Supporting Information to Accompany:

Synthesis of a Sensitive and Selective Potassium-sensing Fluoroionophore

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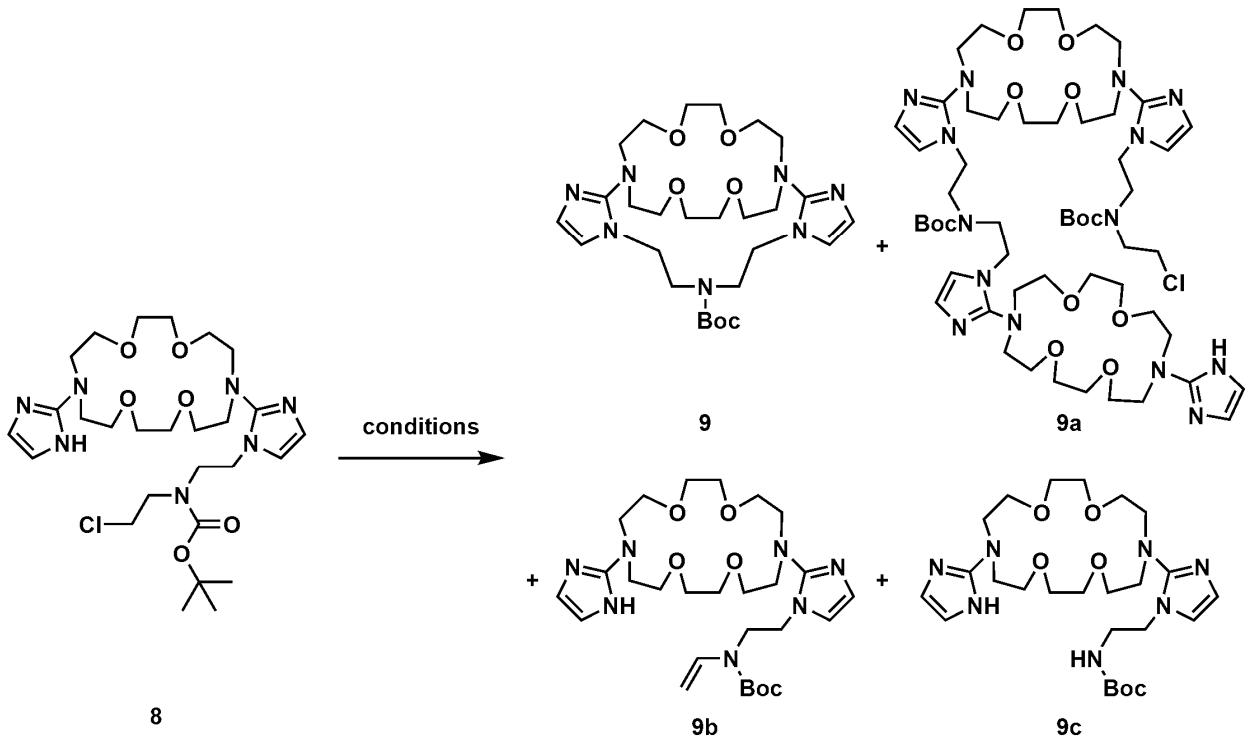
Chart 1



entry	MI additive[a]	base[b]	solvent[c]	*T*	conversion (%) 9/9a/9b/9c[d]
1	--	NaH	THF	0 °C	0/26/0/0
2	NaI (cat)	NaH	THF	25 °C	2/47/0/0
3	--	NaH	THF	reflux	0/38/0/0
4	NaI (cat)	NaH	dioxane	reflux	0/41/6/1
5	KI (cat)	KH	THF	25 °C	3/44/0/0
6	KI (cat)	KH	THF	reflux	0/52/8/3
7	KI (cat)	K_2CO_3	DMF	25 °C	0/36/0/0
8	KI (cat)	K_2CO_3	DMF	100 °C	0/24/0/0
9	KI (cat)	Cs_2CO_3	DMF	0 °C	0/55/7/4
10	KI (cat)	Cs_2CO_3	DMF	100 °C	0/49/11/6
11	KI (cat)	KHMDS	THF	-78 °C	6/40/2/0
12	--	KHMDS	THF	25 °C	0/44/12/7
13	KI (cat)	DIEA	CH_2Cl_2	25 °C	0/27/0/0
14	KI (cat)	DIEA	THF	reflux	0/33/0/0
15	--	Li sticks	THF	-78 °C	0/19/11/4
16	--	Na sticks	THF	-78 °C	0/24/0/0
17	--	K chunks	THF	-78 °C	0/15/3/0
18	--	Mg turnings	THF	-78 °C	0/2/18/5

[a] Where M = Na^+ or K^+. [b] Hydride reagents were treated with dry hexanes and centrifuged to remove mineral oil, carbonate reagents were oven dried at 110 ˚C, KHMDS was titrated, and DIEA was distilled from CaH_2 and kept over 3 Å molecular sieves. [c] All reaction concentrations were [0.005 M]. [d] Determined by LC/MS.

General Procedures: Oxygen and moisture-sensitive reactions were carried out in flame- or oven-dried glassware sealed with a rubber septum under a positive pressure of argon from a balloon. Sensitive liquids and solutions were transferred by syringe or cannula through septa under positive pressure of argon. Concentration refers to rotary evaporation (Büchi) with a vacuum pump at a pressure of 3 mmHg. Residual solvents were removed from non-volatile products on a vacuum line with a pressure of 0.1-0.3 mmHg. The temperature of microwave reactions was maintained using a Biotage microwave reactor, which heated the sealed samples to the indicated temperature in 100-120 sec and maintained that temperature for the duration of the reactions.

Reagents and Solvents: Reagents and solvents were purchased from commercial vendors and used without further purification with the exception of the following. The concentration of alkyllithium reagents was determined by titration to the yellow dianion endpoint of standard solutions of diphenylacetic acid in tetrahydrofuran (THF) at 0 ˚C according to the protocol outlined by Baclawski and Kofron.[1] Ether and THF were distilled from sodium-benzophenone ketyl under agron. Dichloromethane was distilled from calcium hydride under argon. Other solvents and reagents were used without purification unless otherwise noted.

Chromatography and Purification: Thin layer chromatography (TLC) used glass plates coated with silica gel 60 F254, developed in a chamber, and visualized under ultraviolet light (λ_{ex} = 254 nm) as well as by treatment with iodine or potassium permanganate solution. Column chromatography used silica gel 60 packed in glass columns with an eluent consisting of 15:1 hexanes:ethyl acetate. Precipitations were carried out by bubbling in hydrogen chloride (generated from the dropwise addition of concentrated sulfuric acid to solid sodium chloride) into

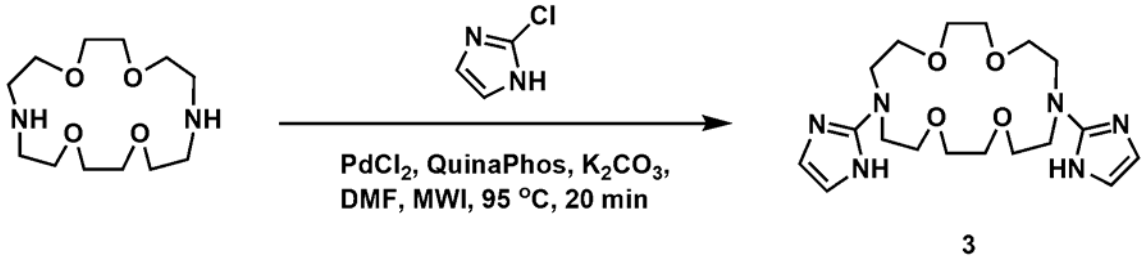
[1] Baclawski, L. M.; Kofron, W. G. *J. Org. Chem.* **1976**, *41*, 1879-1880.

a dropping funnel containing anhydrous ether (ca. 3 h) followed by the dropwise addition of this solution to a concentrated anhydrous ether solution of the amine-containing compound. Following vacuum filtration, the amine-HCl salt was dissolved in sodium bicarbonate and ether and extracted as indicated. Recrystallization was carried out by dissolving the compound with the indicated boiling solvent followed by gradual cooling to ambient temperature or treatment with the indicated non-polar co-solvent at ambient temperature.

Physical Properties and Spectroscopic Measurements: ^{1}H and ^{13}C NMR spectra were obtained using Bruker Instruments (300 and 500 MHz for ^{1}H; 75 and 125 MHz for ^{13}C). ^{1}H and ^{13}C NMR spectra were recorded in DMSO-d_6 with the solvent signals used as a reference (2.50 ppm for ^{1}H; 39.52 for ^{13}C). ^{13}C NMR spectra were recorded with complete heterodecoupling and with nOe. LCMS was accomplished using a Waters Alliance instrument equipped with a Nova-Pak C_{18} column (3.9 x 150 mm). All yields reported refer to isolated material judged to be homogeneous by TLC and NMR spectroscopy. HRMS and EI-MS were performed at the University of California, Davis. Fluorescent spectroscopy shown in was obtained using an excitation wavelength of 480 nm with all solutions balanced with either sodium chloride or choline chloride in order to keep ionic strength constant at 200 mM.

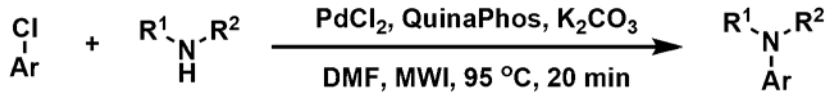
Sample Handling and Storage: Since **1** binds to K^+ with high affinity, all prepared compounds described herein that contain a cryptand ring should be handled with care. No animal toxicity data exist for these compounds. All samples were wrapped in foil, sealed in a plastic bag, and stored at -20 ˚C.

