Supplementary Material (ESI) for Green Chemistry

ELECTRONIC SUPPLEMENTARY INFORMATION

Lewis Basic Ionic Liquids-Catalyzed Synthesis of 5-Aryl-2-oxazolidinones from Aziridines and CO_2 under Solvent-free Conditions

Zhen-Zhen Yang, Liang-Nian He,* Shi-Yong Peng, An-Hua Liu

Institute of Elemento-Organic Chemistry, State Key Laboratory of Elemento-Organic Chemistry, Nankai University, Tianjin, P. R. China

** Corresponding author: Tel: +86-22-23504216; Fax: +86-22-23504216 ; E-mail: heln@nankai.edu.cn*

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1. General experimental methods:

Caution

Experiments using compressed gases CO_2 are potentially hazardous and must only be carried out by using the appropriate equipment and under rigorous safety precautions.

Materials

Aziridines and ILs were synthesized according to the published procedures.[1, 2] CO_2 with a purity of 99.99% was commercially available. The other organic and inorganic compounds from Tianjin Guangfu Fine Chemical Research Institute were used without further purification except for the solvents, which were distilled by the known method prior to use.

Experimental methods

1H NMR spectra was recorded at Bruck 300 or 400 spectrometer in CDCl3 and TMS (0 ppm) was used as internal reference, 13C NMR was recorded at 75 or 100.6 MHz in CDCl3 and CDCl3 (77.0 ppm) was used as internal reference. ESI-MS were recorded on a Thermo Finnigan LCQ Advantage spectrometer in ESI mode with a spray voltage of 4.8 kV. GC analyses were performed on Shimadzu GC-2014, equipped with a capillary column (RTX-5, 30 m × 0.25 μm) using a flame ionization detector. Melting points were measured on an X4 apparatus and uncorrected. In situ FTIR was collected on a Mettler Toledo React IR ic10 analysis system. Melting points were measured on an X4 apparatus and uncorrected.

2. General procedures for the preparation of ionic liquids:

[C_4DABCO]Br:

A solution of freshly sublimed DABCO (0.5609 g, 5 mmol) in MeCN (5 mL) was prepared at r.t. under Ar in a flame dried round-bottomed flask equipped with a reflux condenser. The resulting clear, colorless solution was treated with 1-bromobutane (0.269 mL, 2.5 mmol), added dropwise via syringe, and the reaction mixture was heated to 80 °C (oil bath temperature) and stirred for 22 h. After being cooled to r.t., the reaction mixture was transferred via cannula into 20 mL of Et_2O, yielding a white slurry which eventually separated into two layers. The whole was transferred to a separatory funnel, and the bottom layer was collected, washed repeatedly with Et_2O and dried under high vacuum at 60 ^oC for 16 h to yield 1-butyl-4-aza-1-azaniabicyclo[2.2.2]octane bromide as a white glassy solid.

[C_4DABCO]Cl:

According to the synthetic procedure of [C_4DABCO]Br, 1-butyl-4-aza-1-azaniabicyclo[2.2.2]octane chloride was yielded as a white glassy solid.

[C_4DABCO]OH:

Solid potassium hydroxide (0.112 g, 2 mmol) was added to a solution of [C_4DABCO]Br (0.4984 g, 2 mmol) in dry methylene chloride (2 mL), and the mixture was stirred vigorously at r.t. for 10 h. The precipitated KBr was filtered off, and the filtrate was evaporated to leave the crude [C_4DABCO]OH as a white solid that was washed with ether (2 × 2 mL) and dried at 90 ^oC for 10 h to prepare the pure ionic liquid 1-butyl-4-aza-1-azaniabicyclo[2.2.2]octane hydroxide.

[C_8DABCO]Br:

According to the synthetic procedure of [C_4DABCO]Br, 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane bromide was yielded as a yellow glassy solid.

[C_8DABCO]BF_4:

A solution of 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane bromide (0.4972 g, 1.63 mmol) in MeCN (1.0 mL), prepared at r.t. under Ar in a flame-dried round-bottomed flask, was transferred via cannula to a slurry of $NaBF_4$ (0.181 g, 1.65 mmol) in MeCN (1.5 mL). A 0.5 mL MeCN rinse was used to ensure complete transfer. A white precipitate formed immediately and the resulting slurry was stirred at r.t. for 24 h. Filtration followed by concentration of the filtrate in vacuo yielded a colorless, viscous liquid shown to be contaminated with bromide by a positive $AgNO_3$ test. The crude was partitioned between CH_2Cl_2 and H_2O, and the CH_2Cl_2 layer was washed repeatedly with H_2O until the aqueous layer gave a negative $AgNO_3$ test. The CH_2Cl_2 extract was dried (Na_2SO_4), subjected to filtration and concentrated in vacuo. Drying under high vacuum at 60 °C for 3 d yielded 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane tetrafluoroborate as a clear colourless liquid.

[C_8DABCO]NTf_2:

A solution of $LiN(SO_2CF_3)_2$ (0.465 g, 1.62 mmol) in MeCN (1.0 mL), prepared at r.t. under Ar in a flame-dried round-bottomed flask, was transferred via cannula to a solution of 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane bromide (0.488 g, 1.60 mmol) in MeCN (1.5 mL). A 0.5 mL MeCN rinse was used to ensure complete transfer. A white precipitate formed within 5 min and the resulting slurry was stirred at r.t. for 47 h. Filtration followed by concentration of the filtrate in vacuo yielded a colorless liquid shown to be contaminated with chloride by a positive $AgNO_3$ test. The crude was partitioned between CH_2Cl_2 and H_2O, and the CH_2Cl_2 layer was washed repeatedly with H_2O until the aqueous layer gave a negative $AgNO_3$ test. The CH_2Cl_2 extract was dried (Na_2SO_4), subjected to filtration and concentrated in vacuo. Drying under high vacuum at 60 °C for 5 d yielded 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane bis(trifluoromethylsulfonyl)imide as a colorless liquid.

[C_8DABCO]PF_6:

A solution of 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane bromide (0.4911 g, 1.61 mmol) in MeCN (1.0 mL), prepared at r.t. under Ar in a flame-dried round-bottomed flask, was transferred via cannula to a slurry of KPF_6 (0.3018 g, 1.64 mmol) in MeCN (1.0 mL). A 0.5 mL MeCN rinse was used to ensure complete transfer. A white precipitate formed immediately and the resulting slurry was stirred at r.t. for 20 h. Filtration followed by concentration of the filtrate in vacuo yielded an oily, white solid shown to be contaminated with bromide by a positive $AgNO_3$ test. The crude was partitioned between CH_2Cl_2 and H_2O, and the CH_2Cl_2 layer was washed repeatedly with H_2O until the aqueous layer gave a negative $AgNO_3$ test. The CH_2Cl_2 extract was dried (Na_2SO_4), subjected to filtration and concentrated in vacuo. Drying under high vacuum at 60 °C for 5 d yielded 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane hexafluorophosphate as a white solid.

[C_{12}DABCO]Br:

According to the synthetic procedure of [C_4DABCO]Br, 1-dodecyl-4-aza-1-azaniabicyclo[2.2.2]octane bromide was yielded as a yellow glassy solid.

[C_4MIm]Br:

Under N_2, freshly dried 1-methylimidazole (1.6 mL, 20 mmol) and 1-bromobutane (3.7 mL, 34.4 mmol) were added to dry toluene (2 mL) in a round-bottomed Schlenk flask. The mixture was heated under reflux under N_2 for 24 h, upon which two layers had formed. The flask was allowed to cool to room temperature and was then cooled to -10 ^{o}C overnight, during which time a white solid was formed. The excess toluene was decanted, while N_2 was being passed over the product layer. The resulting white precipitate was washed with dry diethyl ether and then dried in vacuo for 24 h to afford 1-butyl-3-methylimidazolium bromide as a light yellow liquid.

[C_4MIm]BF_4:

To a solution of [C_4MIm]Br (2.1912 g, 10 mmol) in acetone (10 mL) at room temperature was added sodium tetrafluoroborate (1.0979 g, 10 mmol). Afer 24 h stirring, the reaction mixture was filtered and the volatiles were removed under reduced pressure. Drying in vacuo for 10 h afforded 1-butyl-3-methylimidazolium tetrafluoroborate as a light yellow liquid.

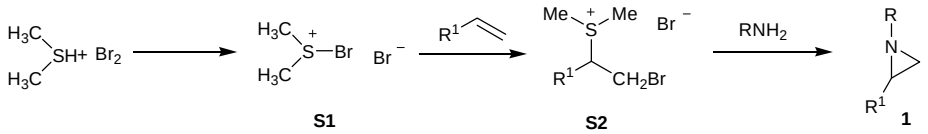
[C_8MIm]Br:

According to the synthetic procedure of [C_4MIm]Br, 1-octyl-3-methylimidazolium bromide was yielded as a colourless liquid.

[C_8MIm]BF_4:

According to the synthetic procedure of [C_4MIm]BF_4, 1-octyl-3-methylimidazolium tetrafluoroborate was yielded as a white glassy solid.

3. General procedure for the preparation of aziridines



Typical procedure was described as below. The bromine (32.0 g, 0.2 mol) in dry CH_2Cl_2 (40 mL) was added dropwise over 30 min to ice-cooled 40 mL CH_2Cl_2 solution of dimethyl sulfide (12.4 g, 0.2 mol). During the addition, light orange crystals of bromodimethyl sulfonium bromide began to separate. After

addition of bromine, the orange crystals **S1** were collected by filtration and then washed with dry diethyl ether and dried under vacuum. Yield: 80%, Mp 80 °C (dec).

Olefin (160 mmol) was added dropwise to the 160 mL CH_3CN solution of **S1** (35.56 g, 160 mmol) in ice-water bath. During the addition, the white solid began to separate. The solution was further stirred for 10 min. The crystals **S2** was collected by filtration, dried under vacuum. Yield: 32-38.6 %.

A solution of amine (20-50 mmol) in water was added dropwise to a stirred solution of compound **S2** (10 mmol) in 20 mL of H_2O at r.t., and the resulting mixture was stirred overnight. The mixture was added into 20 mL of saturated brine, extracted with diethyl ether (3×20 mL), dried with anhydrous $MgSO_4$ overnight and evaporated under reduced pressure. Aziridine was obtained by distillation under reduced pressure. Yield: 85-100 %.

4. General Procedure for Carboxylation of Aziridine with CO_2

In a typical reaction, the carboxylation of aziridines with CO_2 was carried out in a 25 mL stainless steel autoclave. Aziridine (1 mmol) were charged into the reactor at room temperature. CO_2 was introduced into the autoclave and then the mixture was stirred at predetermined temperature for 15 min to reach the equilibration. The pressure was then adjusted to the desired pressure and the mixture was stirred continuously. When the reaction finished, the reactor was cooled in ice-water and CO_2 was ejected slowly. An aliquot of sample was taken from the resultant mixture and dissolved in dry CH_2Cl_2 for GC analysis (GC analyses were performed on Shimadzu GC-2014, equipped with a capillary column (RTX-5, 30 m × 0.25 μm×0.25 μm) using a flame ionization detector. The residue was purified by column chromatography on silica gel (eluting with 8:1 to 1:1 petroleum ether/ethyl acetate) to afford the product. The products were further identified by ^{1}H NMR, ^{13}C NMR and MS which are consistent with those reported in the literature[1,3] and in good agreement with the assigned structures.

5. Characterization of ionic liquids

[C_4DABCO]Br:

White glassy solid; Mp 36-37 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.65 (t, ^3J = 7.2 Hz, 6 H), 3.47 (t, ^3J = 8.4 Hz, 2 H), 3.22 (t, ^3J = 6.6 Hz, 6 H), 1.70-1.75 (m, 2 H), 1.36-1.40 (m, 2 H), 0.94 (t, ^3J = 7.2 Hz, 3 H); ^{13}C {^{1}H} NMR (75 MHz, $CDCl_3$) δ 64.3, 52.4, 45.4, 23.9, 19.7, 13.6; ESI-MS calcd for $C_{10}H_{21}N_2Br$ 249.19, found 169.38 $[M\text{-}Br]^+$, 79.02 $[M\text{-}C_{10}H_{21}N_2]^-$.

[C_4DABCO]OH:

White solid; Mp 45-46 °C; ^{1}H NMR (400 MHz, D_2O) δ 3.39 (t, ^3J = 7.6 Hz, 6 H), 3.25 (t, ^3J = 8.8 Hz, 2 H), 3.19 (t, ^3J = 7.2 Hz, 6 H), 1.74 (quintet, ^3J = 8 Hz, 2 H), 1.33-1.42 (m, 2 H), 0.94 (t, ^3J = 7.6 Hz, 3 H); ^{13}C {^{1}H} NMR (100.6 MHz, D_2O) δ 64.4, 52.0, 44.1, 23.1, 19.1, 12.7; ESI-MS calcd for $C_{10}H_{22}N_2O$ 186.29, found 169.3 $[M\text{-}OH]^+$, bromide was not tested under the negative ion mode.

[C_4DABCO]Cl:

White glassy solid; Mp 36-37 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.67 (t, ^3J = 7.2 Hz, 6 H), 3.54 (t, ^3J = 8.4 Hz, 2 H), 3.25 (t, ^3J =,7.2 Hz, 6 H), 1.69-1.77 (m, 2 H), 1.36-1.45 (m, 2 H), 0.97 (t, ^3J =7.2 Hz, 3 H); ^{13}C {^{1}H} NMR (100.6 MHz, $CDCl_3$) δ 64.3, 52.4, 45.4, 23.9, 19.7, 13.7; ESI-MS calcd for $C_{10}H_{21}N_2Cl$ 204.74, found 169.44 $[M\text{-}Cl]^+$.

[C_8DABCO]Br:

Yellow glassy solid; Mp 37-38 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.49 (t, ^3J = 7.6 Hz, 6 H), 3.27 (t, ^3J = 8.4 Hz, 2 H), 3.08 (t, ^3J =7.2 Hz, 6 H) , 1.59 (s, 2 H), 1.06-1.15 (m, 10 H), 0.68 (t, ^3J = 7.2 Hz, 3 H); ^{13}C {^{1}H} NMR (100.6 MHz,$CDCl_3$) δ 64.1, 52.0, 45.0, 31.1, 28.6, 28.5, 25.9,22.1, 21.6, 13.6; ESI-MS calcd for $C_{14}H_{29}N_2Br$ 305.3, found 225.46 $[M\text{-}Br]^+$, 79.03 $[M\text{-}C_{14}H_{29}N_2]^-$.

[C_8DABCO]BF_4:

White glassy solid; Mp 37-38 °C; ^{1}H NMR (400 MHz,$CDCl_3$) δ 3.28 (t, ^3J= 7.6 Hz, 6 H), 3.10-3.16 (m, 8 H), 1.66 (s, 2 H), 1.20-1.27 (m, 10 H), 0.81 (t, ^3J= 7.2 Hz, 3 H); ^{13}C {^{1}H} NMR (100.6 MHz, $CDCl_3$) δ 64.5, 52.0, 44.9, 31.3, 28.7, 26.0, 22.2, 21.4, 13.7; ^{19}F {^{1}H} NMR (377 MHz, $CDCl_3$) δ -151.10, -151.15; ESI-MS calcd for $C_{14}H_{29}N_2BF_4$ 312.2, found 225.45 $[M\text{-}BF_4]^+$, 87.1 $[M\text{-}C_{14}H_{29}N_2]^-$.

[C_8DABCO]PF_6:

White solid; Mp 161-163 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.27-3.30 (m, 6 H), 3.13-3.22 (m, 8 H), 1.70 (s, 2 H), 1.26-1.33 (m, 10 H), 0.87 (t, ^3J = 7.2 Hz, 3 H); ^{13}C {^{1}H} NMR (100.6 MHz, $CDCl_3$) δ 65.0, 52.5, 45.2, 31.6, 28.94, 28.92, 26.2, 22.5, 21.7, 14.0; ^{19}F {^{1}H} NMR (377 MHz, $CDCl_3$) δ -71.02, -72.91; ^{31}P {^{1}H} NMR

(161.9 MHz, $CDCl_3$) δ -144.33 (septet, $J_{P,F}$ = 712Hz); ESI-MS calcd for $C_{14}H_{29}N_2PF_6$ 370.36, found 225.43 $[M\text{-}PF_6]^+$, 145.20 $[M\text{-}C_{14}H_{29}N_2]^-$.

