ affording a colourless solution. Conversion was determined by ¹H NMR spectroscopy.

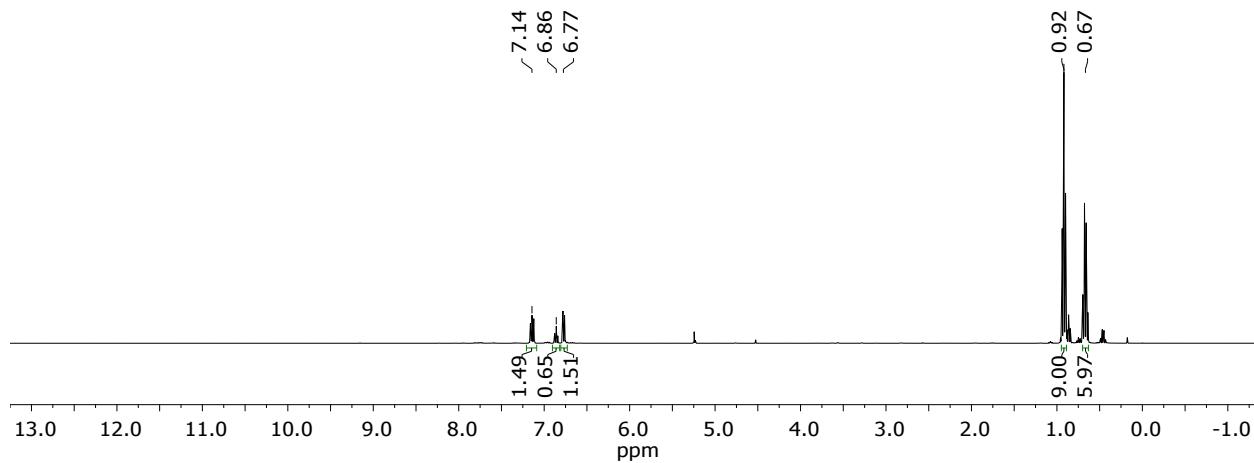
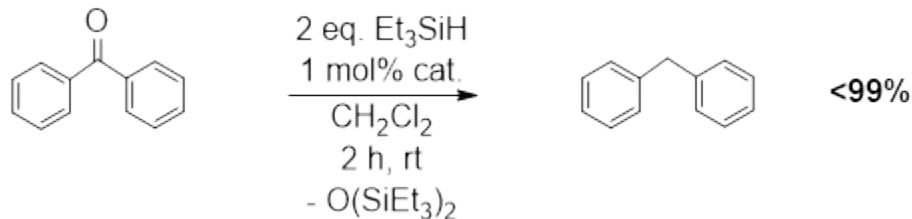


Figure 4. ^1H (CD_2Cl_2) NMR spectrum of dehydrocoupling catalysis.

Deoxygenation of Benzophenone



In a 20 mL vial, a solution of $[(\text{PhO})\text{P}(2-(N\text{-Mepy}))\text{Ph}_2][\text{B}(\text{C}_6\text{F}_5)_4]_2$ (0.0002 mmol, 0.01 eq.) was prepared in 0.6 mL CH_2Cl_2 . Triethylsilane (Et_3SiH , 0.04 mmol, 2.0 eq.) was added at ambient temperature, the reaction was briefly stirred, and then the solution was added to a vial containing benzophenone (0.02 mmol, 1.0 eq.). The reaction mixture was left to stir at ambient temperature for 2 h. The solution was then dried *in vacuo* and re-dissolved in 0.6 mL CDCl_3 affording a colourless solution. Conversion was determined by ^1H NMR spectroscopy. Toluene (0.02 mmol, 1.0 eq.) was added as an internal standard.

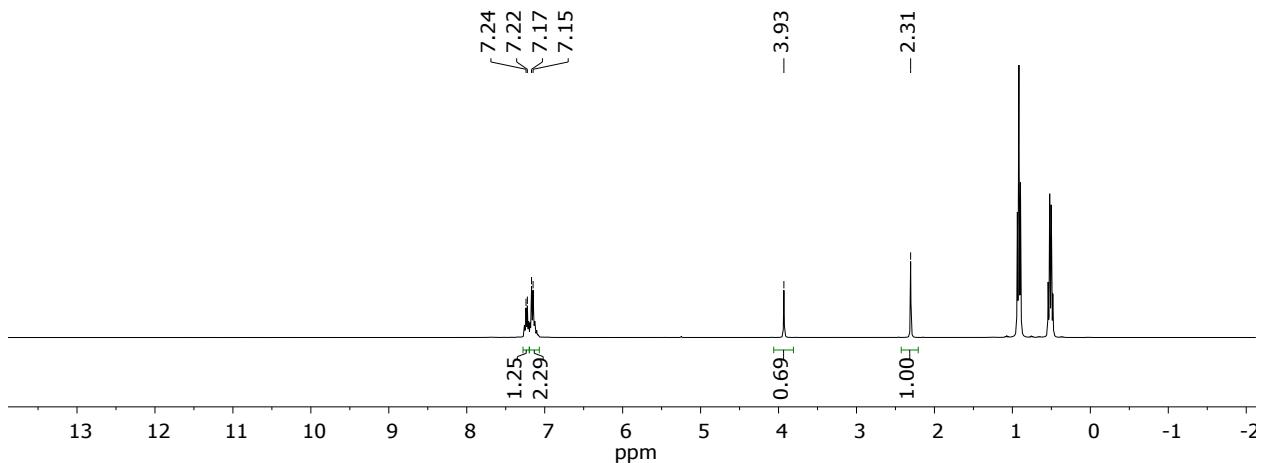
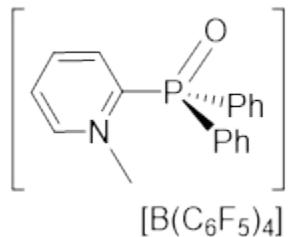


Figure 5. ^1H (CD_2Cl_2) NMR spectrum for the deoxygenation of benzophenone.

3. Pyridinium Phosphine Oxide Synthesis



$[\text{OP}(2-(N\text{-Mepy}))\text{Ph}_2]\text{B}(\text{C}_6\text{F}_5)_4$

A CH_2Cl_2 solution of $[\text{FP}(2-(N\text{-Mepy}))\text{Ph}_2]\text{B}(\text{C}_6\text{F}_5)_4$ was exposed to air for 48h. The resulting solution was then dried *in vacuo* and the off-white solid was washed with *n*-pentane (3×5 mL) to afford an off-white solid. Partial characterization. **^{19}F NMR (377 MHz, CD_2Cl_2):** δ -133.0 (s(br), 8F; B(*o*- C_6F_5)₄), -163.5 (t, $^3J_{\text{FF}} = 22$ Hz, 4F; B(*p*- C_6F_5)₄), -167.3 ppm (m(br), 8F; B(*m*- C_6F_5)₄). **$^{31}\text{P}\{^1\text{H}\}$ NMR (162 MHz, CD_2Cl_2):** δ 28.7 ppm (s).

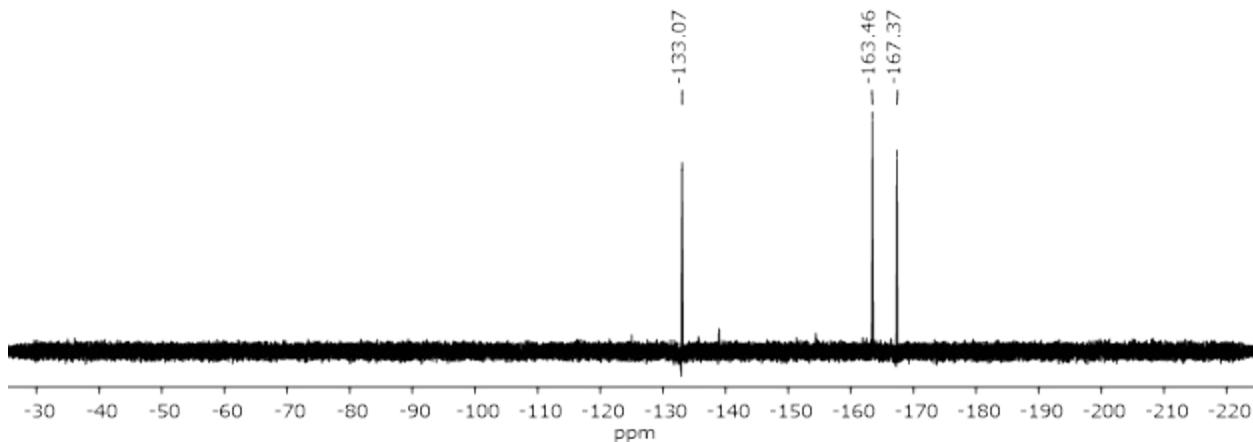


Figure 6. $^{19}\text{F}\{\text{H}\}$ (CH_2Cl_2) NMR spectrum of $[\text{OP}(2-(\text{N-Mepy}))\text{Ph}_2]\text{[B(C}_6\text{F}_5)_4]$.

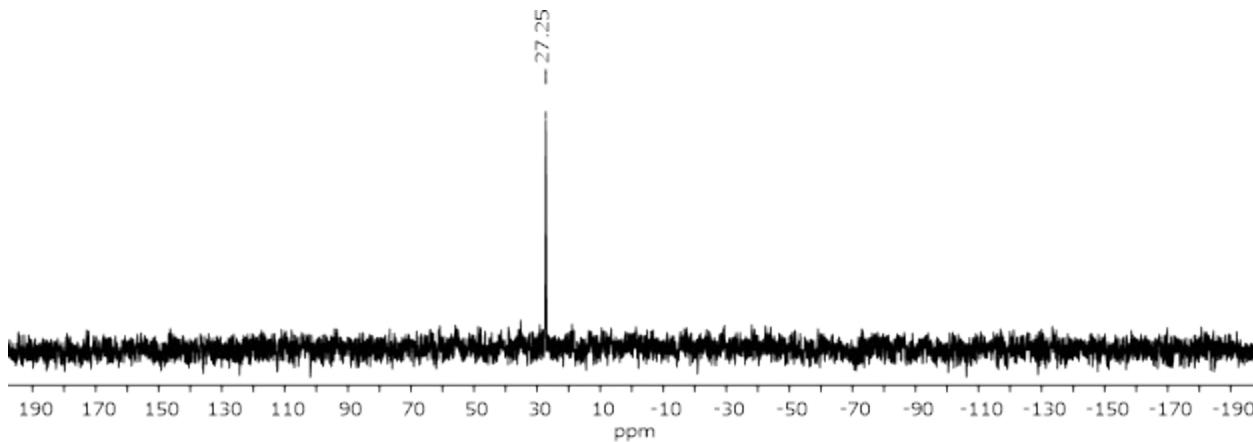
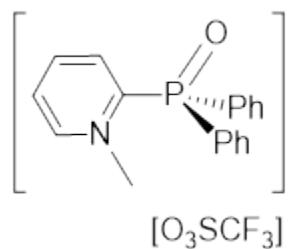


Figure 7. $^{31}\text{P}\{\text{H}\}$ (CH_2Cl_2) NMR spectrum of $[\text{OP}(2-(\text{N-Mepy}))\text{Ph}_2]\text{[B(C}_6\text{F}_5)_4]$.



[OP(2-(N-Mepy))Ph₂][O₃SCF₃]

A CH_2Cl_2 solution of $[\text{F}_2\text{P}(2-(\text{N-Mepy}))\text{Ph}_2]\text{[O}_3\text{SCF}_3]$ was exposed to air for 48h. The resulting solution was then dried *in vacuo* and the off-white solid was washed with *n*-pentane (3 x 5 mL) to afford an off-white solid. **HRMS (ESI-TOF+):** m/z [M] 294.1045 (calc'd for $\text{C}_{18}\text{H}_{17}\text{NOP}$: 294.1042). **$^1\text{H NMR (400 MHz, CD}_2\text{Cl}_2$:** δ 4.52, (s, 3H; NCH_3), 7.61 (m, 5H; phenyl-*o*- CH , pyridyl-*o*-

CH), 7.73 (m, 6H; phenyl-*m,p*-CH), 8.23 (m, 1H; pyridyl-*p*-CH), 8.48 (m, 1H; pyridyl-*m*-CH), 9.21 ppm (m, 1H; pyridyl-*m*-CH). **^{19}F NMR (377 MHz, CD_2Cl_2):** δ -78.4 ppm (s, 3F; O_3SCF_3). **$^{31}\text{P}\{^1\text{H}\}$ NMR (162 MHz, CD_2Cl_2):** δ 28.7 ppm (s). **$^{13}\text{C}\{^1\text{H}\}$ NMR (125 MHz, CD_2Cl_2):** δ 48.9 (d, $^3J_{\text{CP}} = 3$ Hz, 1C; NCH_3), 126.9 (d, $^1J_{\text{CP}} = 111$ Hz, 1C; phenyl-*i-C*), 130.0 (d, $^2J_{\text{CP}} = 13$ Hz, 4C; phenyl-*o*-CH), 131.3 (d, $^4J_{\text{CP}} = 2$ Hz, 1C; pyridyl-*p*-CH), 132.1 (d, $^3J_{\text{CP}} = 11$ Hz, 4C; phenyl-*m*-CH), 133.9 (d, $^2J_{\text{CP}} = 13$ Hz, 1C; pyridyl-*o*-CH), 134.5 (d, $^4J_{\text{CP}} = 3$ Hz, 2C; phenyl-*p*-CH), 145.6 (d, $^3J_{\text{CP}} = 8$ Hz, 1C; pyridyl-*m*-CH), 149.3 (d, $^1J_{\text{CP}} = 89$ Hz, 1C; pyridyl-*i*-C), 151.8 ppm (d, $^3J_{\text{CP}} = 4$ Hz, 1C; pyridyl-*m*-CH), resonance for the sulfur-bound carbon atom of O_3SCF_3 anion was not observed.

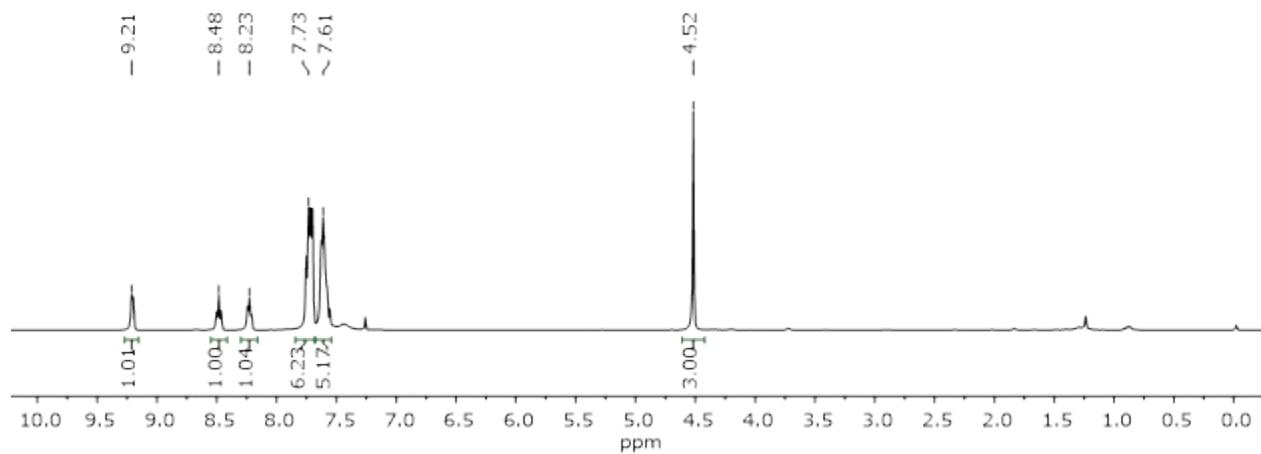


Figure 8. ^1H (CDCl_3) NMR spectrum of $[\text{OP}(2-(\text{N-Mepy}))\text{Ph}_2][\text{O}_3\text{SCF}_3]$.

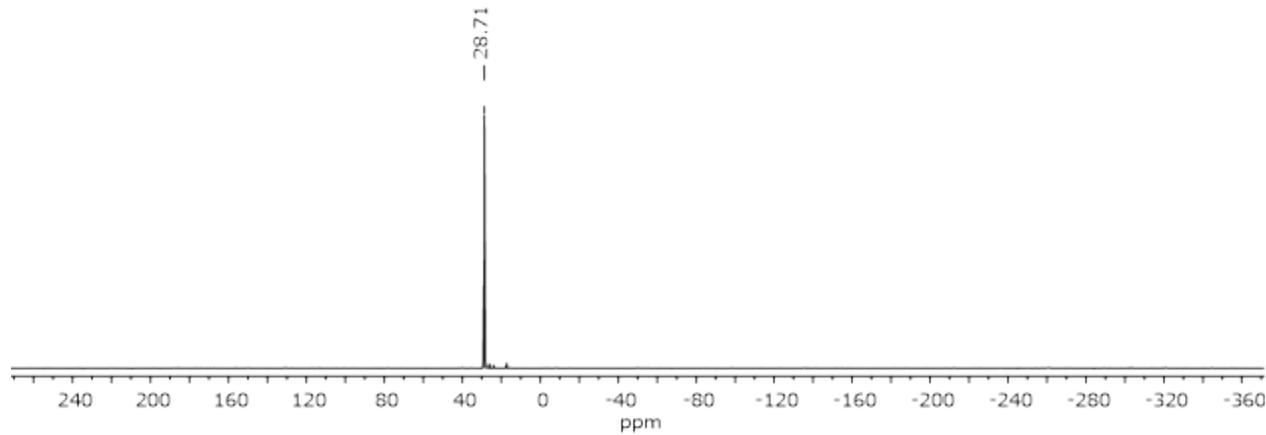


Figure 9. $^{31}\text{P}\{^1\text{H}\}$ (CDCl_3) NMR spectrum of $[\text{OP}(2-(\text{N-Mepy}))\text{Ph}_2][\text{O}_3\text{SCF}_3]$.

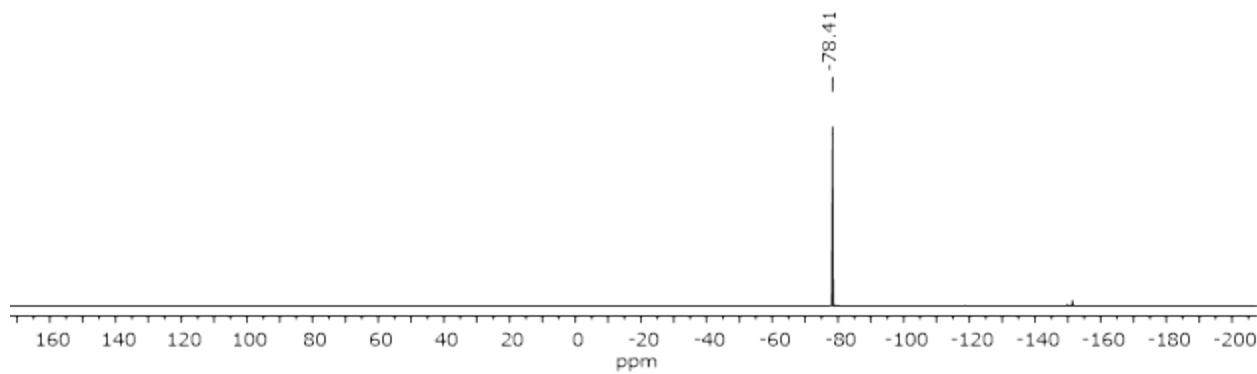


Figure 10. $^{19}\text{F}\{^1\text{H}\}$ (CDCl_3) NMR spectrum of $[\text{OP}(2-(\text{N-Mepy}))\text{Ph}_2][\text{O}_3\text{SCF}_3]$.