Synthetic Protocols



General Procedure for Aminoarylations: 7,16-Di(1*H*-imidazol-2-yl)-1,4,10,13-tetraoxa-7,16-diazacyclooctadecane (3). 1,4,10,13-Tetraoxa-7,16-diazacyclooctadecane (300 mg, 1.14 mmol), and potassium carbonate (237 mg, 1.72 mmol) were placed in a sealable microwave vial, dissolved in DMF (2 mL), and flushed with argon for 5 min. Palladium chloride (0.5 mg, 1.14 μmol) and QuinaPhos ((*2S*)-1-((*11bR*)-dinaphtho[2,1-d:1',2'-*f*][1,3,2]dioxaphosphepin-4-yl)-8-(diphenylphosphino)-2-(naphthal-en-1-yl)-1,2,3,4-tetrahydroquinoline; 1 mg, 1.14 μmol) were dissolved in DMF (1 mL), flushed with argon for 5 min, and cannulated into the microwave vial. A solution of 2-chloroimidazole (280 mg, 2.74 mmol; use 1.4 equiv if monoarylation is desired) in DMF (5 mL) was then added and this vial was sealed and heated to 95 ˚C under microwave irradiation for 20 min. The reaction mixture was then cooled to ambient temperature, diluted with water (20 mL), and extracted with ether (3 x 15 mL). The combined organics were washed with water (50 mL), brine (50 mL), dried ($MgSO_4$), and concentrated. The concentrate was dissolved in a minimal amount of anhydrous ether, and concentrated hydrogen chloride in anhydrous ether was added dropwise. The precipitate was filtered and, to remove the unwanted HCl salt, the precipitate was taken up in ether (15 mL) and saturated $NaHCO_3$ (15 mL). Following separation, the organic layer was washed with brine (15 mL), dried ($MgSO_4$), and concentrated to afford **3** (418 mg, 93%) as a light brown solid:

^{1}H NMR (DMSO-d_6, 300 MHz, 25 ˚C) δ 6.58 (br s, 4H), 3.76 (br s, 8H), 3.52 (br s, 8H), 2.71 (br s 8H).
^{13}C NMR (DMSO-d_6, 75 MHz, 25 ˚C) δ 150.6, 116.9, 71.4, 71.1, 50.3.
ESI-MS (*m/z*) 395.2 $(M + H)^+$.
ESI-HRMS Calcd $(M + H)^+$ for $C_{18}H_{31}N_6O_4^+$: 395.2401, Found 395.2409.
HPLC Purity 99%.

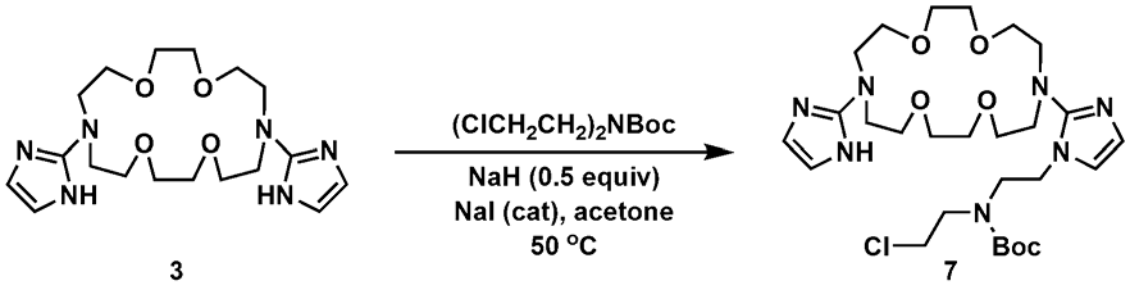


***N*,*N*-Dipropylpyridin-3-amine (4).** Following the General Procedure for Aminoarylations afforded **4** in 96% yield. The analytical data are in accord with literature values.[2]

3-(Piperidin-1-yl)-1*H*-indole (5). Following the General Procedure for Aminoarylations afforded **5** in 91% yield. The analytical data are in accord with literature values.[3]

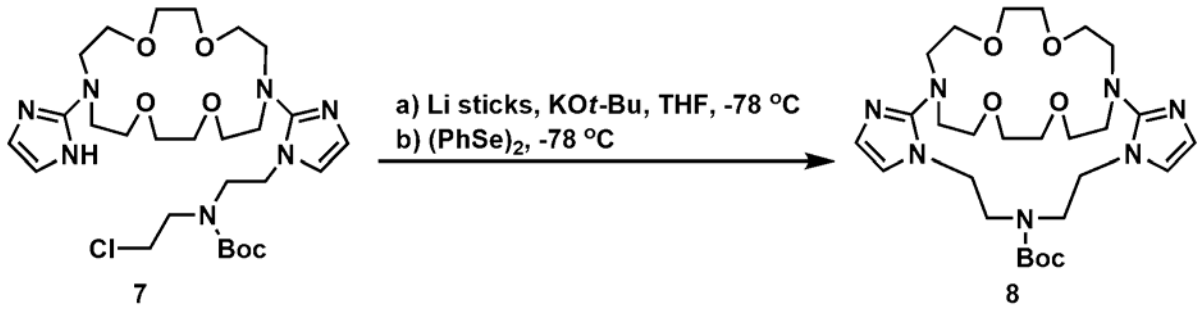
***N*-Methyl-*N*-phenylaniline (6).** Following the General Procedure for Aminoarylations afforded **6** in 89% yield. The analytical data are in accord with literature values.[4]

[2] Vinter-Pasquier, K.; Jamart-Gregoire, B.; Caubere, P. *Heterocycles* **1997**, *45*, 2113-2129.
[3] Donohue, S. R.; Halldin, C.; Schou, M.; Hong, J.; Phebus, L.; Chernet, E.; Hitchcock, S. A.; Gardinier, K. M.; Ruley, K. M.; Krushinski, J. H.; Schaus, J.; Pike, V. W. *J. Labelled Compd. Radiopharm.* **2008**, *51*, 146-152.
[4] Shen, Q.; Ogata, T.; Hartwig, J. F. *J. Am. Chem. Soc.* **2008**, *130*, 6586-6596.



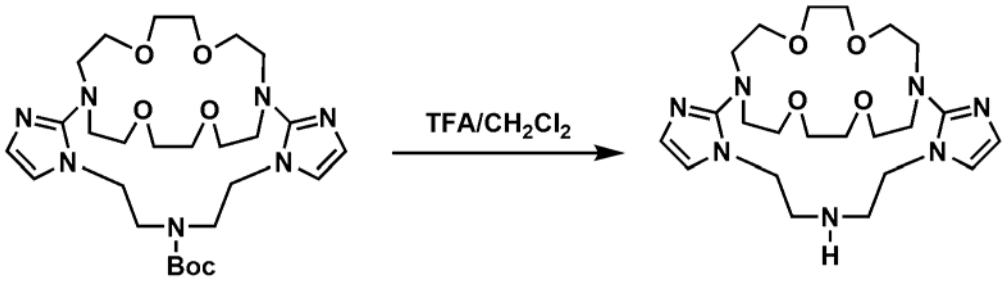
3 7

***Tert*-butyl 2-(2-(16-(1*H*-Imidazol-2-yl)-1,4,10,13-tetraoxa-7,16-diazacyclooctadecan-7-yl)-1*H*-imidazol-1-yl)ethyl(2-chloroethyl)carbamate (7).** Diimidazole **3** (205 mg, 0.519 mmol), *tert*-butyl bis(2-chloroethyl)carbamate (126 mg, 0.519 mmol), sodium iodide (7.8 mg, 0.052 mmol), and sodium hydride (see General Procedures; 10 mg, 0.260 mmol) were dissolved in acetone (10 mL). The reaction mixture was stirred for 16 h at 50 ˚C before being diluted with water (40 mL) and extracted with ether (2 x 30 mL). The combined organics were washed with brine (50 mL), dried ($MgSO_4$), and concentrated. This residue was crystallized with $CHCl_3$/petroleum ether and filtered to afford **7** as a light-brown solid (271 mg, 87%) which was used in subsequent reactions without further purification or analysis.



General Procedure for Dianionic Oxidative Cyclizations: *Tert*-butyl 2,2'-(2,2'-(1,4,10,13-Tetraoxa-7,16-diazacyclooctadecane-7,16-di-yl)bis-(1*H*-imidazole-2,1-diyl))diethancarbamate (8). Lithium sticks (10 mm diameter; 9 mg, 1.25 mmol) were added to a flame-dried flask that was back-filled with argon. THF (5 mL) was added, and the suspension was chilled to -78 ˚C. After cooling this solution for 10 min, a -78 ˚C chilled solution of alkyl chloride **7** (75 mg, 0.125 mmol) in THF (2 mL) was added via cannula over 5 min. After cooling for 20 min, potassium *tert*-butoxide in THF (1.0 M; 1.25 mL, 1.25 mmol) was added and the reaction mixture was stirred for an additional 20 min. To this solution was added diphenyl diselenide (195 mg, 0.625 mmol) and the temperature was kept at -78 ˚C for 2 h, followed by warming the solution to 0 ˚C (ca. 2.5 h). The reaction was quenched with saturated aqueous ammonium chloride (10 mL) and saturated aqueous sodium bisulfite (10 mL). The resulting solution was extracted with ether (3 x 15 mL), and the combined organics were dried ($MgSO_4$), filtered, and concentrated. Recrystallization of the residue with isopropanol afforded **8** as an off-white solid (64 mg, 91%):

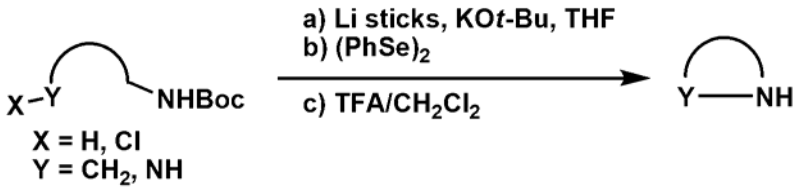
^{1}H NMR (DMSO-d_6, 300 MHz, 25 ˚C) δ 6.64 (br s, 4H), 4.01 (apparent s, 4H), 3.60-3.49 (m, 16H), 3.30-3.26 (m, 4H), 2.87-2.84 (m, 4H), 1.41 (s, 9H).
^{13}C NMR (DMSO-d_6, 75 MHz, 25 ˚C) δ 156.9, 116.5, 71.1, 69.8, 61.1, 60.8, 49.7, 29.8.
ESI-MS (*m/z*) 508.3 (M + H, –*t*-Bu)$^+$.
ESI-HRMS Calcd for $C_{27}H_{46}N_7O_6^+$: 564.3504, Found 508.2871 (–*t*-Bu).
HPLC Purity 100%.