$[C_8DABCO]NTf_2$:

Colorless liquid; ^1H NMR (400 MHz, $CDCl_3$) δ 3.17 (t, ^3J = 6.4 Hz, 6 H), 2.98-3.07 (m, 8 H), 1.58 (s, 2 H), 1.16-1.21 (m, 10 H), 0.76 (t, ^3J = 6.8 Hz, 3 H); ^{13}C $\{^1H\}$ NMR (100.6 MHz, $CDCl_3$) δ 117.2 (q, $J_{C,F}$ = 321 Hz), 62.4, 49.9, 42.5, 28.9, 26.3, 26.2, 23.5, 19.9, 19.0, 11.4; ^{19}F $\{^1H\}$ NMR (377 MHz, $CDCl_3$) δ -81.60; ESI-MS calcd for $C_{16}H_{29}N_3O_4S_2F_6$ 505.54, found 225.43 $[M\text{-}C_2F_6NO_4S_2]^+$, 280.10 $[M\text{-}C_{14}H_{29}N_2]^-$.

$[C_{12}DABCO]Br$:

White solid; Mp 59-60 °C; ^1H NMR (400 MHz,$CDCl_3$) δ 3.64 (s, 6 H), 3.46 (t, ^3J = 7.6 Hz, 2 H), 3.24 (s, 6 H), 1.21-1.30 (m, 20 H), 0.84 (t, ^3J = 5.2 Hz, 3 H); ^{13}C $\{^1H\}$ NMR (100.6 MHz, $CDCl_3$) δ 64.5, 52.4, 45.3, 31.8, 29.5, 29.4, 29.3, 29.2, 29.1, 26.3, 22.6, 22.1, 14.0; ESI-MS calcd for $C_{18}H_7N_2Br$ 338.22, found 281.82 $[M\text{-}Br]^+$, 79.03 $[M\text{-}C_{18}H_{37}N_2]^-$.

$[C_4MIm]Br$:

Light yellow liquid; ^1H NMR (400 MHz, $CDCl_3$) δ 10.27 (s, 1 H), 7.60 (t, ^3J = 1.6 Hz, 1 H), 7.47 (t, ^3J = 1.6 Hz, 1 H), 4.28 (t, ^3J = 7.2 Hz, 2 H), 4.07 (s, 3 H), 1.85 (quintet, ^3J = 7.6 Hz, 2 H), 1.32 (sextet, ^3J = 7.6 Hz, 2 H), 0.89 (t, ^3J = 7.6 Hz, 3 H); ^{13}C $\{^1H\}$ NMR (100.6 MHz, D_2O) δ 135.8, 123.2, 122.2, 49.3, 35.7, 31.3, 18.7, 12.6; ESI-MS calcd for $C_8H_{15}N_2Br$ 219.12, found 139.32 $[M\text{-}Br]^+$, 79.03 $[M\text{-}C_8H_{15}N_2]^-$.

$[C_4MIm]BF_4$:

Light yellow liquid; ^1H NMR (400 MHz, D_2O) δ 8.71 (s, 1 H), 7.51 (s, 1 H), 7.47 (s, 1 H), 4.22-4.23 (m, 2 H), 3.94 (s, 3 H), 1.87-1.89 (m, 2 H), 1.35-1.37 (m, 2 H), 0.96 (t, ^3J = 7.6 Hz, 3 H); ^{13}C $\{^1H\}$ NMR (100.6 MHz, D_2O) δ 135.9, 123.5, 122.2, 49.3, 35.6, 31.3, 18.8, 12.7; ^{19}F $\{^1H\}$ NMR (377 MHz, $CDCl_3$) δ -150.12, -150.30; ESI-MS calcd for $C_8H_{15}N_2BF_4$ 226.02, found 139.32 $[M\text{-}BF_4]^+$, 87.11 $[M\text{-}C_8H_{15}N_2]^-$.

$[C_8MIm]Br$:

Colourless liquid; ^1H NMR (400 MHz, $CDCl_3$) δ 10.06 (s, 1 H), 7.59 (s, 1 H), 7.40 (s, 1 H), 4.17 (t, ^3J = 6.8 Hz, 2 H), 3.99 (s, 3 H), 1.76-1.77 (m, 2 H), 1.09-1.17 (m, 10 H), 0.70 (t, ^3J = 6.4Hz, 3 H); ^{13}C $\{^1H\}$ NMR (100.6 MHz, $CDCl_3$) δ 136.0, 123.1, 121.4, 49.2, 35.9, 30.7, 29.4, 28.1, 28.0, 25.3, 21.6, 13.2; ESI-MS calcd for $C_{12}H_{23}N_2Br$ 275.23, found 195.46 $[M\text{-}Br]^+$, 79.03 $[M\text{-}C_{12}H_{23}N_2]^-$.

$[C_8MIm]BF_4$:

Light yellow liquid; ^1H NMR (400 MHz, $CDCl_3$) δ 8.70 (s, 1 H), 7.38 (s, 1 H), 7.32 (s, 1 H), 4.12 (t, ^3J = 7.2 Hz, 2 H), 3.89 (s, 3 H), 1.82 (t, ^3J = 6.8 Hz, 2 H), 1.20-1.26 (m, 10 H), 0.81 (t, ^3J = 6.8 Hz, 3 H); ^{13}C $\{^1H\}$ NMR (100.6 MHz, $CDCl_3$) δ 136.0, 123.7, 122.1, 49.9, 36.0, 31.5, 29.9, 28.9, 28.7, 26.0, 22.4, 13.9; ^{19}F $\{^1H\}$ NMR (377 MHz, $CDCl_3$) δ -150.99, -151.05; ESI-MS calcd for $C_{12}H_{23}N_2BF_4$ 282.13, found 195.39 $[M\text{-}BF_4]^+$, 87.10 $[M\text{-}C_{12}H_{23}N_2]^-$.

6. Characterization of aziridines

2-Phenylaziridine:

^1H NMR (400 MHz, $CDCl_3$) δ 0.81 (s, 1H), 1.79 (d, ^2J = 3.2 Hz, 1H), 2.20 (d, ^2J = 6.0 Hz, 1H), 3.01 (dd, ^3J = 3.6 Hz, ^3J = 2.4 Hz, 1H), 7.21-7.32 (m, 5H); ESI-MS calcd for C_8H_9N 119.07, found 120.26 $[M + H]^+$.

1-Methyl-2-phenylaziridine:

^1H NMR (400 MHz, $CDCl_3$) δ 1.62 (d, ^2J = 6.4 Hz, 1H), 1.90 (d, ^2J = 3.2 Hz, 1H), 2.26 (dd, ^3J = 3.2 Hz, ^3J = 3.2 Hz, 1H), 2.48 (s, 3H), 7.19-7.30 (m,5H); ESI-MS calcd for $C_9H_{11}N$ 133.19, found 134.21 $[M + H]^+$.

1-Ethyl-2-phenylaziridine:

^1H NMR (400 MHz, $CDCl_3$) δ 1.17 (t, ^3J = 9.6 Hz, 3H), 1.65 (d, ^2J = 8.8 Hz, 1H), 1.89 (d, ^2J = 4.4 Hz, 1H), 2.30 (dd, ^3J = 4.4 Hz, ^3J = 4.8 Hz, 1H), 2.44 (q, ^3J = 9.6 Hz, 2H), 7.18-7.31 (m, 5H); ESI-MS calcd for $C_{10}H_{13}N$ 147.10, found 148.31 $[M + H]^+$.

1-Propyl-2-phenylaziridine:

^1H NMR (400 MHz, $CDCl_3$) δ 0.95 (t, ^3J = 10.0 Hz, 3H), 1.60-1.67 (m, 3H), 1.89 (d, ^2J = 4.0 Hz, 1H), 2.24-2.33 (m, 2H), 2.43-2.51 (m, 1H), 7.18-7.31 (m, 5H); ESI-MS calcd for $C_{11}H_{15}N$ 161.12, found 162.28 $[M + H]^+$.

1-Isopropyl-2-phenylaziridine:

^{1}H NMR (300 MHz, $CDCl_3$) δ 1.17 (d, ^3J = 0.9 Hz, 3H), 1.19 (d, ^3J = 0.9 Hz, 3H), 1.57-1.66 (m, 2H), 1.89 (d, ^2J = 3.3 Hz, 1H), 2.34 (dd, ^3J = 3.3 Hz, ^3J = 3.3 Hz, 1H), 7.17-7.31 (m, 5H); ESI-MS calcd for $C_{11}H_{15}N$ 161.12, found 162.32 $[M + H]^+$.

1-Cyclopropyl-2-phenylaziridine:

^{1}H NMR (300 MHz, $CDCl_3$) δ 0.41-0.50 (m, 2H), 0.55-0.67 (m, 2H), 1.60-1.67 (m, 1H), 1.86-1.88 (m, 2H), 2.57 (dd, ^3J = 3.6 Hz, ^3J = 3.0 Hz, 1H), 7.17-7.30 (m, 5H); ESI-MS calcd for $C_{11}H_{13}N$ 159.10, found 160.32 $[M + H]^+$.

1-Butyl-2-phenylaziridine:

^{1}H NMR (300 MHz, $CDCl_3$) δ 0.91 (t, ^3J = 7.2 Hz, 3H), 1.33-1.45 (m, 2H), 1.55-1.67 (m, 3H), 1.88 (d, ^2J =3.3 Hz, 1H), 2.27-2.36 (m, 2H), 2.45-2.54 (m, 1H), 7.17-7.31 (m, 5H); ESI-MS calcd for $C_{12}H_{17}N$ 175.14, found 176.38 $[M + H]^+$.

1-Isobutyl-2-phenylaziridine:

^{1}H NMR (300 MHz, $CDCl_3$) δ 0.95 (d, ^3J = 6.6 Hz, 3H), 0.98 (d, ^3J = 6.6 Hz, 3H), 1.65 (d, ^2J = 6.3 Hz, 1H), 1.85-1.94 (m, 2H), 2.08 (dd, ^3J = 6.3 Hz, ^3J = 6.6 Hz, 1H), 2.28 (q, ^3J = 3.3 Hz, 1H), 2.44 (dd, ^3J = 7.2 Hz, ^2J = 11.4 Hz, 1H), 7.17-7.31 (m, 5H); ESI-MS calcd for $C_{12}H_{17}N$ 175.14, found 176.36 $[M + H]^+$.

1-Tert-butyl-2-phenylaziridine:

^{1}H NMR (300 MHz, $CDCl_3$) δ 1.05 (s, 9H), 1.64 (dd, ^2J = 3.0 Hz, ^3J = 0.9 Hz, 1H), 1.89 (dd, ^2J = 6.3 Hz, ^3J = 0.6 Hz, 1H), 2.62 (q, ^3J = 3.0 Hz, 1H), 7.16-7.33 (m, 5H); ESI-MS calcd for $C_{12}H_{17}N$ 175.14, found 176.19 $[M + H]^+$.

1-Benzyl-2-phenylaziridine:

^{1}H NMR (300 MHz, $CDCl_3$) δ 1.84 (d, ^2J = 6.3 Hz, 1H), 1.98 (d, ^2J = 3.3 Hz, 1H), 2.50 (q, ^3J = 3.3 Hz, 1H), 3.65 (ABq, $^3J_{AB}$ = 13.8 Hz, $\Delta\nu_{AB}$ = 18.8 Hz, 2H), 7.18-7.38 (m, 10H); ESI-MS calcd for $C_{15}H_{15}N$ 209.29, found 210.13 $[M + H]^+$.

1-Cyclohexyl-2-phenylaziridine:

^{1}H NMR (300 MHz, $CDCl_3$) δ 1.19-1.87 (m, 13H), 2.34 (dd, ^3J =3.3 Hz, ^3J =3.0 Hz, 1H), 7.17-7.27 (m, 5H); ESI-MS calcd for $C_{14}H_{19}N$ 201.15, found 202.37 $[M + H]^+$.

2-(4-Chlorophenyl)-1-ethylaziridine:

^{1}H NMR (300 MHz, $CDCl_3$) δ 1.18 (t, ^3J = 6.9 Hz, 3H), 1.65 (d, ^2J = 6.6 Hz, 1H), 1.83 (d, ^2J = 3.3 Hz, 1H), 2.25-2.46 (m, 3H), 7.15-7.23 (m, 4H); ESI-MS calcd for $C_{10}H_{12}NCl$ 181.66, found 182.13 $[M + H]^+$.

2-(4-Methylphenyl)-1-ethylaziridine:

^{1}H NMR (400 MHz, $CDCl_3$) δ 1.19 (t, ^3J = 7.2 Hz, 3H), 1.62 (d, ^2J = 6.4 Hz, 1H), 1.86 (d, ^2J = 3.2 Hz, 1H), 2.26 (dd, ^3J = 3.6 Hz, ^3J = 3.2 Hz, 1H), 2.31 (s, 3H), 2.37-2.48 (m, 2H), 7.09-7.15 (m, 4H); ESI-MS calcd for $C_{11}H_{15}N$ 161.24, found 162.20 $[M + H]^+$.

7. Characterization of oxazolidinones

5-Phenyloxazolidin-2-one:

White crystals**;** ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.55 (t, ^3J = 8.4 Hz, 1H), 3.99 (t, ^3J = 8.4 Hz, 1H), 5.62 (t, ^3J = 8.4 Hz, 1H), 6.08 (brs, 1H), 7.35-7.43 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 48.2, 77.8, 125.6, 128.9, 138.4, 160.1; ESI-MS calcd for $C_9H_9NO_2$ 163.06, found 164.18 $(M + H)^+$, 186.28 $(M + Na)^+$, 349.03 $(2M + Na)^+$.

3-Methyl-5-phenyloxazolidin-2-one:

White crystals**;** ^{1}H NMR (300 MHz, $CDCl_3$) δ 2.89 (s, 3H), 3.42 (t, ^3J=8.4 Hz, 1H), 3.90 (t, ^3J=8.4 Hz, 1H), 5.45 (t, ^3J=8.0 Hz, 1H), 7.33-7.38 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 30.7, 54.0, 73.0, 125.3, 128.5, 128.6, 138.4, 157.9; ESI-MS calcd for $C_{10}H_{11}NO_2$ 177.08, found 178.21 $(M + H)^+$, 200.25 $(M + Na)^+$, 377.00 $(2M + Na)^+$.

3-Ethyl-5-phenyloxazolidin-2-one:

Colorless liquid; ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.17 (t, ^3J = 7.2 Hz, 3H), 3.29-3.45 (m, 3H), 3.92 (t, ^3J = 8.7 Hz, 1H), 5.48 (t, ^3J = 7.8 Hz, 1H), 7.34-7.42 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 12.4, 38.8, 51.5, 74.2, 125.4, 128.6, 128.8, 138.8, 157.5; ESI-MS calcd for $C_{11}H_{13}NO_2$ 191.09, found 192.29 $(M + H)^+$, 214.38 $(M + Na)^+$, 405.01 $(2 M + Na)^+$.

3-Ethyl-4-phenyloxazolidin-2-one:

Colorless liquid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.05 (t, ^3J = 7.2 Hz, 3H), 2.79-2.88 (m, 1H), 3.48-3.57 (m, 1H), 4.10 (t, ^3J = 8.0 Hz, 1H), 4.62 (t, ^3J = 8.8 Hz, 1H), 4.81 (t, ^3J = 7.2 Hz, 1H), 7.30 7.44 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 12.1, 36.8, 59.3, 69.7, 126.9, 129.0, 129.2, 137.8, 158.1; ESI-MS calcd for $C_{11}H_{13}NO_2$ 191.09, found 192.29 $(M + H)^+$, 214.38 $(M + Na)^+$, 405.01 $(2M + Na)^+$.