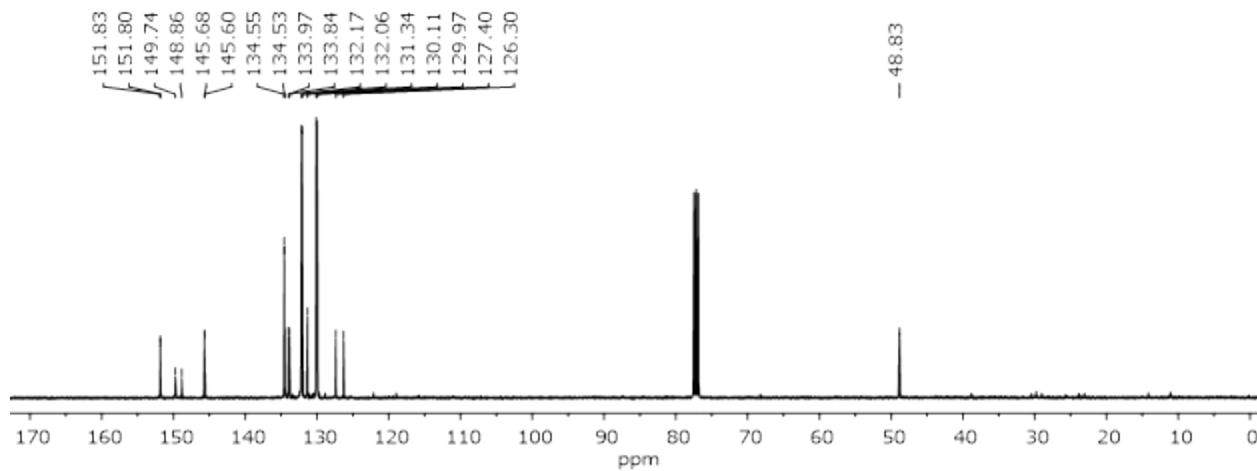
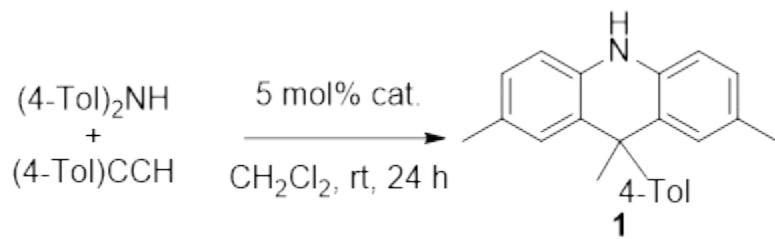


Figure 11. ^{13}C (CDCl_3) NMR spectrum of $[\text{OP}(2-(\text{N-Mepy}))\text{Ph}_2][\text{O}_3\text{SCF}_3]$. Asterisks denote solvent impurities.

4. Catalyst Screening



General Procedure

Catalyst screening reactions for the hydroarylation of diarylamines with alkynes were performed according to a common procedure. A sample procedure is outlined below.

In a 20 mL vial, a solution of acid catalyst (0.004 mmol, 0.05 eq.) was prepared in CH₂Cl₂ (3 mL). A solution of (4-Tol)₂NH (16.0 mg, 0.08 mmol, 1.0 eq.) in CH₂Cl₂ (3 mL) was added at ambient temperature. The mixture was briefly stirred and then a solution of (4-Tol)CCH (9.4 mg, 0.08 mmol, 1.0 eq.) in CH₂Cl₂ (3 mL) was added. The reaction mixture was stirred at ambient temperature for 16 h. The solution was then dried *in vacuo*. Acid catalyst was removed by dissolving the residue in a 2:1 mixture of CH₂Cl₂:*n*-pentane and filtering over a silica plug. Conversion was determined by GCMS.

Table 1. Catalyst Screening for Hydroarylation

Catalyst	Conversion to 1
[(PhO)P(2-(<i>N</i> -Mepy))Ph ₂] [B(C ₆ F ₅) ₄] ₂	62
[FPPPh ₃][B(C ₆ F ₅) ₄]	32
[(PhO)P(C ₆ F ₅) ₃][B(C ₆ F ₅) ₄]	32
[OP(2-(<i>N</i> -Mepy))Ph ₂] [B(C ₆ F ₅) ₄]	0
FeCl ₃	52
AlCl ₃	22
B(C ₆ F ₅) ₃	0
Bi(OSO ₂ CF ₃) ₃	0
InCl ₃	0
ZnCl ₂	0
(CF ₃ SO ₂) ₂ NH	18

5. Condition Screening

General Procedure

Condition screening reactions for the hydroarylation of diarylamines with alkynes were performed according to a common procedure. A sample procedure is outlined below.

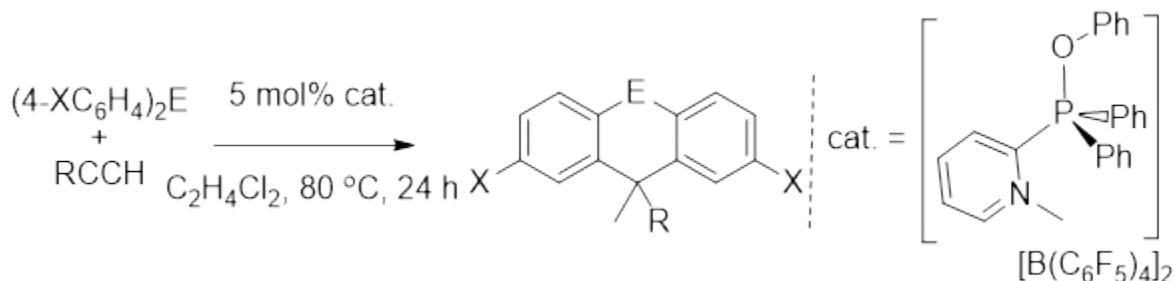
In a 20 mL vial, a solution of [(PhO)P(2-(*N*-Mepy))Ph₂][B(C₆F₅)₄]₂ (10.2 mg, 0.006 mmol, 0.05 eq.) was prepared in CH₂Cl₂ (3 mL). A solution of (4-Tol)₂NMe (25.3 mg, 0.12 mmol, 1.0 eq.), prepared in CH₂Cl₂ (3 mL), was added at ambient temperature. The mixture was briefly stirred and then a solution of (4-Tol)CCH (13.9 mg, 0.12 mmol, 1.0 eq.), prepared in CH₂Cl₂ (3 mL), was added. The reaction mixture was stirred at ambient temperature for 24 h. The solution was then dried *in vacuo* and re-dissolved in CDCl₃ (0.6 mL). Conversion was determined by ¹H NMR spectroscopy.

Table 2. Condition Screening for the Formation of **2** via Hydroarylation Using $[(\text{PhO})\text{P}(2-(N\text{-Mepy}))\text{Ph}_2][\text{B}(\text{C}_6\text{F}_5)_4]_2$ as the Catalyst

Cat. (mol %)	Equiv. alkyne ^a	T (°C)	Solvent	Yield ^b (%)
0	1.0	25	CH_2Cl_2	0
5	1.0	25	CH_2Cl_2	44
5	1.0	25	$\text{C}_2\text{H}_4\text{Cl}_2$	67
5	1.0	50	CH_2Cl_2	71
5	1.0	50	$\text{C}_2\text{H}_4\text{Cl}_2$	85
5	1.0	80	$\text{C}_2\text{H}_4\text{Cl}_2$	92
5	1.5	80	$\text{C}_2\text{H}_4\text{Cl}_2$	97
5	1.5	80	$\text{C}_2\text{H}_4\text{Cl}_2$	95 ^c
1	1.5	80	$\text{C}_2\text{H}_4\text{Cl}_2$	69
0	1.5	80	$\text{C}_2\text{H}_4\text{Cl}_2$	0

^a reaction scale = 0.12 mmol diarylamine; ^b reaction volume = 9 mL; ^c reaction volume = 2 mL.

6. Catalysis Scope



General Procedure

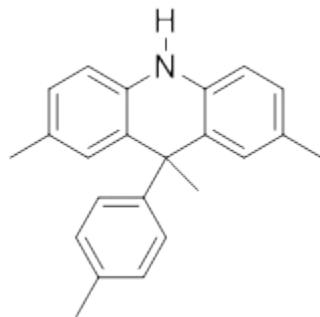
Hydroarylations of diarylamines were performed following a common procedure. A sample procedure is provided below. Reactions with $(4\text{-Tol})_2\text{NH}$, $(4\text{-(OMe)}\text{C}_6\text{H}_4)_2\text{NH}$, and $(4\text{-BrC}_6\text{H}_4)_2\text{NH}$ were carried out at ambient temperature instead of 80°C . Reaction with $1,4\text{-(HCC)}_2\text{Ph}$ performed with 1.3 eq. $(4\text{-Tol})_2\text{NMe}$. Reaction with $(4\text{-Tol})_3\text{N}$ performed with 1.0 eq. $(4\text{-Tol})\text{CCH}$.

In a Schlenk bomb, a solution of $[(\text{PhO})\text{P}(2-(N\text{-Mepy}))\text{Ph}_2][\text{B}(\text{C}_6\text{F}_5)_4]_2$ (10.2 mg, 0.006 mmol, 0.05 eq.) was prepared in $\text{C}_2\text{H}_4\text{Cl}_2$ (0.66 mL). A solution of $(4\text{-XPh})_2\text{NMe}$ (0.12 mmol, 1.0 eq.) in $\text{C}_2\text{H}_4\text{Cl}_2$ (0.66 mL) was added at ambient temperature. The mixture was briefly stirred and then a solution of $(\text{R})\text{CCH}$ (0.18 mmol, 1.5 eq.) in $\text{C}_2\text{H}_4\text{Cl}_2$ (0.66 mL) was added. The reaction mixture was sealed and heated at 80°C for 24 h. The solution was then dried *in vacuo* and re-dissolved in CDCl_3 (0.6 mL). Conversions were determined by ^1H NMR spectroscopy. Products were isolated by silica

chromatography (0-5 % EtOAc in pentane). Single crystals suitable for X-ray diffraction were obtained by recrystallization from hot ethanol.

Table 3. Catalytic Synthesis of 9,9-Disubstituted 9,10-Dihydroacridine Derivatives Using $[(\text{PhO})\text{P}(\text{2-(N-MePy)})\text{Ph}_2][\text{B}(\text{C}_6\text{F}_5)_2]_2$ as the Catalyst

E	X	R	T (°C)	Prod.	Conv (%) (isolated)
NH	Me	4-Tol	25	1	52 (37)
NMe	Me	4-Tol	80	2	95 (76)
NMe	Me	Ph	80	3	95 (74)
NMe	Me	4-biphenyl	80	4	92 (68)
NMe	Me	4-BrC ₆ H ₄	80	5	93 (65)
NMe	Me	2,4-F ₂ C ₆ H ₃	80	6	68 (35)
NMe	Me	3-thiophene-yl	80	7	86 (63)
NMe	Me	4-(MeO)C ₆ H ₄	80	8	65(26)
NMe	Me	4-CF ₃ C ₆ H ₄	80	9	10
NMe	MeO	4-Tol	80	10	97 (66)
NMe	Br	4-Tol	80	11	23 (20)
NMe	H	4-Tol	80	12	55 (35)
O	Me	4-Tol	80	13	21
N(4-Tol)	Me	4-Tol	80	14	65
NH	Br	4-Tol	25, 80	-	0
NSiEt ₃	Me	4-Tol	80	-	0
S	H, Me	4-Tol	80	-	0



(1) 2,7,9-trimethyl-9-(4-tolyl)-9,10-dihydronaphthalene

Obtained as a light yellow solid (13.9 mg, 37% isolated yield). **HRMS (DART-TOF+):** m/z [M+H] 314.19074 (calc'd for C₂₃H₂₄N: 319.19087). **¹H NMR (500 MHz, C₆D₆):** δ = 1.86 (s, 3H; 9-CH₃), 1.99 (s, 6H; 2,7-CH₃), 2.09 (s, 1H; 9-(tolyl-p-CH₃)), 5.50 (s, 1H; NH), 6.31 (d, ³J_{HH} = 8 Hz, 2H; 4,5-CH), 6.78 (s, 2H; 1,8-CH), 6.83 (dd, ³J_{HH} = 8 Hz, ⁴J_{HH} = 2 Hz, 2H; 3,6-CH), 6.99 (d, ³J_{HH} = 8 Hz, 2H; 9-(tolyl-m-CH)), 7.39 ppm (dt, ³J_{HH} = 8 Hz, ⁴J_{HH} = 2 Hz; 9-(tolyl-o-CH)). **¹³C{¹H} NMR (125 MHz, C₆D₆):** δ =

20.9 (2C; 2,7-CH₃), 21.0 (1C; 9-(tolyl-*p*-CH₃)), 31.6 (1C; 9-CH₃), 46.0 (1C; 9-*C*), 113.6 (2C; 4,5-CH), 127.7 (2C; 3,6-CH), 128.9 (2C; 9-(tolyl-*m*-CH)), 129.4 (2C; 2,7-*C*), 129.5 (2C; 9-(tolyl-*o*-CH)), 129.7 (2C; 1,8-CH), 129.9 (2C; 12,13-*C*), 135.5 (1C; 9-(tolyl-*p*-C)), 136.5 (2C; 11,14-*C*), 147.5 ppm (1C; 9-(tolyl-*i*-C)).

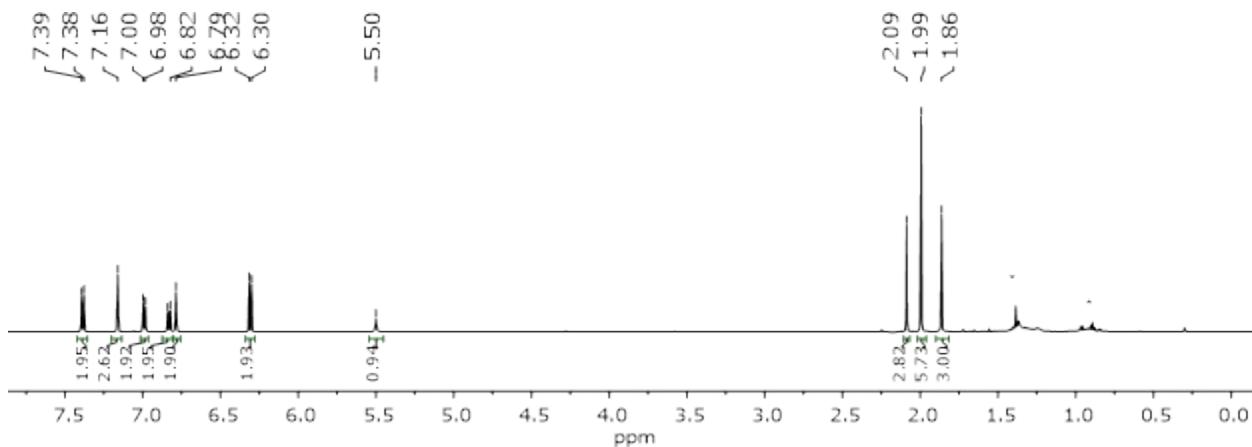


Figure 12. ^1H (C_6D_6) NMR spectrum of **1**. Asterisks denote solvent impurities.

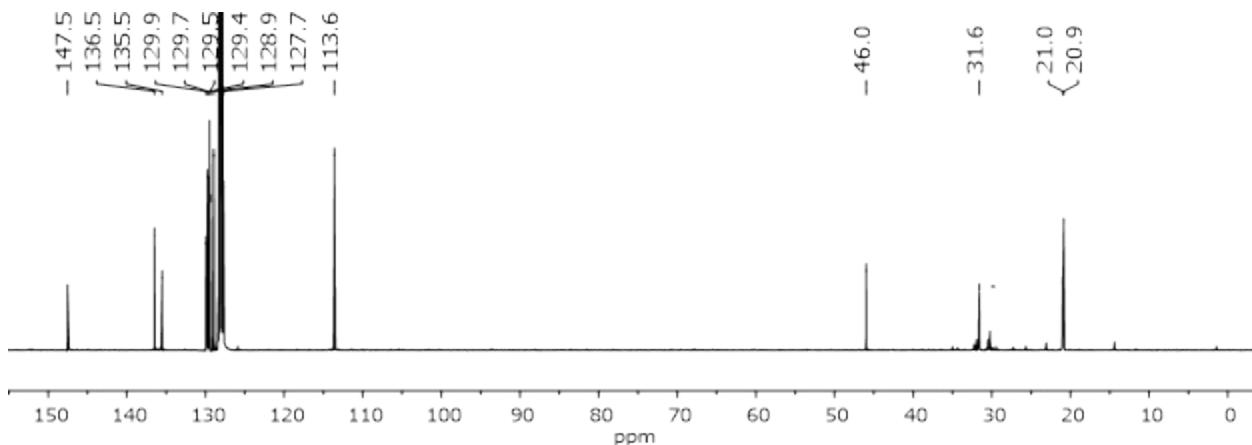
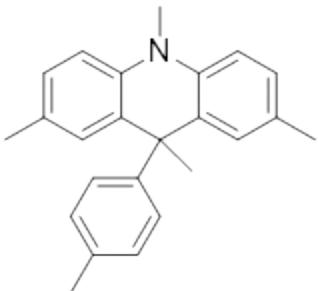


Figure 13. $^{13}\text{C}\{^1\text{H}\}$ (C_6D_6) NMR spectrum of **1**. Asterisks denote solvent impurities.



(2) 2,7,9,10-tetramethyl-9-(4-tolyl)-9,10-dihydoracridine

Obtained as a white solid (29.9 mg, 76% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] 328.20756 (calc'd for C₂₄H₂₆N: 328.20652). **¹H NMR (500 MHz, CDCl₃)**: δ = 1.79 (s, 3H; 9-CH₃), 2.22 (s, 6H; 2,7-CH₃), 2.33 (s, 3H; 9-(tolyl-*p*-CH₃)), 3.35 (s, 3H; NCH₃), 6.75 (d, ⁴J_{HH} = 2 Hz, 2H; 1,8-CH), 6.87 (d, ³J_{HH} = 8 Hz, 2H; 4,5-CH), 7.00 (d, ³J_{HH} = 8 Hz, ⁴J_{HH} = 2 Hz, 2H; 3,6-CH), 7.05 ppm (s, 4H; 9-(tolyl-*o,m*-CH)). **¹³C NMR (125 MHz, CDCl₃)**: δ = 20.9 (2C; 2,7-CH₃), 21.2 (1C; 9-(tolyl-*p*-CH₃)), 28.5 (1C; 9-CH₃), 33.6 (1C; NCH₃), 45.8 (1C; 9-C), 111.7 (2C; 4,5-CH), 127.4 (2C; 3,6-CH), 128.0 (2C; 1,8-CH), 128.5 (2C; 9-(tolyl-*o*-CH)), 128.6 (2C; 9-(tolyl-*o*-CH)), 129.0 (2C; 2,7-C), 132.4 (2C; 12,13-C), 135.4 (1C; 9-(tolyl-*p*-CH₃)), 140.0 (2C; 11,14-C), 145.9 ppm (1C; 9-(tolyl-*i*-C)).