8 14

General Procedure for Boc-deprotections: 2,2'-(2,2'-(1,4,10,13-Tetraoxa-7,16-diaza-cyclooctadecane-7,16-di-yl)bis-(1*H*-imidazole-2,1-diyl))diethanamine (14). Boc-protected amine **8** was dissolved in 1:1 TFA:CH_2Cl_2 (50 mL) and the mixture was stirred overnight at room temperature. The reaction mixture was concentrated and precipitated with saturated aqueous sodium bicarbonate. The solid was filtered to afford **14** (369 mg, ~100%) as a white solid:

^{1}H NMR (DMSO-d_6, 300 MHz, 25 ˚C) δ 8.36 (br s, 1H), 6.55 (apparent s, 4H), 4.16 (apparent s, 4H) 3.64-3.49 (m, 16H), 2.83-2.80 (m, 8H), 2.74-2.71 (m, 8H).
^{13}C NMR (DMSO-d_6, 75 MHz, 25 ˚C) δ 161.5, 158.1, 149.0, 69.5, 69.0, 58.4, 50.0, 48.2.
ESI-MS (*m/z*) 464.6 $(M + H)^+$.
ESI-HRMS Calcd for $C_{22}H_{38}N_7O_4^+$: 464.2980, Found 464.2985.
HPLC Purity 100%.



3,4-Dihydro-2*H*-benzo[*b*][1,4]oxazine (9). Following the General Procedures for Dianionic Oxidative Cyclizations and Boc-deprotections afforded **9** in 78% yield. The analytical data are in accord with literature values.[5]

3,5,6,8,9,11,12,13-Octahydro-2*H*-benzo[*k*][1,4,7,10,13]tetraoxaazacyclopentadecine (10). Following the General Procedures for Dianionic Oxidative Cyclizations and Boc-deprotections afforded **10** in 93% yield. The analytical data are in accord with literature values.[6]

2,3,4,5,6,7-Hexahydrobenzo[*b*][1,5]oxazonine (11). Following the General Procedures for Dianionic Oxidative Cyclizations and Boc-deprotections afforded **11** in 91% yield using *tert*-butyl 4-(2-(chloromethyl)phenoxy)butylcarbamate as an intermediate precursor.

Alternatively, using *tert*-butyl 4-(o-tolyloxy)butylcarbamate as an intermediate precursor afforded **11** in 86% yield:

^{1}H NMR (DMSO-d_6, 500 MHz, 25 ˚C) δ. 7.01 (apparent t, 2H), 6.69 (apparent t, 2H), 3.96 (br s, 1H), 3.82 (s, 2H), 3.34 (t, J = 6 Hz, 2H), 2.52 (t, J = 6.5 Hz, 2H), 1.46-1.41 (m, 4H).
^{13}C NMR (DMSO-d_6, 125 MHz, 25 ˚C) δ. 157.5, 127.8, 127.4, 126.9, 118.2, 115.4, 60.8, 43.2, 41.6, 30.8, 30.3.
ESI-MS (*m/z*) $(M + H)^+$ 178.3.
ESI-HRMS Calcd for $C_{11}H_{16}NO^+$: 178.1226, Found 178.1222.
HPLC Purity 100%.

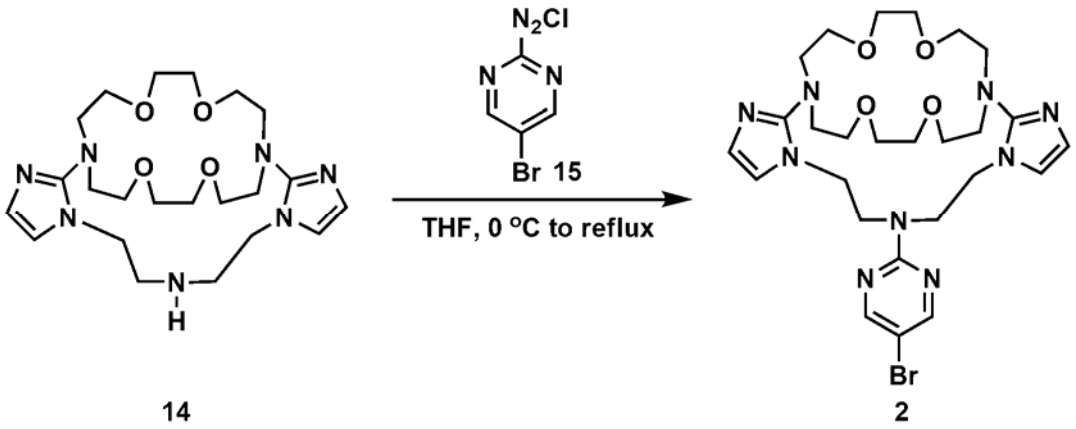
[5] Torraca, K. E.; Kuwabe, S.-I.; Buchwald, S. L. *J. Am. Chem. Soc.* **2000**, *122*, 12907-12908.
[6] Nakamura, M.; Yokono, H.; Tomita, K.-i.; Ouchi, M.; Miki, M.; Dohno, R. *J. Org. Chem.* **2002**, *67*, 3533-3536.

1,2,3,4,5,6-Hexahydrobenzo[*b*][1,4,5]oxadiazonine (12). Following the General Procedures for Dianionic Oxidative Cyclizations and Boc-deprotections afforded **12** in 83% yield:

^{1}H NMR (DMSO-d_6, 500 MHz, 25 ˚C) δ 6.63 (d, J = 8 Hz, 1H), 6.58 (d, J = 8 Hz, 1H), 6.52 (t, J = 7.5 Hz, 1H), 6.37 (t, J = 7.5 Hz, 1H), 4.32 (br s, 2H) 3.40-3.37 (m, 2H), 2.53-2.49 (m, 2H), 1.41-1.25 (m, 8H).
^{13}C NMR (DMSO-d_6, 125 MHz, 25 ˚C) δ 144.3, 136.6, 119.3, 116.5, 114.42, 114.40, 60.7, 41.6, 33.3, 32.6, 26.4, 25.5.
ESI-MS (*m/z*) $(M + H)^+$ 179.2
ESI-HRMS Calcd for $C_{10}H_{15}N_2O^+$: 179.1179, Found 179.1180.
HPLC Purity 100%.

1,4-Oxazecane (13). Following the General Procedures for Dianionic Oxidative Cyclizations and Boc-deprotections afforded **13** in 90% yield:

^{1}H NMR (DMSO-d_6, 500 MHz, 25 ˚C) δ 3.37-3.33 (m, 4H), 2.56-2.48 (m, 5H), 1.40-1.26 (m, 8H)
^{13}C NMR (DMSO-d_6, 125 MHz, 25 ˚C) δ 63.6, 60.7, 44.3, 41.7, 33.5, 32.7, 26.4, 25.6.
EI-MS (*m/z*) $(M + H)^+$ 144.1.
EI-HRMS Calcd for $C_8H_{18}NO^+$: 144.1383, Found 144.1387.
HPLC Purity 99%.

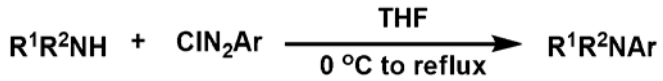


14 2

General Procedure for Sandmeyer-like/Metal-free Aminoarylation Reactions: *N*,*N*'-(2,2'-(2,2'-(1,4,10,13-Tetraoxa-7,16-diazacyclooctadecane-7,16-diyl)bis(1*H*-imid-azole-2,1-diyl))bis(ethane-2,1-diyl))-5-bromopyrimidin-2-amine (2). A solution of 5-bromo-pyrimidin-2-amine (45 mg, 0.256 mmol) in concentrated HCl (2 mL) was cooled to 0 ˚C. A solution of $NaNO_2$ (17 mg, 0.256 mmol) in H_2O (3 mL) was added and the mixture was stirred at 0 ˚C for 1 h. This mixture, presumably containing diazonium salt **15**, was added dropwise over 30 min to a solution of **14** (119 mg, 0.256 mmol) that may (for Sandmeyer-like Reaction) or may not (Metal-free Aminoarylation) contain copper(I) acetate (1 µL of 1 mg/mL solution in THF) in THF (10 mL) at 0 ˚C. The reaction mixture was allowed to warm first to room temperature (ca. 2 h) and then heated to reflux for 12 h. The mixture was extracted with ether (3 x 50 mL). The combined extracts were washed with brine (100 mL), dried ($MgSO_4$), and concentrated. The concentrate was dissolved in a minimal amount of anhydrous ether, and concentrated hydrogen chloride in anhydrous ether was added dropwise. The precipitate was filtered and, to remove the unwanted HCl salt, the precipitate was taken up in ether (15 mL) and saturated $NaHCO_3$ (15 mL). Following separation, the organic layer was washed with brine (15 mL), dried ($MgSO_4$), and concentrated to afford **2** (124 mg, 78% for Sandmeyer-like Reaction) as a light-brown solid. The Metal-free Aminoarylation Reaction afforded **2** (136 mg, 86%) as a light-brown solid:

^{1}H NMR (DMSO-d_6, 500 MHz, 25 ˚C) δ 8.28 (s, 2H), 6.84 (br s, 2H), 6.49 (s, 2H), 3.78 (apparent s, 16H), 3.54-3.43 (m, 8H), 2.75-2.50 (m, 8H).

^{13}C NMR (DMSO-d_6, 125 MHz, 25 ˚C) δ 162.1, 162.1, 158.4, 149.4, 116.0, 105.5, 70.0, 69.9, 58.8, 50.7, 48.9.
ESI-MS (*m/z*) 620.3, 622.2 $(M + H)^+$.
ESI-HRMS Calcd for $C_{26}H_{39}BrN_9O_4^+$: 620.2303, Found 620.2309.
HPLC Purity 100%.