1, 4-Diethyl-2, 5-diphenylpiperazine:

White crystals; ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.91 (t, ^3J=7.2 Hz, 6H), 1.99-2.05 (m, 2H), 2.30 (t, ^3J=10.8 Hz, 2H), 2.54-2.62 (m, 2H), 3.08 (dd, ^2J=11.6 Hz, ^3J=2.4 Hz, 2H), 3.45 (dd, ^3J=2.0 Hz, ^2J=12.0 Hz, 2H), 7.29-7.43 (m, 10H). LC-MS, calcd for $C_{20}H_{26}N_2$ 294.21, found 295.35 $(M + H)^+$.

1, 4-Diethyl-2, 3-diphenyl-piperazine:

Colorless liquid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.01 (t, ^3J=7.2 Hz, 6H), 2.17-2.26 (m, 2H), 2.33-2.26 (m, 2H), 2.65-2.69 (m, 2H), 2.95-2.99 (q, ^3J=6.0 Hz, 2H), 3.73 (s, 2H), 7.27-7.38 (m, 6H), 7.69-7.71 (d, ^3J=7.2 Hz, 4H). LC-MS, calcd for $C_{20}H_{26}N_2$ 294.21, found 295.31$(M+H)^+$.

3-Propyl-5-phenyloxazolidin-2-one:

Colorless liquid; ^{1}H NMR (300 MHz, $CDCl_3$) δ 0.91 (t, ^3J=7.2 Hz, 3H), 1.52-1.61 (m, 2H), 3.18-3.31 (m, 2H) 3.40 (t, ^3J=8.0 Hz, 1H), 3.90 (t, ^3J=8.8 Hz, 1H), 5.46 (t, ^3J=8.0 Hz, 1H), 7.31-7.37 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 10.7, 20.3, 45.5, 51.8, 74.0, 125.2, 128.4, 128.5, 138.7, 157.6; ESI-MS calcd for $C_{12}H_{15}NO_2$ 205.11, found 206.30 $(M + H)^+$, 228.30 $(M + Na)^+$, 433.04 $(2M + Na)^+$.

3-Isopropyl-5-phenyloxazolidin-2-one:

Colorless liquid; ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.16 (d, ^3J=6.8 Hz, 3H), 1.22 (d, ^3J=6.8 Hz, 3H), 3.37 (t, ^3J=8.0 Hz, 1H), 3.87 (t, ^3J=8.8 Hz, 1H), 4.13-4.23 (m, 1H), 5.48 (t, ^3J=8.0 Hz, 1H), 7.34-7.42 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 19.1, 19.6, 44.5, 47.0, 74.2, 125.1, 128.3, 128.5, 138.7, 156.7; ESI-MS calcd for $C_{12}H_{15}NO_2$ 205.11, found 206.29 $(M + H)^+$, 433.08 $(2M + Na)^+$.

3-Cyclopropyl-5-phenyloxazolidin-2-one:

White crystals; ^{1}H NMR (300 MHz, $CDCl_3$) δ 0.75 (s, 4H), 2.55-2.59 (m, 1H), 3.43 (t, ^3J=8.1 Hz, 1H), 3.88 (t, ^3J=8.7 Hz, 1H), 5.42 (t, ^3J=8.1 Hz, 1H), 7.28-7.37 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 5.4, 5.8, 25.7, 53.3, 74.3, 125.4, 128.6, 128.7, 138.5, 157.9; ESI-MS calcd for $C_{12}H_{13}NO_2$ 203.09, found 429.27 $(2M + Na)^+$, 631.80 $(3M + Na)^+$.

3-Butyl-5-phenyloxazolidin-2-one:

Colorless liquid; ^{1}H NMR (300 MHz, $CDCl_3$) δ 0.94 (t, ^3J=7.2 Hz, 3H), 1.31-140 (m, 2H), 1.51-1.58 (m, 2H), 3.23-3.38 (m, 2H) 3.43 (t, ^3J=8.0 Hz, 1H), 3.92 (t, ^3J=8.8 Hz, 1H), 5.49 (t, ^3J=8.0 Hz, 1H), 7.28-7.42 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 13.4, 19.5, 29.1, 43.6, 51.8, 74.1, 125.2, 128.4, 128.5, 138.7, 157.7; ESI-MS calcd for $C_{13}H_{17}NO_2$ 219.13, found 220.34 $(M + H)^+$, 259.48 $(M + K)^+$, 461.05 $(2M + Na)^+$.

3-Isobutyl-5-phenyloxazolidin-2-one:

White crystals; ^{1}H NMR (300 MHz, $CDCl_3$) δ 0.91 (d, ^3J=4.8 Hz, 3H), 0.93 (d, ^3J=4.8 Hz, 3H), 1.81-1.95 (m, 1H), 3.02-3.16 (m, 2H), 3.42 (dd, ^2J=8.7 Hz , ^3J=7.5 Hz, 1H), 3.91 (t, ^3J=8.7 Hz, 1H), 5.48 (t, ^3J=8.4 Hz, 1H), 7.32-7.41 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 19.7, 19.8, 26.7, 51.6, 52.6, 74.1, 125.3, 128.5, 128.7, 138.8, 158.0; ESI-MS calcd for $C_{13}H_{17}NO_2$ 219.13, found 461.22 $(2M + Na)^+$, 679.70 $(3M + Na)^+$.

3-Tert-butyl-5-phenyloxazolidin-2-one:

Colorless liquid; ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.41 (s, 9H), 3.45 (t, ^3J=8.4 Hz , 1H), 3.95 (t, ^3J=8.7 Hz, 1H), 5.36 (t, ^3J=8.1 Hz, 1H), 7.32-7.41 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 27.3, 50.9, 53.5, 73.4, 125.4, 128.5, 128.7, 138.9, 156.6; ESI-MS calcd for $C_{13}H_{17}NO_2$ 219.13, found 242.46 $(M + Na)^+$, 259.30 $(M + K)^+$.

3-Benzyl-5-phenyloxazolidin-2-one:

White crystals; ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.28 (t, ^3J=8.4 Hz, 1H), 3.75 (t, ^3J=8.7 Hz, 1H), 4.45 (ABq, J_{AB}=15.0 Hz, $\Delta\nu_{AB}$ =36.0 Hz, 2H), 5.43 (t, ^3J=8.1 Hz, 1H), 7.27-7.35 (m, 10H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 48.1, 51.3, 74.3, 125.3, 127.8, 127.9, 128.6, 128.7, 135.5, 138.5, 157.8; ESI-MS calcd for $C_{16}H_{15}NO_2$ 253.11, found 276.44$(M + Na)^+$, 781.66 $(3M + Na)^+$.

3-Cyclohexyl-5-phenyloxazolidin-2-one:

White crystals; ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.0-1.8 (m, 10H), 3.38 (t, ^3J=8.4 Hz, 1H), 3.70-3.73 (m, 1H), 3.88 (t, ^3J=8.7 Hz, 1H), 5.45 (t, ^3J=8.4 Hz, 1H), 7.35-7.38 (m, 5H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 25.1, 25.2, 29.9, 30.3, 48.1, 52.4, 74.4, 125.3, 128.5, 128.7, 138.9, 157.0; ESI-MS calcd for $C_{15}H_{19}NO_2$ 245.14, found 246.27 $(M + H)^+$, 757.70 $(3M + Na)^+$.

3-Ethyl-5-(4-chlorophenyl)oxazolidin-2-one:

White solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.17 (t, ^3J=7.3 Hz, 3H), 3.30-3.43 (m, 2H), 3.69-3.76 (m, 1H), 3.92 (t, ^3J=8.7 Hz, 1H), 5.44 (t, ^3J=8.0 Hz, 1H), 7.27-7.38 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 12.6, 38.9, 51.5, 73.6, 126.9, 129.1, 134.7, 137.4, 157.4; ESI-MS calcd for $C_{11}H_{12}ClNO_2$ 225.67, found 451.64 $(2M + H)^+$.

3-Ethyl-5-p-tolyloxazolidin-2-one:

White solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.18 (t, ^3J=7.3 Hz, 3H), 1.62 (d, ^3J=6.4 Hz, 1H),1.87 (d, ^3J=3.2 Hz, 1H), 2.27 (dd, ^3J=6.6 Hz, ^2J=3.2 Hz, 1H), 2.31 (s, 3H), 2.36-2.48 (m, 2H), 7.09- 7.15 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 12.6, 21.2, 38.9, 51.6, 74.3, 125.6, 129.5, 135.8, 138.7, 157.7; ESI-MS calcd for $C_{12}H_{15}NO_2$ 205.25, found 206.45 $(M + H)^+$, 411.15 $(2M + H)^+$.

8. References :

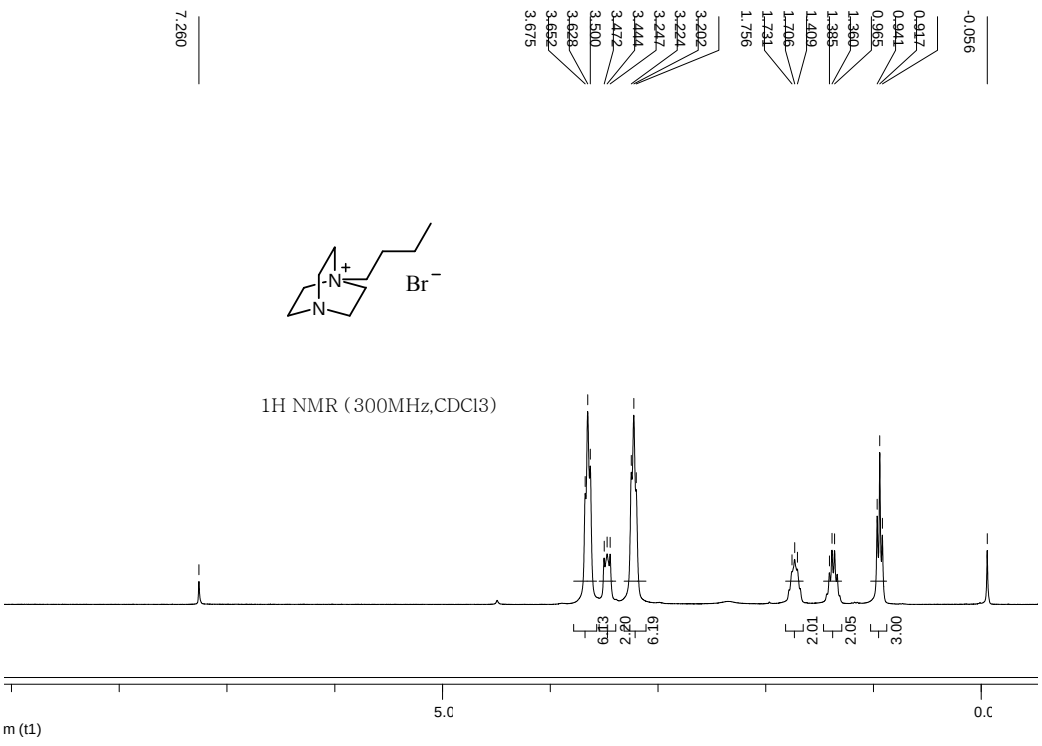
1 (a) Y. Du, Y. Wu, A.-H. Liu and L.-N. He, *J. Org. Chem.,* 2008, **73,** 4709-4712; (b) Y. Wu, L.-N. He, et. al., *Tetrahedron,* 2009, **65,** 6204-6210.

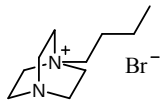
2 (a) A. Wykes, S. L. MacNeil, *Synlett* 2007, 107-110; (b) P. J. Dyson, M. C. Grossel, T. Welton, *J. Chem. Soc., Dalton Trans.* 1997, 3465-69; (c) P. A. Z. Suarez, J. Dupont, *Polyhedron* 1996, **15,** 1217-1219.

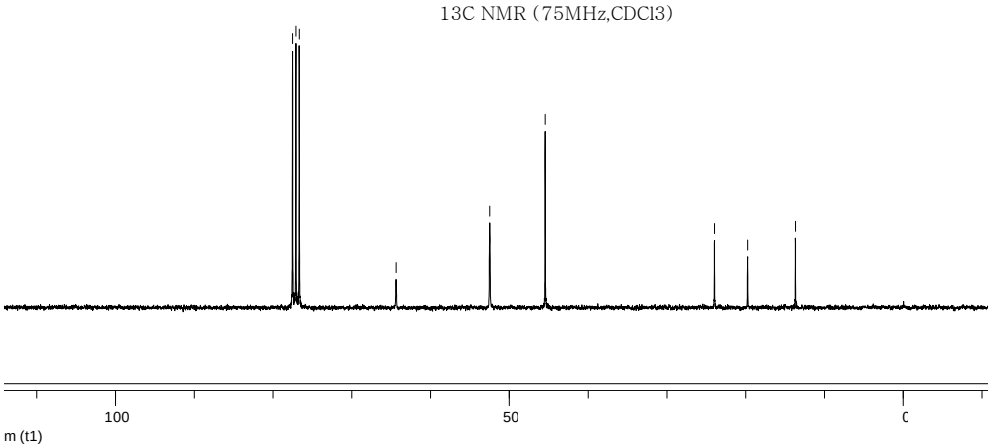
3 A. W. Miller, S. T. Nguyen, *Org. Lett.* 2004, **6,** 2301-2304.

9. The ^{1}H NMR and ^{13}C NMR Charts for ionic liquids

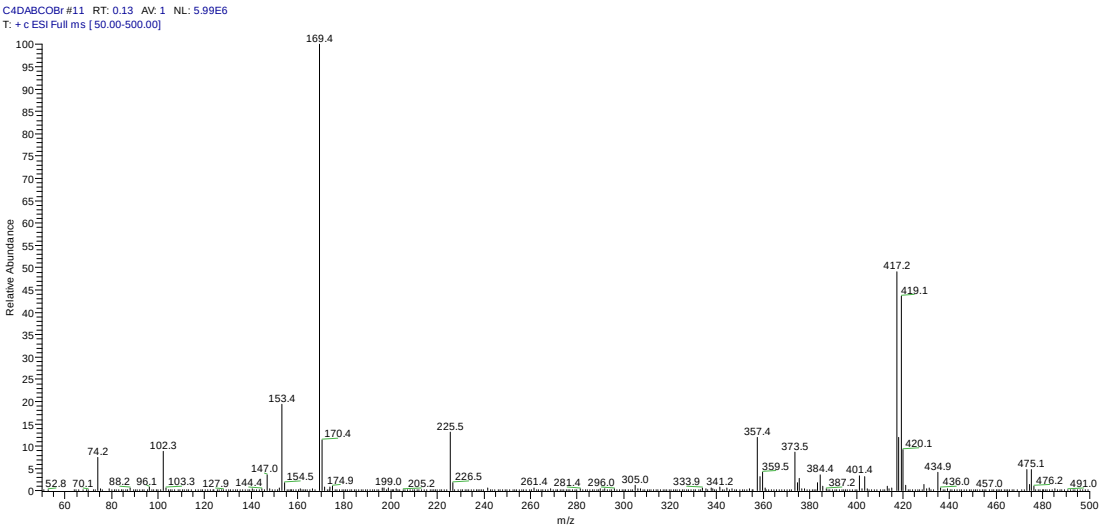
[C_4DABCO]Br: 1-butyl-4-aza-1-azaniabicyclo[2.2.2]octane bromide