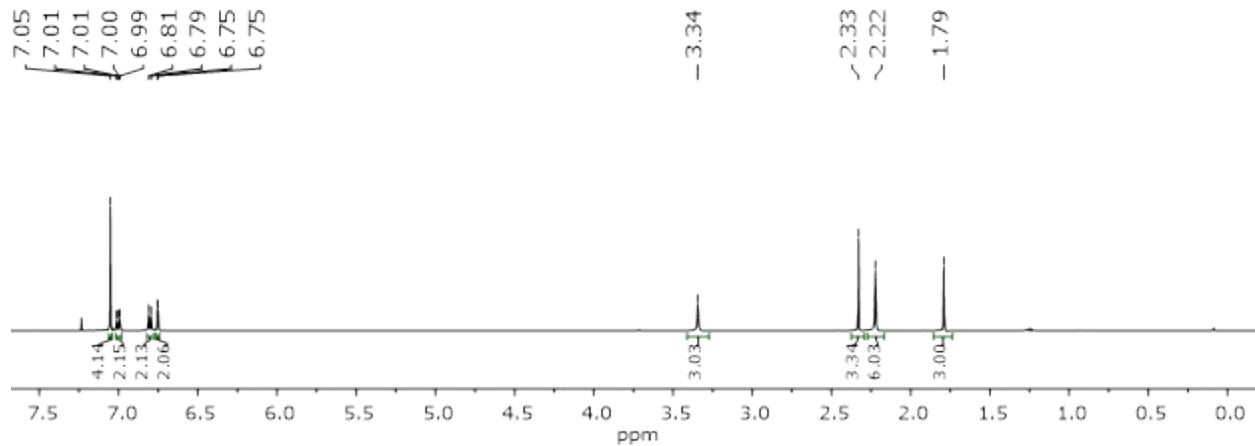


Figure 14. ¹H (CDCl₃) NMR spectrum of **2**.

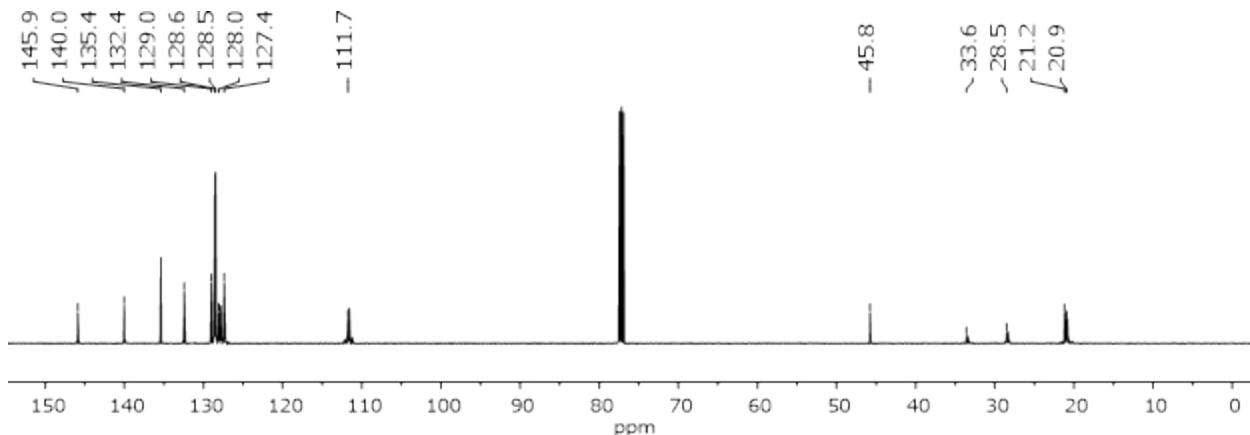


Figure 15. ^{13}C (CDCl_3) NMR spectrum of **2**.

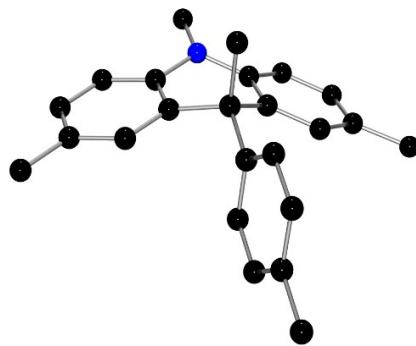
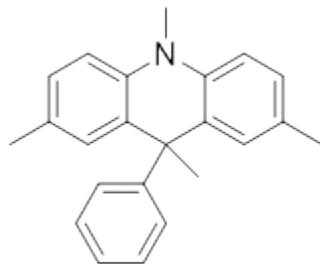


Figure 16. Molecular structure of **2**.



(3) 2,7,9,10-tetramethyl-9-phenyl-9,10-dihydoracridine

Obtained as a white solid (27.8 mg, 74% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] 314.19205 (calc'd for $\text{C}_{23}\text{H}_{24}\text{N}$: 314.19087). **^1H NMR (500 MHz, CDCl_3)**: δ = 1.81 (s, 3H; 9- CH_3), 2.22 (s, 6H; 2,7- CH_3), 3.35 (s, 3H; NCH_3), 6.74 (d, $^4J_{\text{HH}} = 2$ Hz, 2H; 1,8- CH), 6.82 (d, $^3J_{\text{HH}} = 8$ Hz, 2H; 4,5- CH), 7.00 (dd, $^3J_{\text{HH}} = 8$ Hz, $^4J_{\text{HH}} = 2$ Hz, 2H; 3,6- CH), 7.23 ppm (m, 5H; 9-(phenyl-*o,m,p*- CH). **^{13}C NMR (125 MHz, CDCl_3)**: δ = 20.9 (2C; 2,7- CH_3), 28.3 (1C; 9- CH_3), 33.4 (1C; NCH_3), 46.1 (1C; 9- C),

111.7 (2C; 4,5-CH), 126.0 (1C; 9-(phenyl-*p*-CH), 127.4 (1C; 9-(phenyl-*m*-CH), 127.7 (2C; 3,6-CH), 127.9 (2C; 1,8-CH), 128.6 (1C; 9-(phenyl-*o*-CH), 129.0 (2C; 2,7-C), 132.2 (2C; 12,13-C), 140.0 (2C; 11,14-C), 149.0 ppm (1C; 9-phenyl-C).

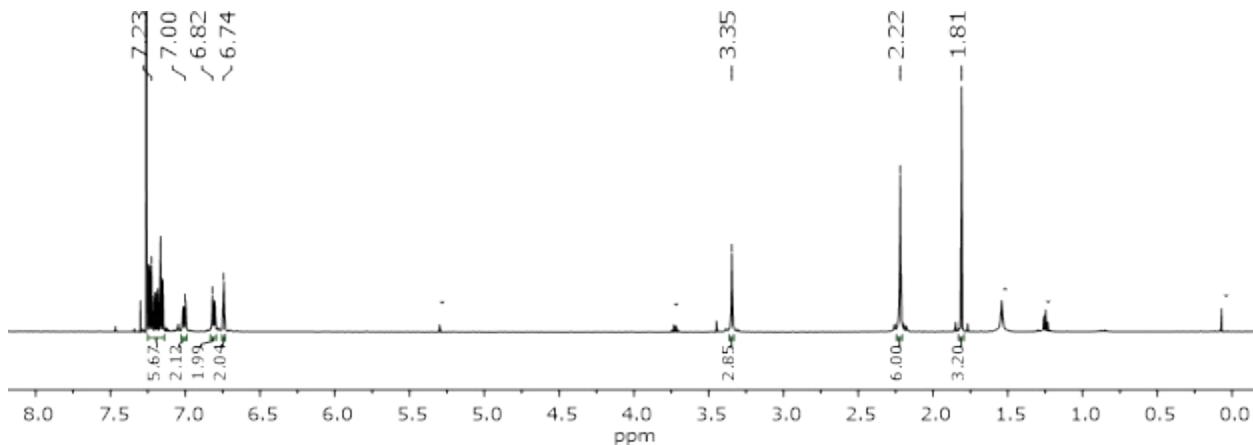


Figure 17. ^1H (CDCl_3) NMR spectrum of **3**. Asterisks denote solvent impurities.

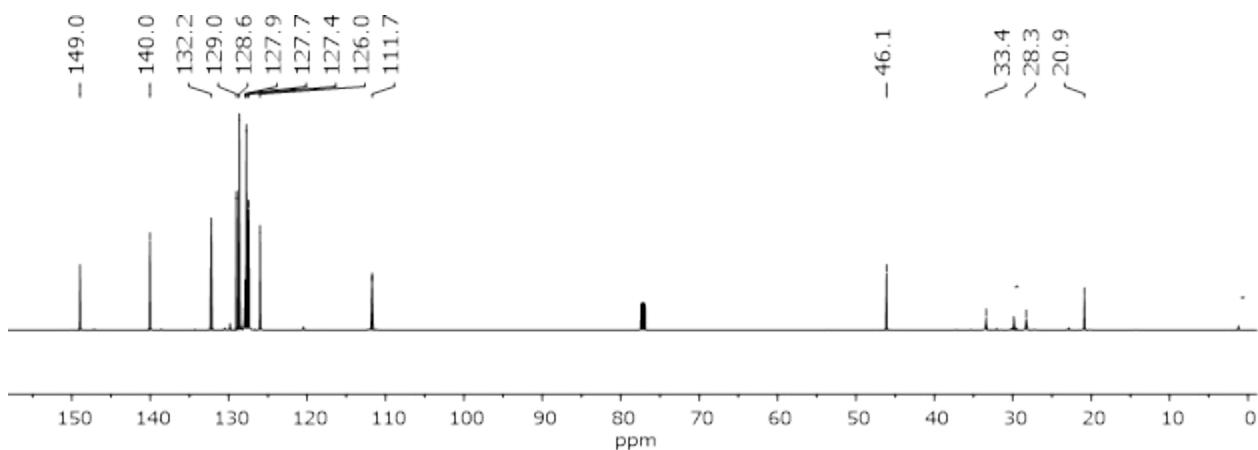


Figure 18. ^{13}C (CDCl_3) NMR spectrum of **3**. Asterisks denote solvent impurities.

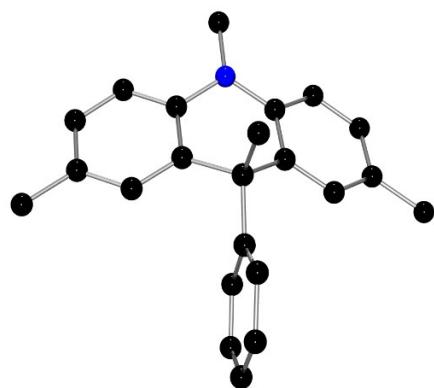
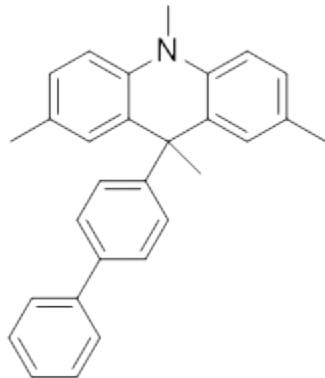


Figure 19. Molecular structure of **3**.



(4) 2,7,9,10-tetramethyl-9-([1,1'-biphenyl]-4-yl)-9,10-dihydoracridine

Obtained as a white solid (31.8 mg, 68% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] 390.22252 (calc'd for C₂₉H₂₈N: 390.22217). **¹H NMR (500 MHz, CDCl₃)**: δ = 1.86 (s, 3H; 9-CH₃), 2.24 (s, 6H; 2,7-CH₃), 3.36 (s, 3H; NCH₃), 6.82 (d, ⁴J_{HH} = 2 Hz, 2H; 1,8-CH), 6.83 (d, ³J_{HH} = 8 Hz, 2H; 4,5-CH), 7.03 (m, 2H; 3,6-CH), 7.22 (dt, ³J_{HH} = 8 Hz, ⁴J_{HH} = 2 Hz, 2H; 9-(biphenyl-2,6-CH)), 7.32 (tt, ³J_{HH} = 8 Hz, ⁴J_{HH} = 1 Hz, 1H; 9-(biphenyl-4'-CH)), 7.42 (t, ³J_{HH} = 8 Hz, ⁴J_{HH} = 2 Hz, 2H; 9-(biphenyl-3',5'-CH)), 7.49 (dt, ³J_{HH} = 8 Hz, ⁴J_{HH} = 2 Hz, 2H; 9-(biphenyl-3,5-CH)), 7.61 ppm (m, 2H; 9-(biphenyl-2',6'-CH)). **¹³C{¹H} NMR (125 MHz, CDCl₃)**: δ = 20.9 (2C; 2,7-CH₃), 28.3 (1C; 9-CH₃), 33.5 (1C; NCH₃), 45.9 (1C; 9-C), 111.8 (2C; 4,5-CH), 126.4 (2C; 9-(biphenyl-3,5-CH)), 127.1 (2C; 9-(biphenyl-2',6'-CH)), 127.2 (1C; 9-(biphenyl-4'-CH)), 127.5 (2C; 3,6-CH), 127.9 (2C; 1,8-CH), 128.8 (2C; 9-(biphenyl-3',5'-CH)), 129.0 (2C; 9-(biphenyl-2,6-CH)), 129.2 (2C; 2,7-C), 132.1 (2C; 12,13-C), 138.6 (1C; 9-(biphenyl-1-C)), 140.1 (2C; 11,14-C), 141.0 (1C; 9-(biphenyl-1'-C)), 148.2 ppm (1C; 9-(biphenyl-4-C)).

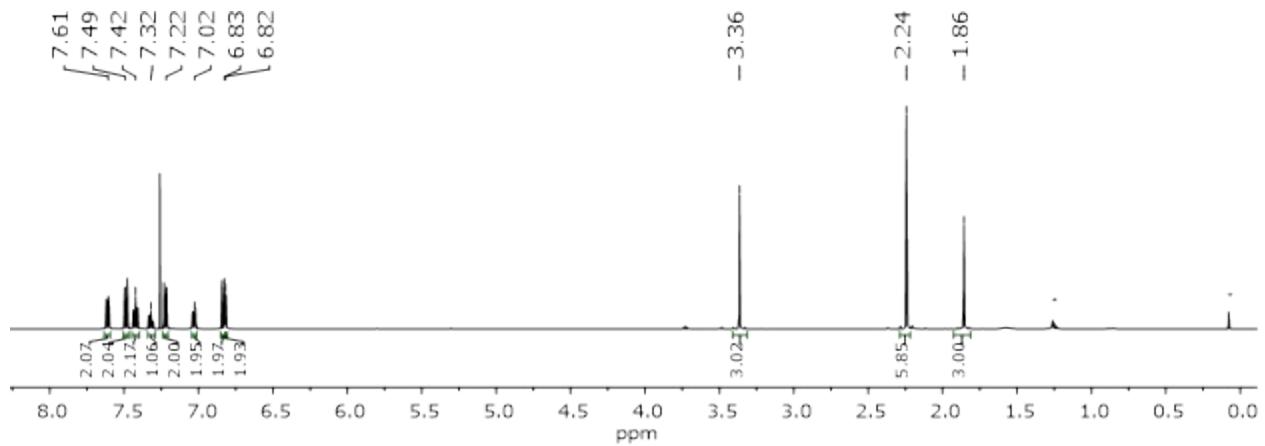


Figure 20. ^1H (CDCl_3) NMR spectrum of **4**. Asterisks denote solvent impurities.

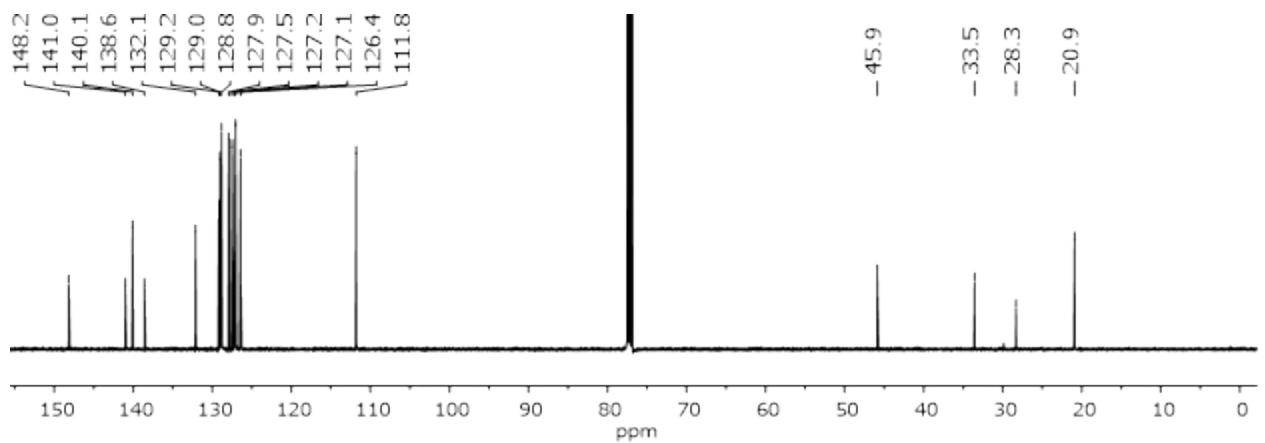


Figure 21. $^{13}\text{C}\{^1\text{H}\}$ (CDCl_3) NMR spectrum of **4**.

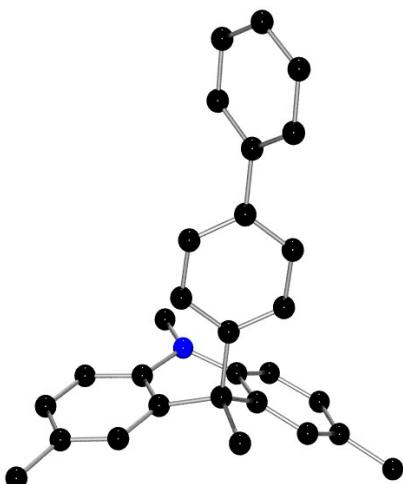
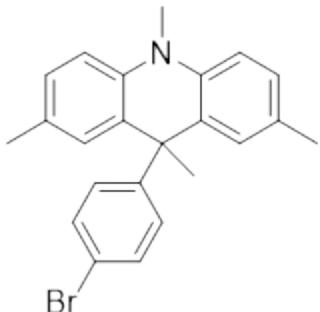


Figure 22. Molecular structure of **4**.