4-Methoxy-*N*,*N*-dipropylaniline (16). Following the General Procedure for Sandmeyer-like/Metal-free Aminoarylation Reactions afforded **16** in 73%/76% yield. The analytical data are in accord with literature values.[7]

1-(3-Methoxyphenyl)pyrrolidine (17). Following the General Procedure for Sandmeyer-like/Metal-free Aminoarylation Reactions afforded **17** in 81%/75% yield. The analytical data are in accord with literature values.[8]

1-(2-Methoxyphenyl)pyrrolidine (18). Following the General Procedure for Sandmeyer-like/Metal-free Aminoarylation Reactions afforded **18** in 65%/58% yield. The analytical data are in accord with literature values.[9]

4-(Pyridin-2-yl)morpholine (19). Following the General Procedure for Sandmeyer-like/Metal-free Aminoarylation Reactions afforded **19** in 86%/88% yield. The analytical data are in accord with literature values.[10]

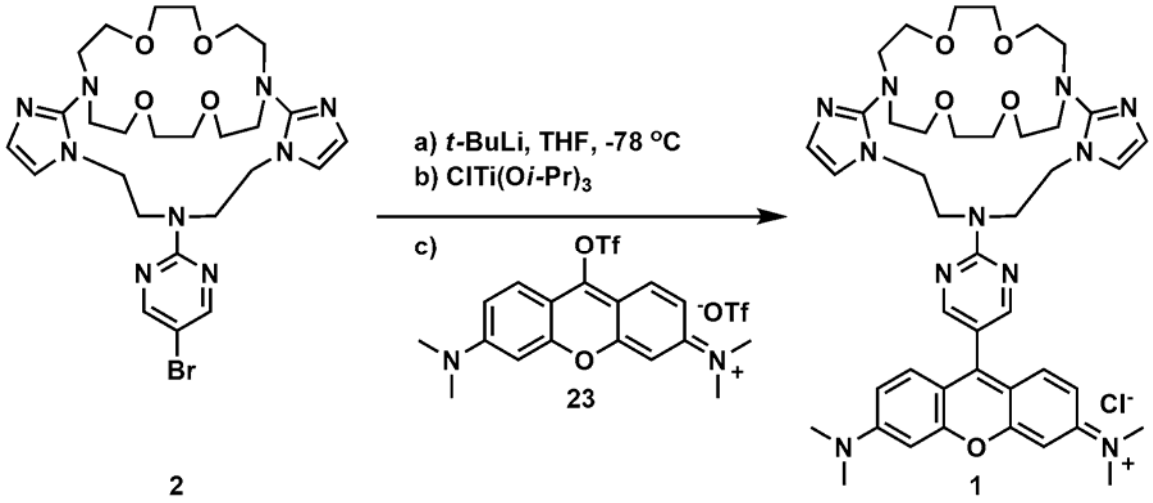
[7] Brenstrum, T.; Clattenburg, J.; Britten, J.; Zavorine, S.; Dyck, J.; Robertson, A. J.; McNulty, J.; Capretta, A. *Org. Lett.* **2006**, *8*, 103-105.
[8] Zim, D.; Buchwald, S. L. *Org. Lett.* **2003**, *5*, 2413-2415.
[9] Wolfe, J. P.; Tomori, H.; Sadighi, J. P.; Yin, J.; Buchwald, S. L. *J. Org. Chem.* **2000**, *65*, 1158-1174.
[10] Guo, D.; Huang, H.; Xu, J.; Jiang, H.; Liu, H. *Org. Lett.* **2008**, *10*, 4513-4516.

***N*,*N*-Dipropylaniline (20).** Following the General Procedure for Sandmeyer-like/Metal-free Aminoarylation Reactions afforded **20** in 79%/74% yield. The analytical data are in accord with literature values.[11]

1-(4-(Trifluoromethyl)phenyl)pyrrolidine (21). Following the General Procedure for Sandmeyer-like/Metal-free Aminoarylation Reactions afforded **21** in 89%/82% yield. The analytical data are in accord with literature values.[12]

4-Methyl-*N*,*N*-dipropylaniline (22). Following the General Procedure for Sandmeyer-like/Metal-free Aminoarylation afforded **22** in 78%/72% yield. The analytical data are in accord with literature values.[11]

[11] Nacario, R.; Kotakonda, S.; Fouchard, D. M. D.; Tillekeratne, L. M. V.; Hudson, R. A. *Org. Lett.* **2005**, *7*, 471-474.
[12] Manolikakes, G.; Gavryushin, A.; Knochel, P. *J. Org. Chem.* **2008**, *73*, 1429-1434.

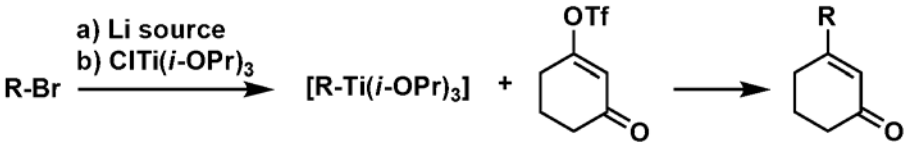


General Procedure for Organotitanium Addition to Vinylogous Sulfonates: *N*,*N*'-(2,2'-(2,2'-(1,4,10,13-Tetraoxa-7,16-diazacyclooctadecane-7,16-diyl)bis(1*H*-imidazole-2,1-diyl))-bis(ethane-2,1-diyl))-5-(*N*-(6-(dimethylamino)-9-(3*H*-xanthen-3-ylidene)-*N*-methyl-methanaminium)pyrimidin-2-amine chloride (1). A solution 3,6-bis(dimethylamino)-anthracen-9(10*H*)-one (300 mg, 1.06 mmol) in freshly distilled dichloromethane (5 mL) was treated with triflic anhydride (1.0 M in CH_2Cl_2; 1.06 mL, 1.06 mmol) at 0 ˚C. The solution was allowed to warm to room temp (ca. 3 h), and the reaction mixture was concentrated to afford crude xanthylium triflate **23** (598 mg, ~100%) which was used in the subsequent reaction without further purification or analysis. Ionophore bromide **2** (50 mg, 0.080 mmol) was dissolved in dry THF (1 mL) and treated with *tert*-butyllithium (1.7 M in pentane; 97 µL, 0.165 mmol). The solution was cooled for 15 min and chlorotriisopropoxytitanium(IV) (1.0 M in hexanes; 84 µL, 0.084 mmol) was added and the solution was warmed to 0 ˚C (ca. 1.5 h). A solution of xanthylium triflate **23** (45 mg, 0.080 mmol) in THF (2 mL) was added dropwise while maintaining the temperature at 0 ˚C. Following this addition, the solution was warmed to room temperature (ca. 2 h) and the reaction was neutralized with saturated aqueous ammonium chloride to pH 7 and extracted with ether (3 x 5 mL). The combined organics were washed with brine (10 mL), dried ($MgSO_4$), filtered, and concentrated. Cyclohexenones **24-27** were purified by silica gel column chromatography using 15:1 Hexanes:Ethyl Acetate. The concentrate of crude K^+

sensor **1** was dissolved in a minimal amount of anhydrous ether, concentrated hydrogen chloride in anhydrous ether was added dropwise, and the precipitate was filtered to afford **1** as a reddish-brown solid (55 mg, 82%):

^{1}H NMR (20:1 DMSO-d_6:D_2O, 500 MHz, 25 ˚C) δ 8.28 (s, 2H), 7.03-4.91 (m, 10H), 4.09 (apparent s, 16H), 3.64-3.48 (m, 8H), 3.29-2.74 (m, 14H).
^{13}C NMR (20:1 DMSO-d_6:D_2O, 125 MHz, 25 ˚C) δ 161.8, 158.3, 157.5, 151.5, 151.1, 150.3, 148.6, 148.3, 147.4, 129.7, 129.3, 128.8, 114.0, 110.0, 108.1, 105.2, 99.5, 99.1, 96.5, 69.3, 68.1, 56.8, 49.3, 47.9, 40.1.
ESI-MS (*m/z*) 806.4 $(M - Cl^-)^+$, 403.8 $(M + H - Cl^-)^{2+}$
ESI-HRMS Calcd for $C_{43}H_{56}N_{11}O_5^+$: 808.4460, Found 808.4463.
HPLC Purity 100%.
Fluorescent properties of the xanthylium chromophore were in accord with literature values.[13]

[13] Kenmoku, S.; Urano, Y.; Kojima, H.; Nagano, T. *J. Am. Chem. Soc.* **2007**, *129*, 7313-7318.



3-Phenylcyclohex-2-enone (24). Following the General Procedure for Organotitanium Addition to Vinylogous Sulfonates afforded **24** in 84% yield. The analytical data are in accord with literature values.[14]