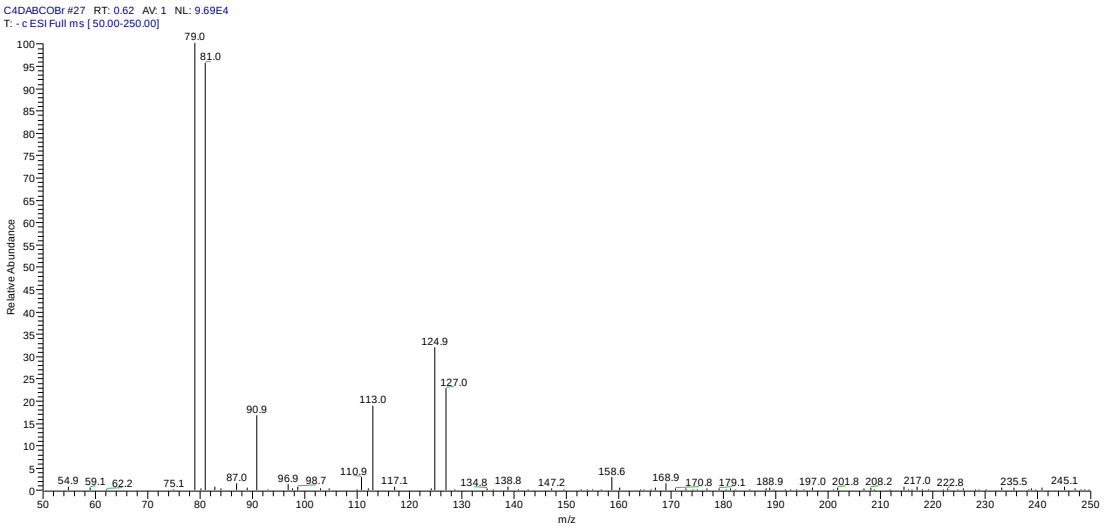




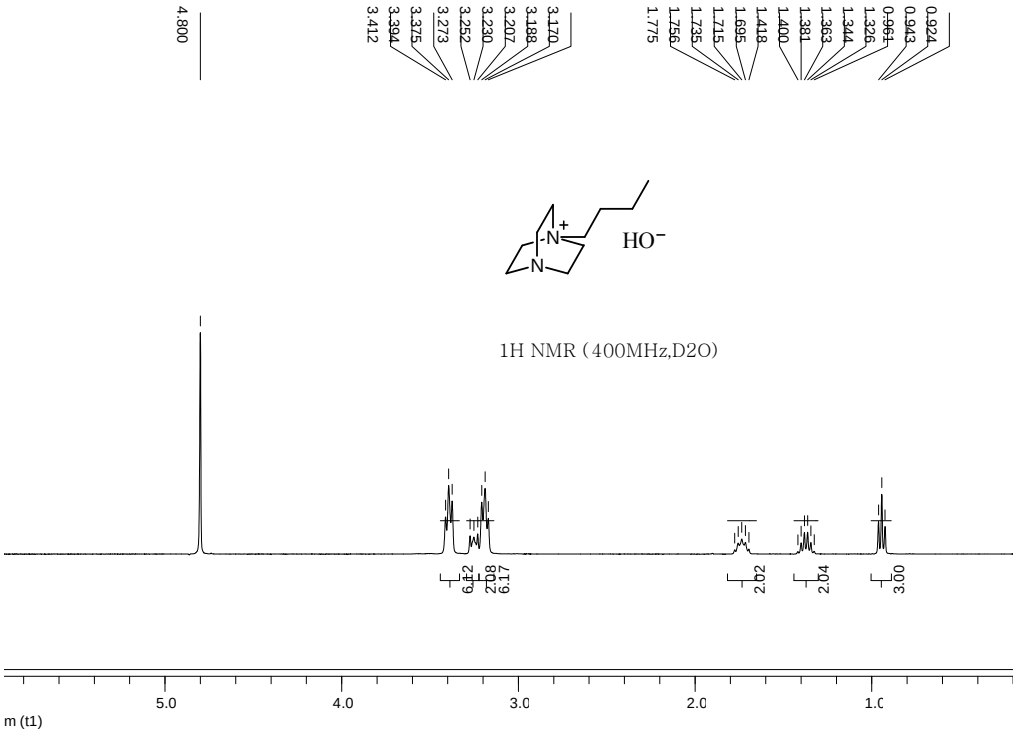
ESI-MS (4.8 kV): m/z (%) = 169.38 (100) $[M\text{-}Br]^+$