(5) 2,7,9,10-tetramethyl-9-(4-bromophenyl)-9,10-dihydoracridine

Obtained as a white solid (30.6 mg, 65% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] 392.10177 (calc'd for C₂₃H₂₃BrN: 392.10139). **¹H NMR (500 MHz, CDCl₃)**: δ = 1.79 (s, 3H; 9-CH₃), 2.24 (s, 6H; 2,7-CH₃), 3.33 (s, 3H; NCH₃), 6.75 (d, ⁴J_{HH} = 2 Hz, 2H; 1,8-CH), 6.81 (d, ³J_{HH} = 8 Hz, 2H; 4,5-CH), 7.02 (m, 4H; 3,6-CH, 9-(phenyl-*o*-CH)), 7.35 ppm (dt, ³J_{HH} = 8 Hz, ⁴J_{HH} = 2 Hz, 2H; 9-(phenyl-*m*-CH)). **¹³C NMR (125 MHz, CDCl₃)**: δ = 20.9 (2C; 2,7-CH₃), 28.1 (1C; 9-CH₃), 33.4 (1C; NCH₃), 45.8 (1C; 9-C), 111.9 (2C; 4,5-CH), 120.0 (1C; 9-(phenyl-*p*-CBr)), 127.6 (4C; 1,8-CH, 3,6-CH), 129.3 (2C; 2,7-C), 130.4 (2C; 9-(phenyl-*o*-CH)), 130.8 (2C; 9-(phenyl-*m*-CH)), 131.6 (2C; 12,13-C), 140.1 (2C; 11,14-C), 148.3 ppm (1C; 9-(phenyl-*i*-C)).

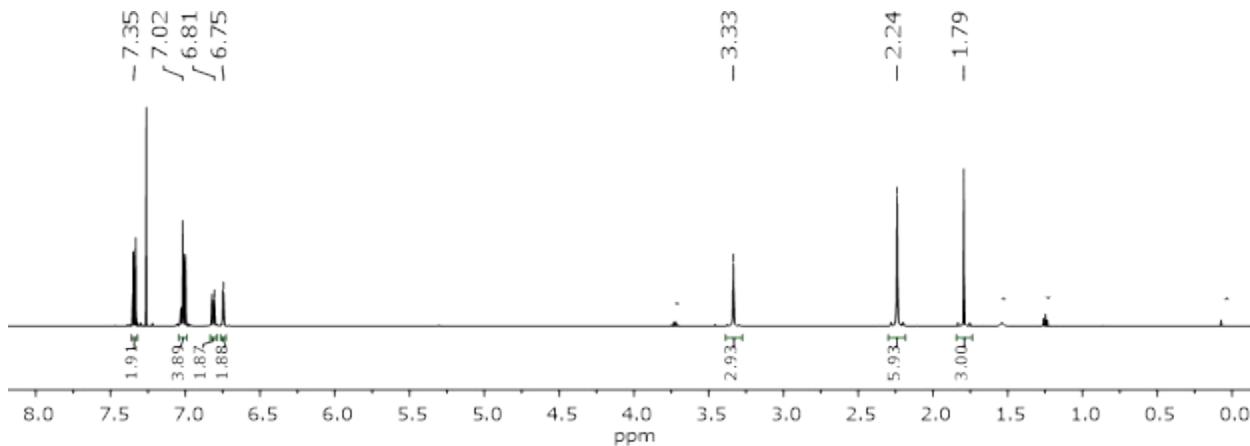


Figure 23. ¹H (CDCl₃) NMR spectrum of **5**. Asterisks denote solvent impurities.

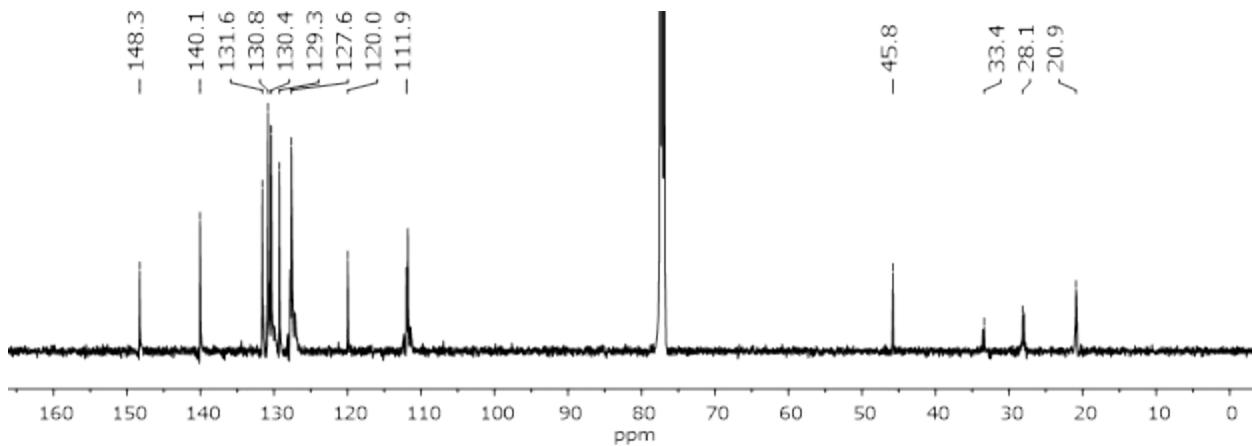


Figure 24. ^{13}C (CDCl_3) NMR spectrum of **5**.

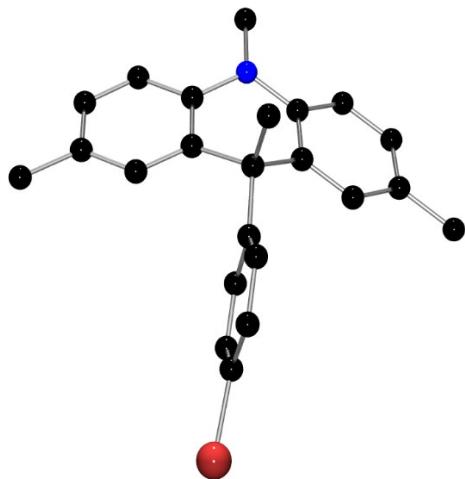
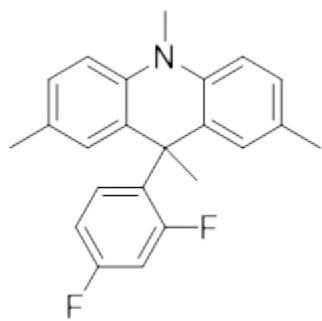


Figure 25. Molecular structure of **5**.



(6) 2,7,9,10-tetramethyl-9-(2,4-difluorophenyl)-9,10-dihydoracridine

Obtained as a white solid (14.7 mg, 35% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] 350.17171 (calc'd for $\text{C}_{23}\text{H}_{22}\text{F}_2\text{N}$: 350.17203). **^1H NMR (500 MHz, CDCl_3)**: δ = 1.73 (s, 3H; 9- CH_3),

2.17 (s, 6H; 2,7-CH₃), 3.41 (s, 3H; NCH₃), 6.50 (d, ⁴J_{HH} = 2 Hz, 2H; 1,8-CH), 6.73 (m, 1H; 9-(phenyl-3-CH)), 6.81 (d, ³J_{HH} = 8 Hz, 2H; 5,4-CH), 6.96 (m, 1H; 9-(phenyl-5-CH)), 7.00 (m, 2H; 3,6-CH), 7.49 ppm (dt, ³J_{HF} = 8 Hz, 1F; 9-(phenyl-6-CH)). ¹⁹F{¹H} NMR (375 MHz, CDCl₃): δ = -99.20 (d, ³J_{FF} = 8 Hz, 1F; 9-(phenyl-2-F)), -112.69 ppm (d, ³J_{FF} = 8 Hz, 1F; 9-(phenyl-4-F)). ¹³C NMR (125 MHz, CDCl₃): δ = 20.8 (2C; 2,7-CH₃), 29.6 (1C; 9-CH₃), 33.5 (1C; NCH₃), 44.0 (1C; 9-C), 105.5 (1C; 9-(phenyl-3-CH)), 110.1 (1C; 9-(phenyl-5-CH)), 111.8 (2C; 4,5-CH), 126.6 (2C; 1,8-CH), 127.7 (2C; 3,6-CH), 129.1 (2C; 2,7-C), 129.6 (1C; 9-(phenyl-6-CH)), 131.0 (1C; 9-(phenyl-1-C)), 131.2 (2C; 12,13-C), 138.9 (2C; 11,14-C), 161.2 (1C; 9-(phenyl-4-CF)), 162.4 ppm (1C; 9-(phenyl-2-CH)).

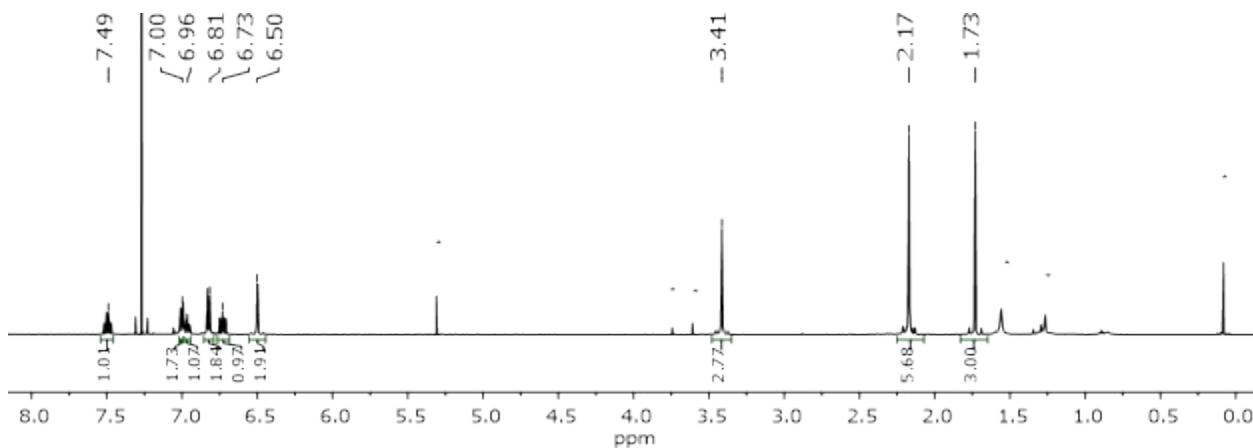


Figure 26. ¹H (CDCl₃) NMR spectrum of **6**. Asterisks denote solvent impurities.

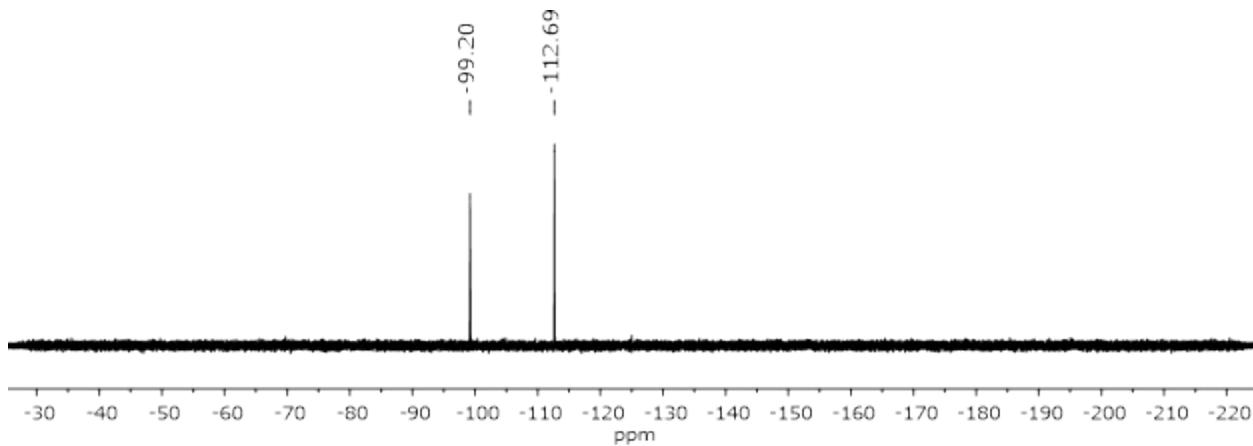


Figure 27. ¹⁹F (CDCl₃) NMR spectrum of **6**.

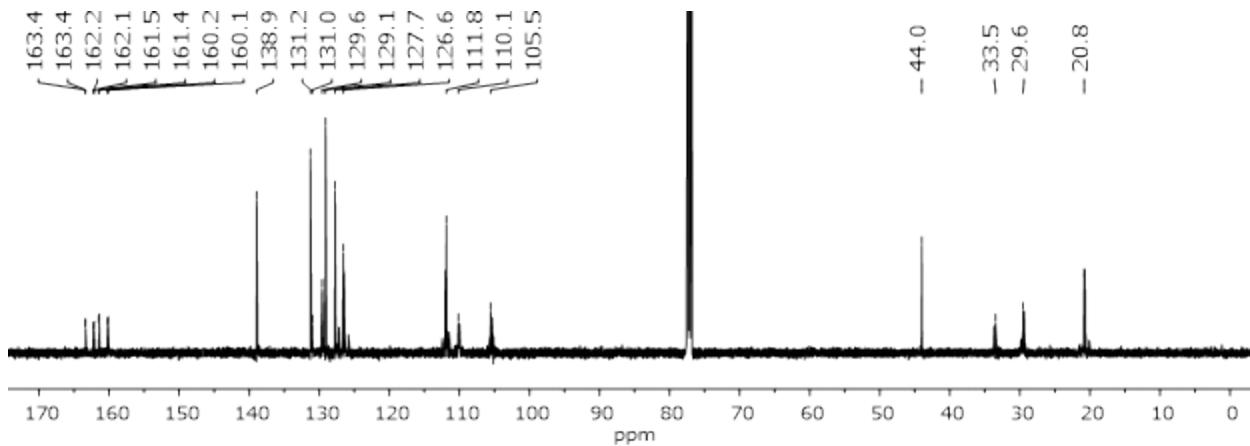
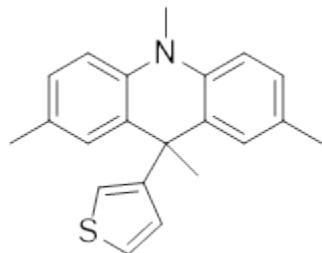


Figure 28. ^{13}C (CDCl_3) NMR spectrum of **6**.



(7) 2,7,9,10-tetramethyl-9-(3-thiophenyl)-9,10-dihydoracridine

Obtained as a white solid (24.1 mg, 63% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] 320.14802 (calc'd for $\text{C}_{21}\text{H}_{22}\text{NS}$: 320.14729). **^1H NMR (500 MHz, CDCl_3)**: δ = 1.72 (s, 3H; 9- CH_3), 2.19 (s, 6H; 2,7- CH_3), 3.40 (s, 3H; NCH_3), 6.61 (d, $^4J_{\text{HH}} = 2\text{Hz}$, 2H; 1,8- CH), 6.74 (dd, $^3J_{\text{HH}} = 5\text{Hz}$, $^4J_{\text{HH}} = 1\text{Hz}$, 1H; 9-(thiophenyl-2- CH)), 6.82 (d, $^3J_{\text{HH}} = 8\text{Hz}$, 2H; 4,5- CH), 7.01 (m, 2H; 3,6- CH), 7.18 (dd, $^3J_{\text{HH}} = 3\text{Hz}$, $^3J_{\text{HH}} = 1\text{Hz}$, 1H; 9-(thiophenyl-4- CH)), 7.25 ppm (dd, $^3J_{\text{HH}} = 5\text{Hz}$, $^3J_{\text{HH}} = 3\text{Hz}$, 1H; 9-(thiophenyl-5- CH)). **^{13}C NMR (125 MHz, CDCl_3)**: δ = 20.8 (2C; 2,7- CH_3), 29.3 (1C; 9- CH_3), 33.4 (1C; NCH_3), 44.3 (1C; 9-C), 111.6 (2C; 4,5- CH), 121.7 (1C; 9-(thiophenyl-4- CH)), 125.2 (1C; 9-(thiophenyl-5- CH)), 127.6 (4C; 1,3,6,8- CH), 129.2 (2C; 2,7-C), 129.6 (1C; 9-(thiophenyl-2- CH)), 131.7 (2C; 12,13-C), 139.5 (2C; 11,14-C), 149.3 ppm (1C; 9-(thiophenyl-3-C)).

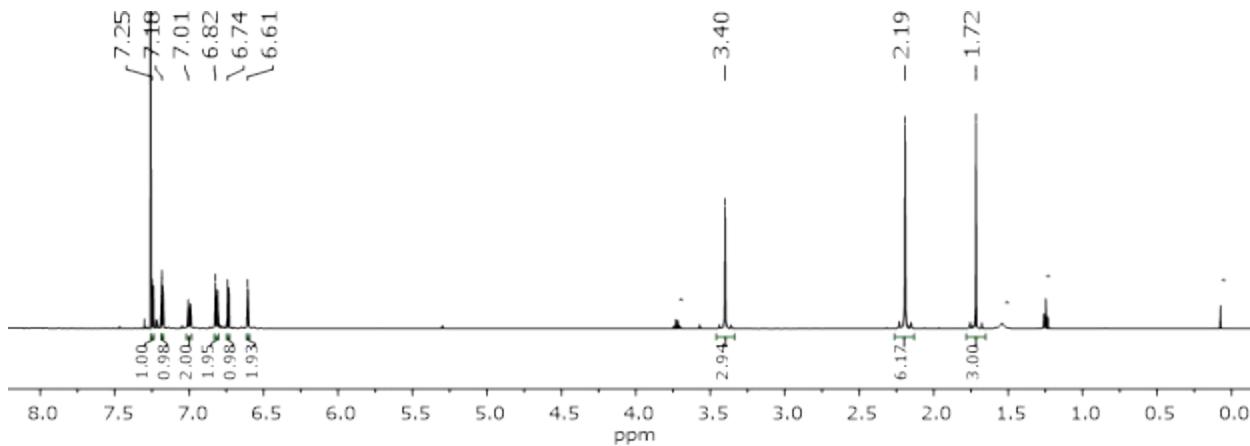


Figure 29. ^1H (CDCl_3) NMR spectrum of **7**. Asterisks denote solvent impurities.

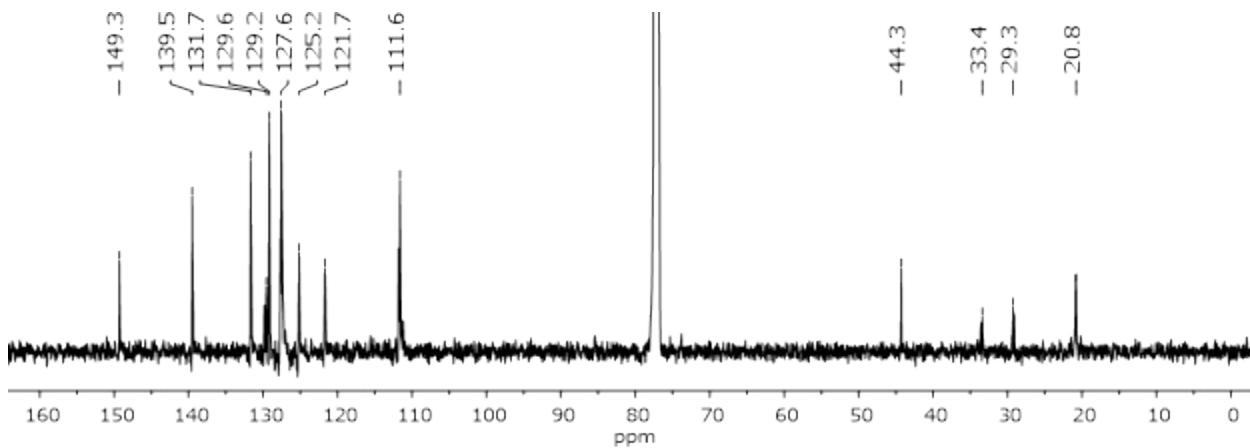
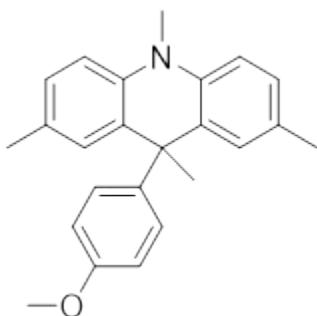


Figure 30. ^{13}C (CDCl_3) NMR spectrum of **7**.