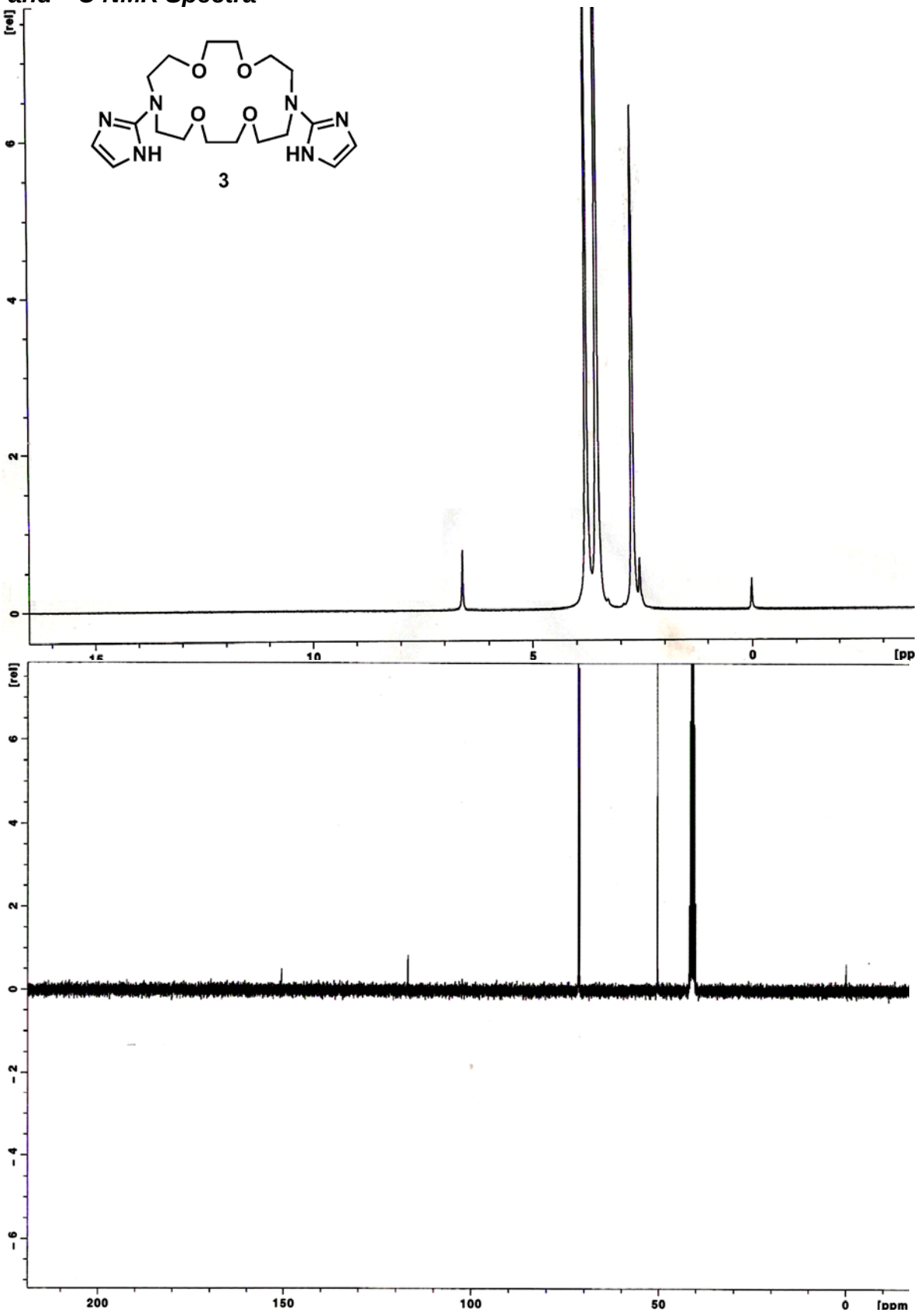
3-(Pyridin-4-yl)cyclohex-2-enone (25). Following the General Procedure for Organotitanium Addition to Vinylogous Sulfonates afforded **25** in 89% yield. The analytical data are in accord with literature values.[15]

3-Cyclohexylcyclohex-2-enone (26). Following the General Procedure for Organotitanium Addition to Vinylogous Sulfonates afforded **26** in 78% yield. The analytical data are in accord with literature values.[16]

3-*Sec*-butylcyclohex-2-enone (27). Following the General Procedure for Organotitanium Addition to Vinylogous Sulfonates afforded **27** in 74% yield. The analytical data are in accord with literature values.[17]

[14] Uyanik, M.; Fukatsu, R.; Ishihara, K. *Org. Lett.* **2009**, *11*, 3470-3473.
[15] Carabateas, P. M.; Brundage, R. P.; Gelotte, K. O.; Gruett, M. D.; Lorenz, R. R.; Opalka, C. J., Jr.; Singh, B.; Thielking, W. H.; Williams, G. L.; Lesher, G. Y. *J. Heterocycl. Chem.* **1984**, *21*, 1849-1856.
[16] Snider, B. B.; Rodini, D. J.; Van Straten, J. *J. Am. Chem. Soc.* **1980**, *102*, 5872-5880.
[17] Jun, J.-G.; Ha, T. H. *J. Heterocycl. Chem.* **1997**, *34*, 325-328.

^{1}H and ^{13}C NMR Spectra



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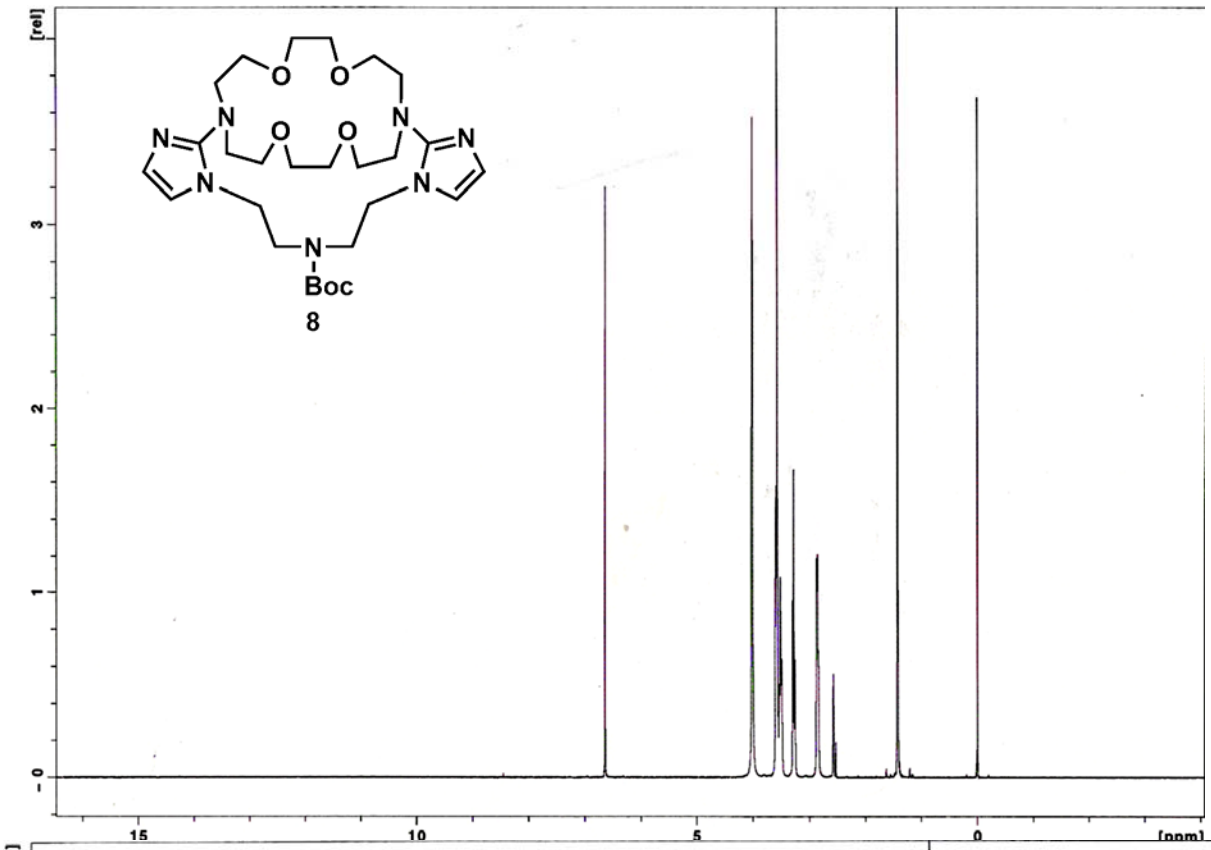
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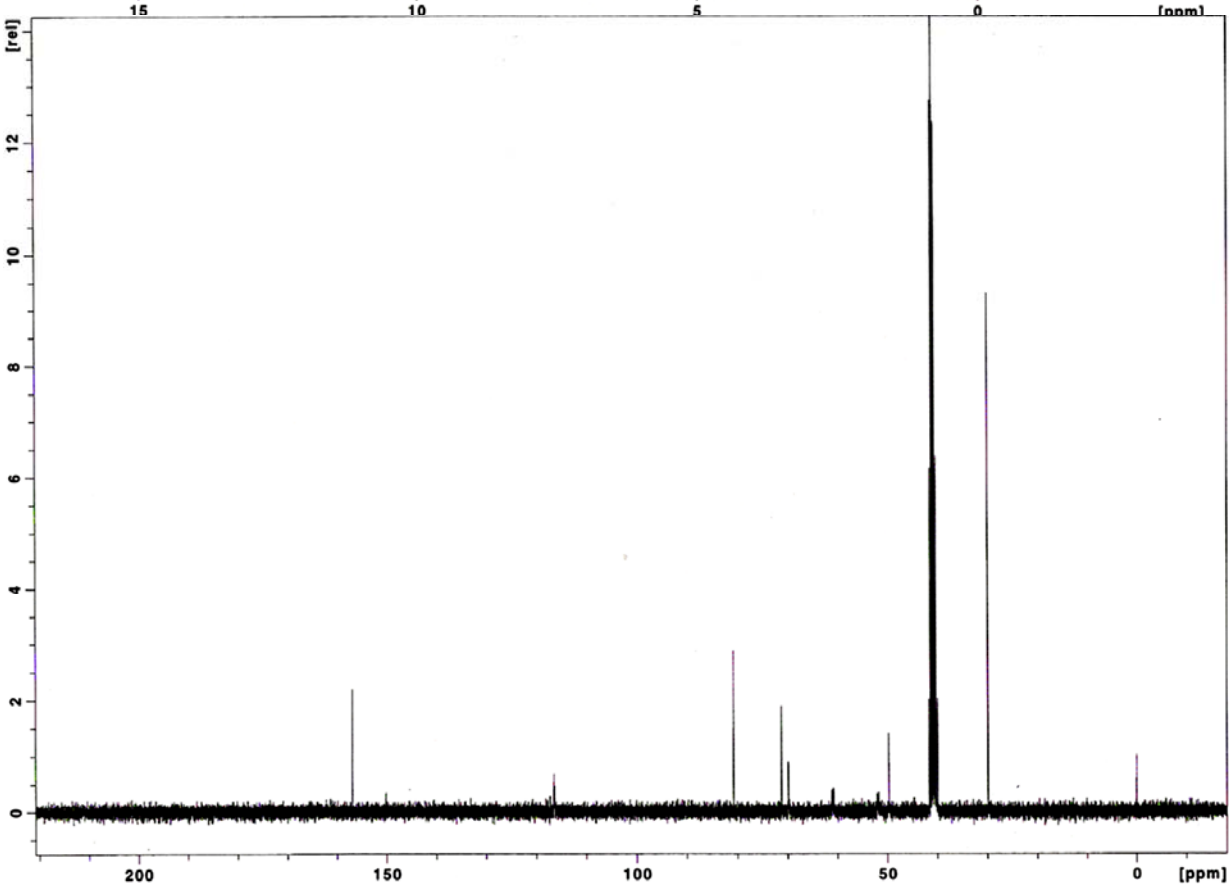
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N
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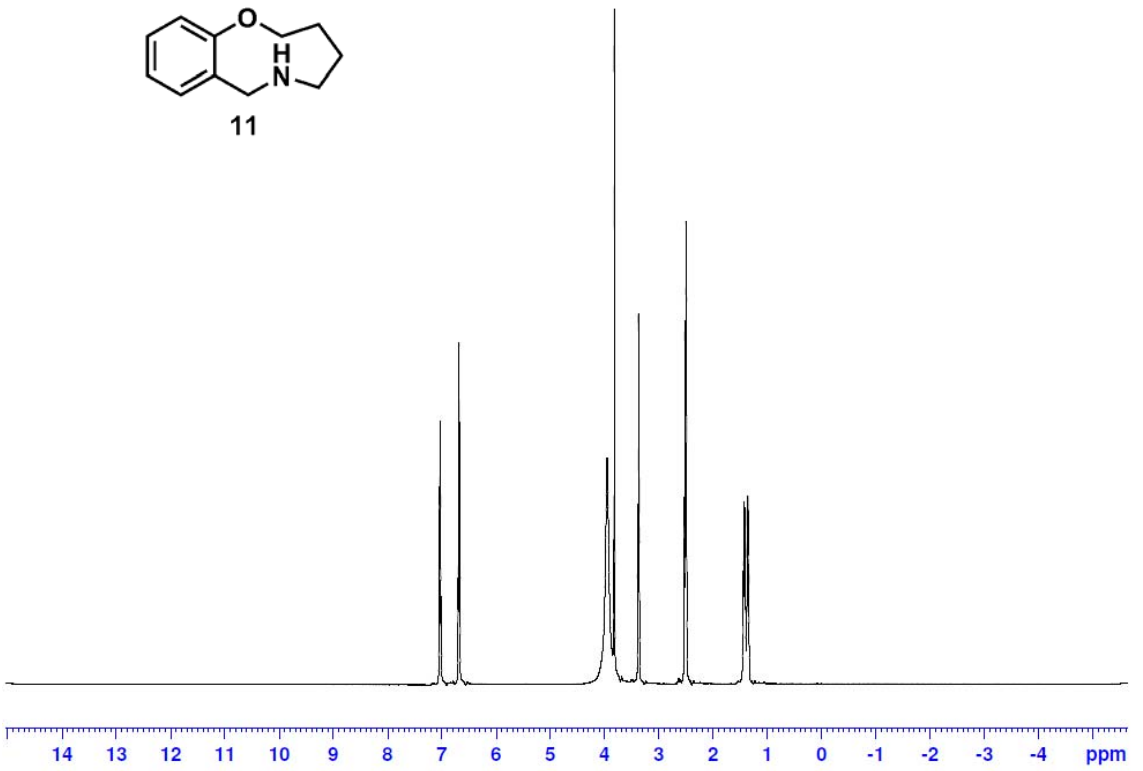
N
N
N
Boc