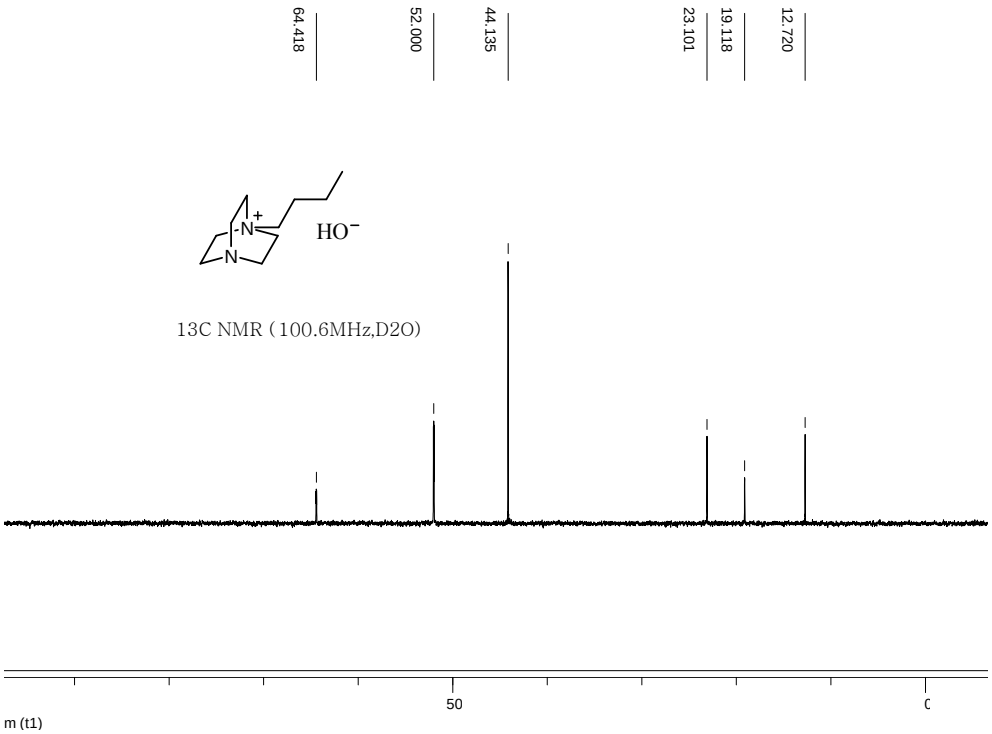


79.02 (100) $[M\text{-}C_{10}H_{21}N_2]^-$

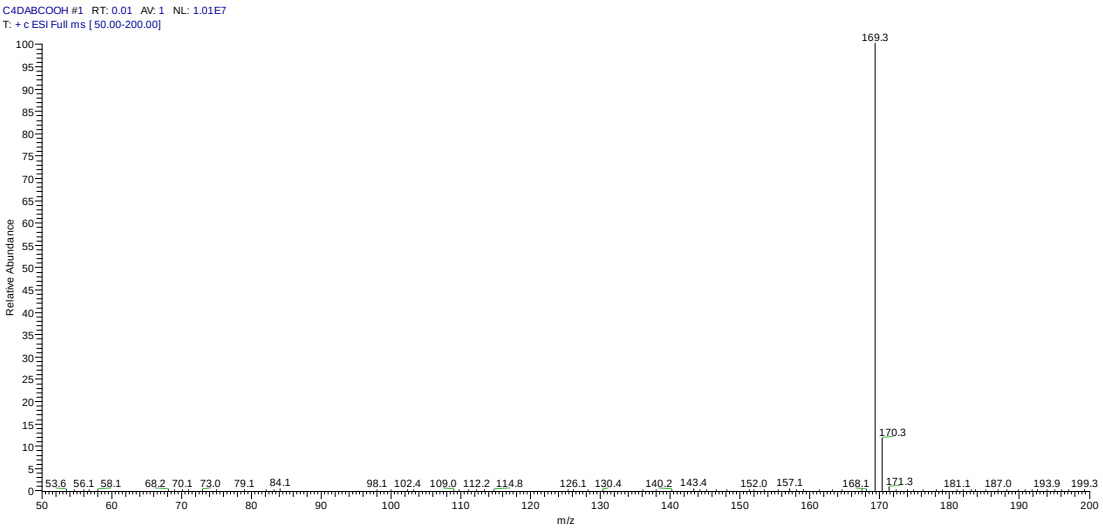


[C_4DABCO]OH: 1-butyl-4-aza-1-azaniabicyclo[2.2.2]octane hydroxide

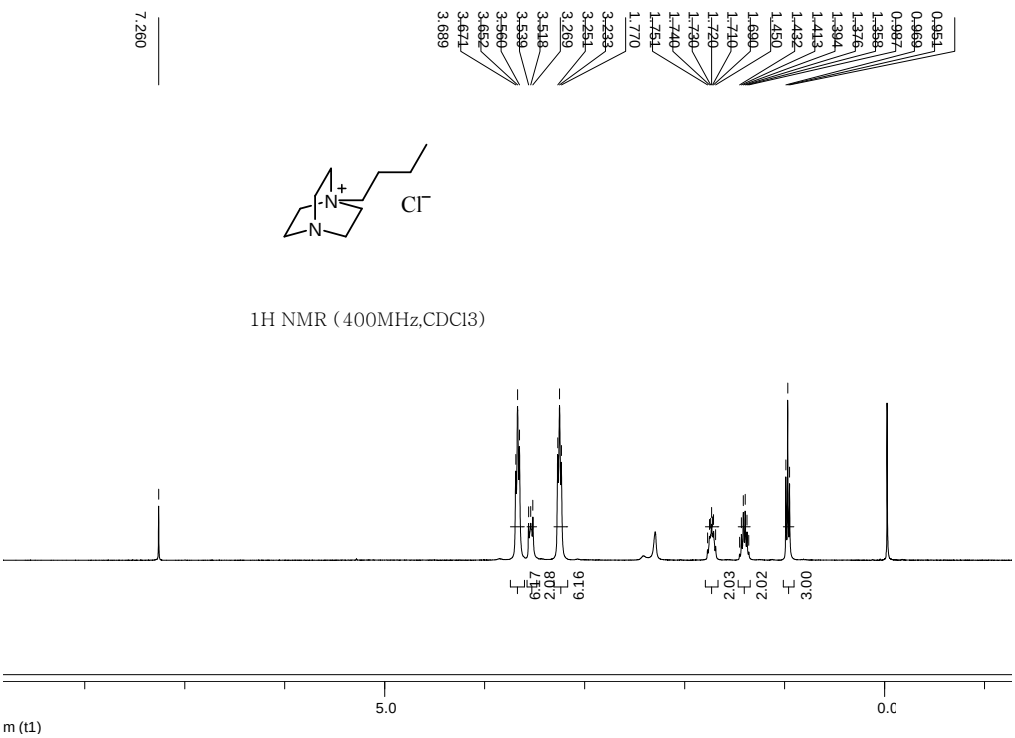


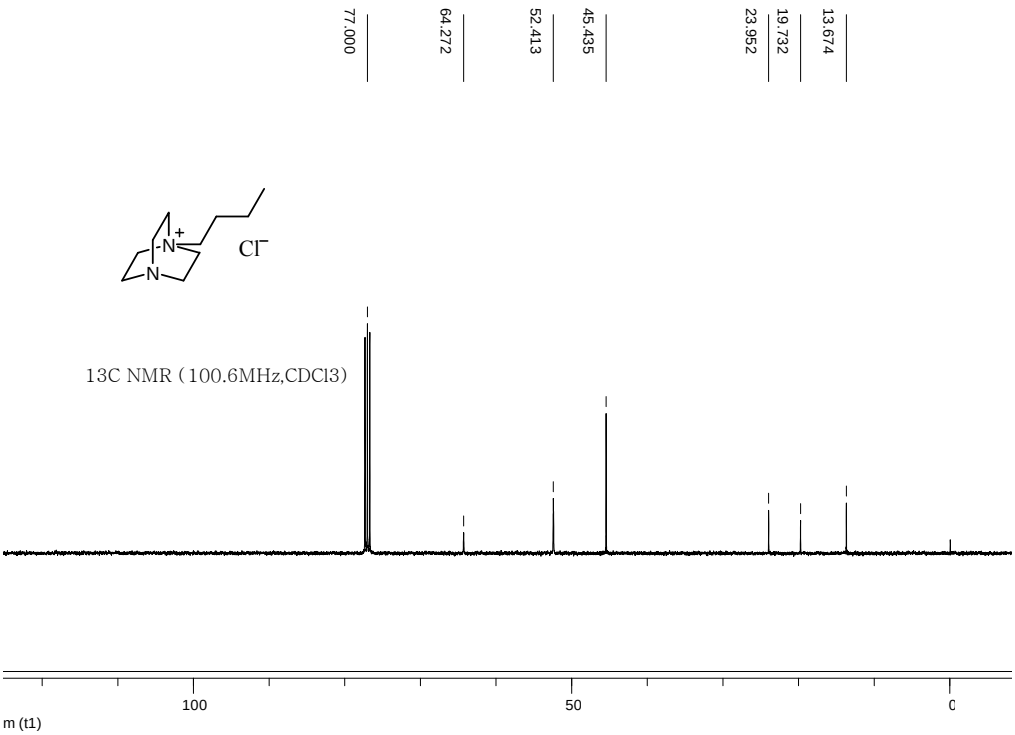


ESI-MS (4.8 kV): m/z (%) = 169.3 (100) $[M\text{-}OH]^+$

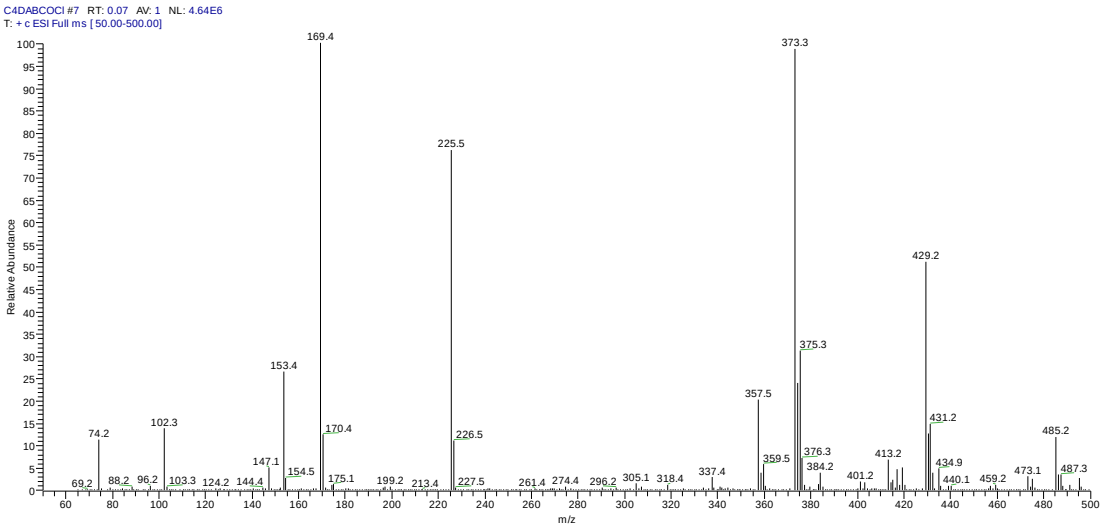


$[C_4DABCO]Cl$: 1-butyl-4-aza-1-azaniabicyclo[2.2.2]octane chloride

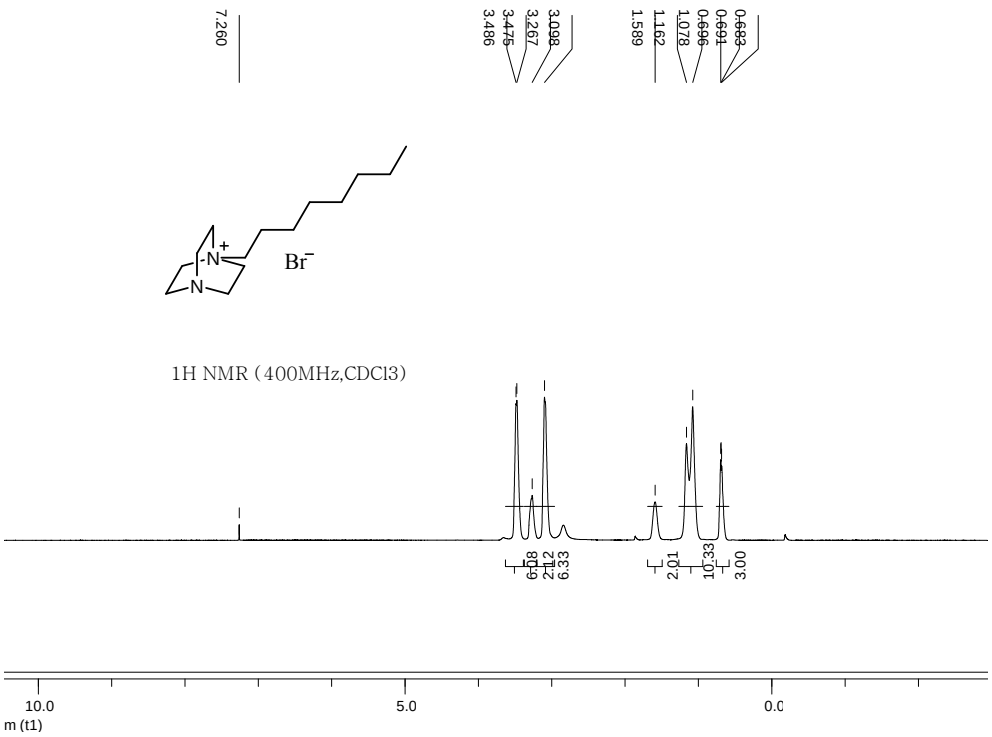


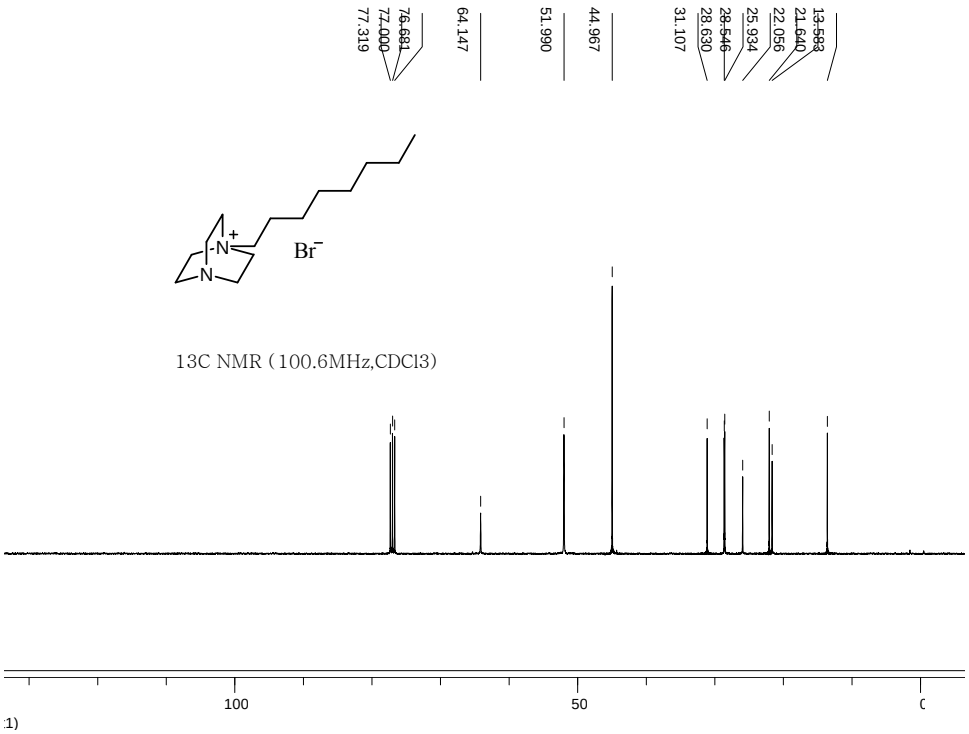


ESI-MS (4.8 kV): m/z (%) = 169.44 (100) $[M\text{-}Cl]^+$

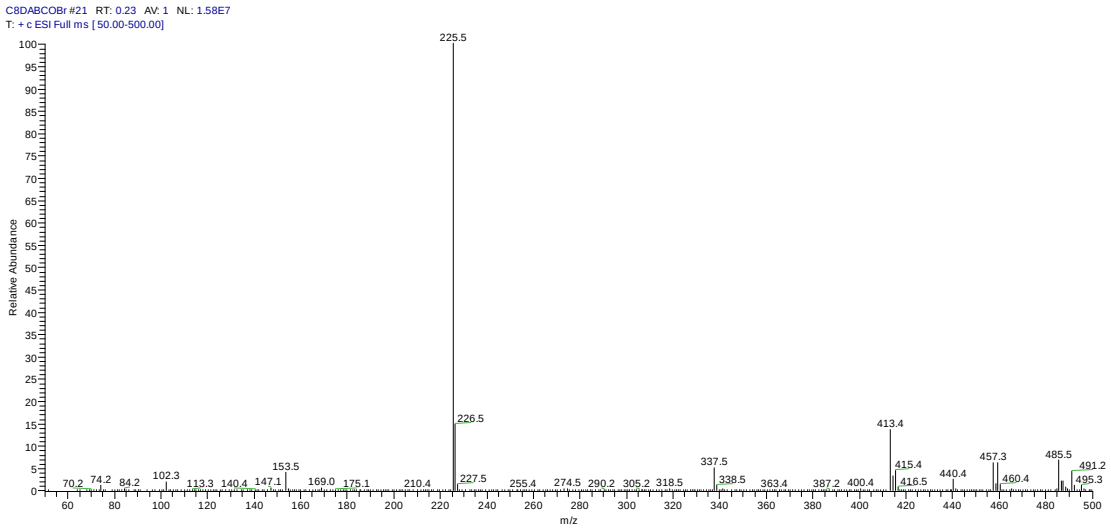


[C_8DABCO]Br: 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane bromide

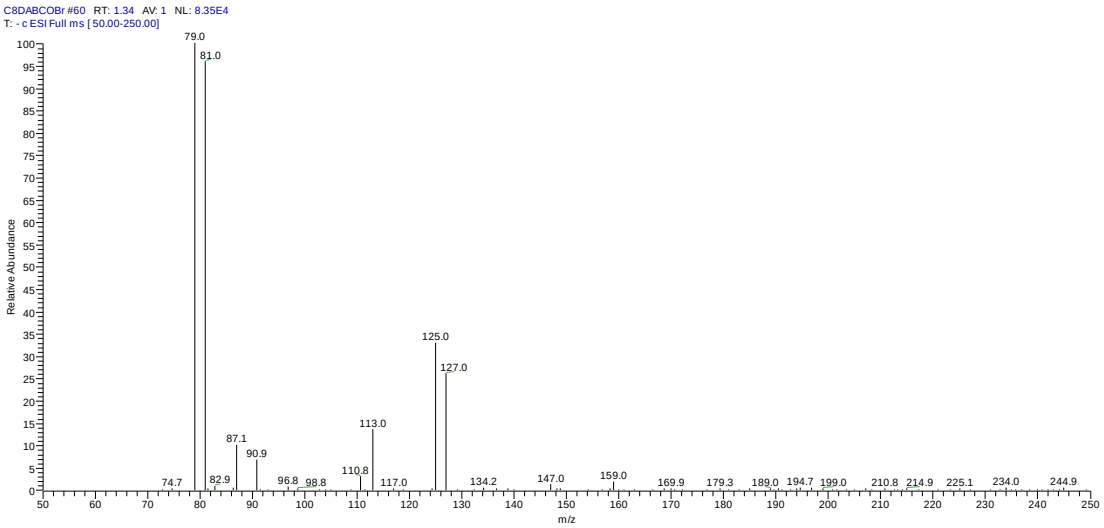




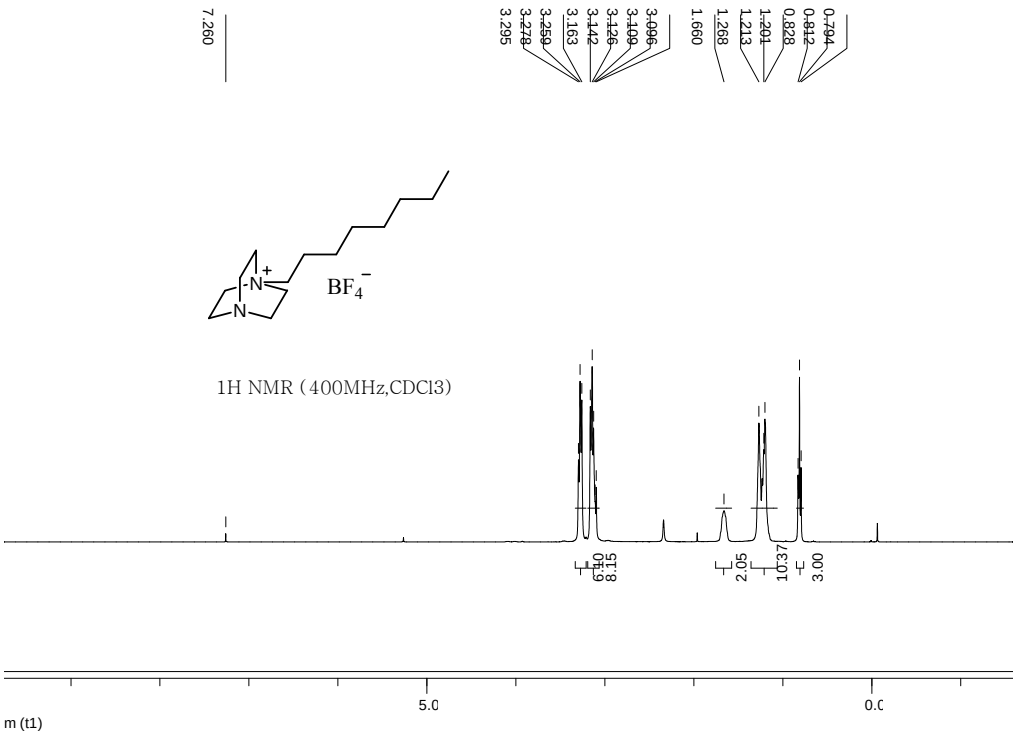
ESI-MS (4.8kV): m/z (%) = 225.46 (100) $[M-Br]^+$

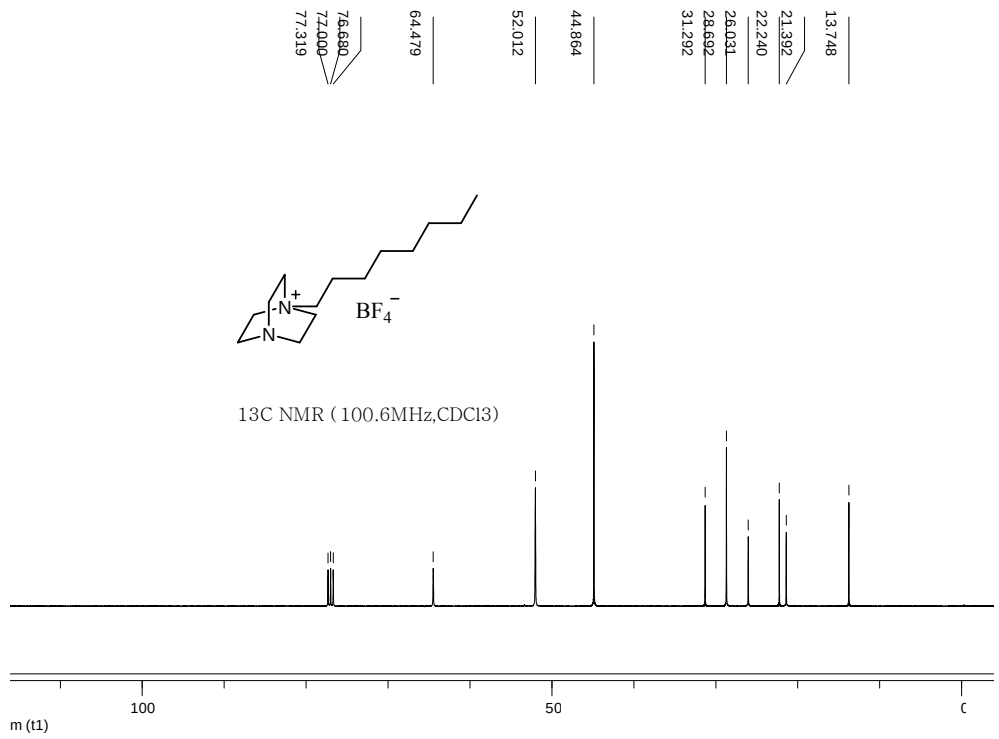


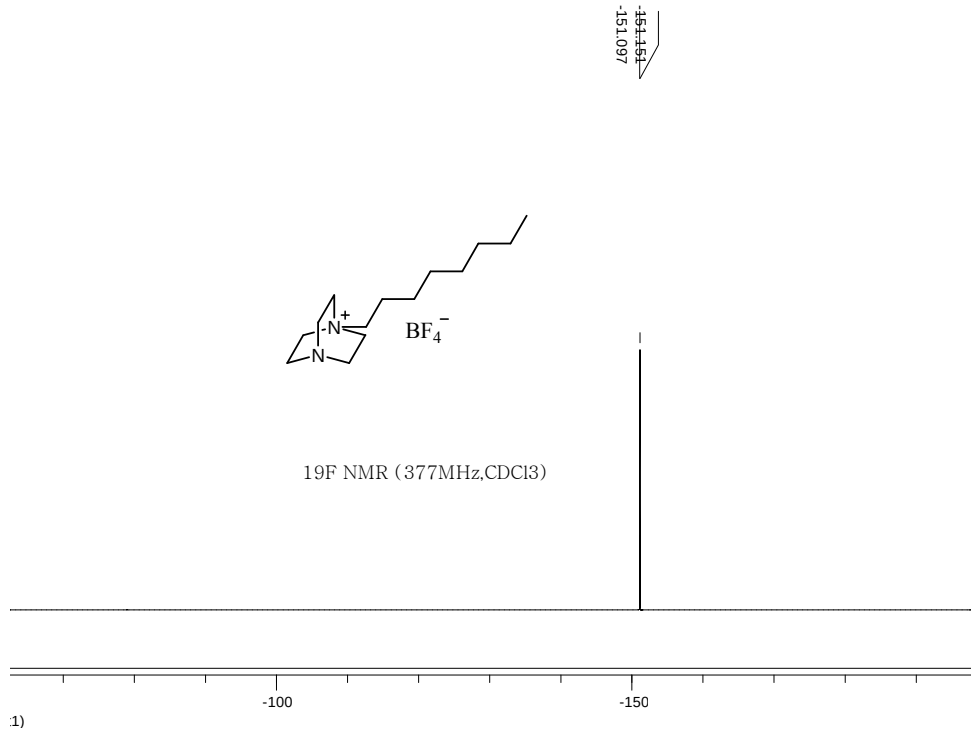
79.03 (100) $[M-C_{14}H_{29}N_2]^-$



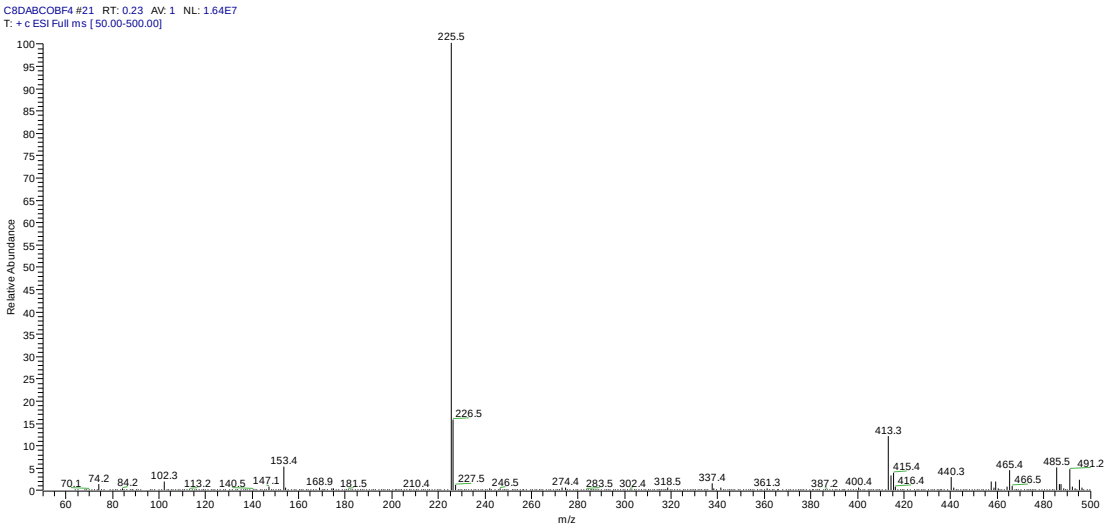
[C_8DABCO]BF_4: 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane tetrafluoroborate