(8) 2,7,9,10-tetramethyl-9-(4-methoxyphenyl)-9,10-dihydoracridine

Obtained as a white solid (10.5 mg, 26% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] 344.20418 (calc'd for $\text{C}_{24}\text{H}_{25}\text{NO}$: 344.20144). **^1H NMR (500 MHz, CDCl_3)**: δ = 1.76 (s, 3H; 9- CH_3), 2.21 (s, 6H; 2,7- CH_3), 3.36 (s, 3H; NCH_3), 3.81 (s, 3H; 9-(phenyl-*p*- OCH_3)), 6.71 (d, $^4J_{\text{HH}} = 2\text{Hz}$, 2H;

*1,8-CH), 6.80 (m, 4H; 4,5-CH, 9-(phenyl-*m*-CH)), 7.00 (m, 2H; 3,6-CH), 7.09 ppm (m, 2H; 9-(phenyl-*o*-CH)). ¹³C NMR (125 MHz, CDCl₃): δ = 21.0 (2C; 2,7-CH₃), 28.7 (1C; 9-CH₃), 33.6 (1C; NCH₃), 45.7 (1C; 9-C), 55.4 (1C; 9-(phenyl-*p*-OCH₃)), 111.7 (2C; 9-(phenyl-*m*-CH)), 113.2 (2C; 4,5-CH), 127.5 (2C; 3,6-CH)), 128.1 (2C; 1,8-CH)), 129.1 (2C; 2,7-C), 129.9 (2C; 9-(phenyl-*o*-CH)), 132.7 (2C; 12,13-C), 140.0 (2C; 11,14-C), 141.1 (1C; 9-(phenyl-*i*-C)), 157.8 ppm (1C; 9-(phenyl-*p*-C)).*

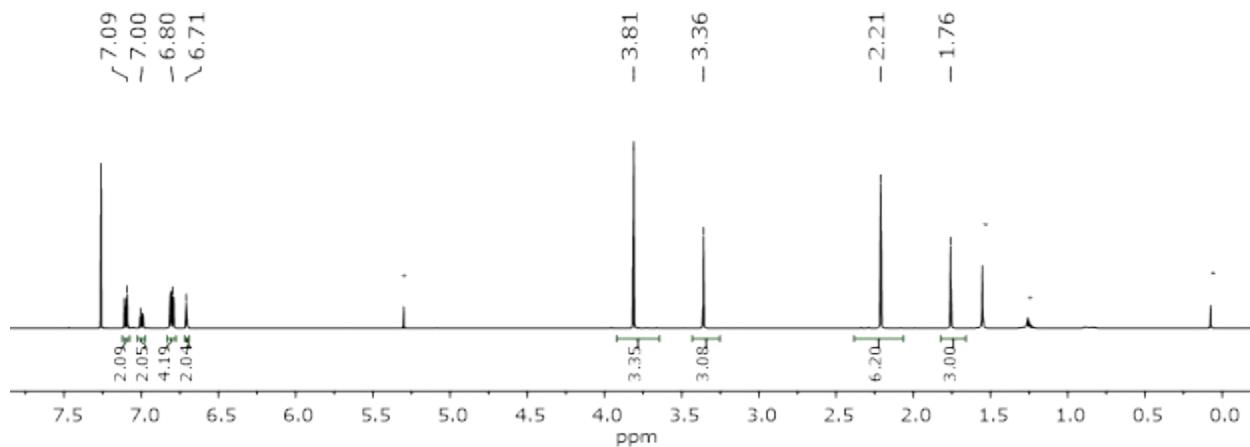


Figure 31. ¹H (CDCl₃) NMR spectrum of **8**. Asterisks denote solvent impurities.

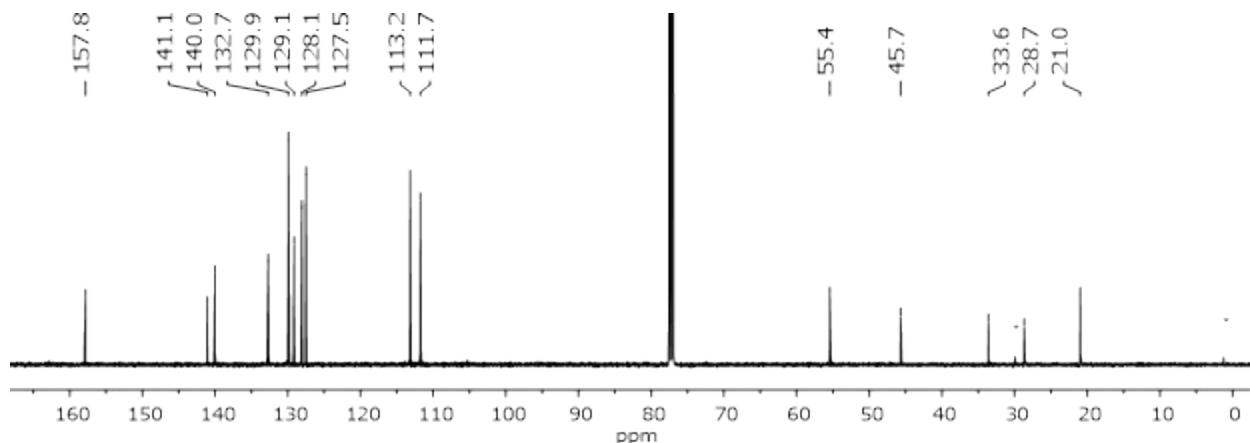
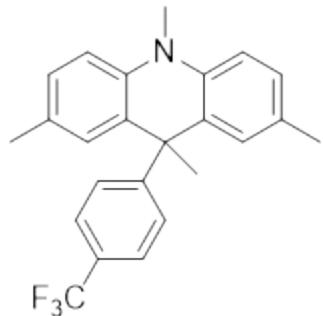


Figure 32. ¹³C{¹H} (CDCl₃) NMR spectrum of **8**. Asterisks denote solvent impurities.



(9) 2,7,9,10-tetramethyl-9-(4-trifluoromethylphenyl)-9,10-dihydoracridine

Partial characterization (10% conversion). **MS (EI+)**: [m/z, (%)] 366.10 ([M-CH₃]⁺, 100), 367.20 (33.6). **¹H NMR (500 MHz, CDCl₃)**: δ = 1.91 (s, 3H; 9-CH₃), 2.30 (s, 6H; 2,7-CH₃), 3.36 (s, 3H; NCH₃), 7.25 (d, ³J_{HH} = 8 Hz, 2H; 9-(phenyl-CH)), 7.48 ppm (d, ³J_{HH} = 8 Hz, 2H; 9-(phenyl-CH)). **¹⁹F{¹H} NMR (282 MHz, CDCl₃)**: -62.47 ppm.

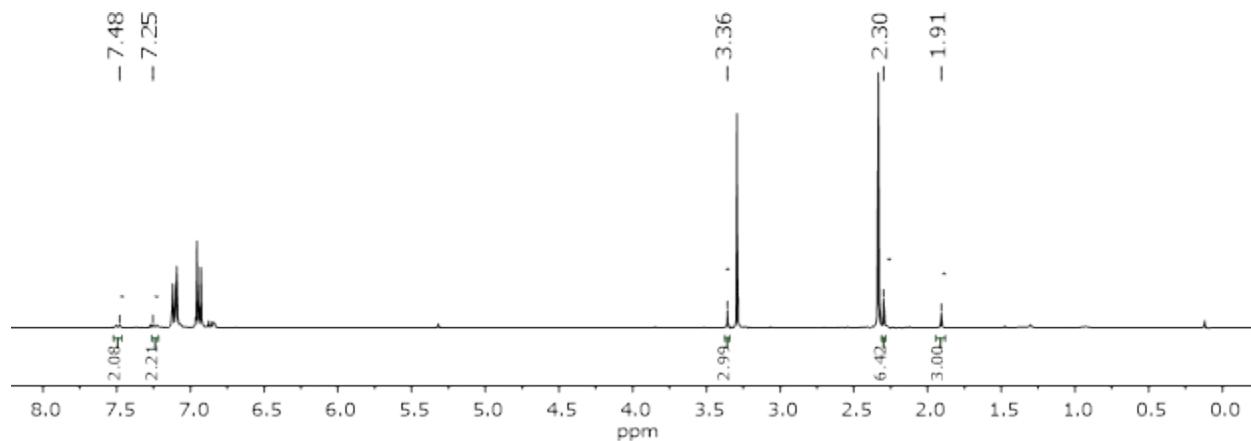


Figure 33. ¹H (CDCl₃) NMR spectrum of reaction mixture of **9**. Asterisks denote product peaks.

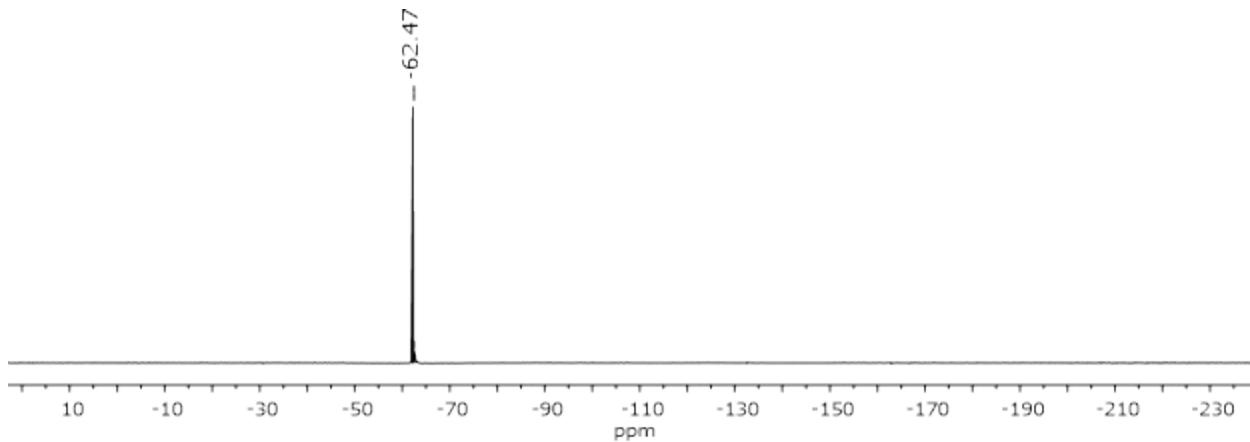
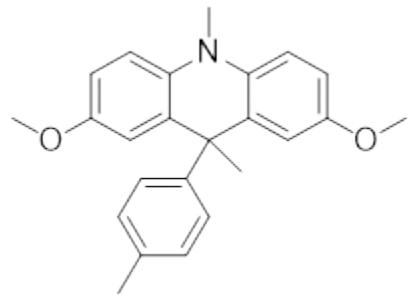


Figure 34. $^{19}\text{F}\{\text{H}\}$ (CDCl_3) NMR spectrum of reaction mixture of **9**.



(10) 2,7-dimethoxy-9,10-dimethyl-9-(4-tolyl)-9,10-dihydoracridine

Obtained as a white solid (28.4 mg, 66% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] m/z 360.19568 (calc'd for $\text{C}_{24}\text{H}_{26}\text{NO}_2$: 360.1965). **^1H NMR (500 MHz, CDCl_3)**: δ = 1.81 (s, 3H; 9- CH_3), 2.31 (s, 3H; 9-(tolyl-*p*- CH_3)), 3.33 (s, 3H; NCH_3), 3.71 (s, 6H; 2,7- OCH_3), 6.61 (d, $^4J_{\text{HH}} = 3$ Hz, 2H; 1,8- CH), 6.78 (dd, $^3J_{\text{HH}} = 8$ Hz, $^4J_{\text{HH}} = 3$ Hz, 2H; 3,6- CH), 6.81 (d, $^3J_{\text{HH}} = 8$ Hz, 2H; 4,5- CH), 7.04 ppm (s, 4H; 9-(tolyl-*o,m*- CH)). **$^{13}\text{C}\{\text{H}\}$ NMR (500 MHz, CDCl_3)**: δ = 21.1 (1C; 9-(tolyl-*p*- CH_3)), 27.7 (1C; 9- CH_3), 33.6 (1C; NCH_3), 46.4 (1C; 9-*C*), 55.8 (2C; 2,7- OCH_3), 111.3 (2C; 3,6- CH), 112.1 (2C; 4,5- CH), 114.2 (2C; 1,8- CH), 128.4 (2C; 9-(tolyl-*o*- CH)), 128.6 (2C; 9-(tolyl-*m*- CH)), 133.6 (2C; 12,13-*C*), 135.6 (1C; 9-(tolyl-*p*-*C*)), 137.0 (2C; 11,14-*C*), 144.9 (1C; 9-(tolyl-*i*-*C*)), 153.7 ppm (2C; 2,7- COCH_3).

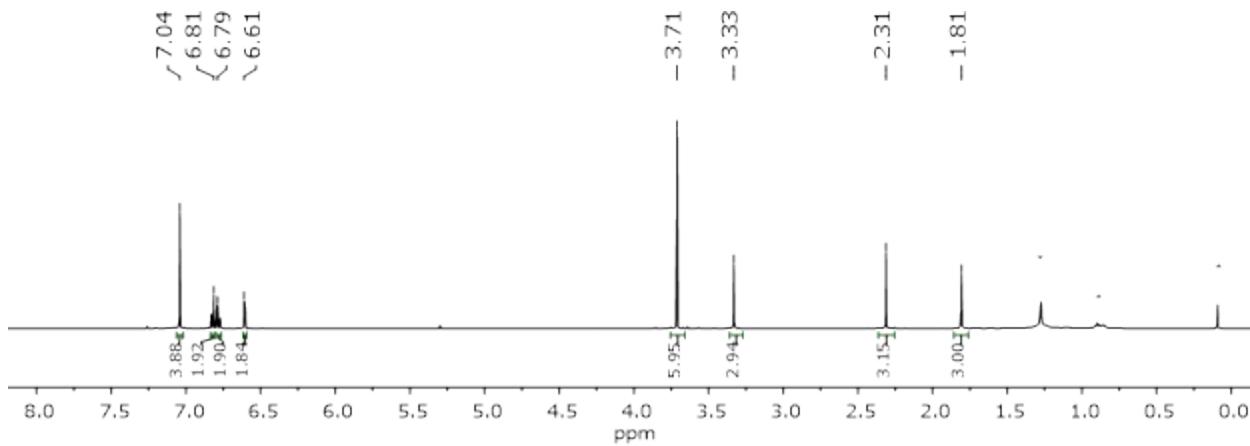


Figure 35. ^1H (CDCl_3) NMR spectrum of **10**. Asterisks denote solvent impurities.

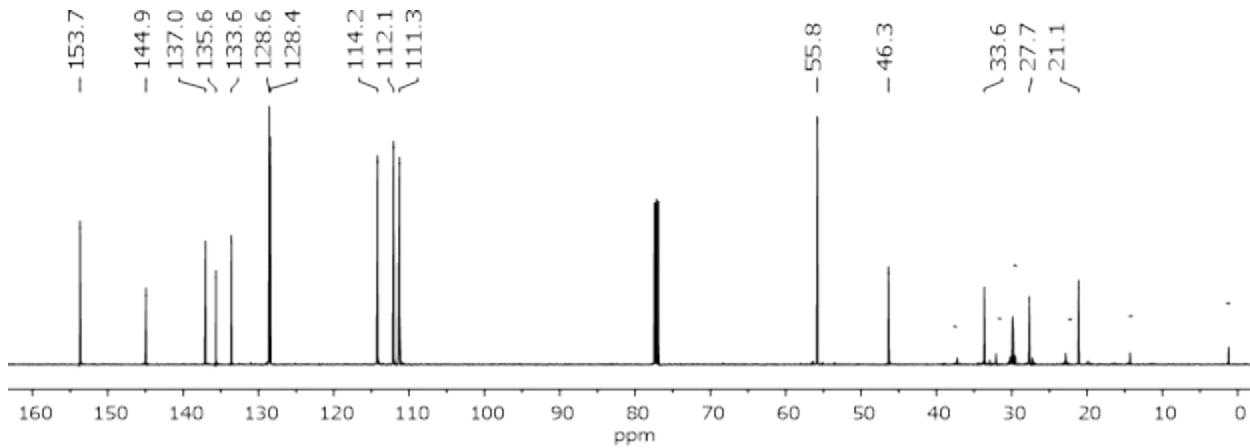
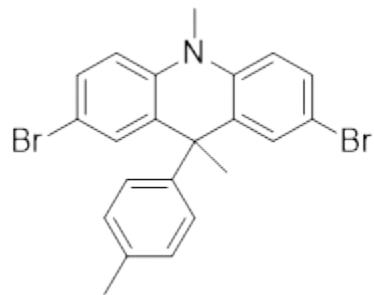


Figure 36. $^{13}\text{C}\{^1\text{H}\}$ (CDCl_3) NMR spectrum of **10**. Asterisks denote solvent impurities.



(11) 2,7-dibromo-9,10-dimethyl-9-(4-tolyl)-9,10-dihydoracridine

Obtained as a light yellow solid (11.0 mg, 20% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] 455.99605 (calc'd for $\text{C}_{22}\text{H}_{20}\text{Br}_2\text{N}$: 455.99625). **$^1\text{H NMR}$ (500 MHz, CDCl_3)**: δ = 1.77 (s, 3H; 9- CH_3), 2.34 (s, 3H; 9-(tolyl- $p\text{-CH}_3$)), 3.35 (s, 3H; NCH_3), 6.80 (d, $^3J_{\text{HH}} = 8$ Hz, 2H; 4,5- CH), 7.01 (d, $^3J_{\text{HH}} = 8$

Hz, $^4J_{HH}$ = 1 Hz, 2H; 9-(tolyl-*o*-CH)), 7.03 (m, 2H; 1,8-CH), 7.08 (d, $^3J_{HH}$ = 8 Hz, 2H; 9-(tolyl-*m*-CH)), 7.32 ppm (m, 2H; 3,6-CH). **$^{13}\text{C}\{\text{H}\}$ NMR (125 MHz, CDCl_3)**: δ = 21.1 (1C; 9-(tolyl-*p*-CH₃), 28.2 (1C; 9-CH₃), 33.8 (1C; NCH₃), 45.9 (1C; 9-C), 113.3 (2C; 2,7-CBr), 113.8 (2C; 4,5-CH), 128.3 (2C; 9-(tolyl-*o*-CH)), 128.9 (2C; 9-(tolyl-*m*-CH)), 129.9 (2C; 3,6-CH), 130.1 (2C; 1,8-CH), 134.4 (2C; 12,13-C), 136.3 (1C; 9-(tolyl-*p*-C)), 140.7 (2C; 11,14-C), 144.0 ppm (1C; 9-(tolyl-*i*-C)).