8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H
N
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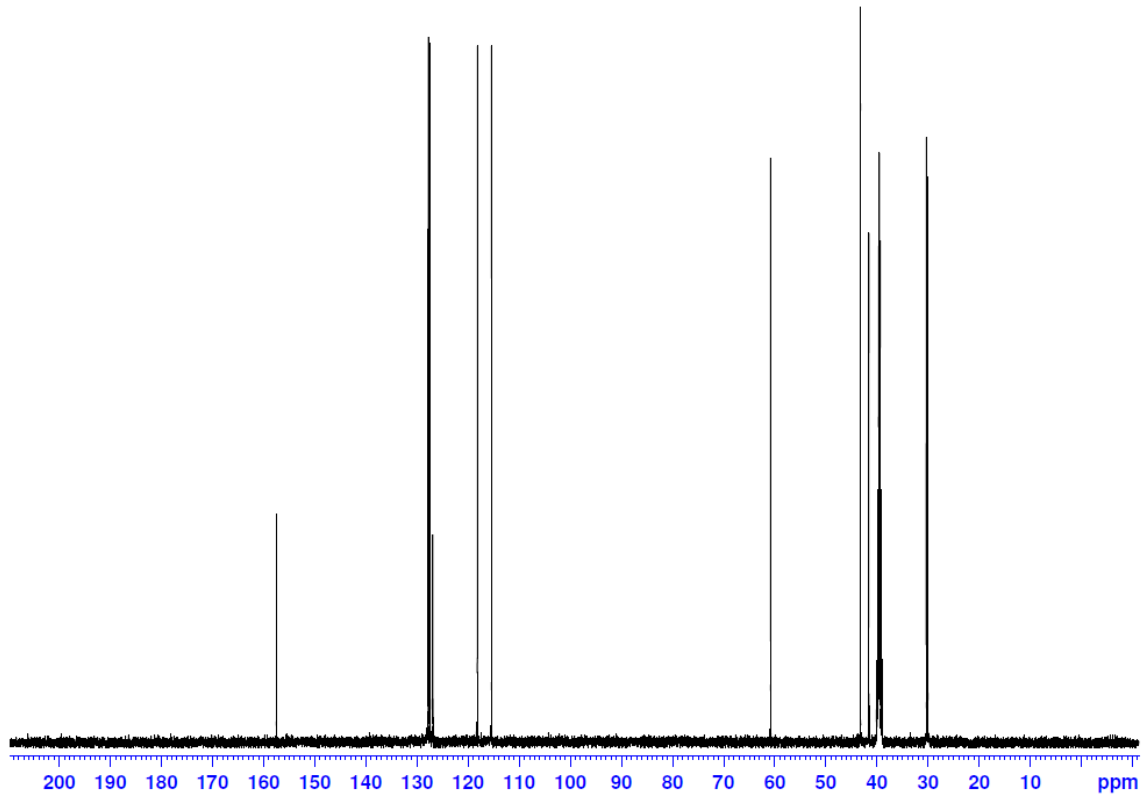
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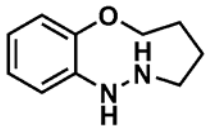