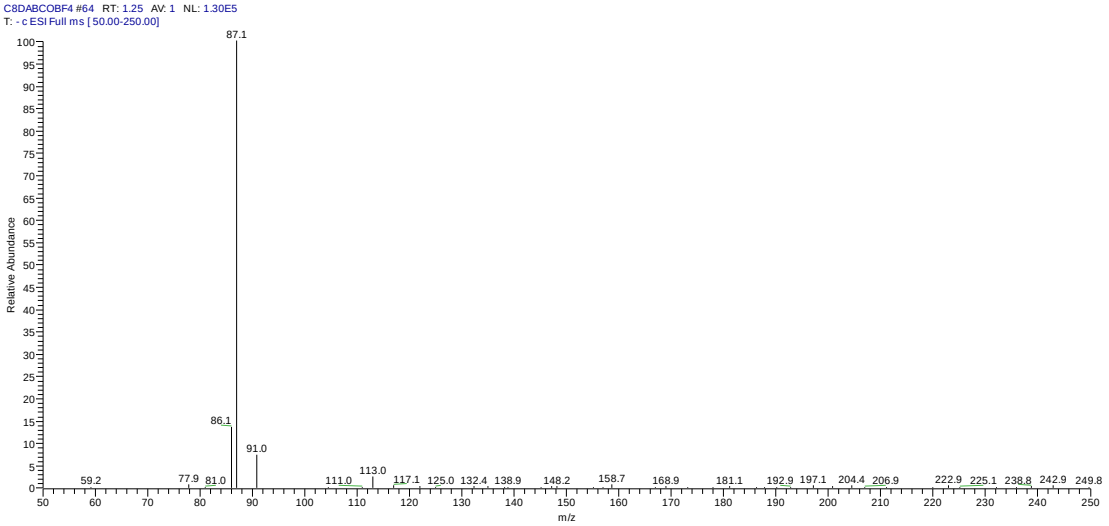




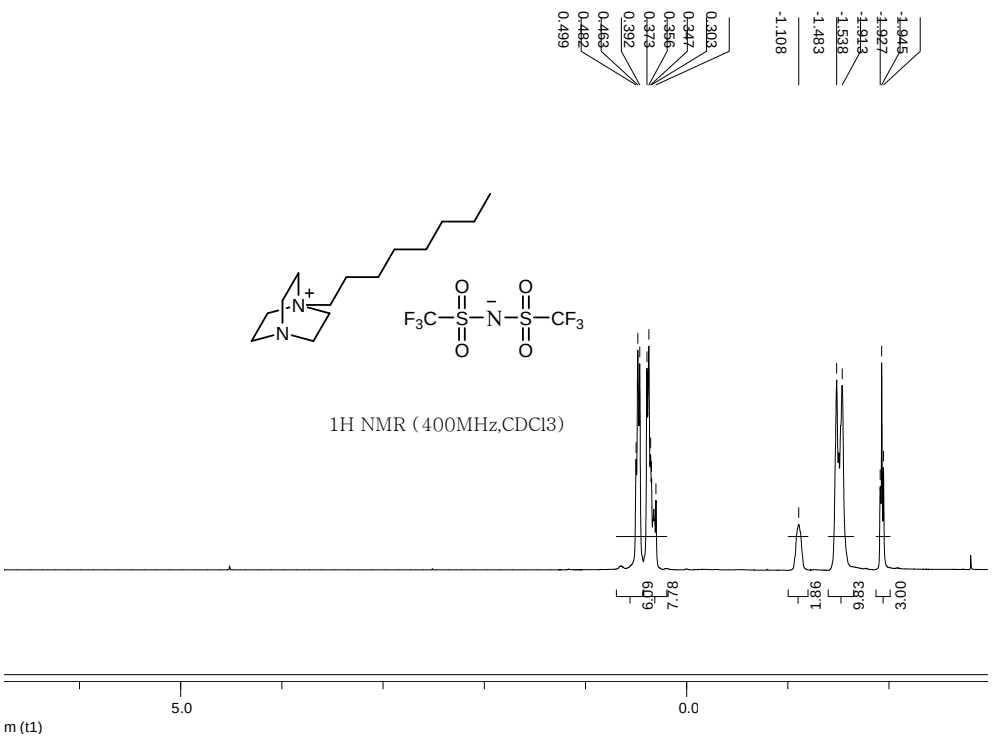
ESI-MS (4.8kV): m/z (%) = 225.45 (100) $[M\text{-}BF_4]^+$



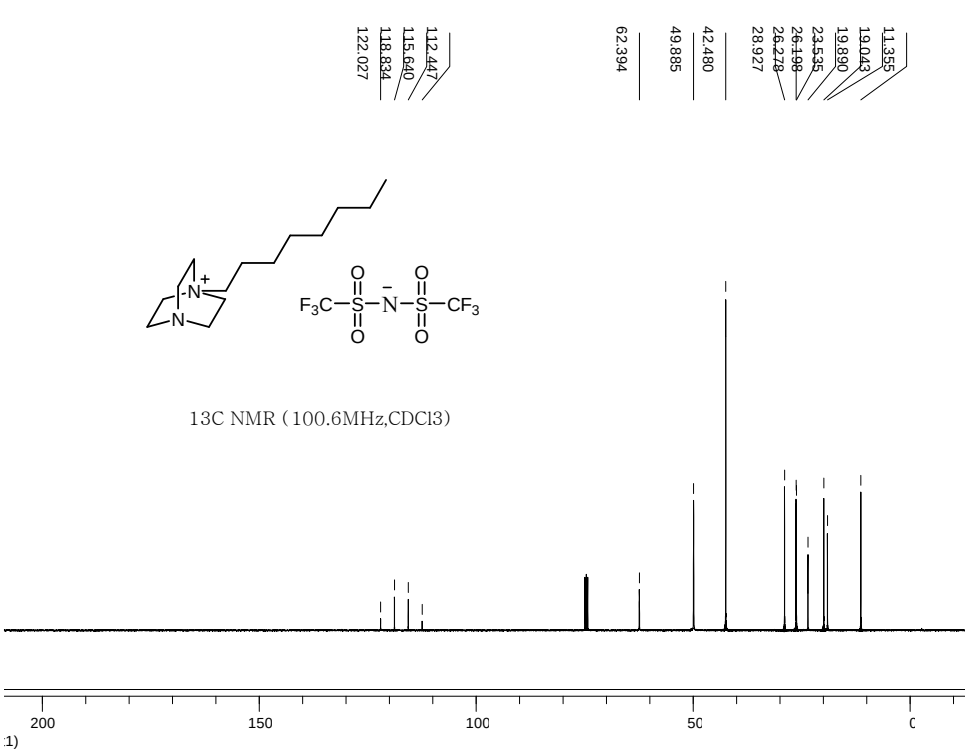
87.1 (100) [M-$C_{14}H_{29}N_2$]$^-$



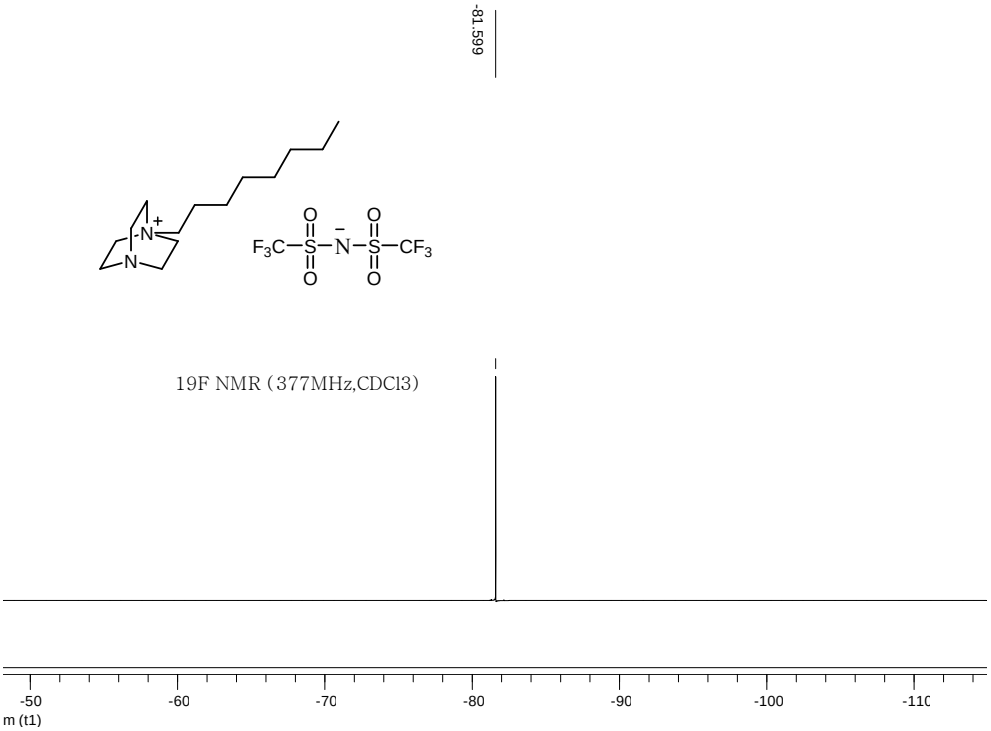
[C_8DABCO]NTf_2: 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane bis(trifluoromethylsulfonyl)imide



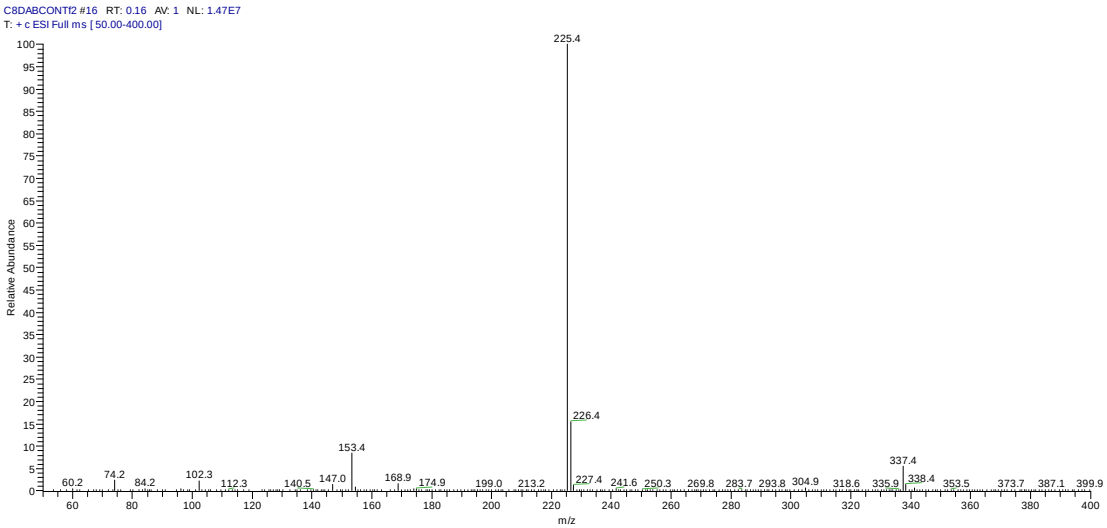
1H NMR (400MHz,CDCl3)



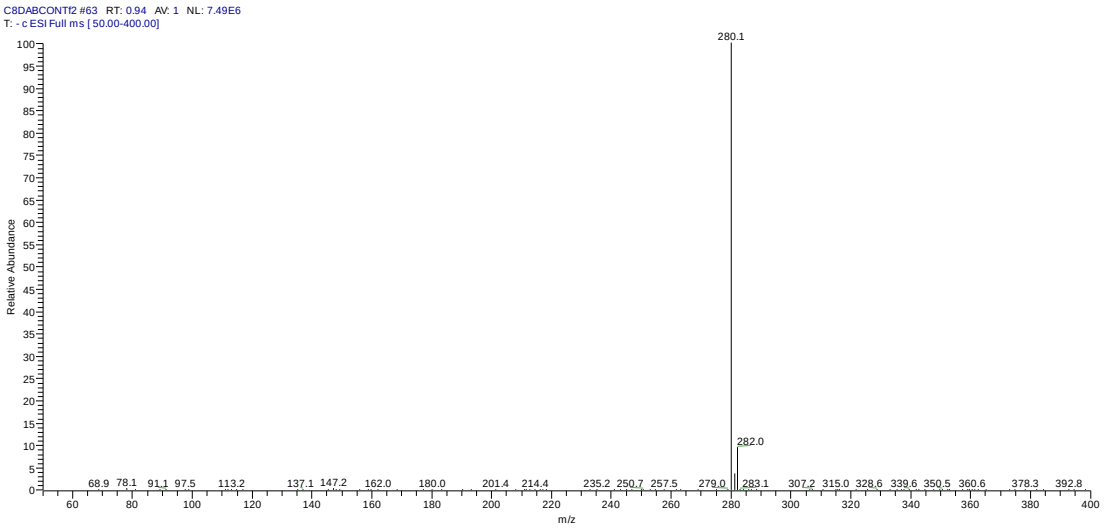
13C NMR (100.6MHz,CDCl3)



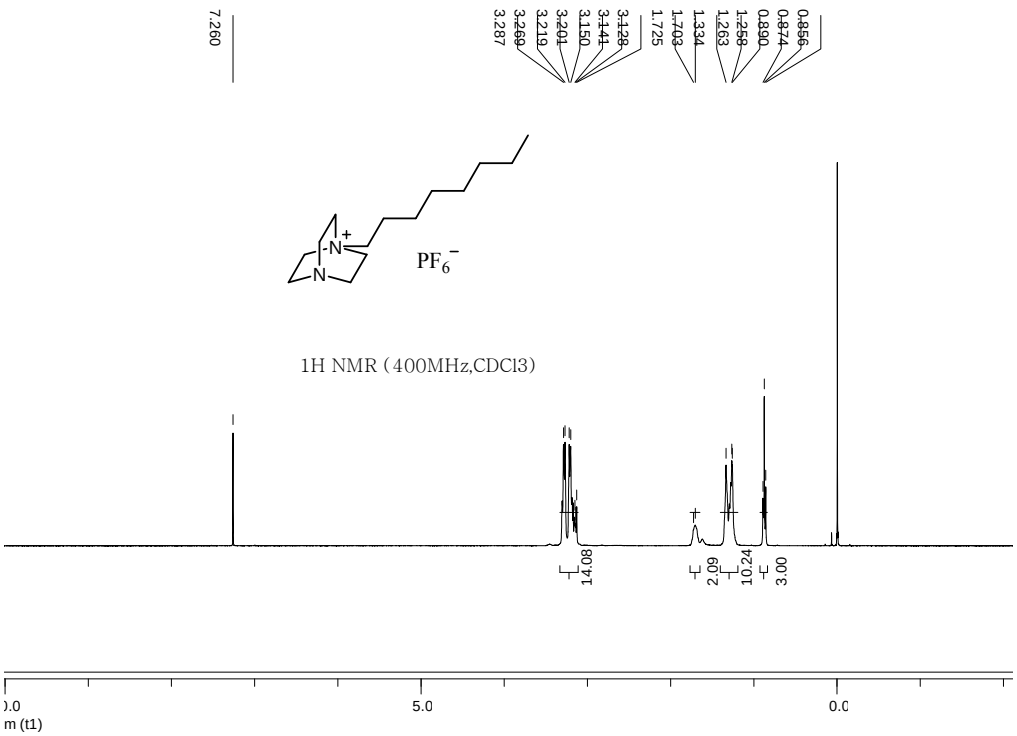
ESI-MS (4.8 kV): m/z (%) = 225.43 (100) [M-$C_2F_6NO_4S_2$]$^+$