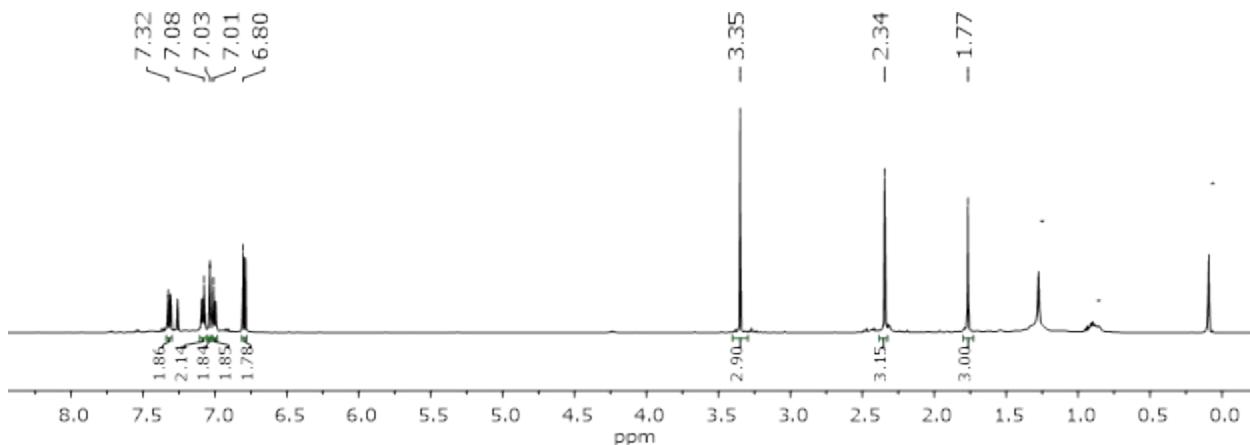


Figure 37. ^1H (CDCl_3) NMR spectrum of **11**. Asterisks denote solvent impurities.

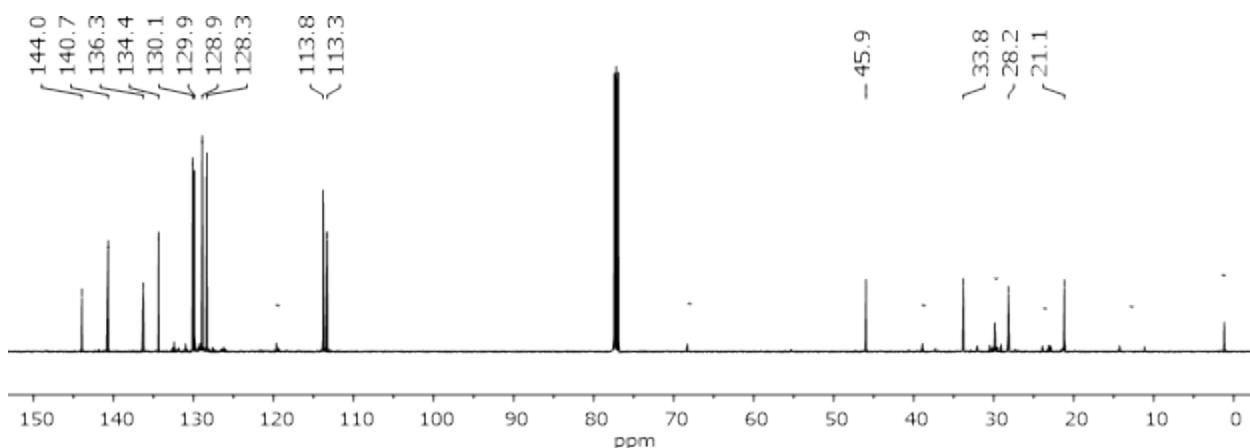
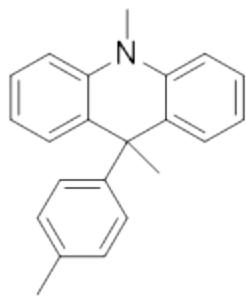


Figure 38. $^{13}\text{C}\{\text{H}\}$ (CDCl_3) NMR spectrum of **11**. Asterisks denote solvent impurities.



(12) 9,10-dimethyl-9-(4-tolyl)-9,10-dihydoracridine

Obtained as a white yellow solid (12.6 mg, 35% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] 455.99605 (calc'd for $C_{22}H_{20}Br_2N$: 455.99625). **1H NMR (500 MHz, $CDCl_3$)**: δ = 1.82 (s, 3H; 9- CH_3), 2.34 (s, 3H; 9-(tolyl-*p*- CH_3)), 3.42 (s, 3H; NCH_3), 6.89 (m, 2H; 1,8- CH), 6.96 (m, 4H; 2,3,6,7- CH), 7.08 (s, 4H; 9-(tolyl-*o,m*- CH)), 7.23 ppm (m, 2H; 4,5- CH). **$^{13}C\{^1H\}$ NMR (125 MHz, $CDCl_3$)**: δ = 21.1 (1C; 9-(tolyl-*p*- CH_3)), 28.3 (1C; 9- CH_3), 33.5 (1C; NCH_3), 45.9 (1C; 9- C), 112.0 (2C; 2,7- CH), 120.3 (2C; 1,8- CH), 126.9 (2C; 4,5- CH), 127.4 (2C; 3,6- CH), 128.5 (2C; 9-(tolyl-*o*- CH)), 128.7 (2C; 9-(tolyl-*m*- CH)), 132.6 (2C; 12,13- C), 135.6 (1C; 9-(tolyl-*p*- C)), 141.9 (2C; 11,14- C), 145.8 ppm (1C; 9-(tolyl-*i*- C)).

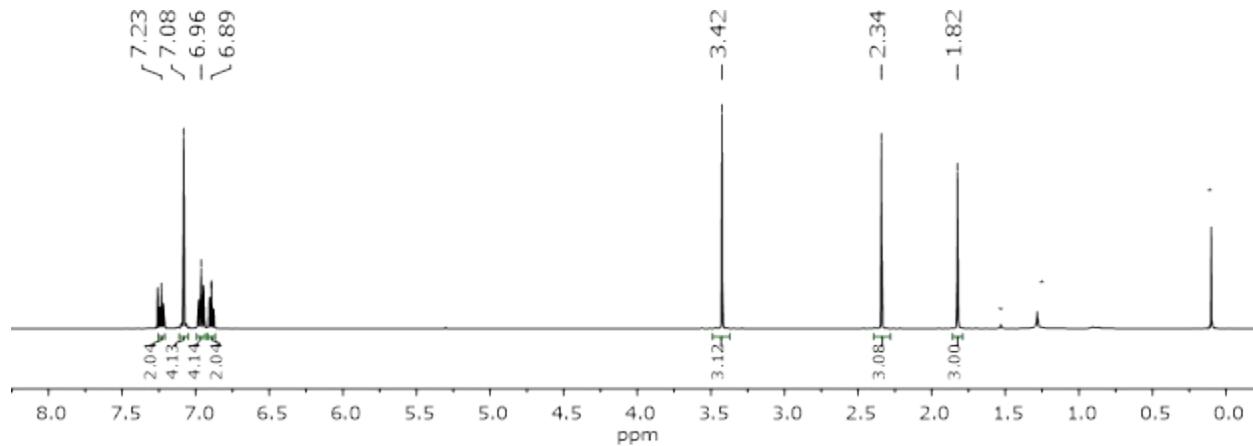


Figure 39. 1H ($CDCl_3$) NMR spectrum of **12**. Asterisks denote solvent impurities.

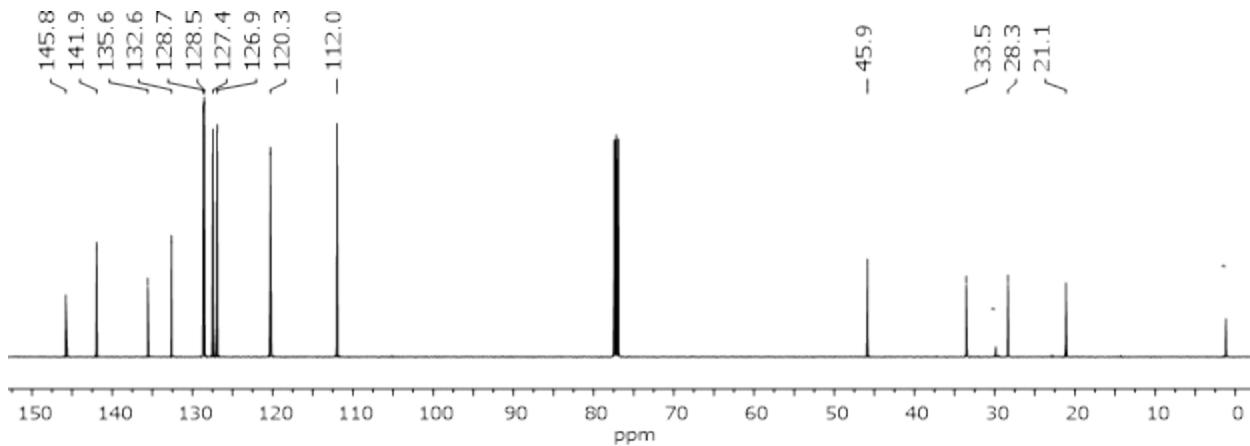


Figure 40. $^{13}\text{C}\{^1\text{H}\}$ (CDCl_3) NMR spectrum of **12**. Asterisks denote solvent impurities.

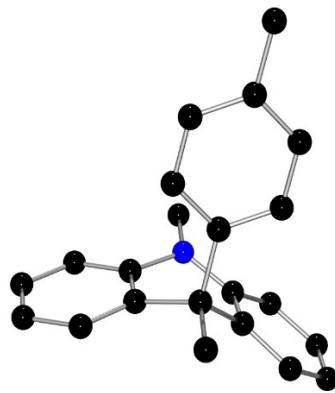
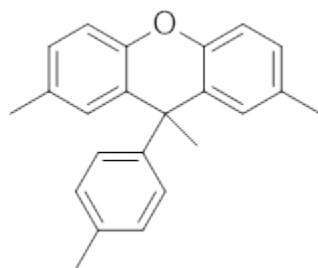


Figure 41. Molecular structure of **12**.



(13) 2,7,9-trimethyl-9-(4-tolyl)-9*H*-xanthene

Partial characterization (21% conversion). **MS (EI+)**: [m/z, (%)] 313.20 ([$\text{M}-\text{H}^+$], 100), 314.30 (23.4), 315.20 (2.5). **^1H NMR (500 MHz, CDCl_3)**: δ = 1.92 (s, 3H; 9- CH_3), 2.21 (s, 6H; 2,7- CH_3), 6.67 (m, 2H; 1,8- CH), 6.99 ppm (m, 4H).

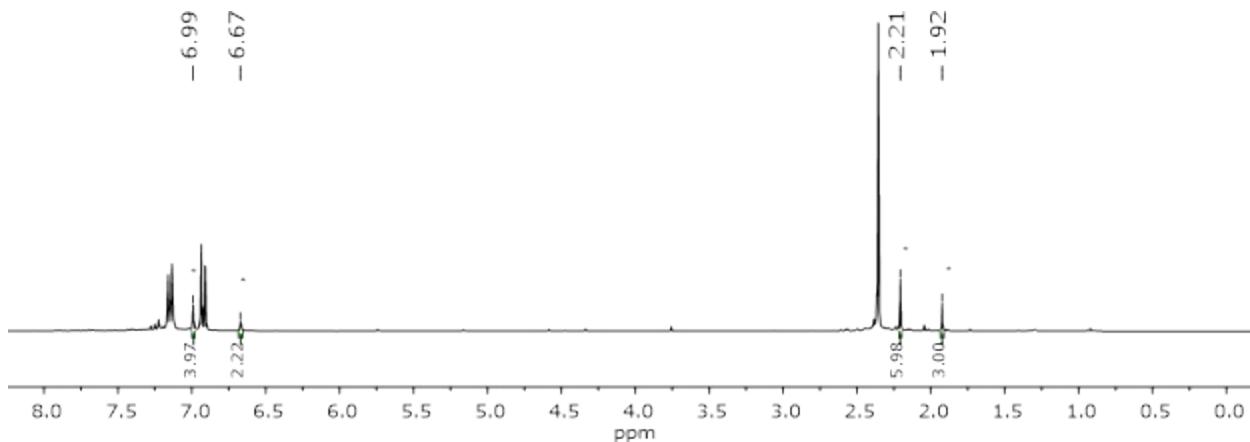
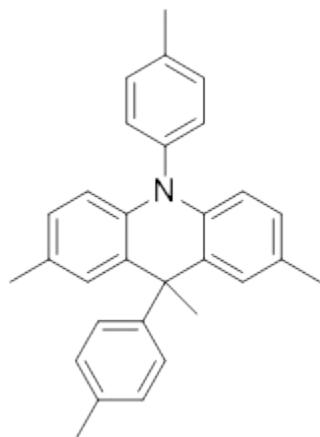


Figure 42. ^1H (CDCl_3) NMR spectrum of **13**. Asterisks denote product peaks.



(14) 2,7,9-trimethyl-9,10-(di-4-tolyl)-9,10-dihydoracridine

Product was inseparable from a by-product, putatively with two alkyne additions. Partial characterization (65% conversion). **HRMS (DART-TOF+)**: m/z [M+H] 404.23847 (calc'd for $\text{C}_{30}\text{H}_{30}\text{N}$: 404.23782). **By-product HRMS (DART-TOF+)**: m/z [M+H] 520.30039 (calc'd for $\text{C}_{39}\text{H}_{38}\text{N}$: 520.30042). **$^1\text{H NMR}$ (500 MHz, CDCl_3)**: δ = 1.91 (s, 3H; 9- CH_3), 2.12 (s, 6H; 2,7- CH_3), 2.38 (s, 3H; 9-(tolyl-*p*- CH_3)), 2.49 (s, 3H; *N*-(tolyl-*p*- CH_3)), 6.19 (d, $^3J_{\text{HH}} = 8$ Hz, 2H; 4,5- CH), 6.60 (d, $^4J_{\text{HH}} = 2$ Hz, 2H; 1,8- CH), 6.72 (dd, $^3J_{\text{HH}} = 8$ Hz, $^4J_{\text{HH}} = 2$ Hz, 2H; 3,6- CH), 7.16 (m, 2H; 9-(tolyl-*o*- CH)), 7.21 (dt, $^3J_{\text{HH}} = 8$ Hz, $^4J_{\text{HH}} = 2$ Hz, 2H; *N*-(tolyl-*o*- CH)), 7.32 (dt, $^3J_{\text{HH}} = 8$ Hz, $^4J_{\text{HH}} = 2$ Hz, 2H; 9-(tolyl-*m*- CH)), 7.41 ppm (m, 2H; *N*-(tolyl-*m*- CH)). **$^{13}\text{C}\{^1\text{H}\}$ NMR (125 MHz, CDCl_3)**: δ = 20.7 (2C; 2,7- CH_3), 21.2 (1C; 9-(tolyl-*p*- CH_3)), 21.5 (1C; *N*-(tolyl-*p*- CH_3)), 32.4 (1C; 9- CH_3), 45.3 (1C; 9- C), 113.8 (2C; 4,5- CH), 127.1 (2C; 3,6- CH), 128.6 (2C; 9-(tolyl-*o*- CH)), 129.0 (2C; 9-(tolyl-*m*- CH)), 129.3 (2C; 1,8- CH), 130.3

(2C; 12,13-CH), 131.2 (2C; *N*-(tolyl-*o*-CH)), 131.6 (2C; *N*-(tolyl-*m*-CH)), 135.3 (1C; 9-(tolyl-*p*-C)), 137.9 (1C; *N*-(tolyl-*p*-C)), 138.8 (2C; 11,14-CH), 139.0 (1C; *N*-(tolyl-*i*-C)), 147.5 ppm (1C; 9-(tolyl-*i*-C)).

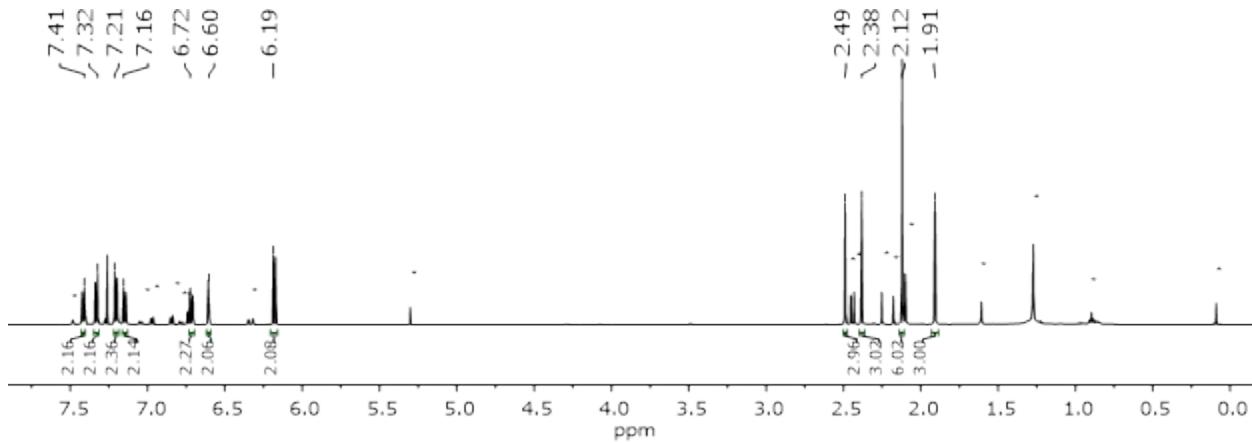


Figure 43. ¹H (CDCl₃) NMR spectrum of partially isolated **14**. Asterisks denote solvent impurities and by-product.

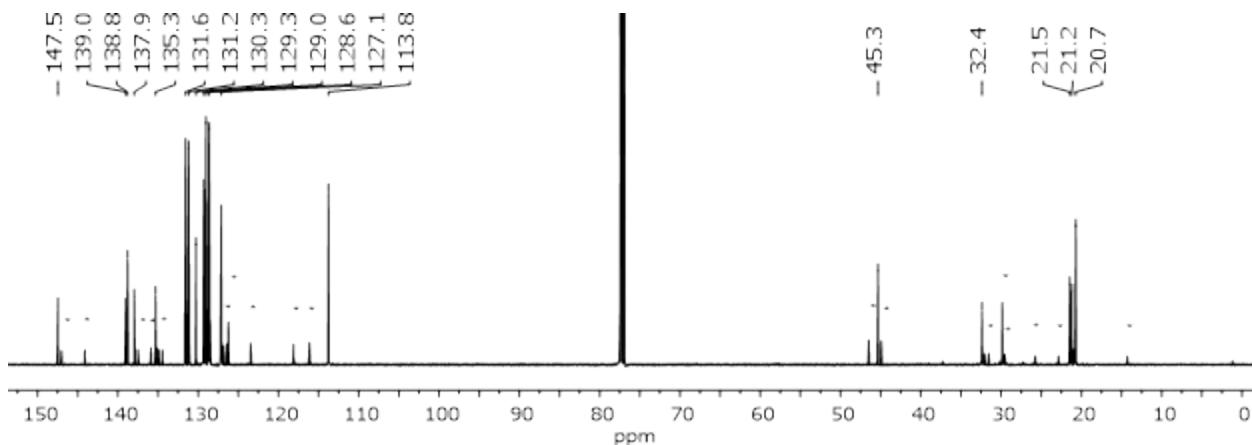
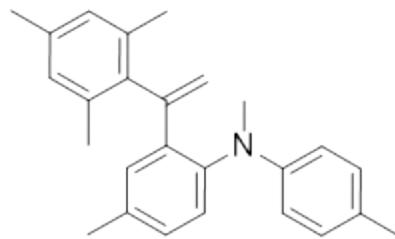


Figure 44. ¹³C{¹H} (CDCl₃) NMR spectrum of partially isolated **14**. Asterisks denote solvent impurities and by-product.