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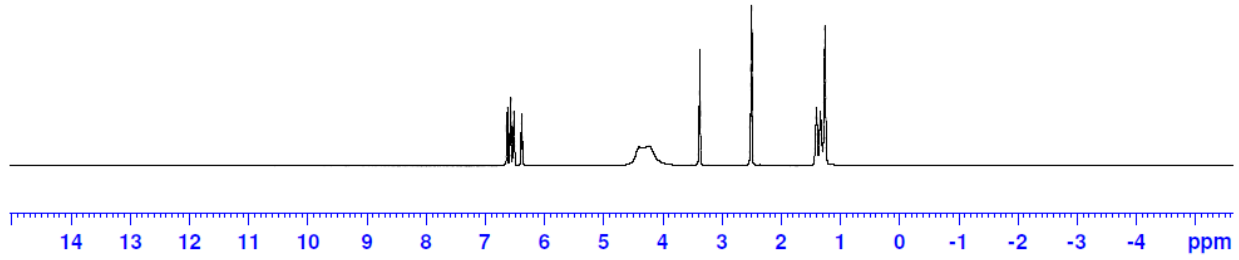
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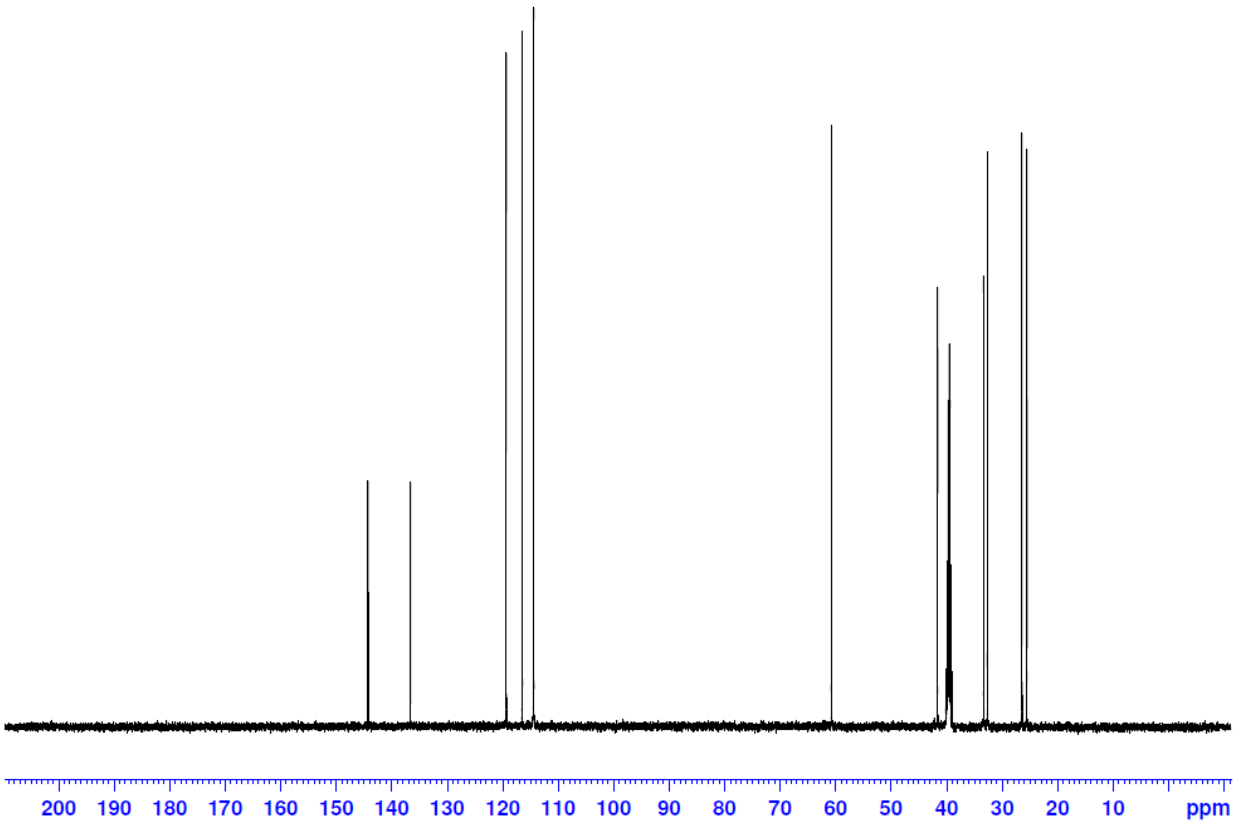
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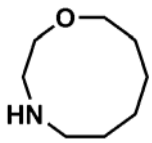
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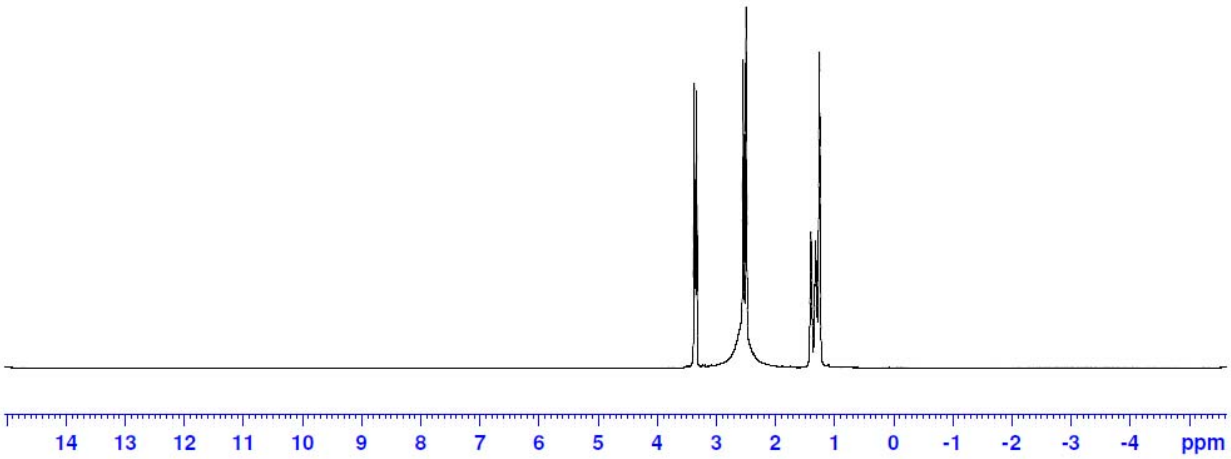
13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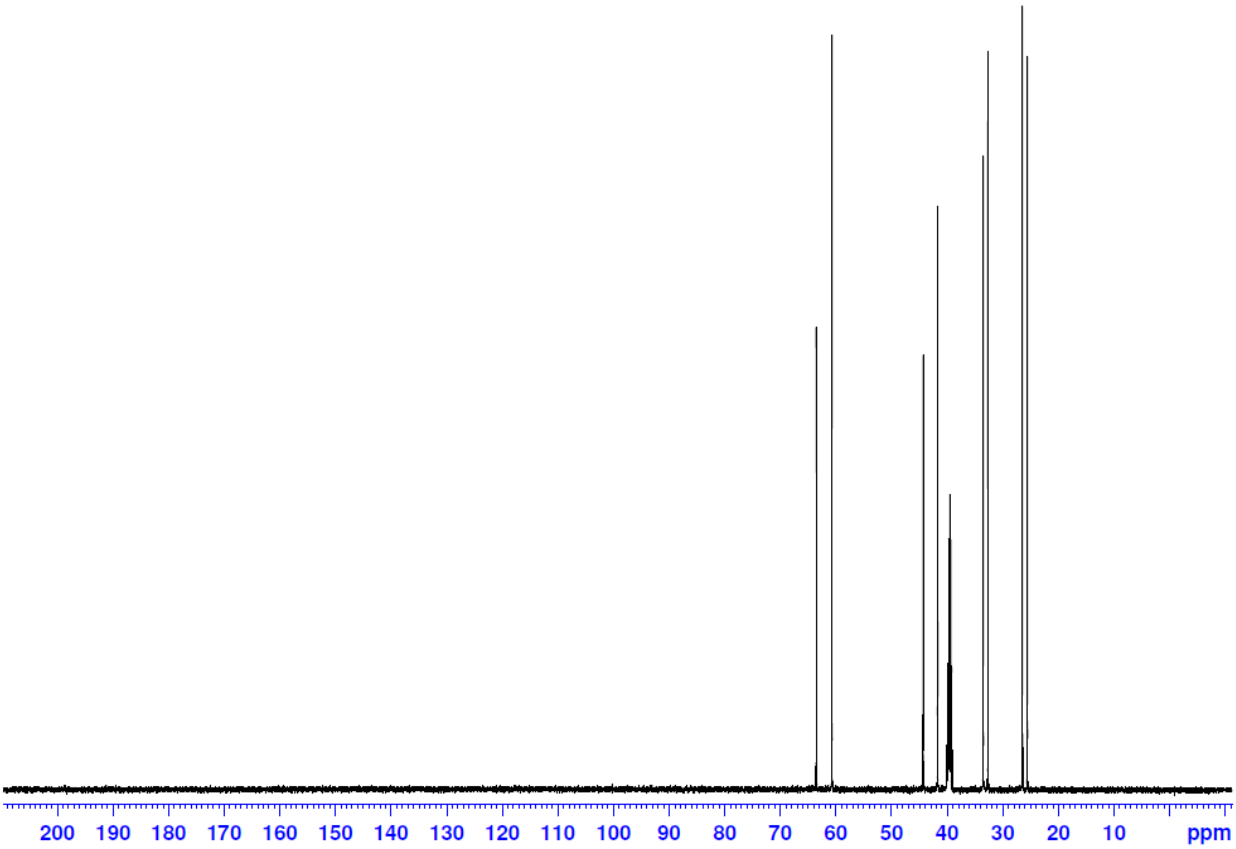
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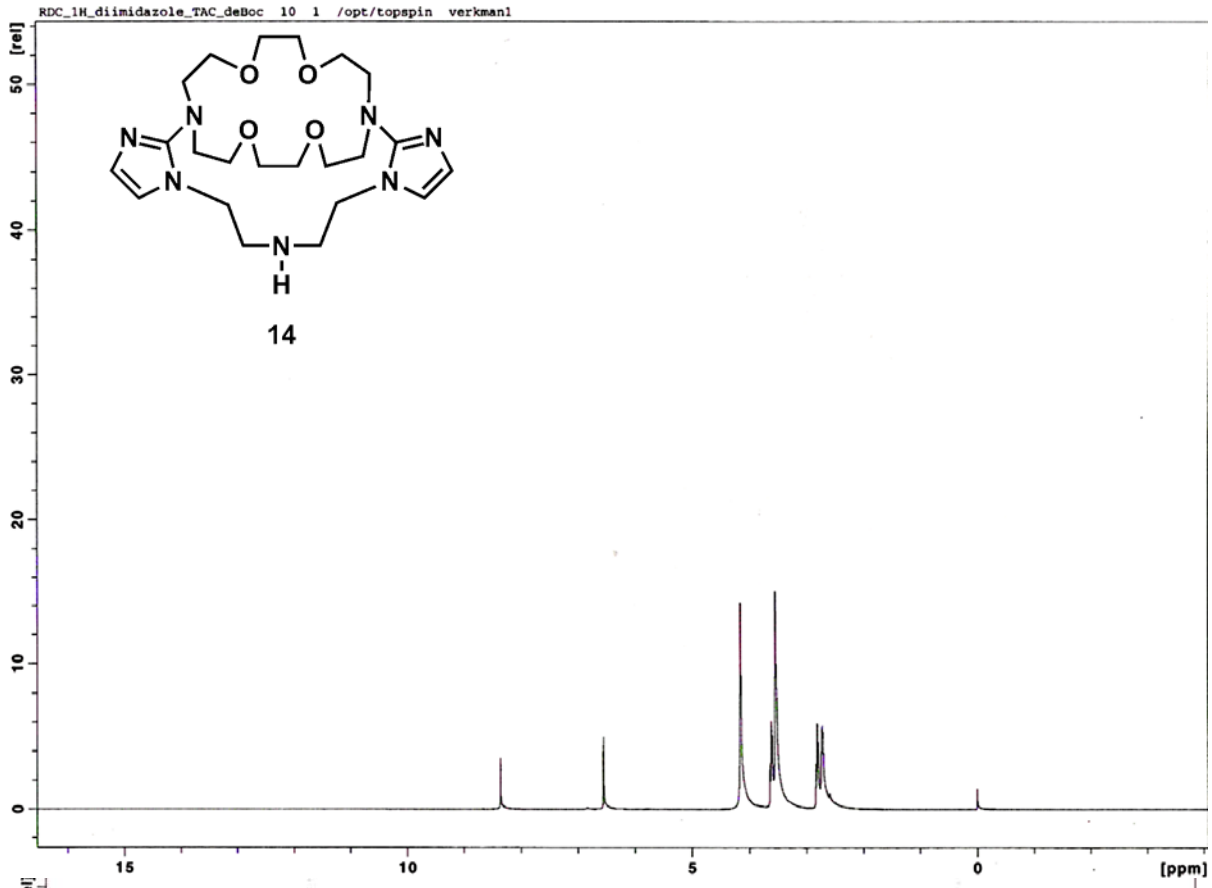
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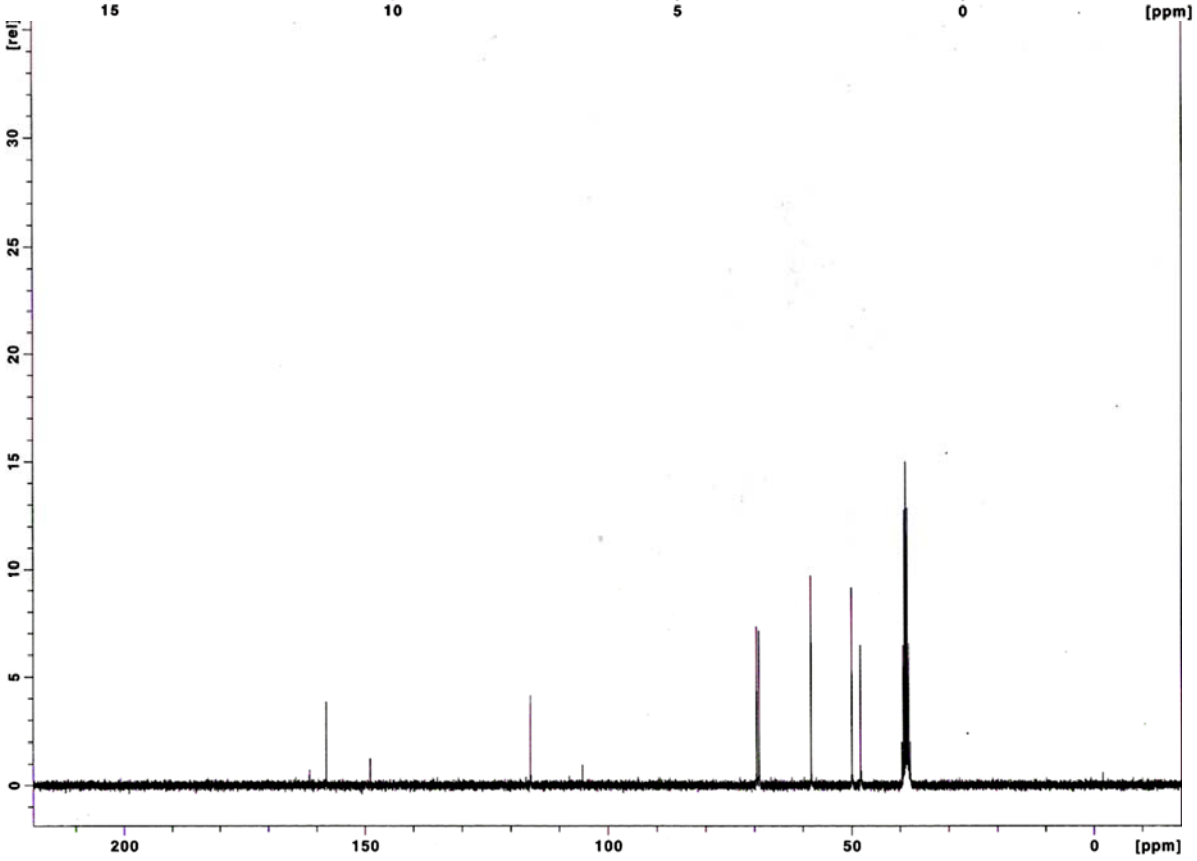
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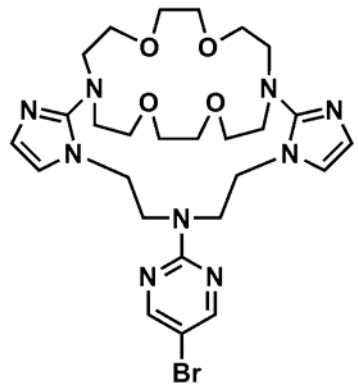