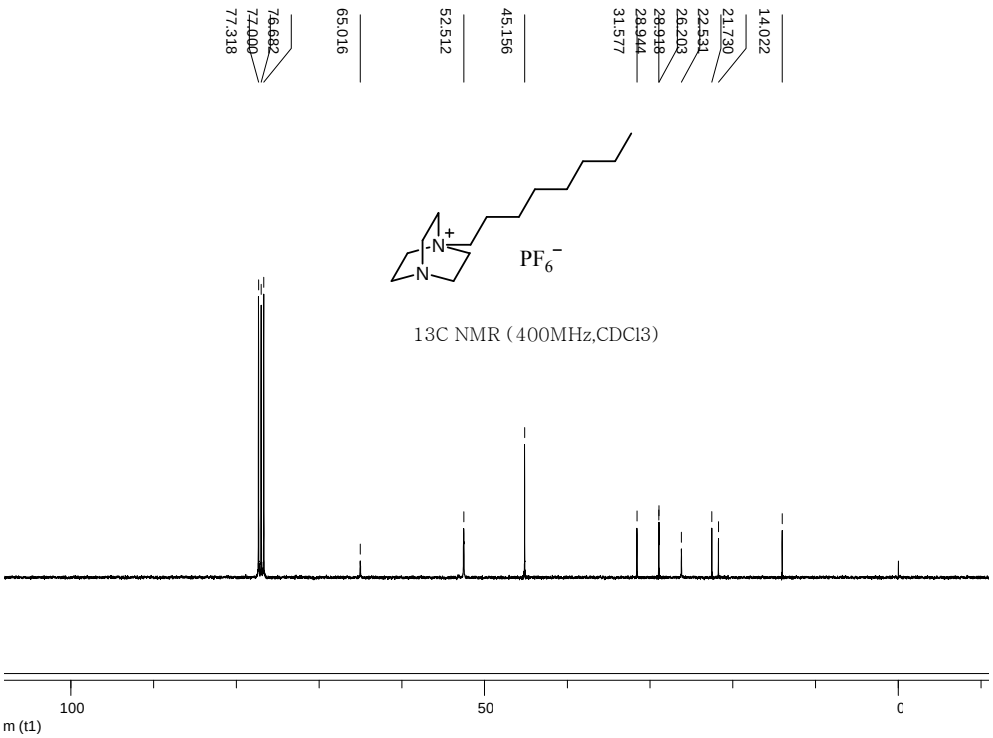


280.10 (100) [M-$C_{14}H_{29}N_2$]$^-$

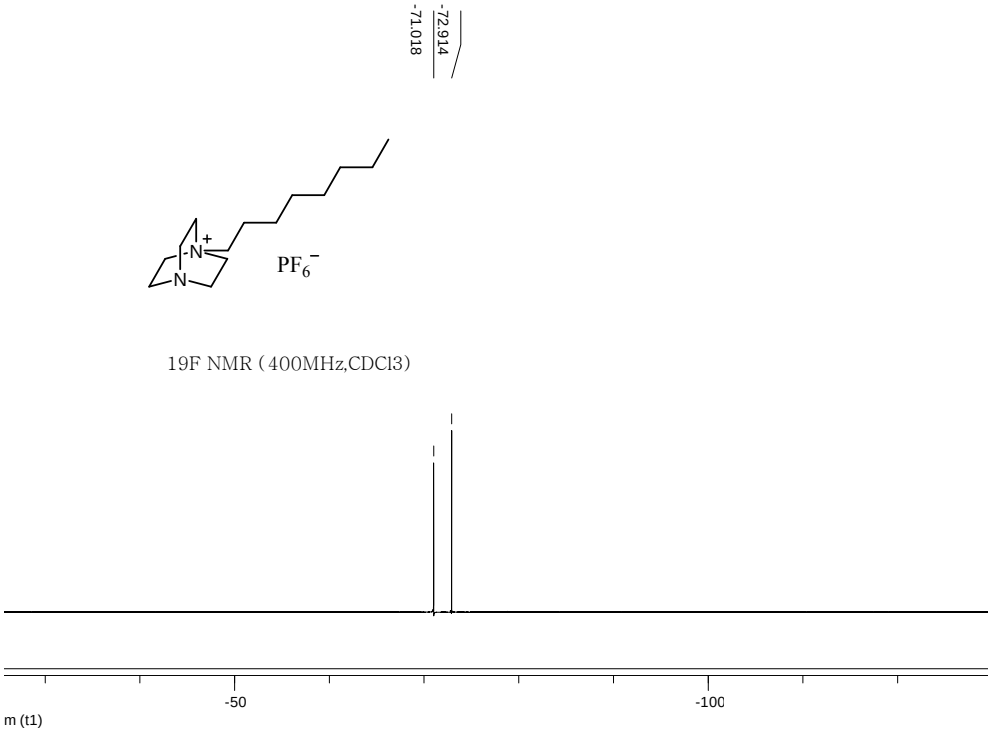


[C_8DABCO]PF_6: 1-octyl-4-aza-1-azaniabicyclo[2.2.2]octane hexafluorophosphate

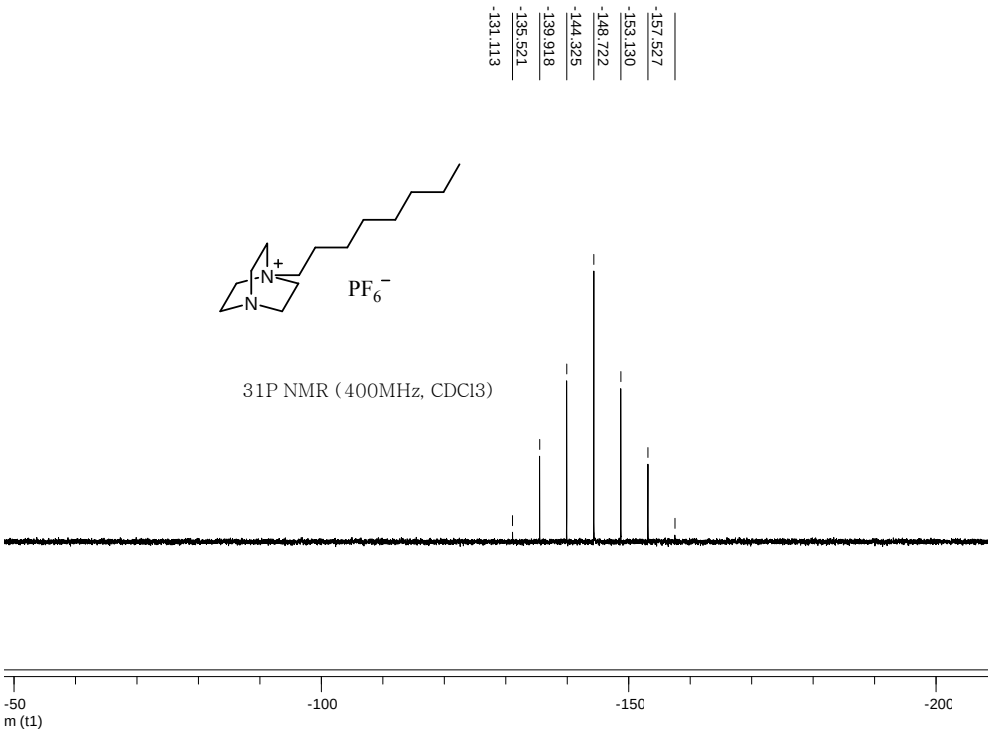




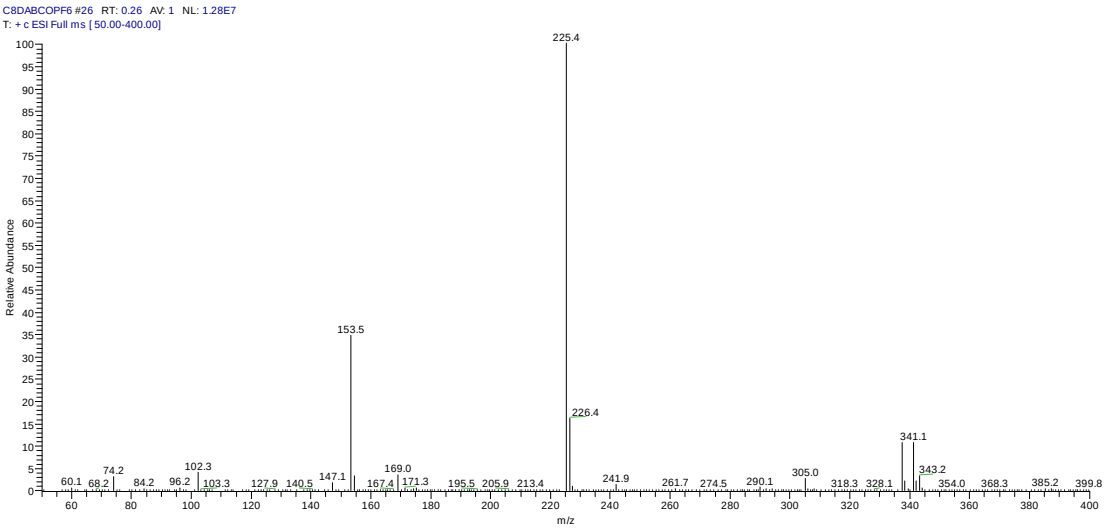
13C NMR (400MHz,CDCl3)



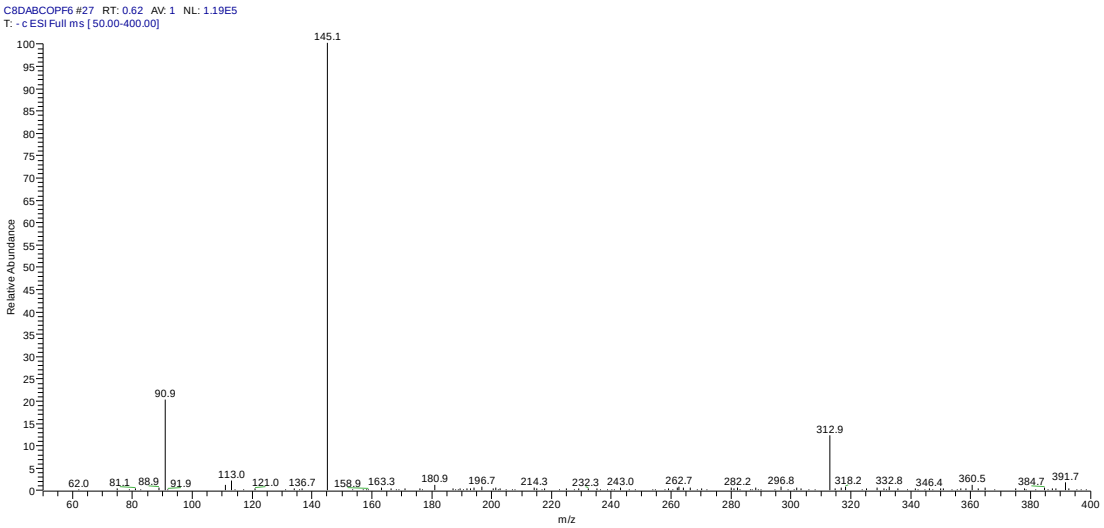
19F NMR (400MHz,CDCl3)



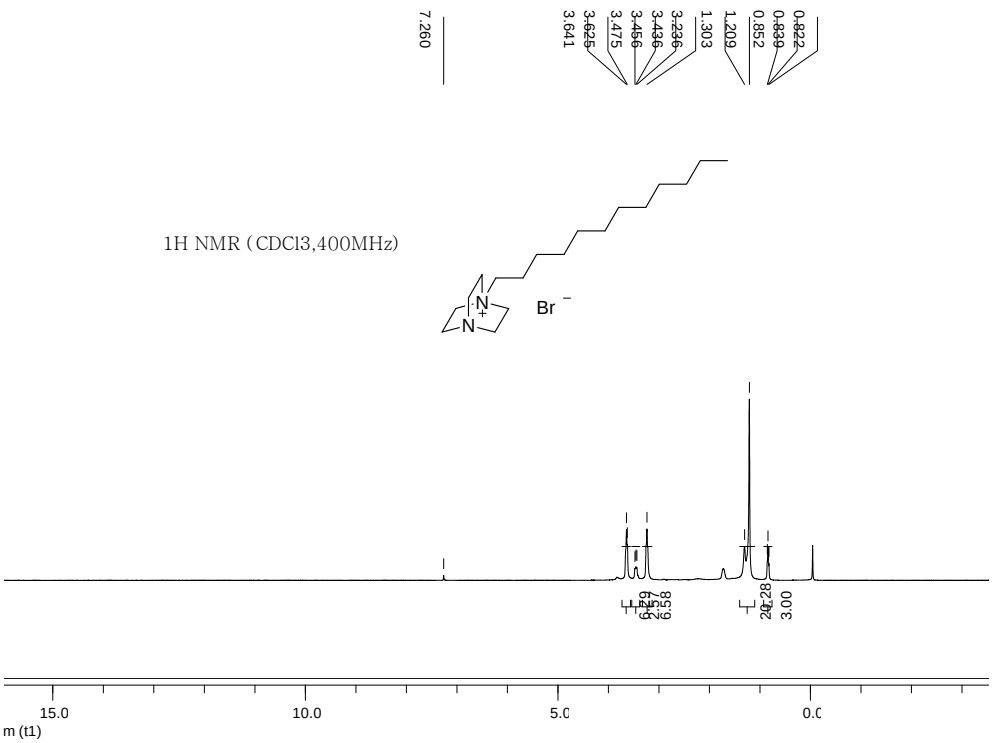
ESI-MS (4.8 kV): m/z (%) = 225.43 (100) [M-PF_6]$^+$

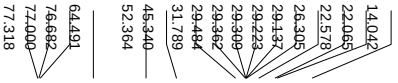


145.20 (100) [M-$C_{14}H_{29}N_2$]$^-$

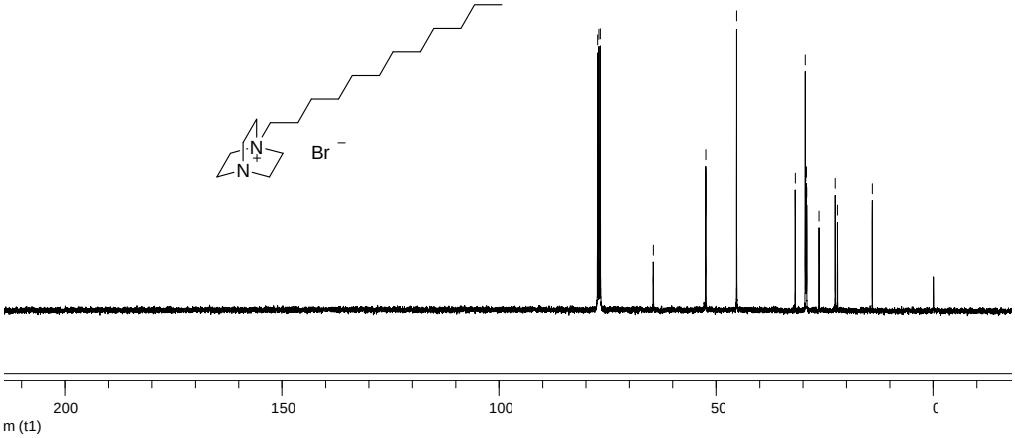


[C_{12}DABCO]Br: 1-dodecyl-4-aza-1-azaniabicyclo[2.2.2]octane bromide

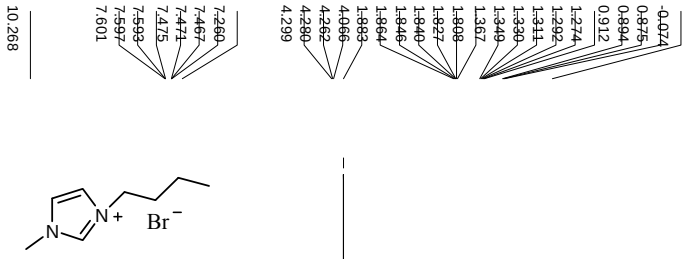




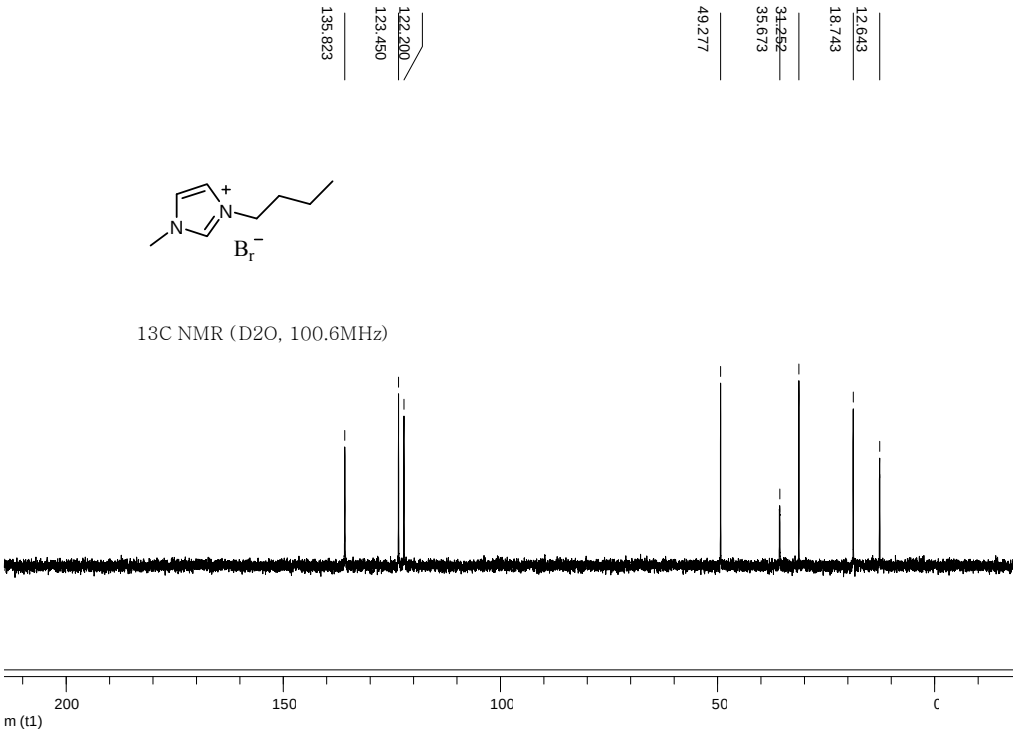
13C NMR (CDCl3,100.6MHz)