(15) 2-(1-mesitylvinyl)-N,N-dimethyl-N-(4-tolyl)aniline

Obtained as a white solid (28.1 mg, 66% isolated yield). **HRMS (DART-TOF+)**: m/z [M+H] m/z 356.23764 (calc'd for C₂₆H₃₀N: 356.23782). **¹H NMR (500 MHz, CDCl₃)**: δ = 2.02 (s, 6H; mesityl-*o*-CH₃), 2.25 (s, 3H; tolyl-*p*-CH₃), 2.29 (s, 3H; mesityl-*o*-CH₃), 2.32 (s, 3H; aniline-4-CH₃), 2.71 (s, 3H; NCH₃), 5.14 (d, ¹J_{HH} = 2 Hz, 1H; vinyl-C=CH₂), 5.96 (d, ¹J_{HH} = 2 Hz, 1H; C=CH₂), 6.38 (dt, ³J_{HH} = 8 Hz, ⁴J_{HH} = 2 Hz, 2H; tolyl-*o*-CH), 6.84 (s, 2H; mesityl-*m*-CH), 6.96 (d, ³J_{HH} = 8 Hz, tolyl-*m*-CH, aniline-6-CH), 7.08 (m, aniline-3-CH), 7.11 ppm (m, aniline-5-CH). **¹³C NMR (125 MHz, CDCl₃)**: δ = 20.4 (1C; tolyl-*p*-CH₃), 20.8 (2C; mesityl-*o*-CH₃), 21.1 (1C; mesityl-*p*-CH₃), 21.3 (1C; aniline-4-CH₃), 38.6 (1C; NCH₃), 113.2 (2C; tolyl-*o*-CH), 119.7 (1C; vinyl-C=CH₂), 125.6 (1C; tolyl-*p*-C), 128.3 (2C; mesityl-*m*-CH), 129.4 (2C; tolyl-*m*-CH), 129.9 (1C; aniline-6-CH), 130.1 (1C; aniline-5-CH), 131.4 (1C; aniline-3-CH), 135.8 (1C; mesityl-*p*-C), 136.2 (2C; mesityl-*o*-C), 136.5 (1C; aniline-4-C), 139.4 (1C; mesityl-*i*-C), 139.6 (1C; aniline-2-C), 144.2 (1C; aniline-1-C), 145.7 (1C; vinyl-C=CH₂), 148.1 ppm (1C; tolyl-*i*-C).

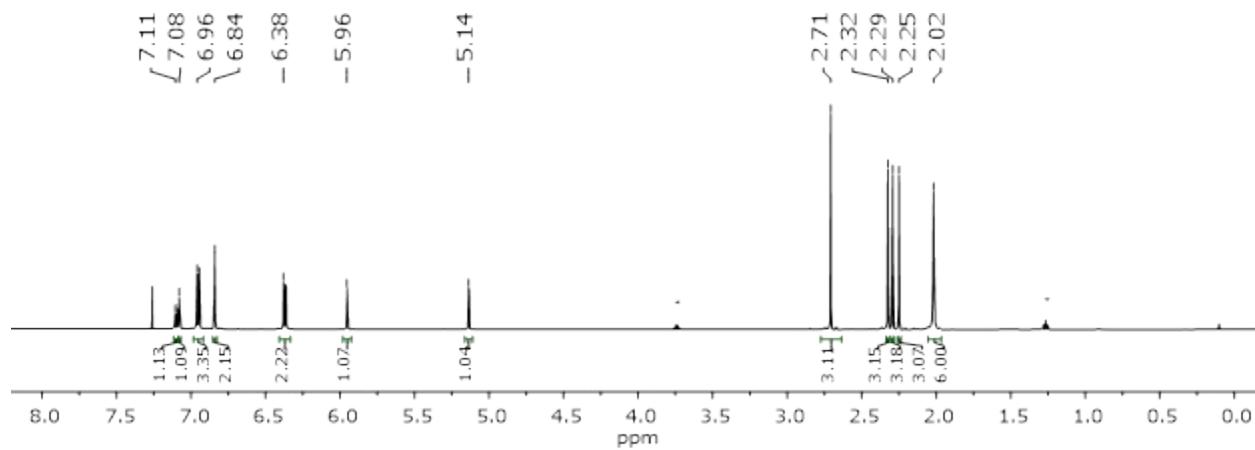


Figure 45. ¹H (CDCl₃) NMR spectrum of **15**. Asterisks denote solvent impurities.

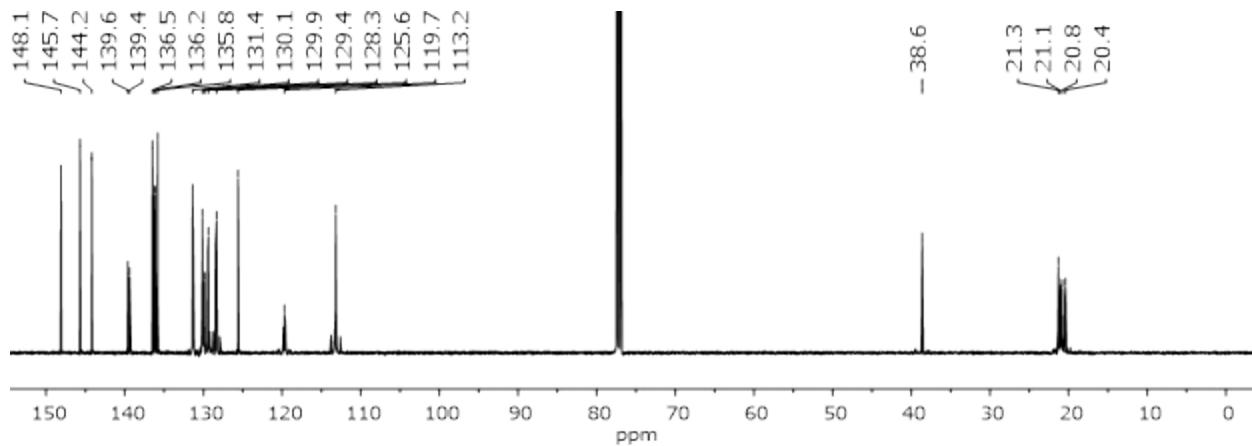


Figure 46. ^{13}C (CDCl_3) NMR spectrum of **15**.

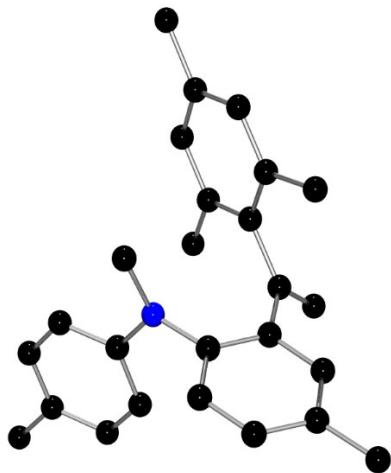
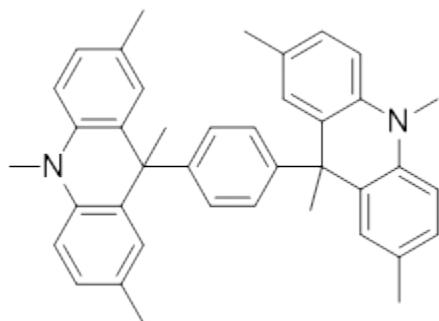


Figure 47. Molecular structure of **15**.



(16) 1,4-bis(2,7,9,10-tetramethyl-9,10-dihydroacridin-9-yl)benzene

Obtained as a white solid (16.9 mg, 52% isolated yield). **HRMS (DART-TOF+):** m/z [M+H] 549.32585 (calc'd for $\text{C}_{40}\text{H}_{40}\text{N}_2$: 549.32697). **^1H NMR (500 MHz, CDCl_3):** δ = 1.78 (s, 6H; 9,9'- CH_3),

2.22 (s, 12H; 2,2',7,7'-CH₃), 3.37 (s, 6H; NCH₃), 6.70 (d, $^4J_{\text{HH}} = 2$ Hz, 4H; 1,1',8,8'-CH), 6.80 (d, $^3J_{\text{HH}} = 8$ Hz, 4H; 4,4',5,5'-CH), 7.01 (m, 4H; 3,3',6,6'-CH), 7.12 ppm (s, 4H; benzene-2,3,5,6-CH). ^{13}C NMR (125 MHz, CDCl₃): δ = 20.8 (4C; 2,2',7,7'-CH₃), 28.4 (2C; 9,9'-CH₃), 33.4 (2C; NCH₃), 46.0 (2C, 9-C), 111.6 (4C; 4,4',5,5'-CH), 127.3 (4C; 3,3',6,6'-CH), 128.3 (8C; 1,1',8,8'-CH, benzene-2,3,5,6-CH), 128.9 (4C; 2,2',7,7'-C), 132.7 (4C; 12,12',13,13'-C), 139.9 (4C; 11,11',14,14'-C), 146.3 ppm (2C; benzene-1,4-C).

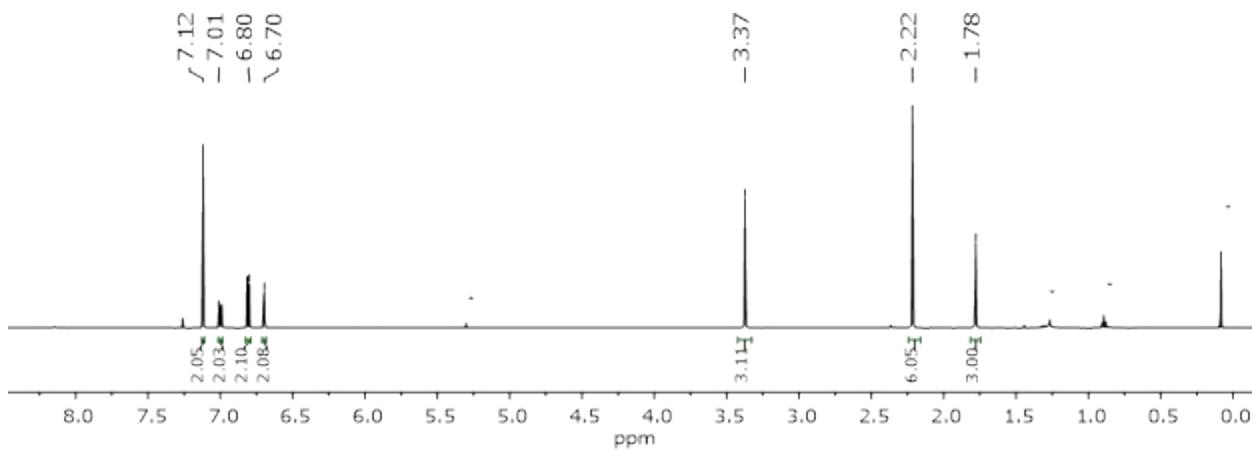


Figure 48. ^1H (CDCl₃) NMR spectrum of **16**. Asterisks denote solvent impurities.

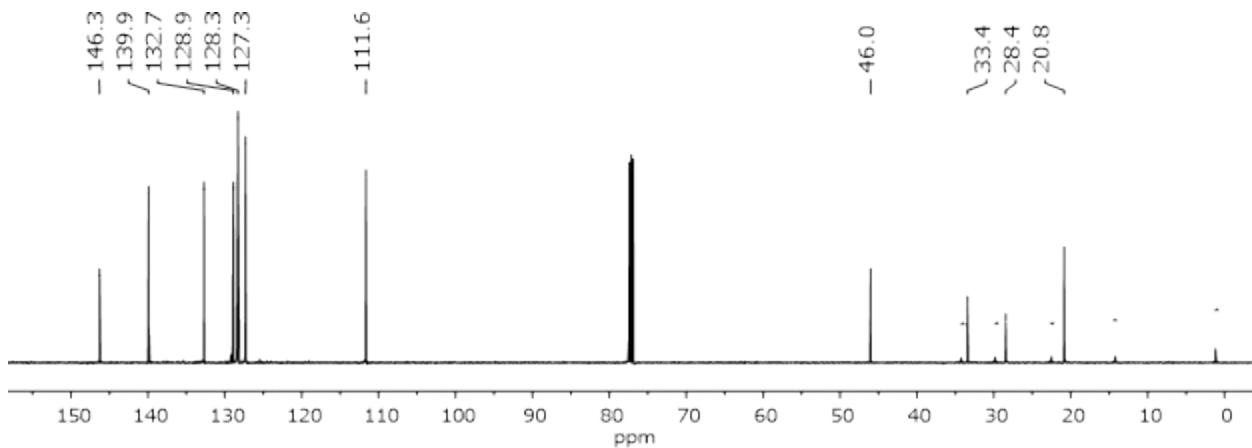
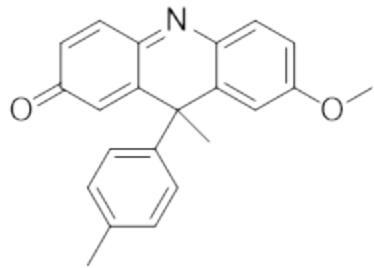


Figure 49. $^{13}\text{C}\{^1\text{H}\}$ (CDCl₃) NMR spectrum of **16**. Asterisks denote solvent impurities.



(17) 7-methoxy-9-methyl-9-(4-tolyl)acridin-2(9H)-one

Obtained as a yellow solid (12.7 mg, 33% isolated yield). **HRMS (DART-TOF+):** m/z [M+H] 330.15001 (calc'd for C₂₂H₂₀NO₂: 330.14940). **¹H NMR (500 MHz, CDCl₃):** δ = 1.74 (s, 3H; 9-CH₃), 2.33 (s, 3H; 9-(tolyl-*p*-CH₃)), 3.74 (s, 3H; 7-OCH₃), 6.09 (d, ⁴J_{HH} = 2 Hz, 1H; 1-CH), 6.44 (d, ⁴J_{HH} = 3 Hz, 1H; 8-CH), 6.57 (dd, ³J_{HH} = 10 Hz, ⁴J_{HH} = 2 Hz, 1H; 3-CH), 6.88 (dd, ³J_{HH} = 8 Hz, ⁴J_{HH} = 3 Hz, 1H; 6-CH), 7.10 (m, 4H; 9-(tolyl-*o,m*-CH)), 7.41 (d, ³J_{HH} = 10 Hz, 1H; 4-CH), 7.67 ppm (d, ³J_{HH} = 8 Hz, 1H; 5-CH). **¹³C{¹H} NMR (125 MHz, CDCl₃):** δ = 21.1 (1C; 9-(tolyl-*p*-CH₃)), 33.4 (1C; 9-CH₃), 47.0 (1C; 9-C), 55.7 (1C; 7-OCH₃), 112.9 (1C; 6-CH), 114.9 (1C; 8-CH), 128.2 (2C; 9-(tolyl-*o*-CH)), 129.5 (2C; 9-(tolyl-*m*-CH)), 130.2 (1C; 1-CH), 131.4 (1C; 3-CH), 133.6 (1C; 5-CH), 137.0 (1C; 11-C), 137.2 (1C; 9-(tolyl-*p*-C)), 141.0 (1C; 12-C), 141.5 (1C; 4-CH), 142.5 (1C; 9-(tolyl-*i*-C)), 149.2 (1C; 13-C), 150.1 (1C; 14-C), 161.9 (1C; 7-C), 187.1 ppm (1C; 2-C).

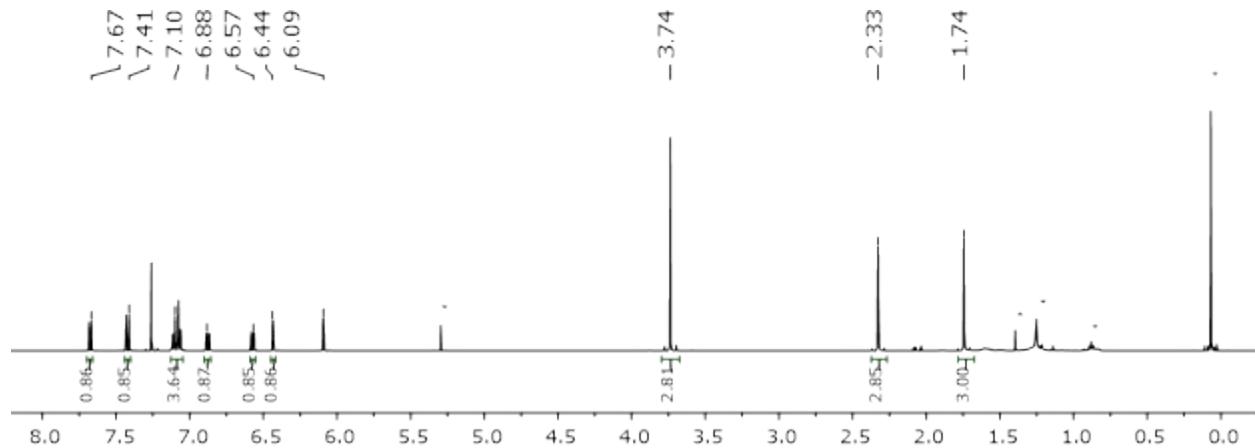


Figure 50. ¹H (CDCl₃) NMR spectrum of **17**. Asterisks denote solvent impurities.

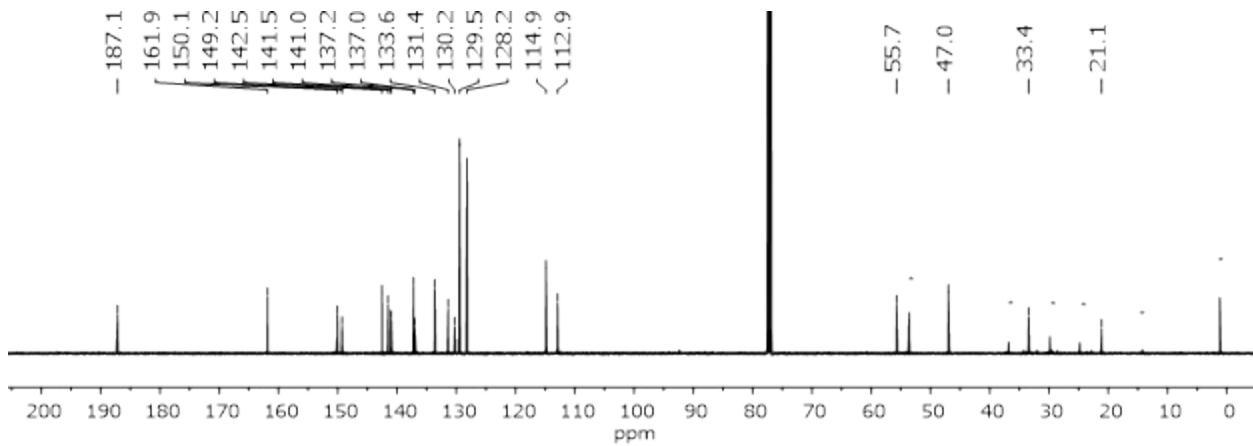
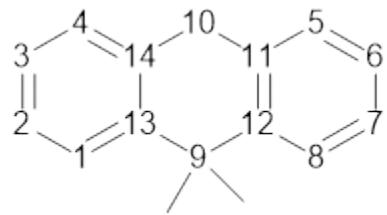


Figure 51. $^{13}\text{C}\{^1\text{H}\}$ (CDCl_3) NMR spectrum of **17**. Asterisks denote solvent impurities.