2

1H spectrum
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PULPROG               zg
TD                 32768
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RG                    20
DW                48.400 usec
DE                 6.00 usec
TE                295.0 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
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P1                  9.00 usec
PL1                -1.00 dB
SFO1         500.1123505 MHz

F2 - Processing parameters
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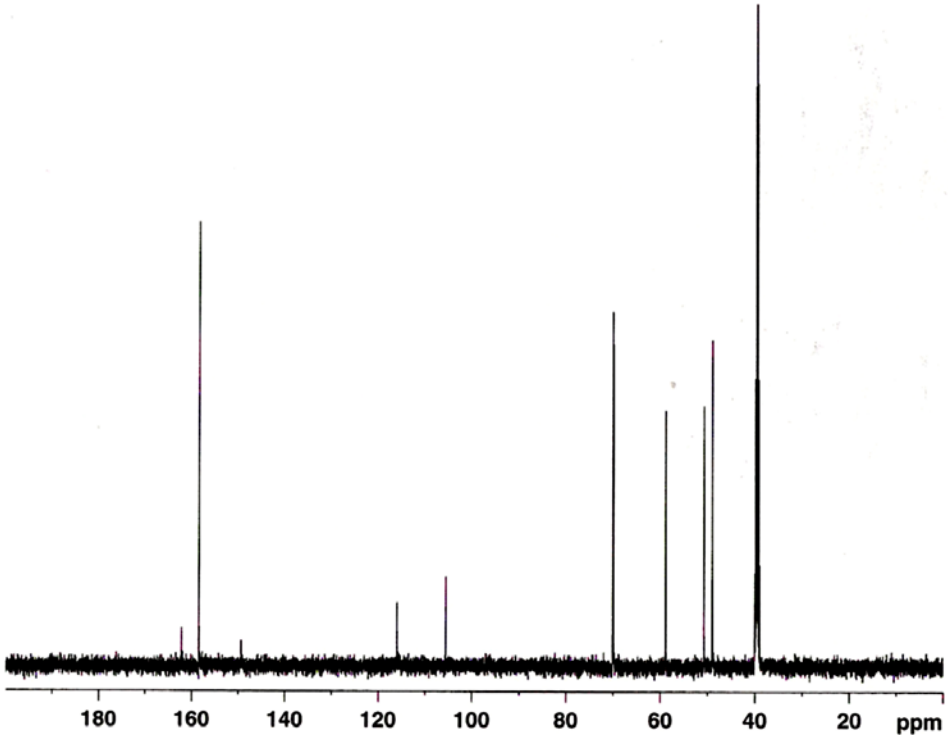
with 1H dec & NOE
11.75T

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D1             1.50000000 sec
d11            0.03000000 sec
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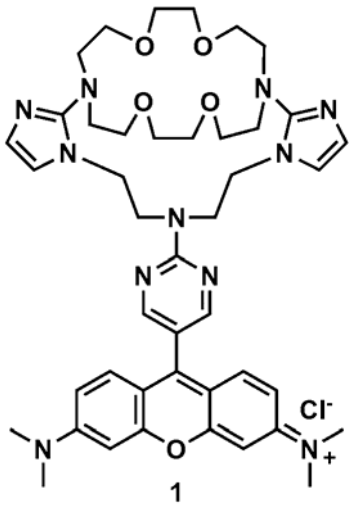
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N+

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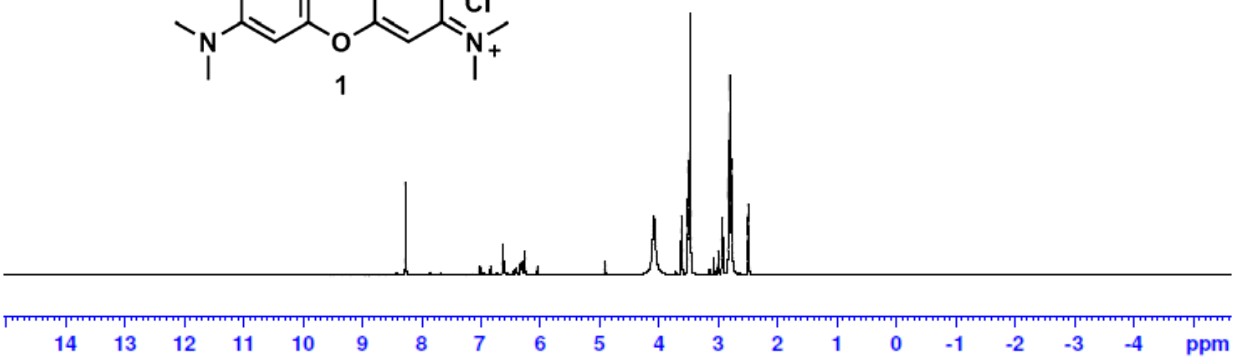
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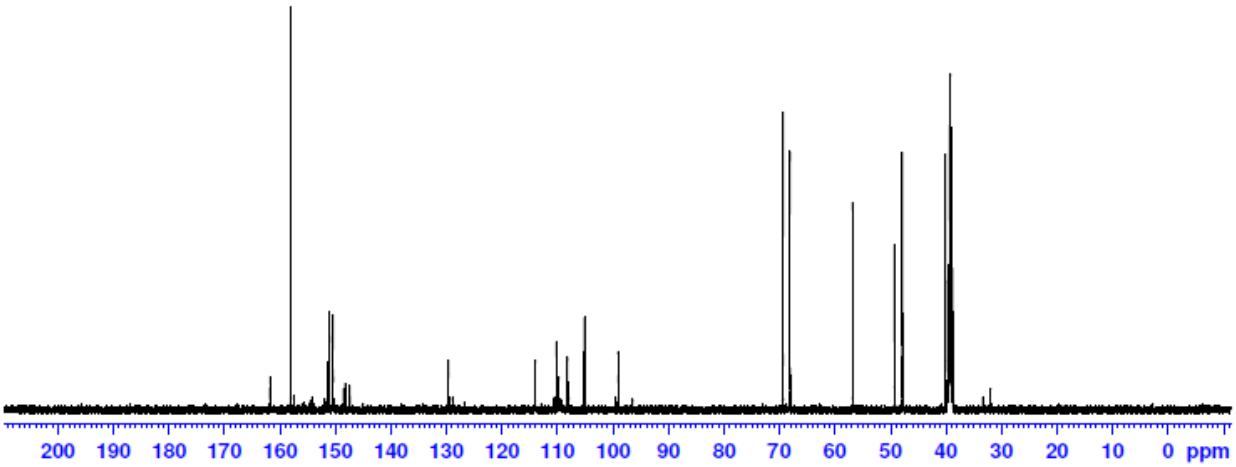
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