7. Numbering Convention



8. Computational Details

Electronic structure calculations were performed using *Gaussian 09*. Geometry optimizations were carried out at the BP86/def2-TZVP level and each geometry was confirmed to be a minimum on its potential energy surface by confirming the Hessian to be positive definite with a frequency calculation. The Cartesian coordinates of the optimized structures are collected in Tables S4-S11. Orbital and internal energies needed to calculate global electrophilicity indices (GEIs) and fluoride ion affinities (FIAs) were obtained from MP2/def2-TZVPP calculations at the BP86/def2-TZVP geometries. FIA and GEI were calculated as previously described.²

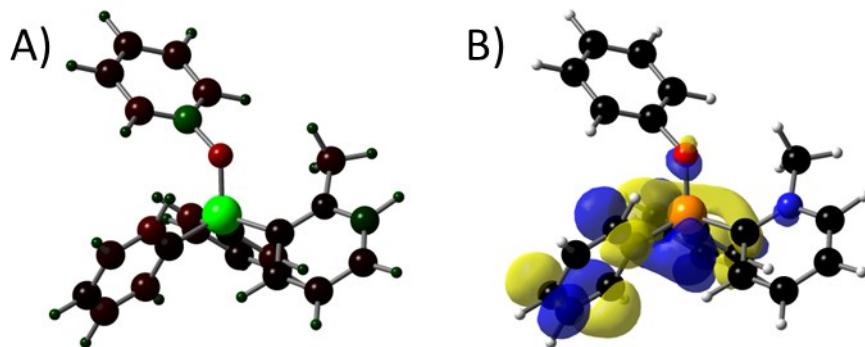


Figure 52. Electronic structure of $[(\text{PhO})\text{P}(2-(\text{N-Mepy}))\text{Ph}_2]^{2+}$. A) Mulliken charges ranging from -0.446 (red) to 0.877 (green), highlighting the concentration of positive charge on phosphorus. B) Canonical LUMO+2 contoured at an isovalue of 0.04, featuring significant contribution from the P–O σ^* orbital with a lobe oriented opposite this bond.

Table S4. Cartesian coordinates (\AA) of $[(\text{PhO})\text{P}(2-(N\text{-Mepy}))\text{Ph}_2]^{2+}$.

Center Number	Atomic Number	Atomic Type	Coordinates (Angstroms)		
			X	Y	Z
1	6	0	2.007734	-0.301247	-0.621687
2	6	0	3.035015	0.578952	-0.289645
3	1	0	2.802970	1.442827	0.333015
4	6	0	4.341708	0.372302	-0.750456
5	1	0	5.137038	1.068060	-0.477989
6	6	0	4.599913	-0.726907	-1.563331
7	1	0	5.594310	-0.932311	-1.960681
8	6	0	3.557580	-1.593437	-1.869728
9	1	0	3.701290	-2.475519	-2.493360
10	6	0	1.266606	-2.397059	-1.796264
11	1	0	0.647893	-1.986222	-2.602094
12	1	0	0.644883	-2.639067	-0.927895
13	1	0	1.780358	-3.301428	-2.136380
14	6	0	0.262161	1.791632	0.498874
15	6	0	0.306981	2.798317	-0.493559
16	1	0	0.343745	2.536121	-1.552990
17	6	0	0.292349	4.137236	-0.110545
18	1	0	0.319044	4.918758	-0.871313
19	6	0	0.236519	4.478851	1.248600
20	1	0	0.220483	5.530159	1.541341
21	6	0	0.198079	3.483938	2.231442
22	1	0	0.150837	3.756503	3.286645
23	6	0	0.212812	2.136813	1.866216
24	1	0	0.178004	1.362969	2.634059
25	6	0	-0.111656	-1.018774	1.342617
26	6	0	-1.409653	-0.936830	1.898092
27	1	0	-2.139857	-0.221114	1.516458
28	6	0	-1.758856	-1.786703	2.947063
29	1	0	-2.760548	-1.728578	3.375207
30	6	0	-0.829149	-2.703734	3.452027
31	1	0	-1.108947	-3.360954	4.277074
32	6	0	0.460174	-2.777471	2.912095
33	1	0	1.185311	-3.483886	3.318494
34	6	0	0.824608	-1.940923	1.857473
35	1	0	1.840707	-1.994295	1.461454
36	7	0	2.297471	-1.395789	-1.405758
37	15	0	0.297405	0.082355	0.002073
38	8	0	-0.543777	-0.138945	-1.341158
39	6	0	-1.992950	-0.184338	-1.409683
40	6	0	-2.696348	1.001904	-1.588206
41	6	0	-2.605785	-1.433714	-1.389079
42	6	0	-4.085892	0.924556	-1.742484
43	1	0	-2.182396	1.961688	-1.628159
44	6	0	-3.995141	-1.489136	-1.546937
45	1	0	-2.023582	-2.346825	-1.263253
46	6	0	-4.732947	-0.314370	-1.720877
47	1	0	-4.657745	1.841252	-1.892601
48	1	0	-4.496076	-2.458187	-1.542076
49	1	0	-5.814730	-0.365602	-1.849600

Table S5. Cartesian coordinates (Å) of [(PhO)P(F)(2-(*N*-Mepy))Ph₂]⁺.

Center Number	Atomic Number	Atomic Type	Coordinates (Angstroms)		
			X	Y	Z
1	6	0	1.759434	-0.359554	-1.176841
2	6	0	2.715327	0.658578	-1.283120
3	1	0	2.572584	1.561729	-0.691753
4	6	0	3.821827	0.523670	-2.114483
5	1	0	4.551527	1.330931	-2.192405
6	6	0	3.993892	-0.664531	-2.831749
7	1	0	4.848827	-0.826179	-3.487144
8	6	0	3.055628	-1.664511	-2.683204
9	1	0	3.132840	-2.624136	-3.192022
10	6	0	1.007948	-2.643435	-1.842109
11	1	0	0.255738	-2.503749	-2.627003
12	1	0	0.515702	-2.686744	-0.866484
13	1	0	1.568716	-3.569690	-2.009066
14	6	0	-0.012055	1.752730	0.194192
15	6	0	-0.098147	2.630992	-0.899153
16	1	0	-0.016415	2.246566	-1.917022
17	6	0	-0.281672	3.999336	-0.684072
18	1	0	-0.331776	4.679296	-1.536252
19	6	0	-0.411696	4.492582	0.617800
20	1	0	-0.569286	5.559725	0.783530
21	6	0	-0.334479	3.619946	1.708137
22	1	0	-0.434388	4.002699	2.725089
23	6	0	-0.114858	2.256572	1.503143
24	1	0	-0.022710	1.586031	2.358160
25	6	0	-0.702263	-1.162818	1.003372
26	6	0	-2.069214	-0.909906	1.213170
27	1	0	-2.556087	-0.050180	0.753434
28	6	0	-2.812681	-1.748030	2.049441
29	1	0	-3.867445	-1.529946	2.223866
30	6	0	-2.213412	-2.854688	2.655042
31	1	0	-2.801275	-3.510797	3.299132
32	6	0	-0.853216	-3.108508	2.451094
33	1	0	-0.373347	-3.957636	2.940675
34	6	0	-0.094019	-2.257267	1.646392
35	1	0	0.979481	-2.426370	1.552352
36	7	0	1.962484	-1.1509607	-1.880542
37	8	0	-0.612899	-0.233703	-1.518604
38	6	0	-1.979686	-0.331283	-1.786239
39	6	0	-2.753156	0.815946	-2.001810
40	6	0	-2.555475	-1.600610	-1.929566
41	6	0	-4.100368	0.685150	-2.353383
42	1	0	-2.307014	1.803825	-1.897338
43	6	0	-3.901884	-1.719832	-2.284207
44	1	0	-1.957623	-2.493975	-1.747829
45	6	0	-4.680054	-0.578458	-2.496223
46	1	0	-4.696944	1.583319	-2.523305
47	1	0	-4.342190	-2.712576	-2.393336
48	1	0	-5.730106	-0.673041	-2.776041
49	15	0	0.279600	-0.028096	-0.045254
50	9	0	1.504082	-0.045155	1.156796

Table S6. Cartesian coordinates (Å) of [(PhO)P(C₆F₅)₃]⁺.

Center Number	Atomic Number	Atomic Type	Coordinates (Angstroms)		
			X	Y	Z
1	15	0	-0.094390	0.039541	0.337819
2	9	0	4.231469	-3.452236	-1.783685
3	9	0	-1.443971	2.521219	1.223903
4	9	0	-1.769131	4.862386	-0.069784
5	9	0	-0.831687	5.161679	-2.618850
6	9	0	0.426797	3.092068	-3.873317
7	9	0	0.764889	0.747279	-2.622639
8	9	0	-1.950975	-0.475854	-1.905300
9	9	0	-4.452419	-1.500708	-1.863581
10	9	0	-5.527867	-2.374774	0.493596
11	9	0	-4.087173	-2.222732	2.801666
12	9	0	-1.613142	-1.219484	2.803110
13	9	0	-0.192137	-3.015329	-0.277407
14	9	0	1.796392	-4.542375	-1.216700
15	9	0	4.670221	-0.783512	-1.406108
16	9	0	2.684663	0.794156	-0.483506
17	8	0	0.249404	0.391504	1.843283
18	6	0	3.255204	-2.682046	-1.329043
19	6	0	2.003247	-3.239470	-1.037819
20	6	0	0.978848	-2.424541	-0.553263
21	6	0	1.165516	-1.038150	-0.359286
22	6	0	1.530580	0.645754	2.431661
23	6	0	1.955158	1.964335	2.556000
24	1	0	1.346197	2.783089	2.173257
25	6	0	3.166699	2.206640	3.210922
26	1	0	3.516717	3.233393	3.325626
27	6	0	3.916849	1.144572	3.725327
28	1	0	4.858153	1.342372	4.239511
29	6	0	-0.267469	1.561261	-0.620120
30	6	0	-0.946547	2.644136	-0.016702
31	6	0	-1.134932	3.859166	-0.673624
32	6	0	-0.656789	4.013474	-1.981872
33	6	0	-0.006111	2.950239	-2.622202
34	6	0	0.173455	1.742469	-1.947825
35	6	0	-1.708069	-0.743664	0.448857
36	6	0	-2.476272	-0.864165	-0.728126
37	6	0	-3.759410	-1.402488	-0.730846
38	6	0	-4.309258	-1.855530	0.476778
39	6	0	-3.566743	-1.774169	1.661421
40	6	0	-2.277383	-1.234604	1.645745
41	6	0	3.479115	-1.311267	-1.134335
42	6	0	2.443703	-0.515070	-0.653633
43	6	0	2.244103	-0.431883	2.947709
44	1	0	1.852070	-1.446544	2.871361
45	6	0	3.454989	-0.168510	3.597752
46	1	0	4.027851	-0.996422	4.017925

Table S7. Cartesian coordinates (Å) of [(PhO)P(F)(C₆F₅)₃]⁺.

Center Number	Atomic Number	Atomic Type	Coordinates (Angstroms)		
			X	Y	Z
1	6	0	-0.446151	-2.147810	4.090124
2	6	0	-1.095803	-1.641516	2.955449
3	6	0	-1.432953	-0.292221	2.833685
4	6	0	-1.143736	0.588166	3.879848
5	6	0	0.155363	-5.049478	2.723508
6	6	0	0.781887	-4.620286	1.544266
7	6	0	0.904610	-5.449340	0.426692
8	6	0	0.408522	-6.753996	0.473778
9	6	0	-0.215635	-7.213285	1.635402
10	6	0	-0.345544	-6.359926	2.733480
11	9	0	-1.414229	-2.449840	1.927609
12	9	0	-2.038174	0.161305	1.725936
13	9	0	-1.468639	1.882196	3.777765
14	9	0	1.254196	-3.367102	1.420110
15	9	0	1.486940	-4.995874	-0.693641
16	9	0	0.527813	-7.557959	-0.588860
17	9	0	-0.681047	-8.469982	1.693565
18	9	0	-0.939538	-6.865987	3.829203
19	15	0	-0.037263	-3.954474	4.199293
20	6	0	-0.176739	-1.242043	5.122329
21	6	0	-0.519773	0.109516	5.033260
22	6	0	-0.026472	-4.738163	5.870634
23	9	0	-1.697505	-4.247533	4.109614
24	9	0	0.395382	-1.653060	6.270209
25	9	0	-0.254861	0.945477	6.047580
26	6	0	-0.932151	-4.355354	6.874294
27	6	0	0.845800	-5.794640	6.178693
28	6	0	-0.944661	-4.960099	8.133224
29	9	0	-1.814636	-3.363741	6.672988
30	6	0	0.836431	-6.427818	7.424079
31	9	0	1.704351	-6.278588	5.263161
32	6	0	-0.057717	-6.003140	8.409116
33	9	0	-1.802091	-4.545969	9.077173
34	9	0	1.673374	-7.446026	7.673946
35	9	0	-0.068234	-6.595365	9.607899
36	8	0	1.660013	-3.740838	4.118047
37	6	0	2.530909	-2.822151	4.674665
38	6	0	3.205111	-3.123605	5.865509
39	6	0	2.828888	-1.642777	3.977445
40	6	0	4.154844	-2.231137	6.367697
41	1	0	3.000310	-4.062630	6.379568
42	6	0	3.779639	-0.756494	4.491286
43	1	0	2.332438	-1.442611	3.027680
44	6	0	4.441646	-1.042767	5.688630
45	1	0	4.679519	-2.472637	7.294234
46	1	0	4.011786	0.158185	3.942028
47	1	0	5.186711	-0.350407	6.083838

Table S8. Cartesian coordinates (Å) of $\text{B}(\text{C}_6\text{F}_5)_3$.

Center Number	Atomic Number	Atomic Type	Coordinates (Angstroms)		
			X	Y	Z
1	6	0	-0.094953	2.489641	-0.656690
2	6	0	0.515293	1.487129	-1.433171
3	6	0	1.611722	1.905108	-2.210128
4	6	0	2.069444	3.221994	-2.234028
5	6	0	1.436055	4.179230	-1.434702
6	6	0	0.349688	3.810999	-0.634289
7	5	0	0.006554	0.001806	-1.434001
8	9	0	2.248187	1.026002	-3.012134
9	9	0	3.103895	3.580476	-3.009614
10	9	0	-0.248120	4.728704	0.140651
11	9	0	-1.135786	2.185124	0.146397
12	6	0	-1.534094	-0.299791	-1.440231
13	6	0	-2.443158	0.451045	-2.209290
14	6	0	-3.812186	0.188026	-2.241266
15	6	0	-4.326049	-0.850980	-1.458539
16	6	0	-3.465811	-1.618242	-0.666235
17	6	0	-2.099458	-1.340984	-0.680003
18	9	0	-1.999981	1.452779	-2.997326
19	9	0	-1.318258	-2.101370	0.115191
20	9	0	-3.963347	-2.605858	0.093382
21	9	0	-4.637892	0.914306	-3.009819
22	6	0	1.037863	-1.181754	-1.430635
23	6	0	0.844706	-2.347137	-2.196280
24	6	0	1.752099	-3.405460	-2.214062
25	6	0	2.901219	-3.332630	-1.419856
26	6	0	3.133662	-2.200729	-0.631809
27	6	0	2.215542	-1.151582	-0.660104
28	9	0	-0.238813	-2.463587	-2.992212
29	9	0	1.537974	-4.487284	-2.978070
30	9	0	4.230462	-2.139114	0.138400
31	9	0	2.480872	-0.091899	0.131896
32	9	0	3.775507	-4.343456	-1.413798
33	9	0	-5.637113	-1.110209	-1.467543
34	9	0	1.868432	5.443945	-1.435570

Table S6. Cartesian coordinates (Å) of $[\text{FB}(\text{C}_6\text{F}_5)_3]$.

Center Number	Atomic Number	Atomic Type	Coordinates (Angstroms)		
			X	Y	Z
1	6	0	0.125172	2.589072	-0.607718
2	6	0	0.550241	1.713780	-1.617001
3	6	0	1.450908	2.276476	-2.525841
4	6	0	0.931976	3.586852	-2.438268
5	6	0	1.495770	4.408471	-1.400931
6	6	0	0.579141	3.904818	-0.478797
7	9	0	1.907043	1.563351	-3.590586
8	9	0	2.810983	4.071141	-3.348529
9	9	0	0.133179	4.703928	0.520273
10	9	0	-0.799139	2.198028	0.302263
11	6	0	-1.558038	0.001975	-2.151554
12	6	0	-2.280662	0.972430	-2.850875
13	6	0	-3.631257	0.843013	-3.192817
14	6	0	-4.319975	-0.314903	-2.838493
15	6	0	-3.641069	-1.324700	-2.157038
16	6	0	-2.291911	-1.150834	-1.837734
17	9	0	-1.689441	2.125606	-3.264131
18	9	0	-1.698016	-2.196815	-1.214112
19	9	0	-4.298208	-2.462371	-1.826627
20	9	0	-4.278929	1.825155	-3.864822
21	6	0	1.057013	-0.867034	-2.453887
22	6	0	0.808433	-1.487096	-3.681125
23	6	0	1.690533	-2.382622	-4.295192
24	6	0	2.901965	-2.684220	-3.676389
25	6	0	3.210119	-2.076730	-2.459674
26	6	0	2.297159	-1.188723	-1.884341
27	9	0	-0.332302	-1.231653	-4.376376
28	9	0	1.387206	-2.957752	-5.483889
29	9	0	4.394720	-2.348474	-1.861092
30	9	0	2.693558	-0.611718	-0.724043
31	9	0	3.770117	-3.546936	-4.251617
32	9	0	-5.625843	-0.461476	-3.157757
33	9	0	1.947171	5.678906	-1.295800
34	5	0	0.016489	0.133319	-1.617410
35	9	0	0.025449	-0.313482	-0.257156

Table S10. Cartesian coordinates (\AA) of CF_2O .

Center Number	Atomic Number	Atomic Type	Coordinates (Angstroms)		
			X	Y	Z
1	6	0	0.392343	-0.881189	0.000024
2	8	0	1.574231	-0.881188	-0.000009
3	9	0	-0.396439	0.193561	-0.000006
4	9	0	-0.396439	-1.955938	0.000039

Table S11. Cartesian coordinates (\AA) of CF_3O^- .

Center Number	Atomic Number	Atomic Type	Coordinates (Angstroms)		
			X	Y	Z
1	6	0	-0.922255	-0.027060	-0.141732
2	9	0	-0.535423	0.520074	1.151943
3	9	0	-0.535528	-1.420909	0.031214
4	9	0	-2.365460	-0.126958	0.031190
5	8	0	-0.515657	0.548010	-1.137934

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