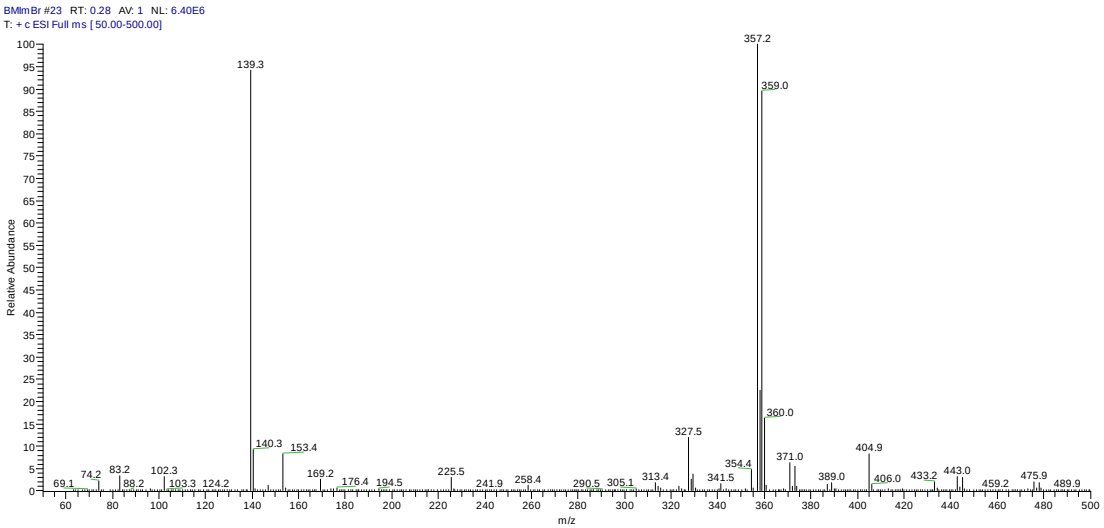
[C_4MIm]Br: 1-Butyl-3-methylimidazolium bromide



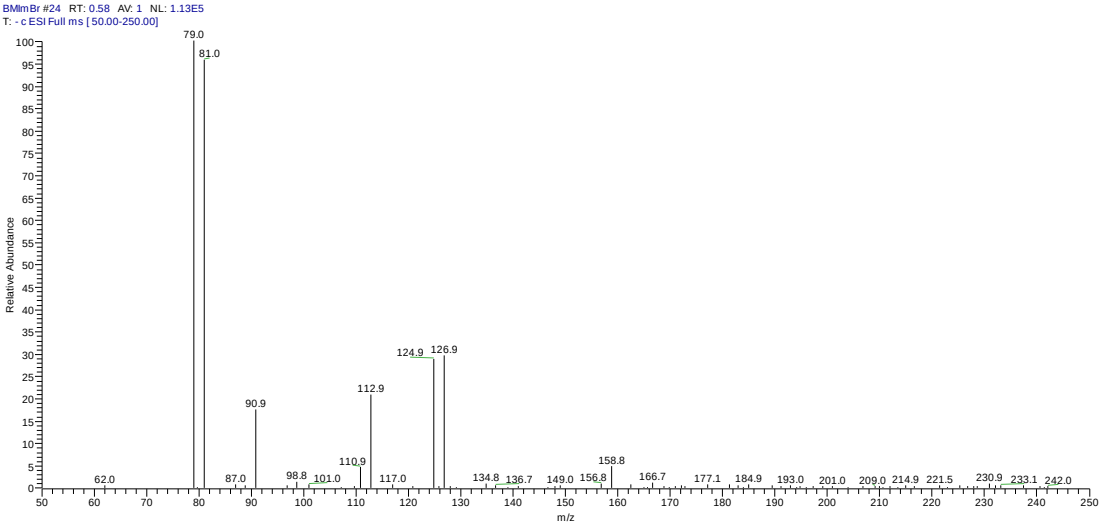
1H NMR (400MHz, CDCl3)



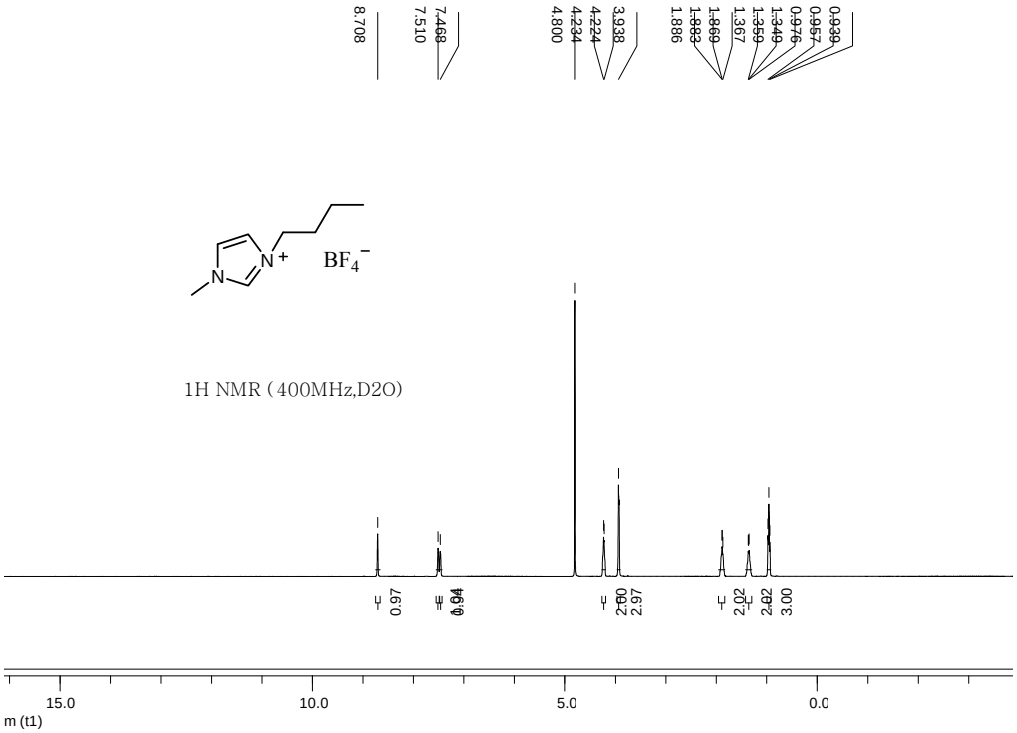
ESI-MS (4.8 kV): m/z (%) = 139.32 (100) $[M\text{-}Br]^+$

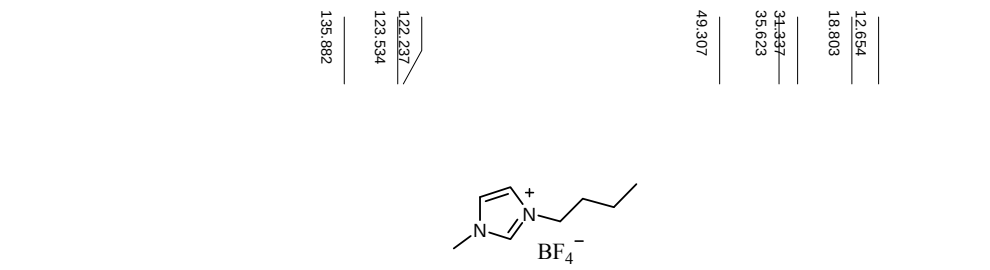


79.03 (100) $[M-C_8H_{15}N_2]^-$

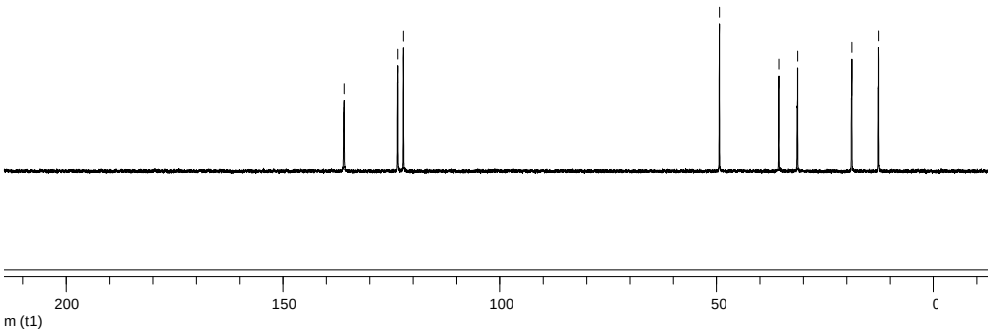


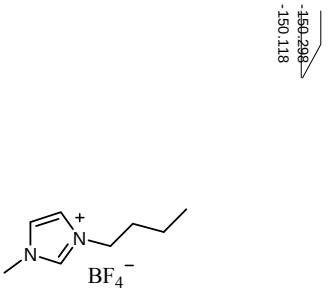
$[C_4MIm]BF_4$: 1-Butyl-3-methylimidazolium tetrafluoroborate



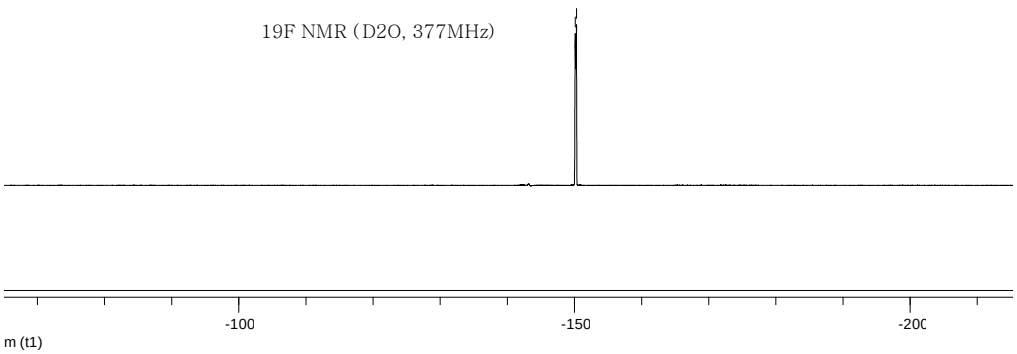


13C NMR (D2O, 100.6MHz)

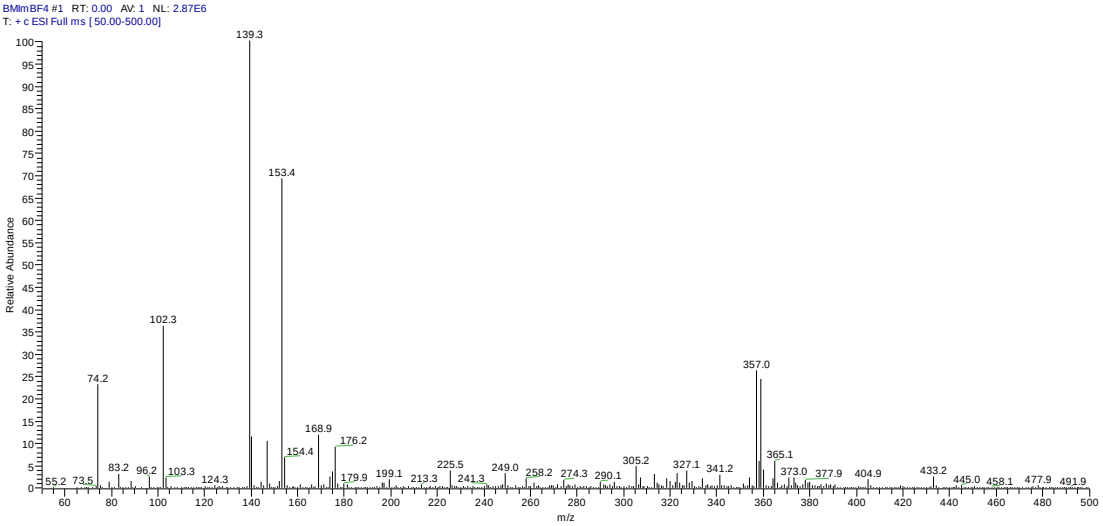




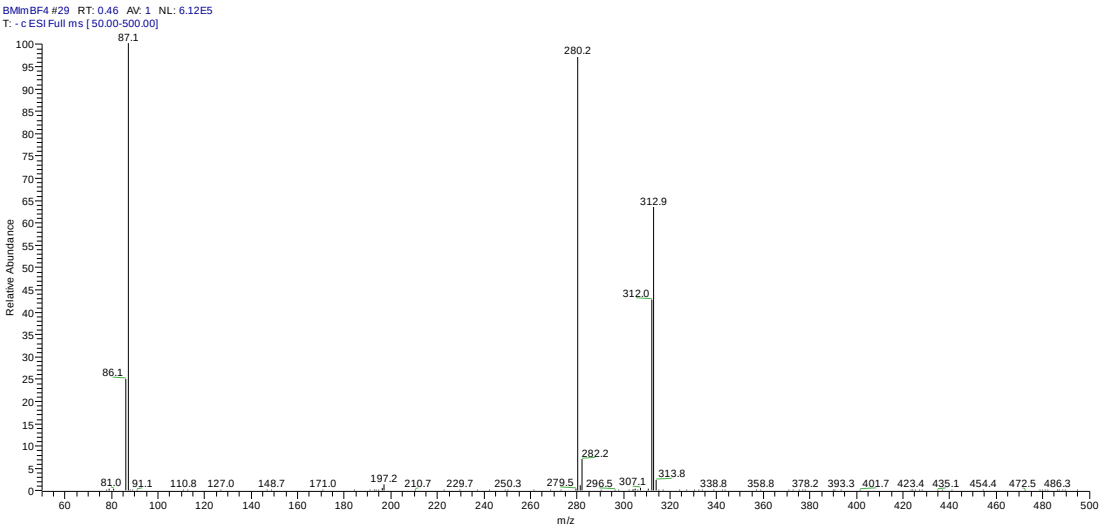
19F NMR (D2O, 377MHz)



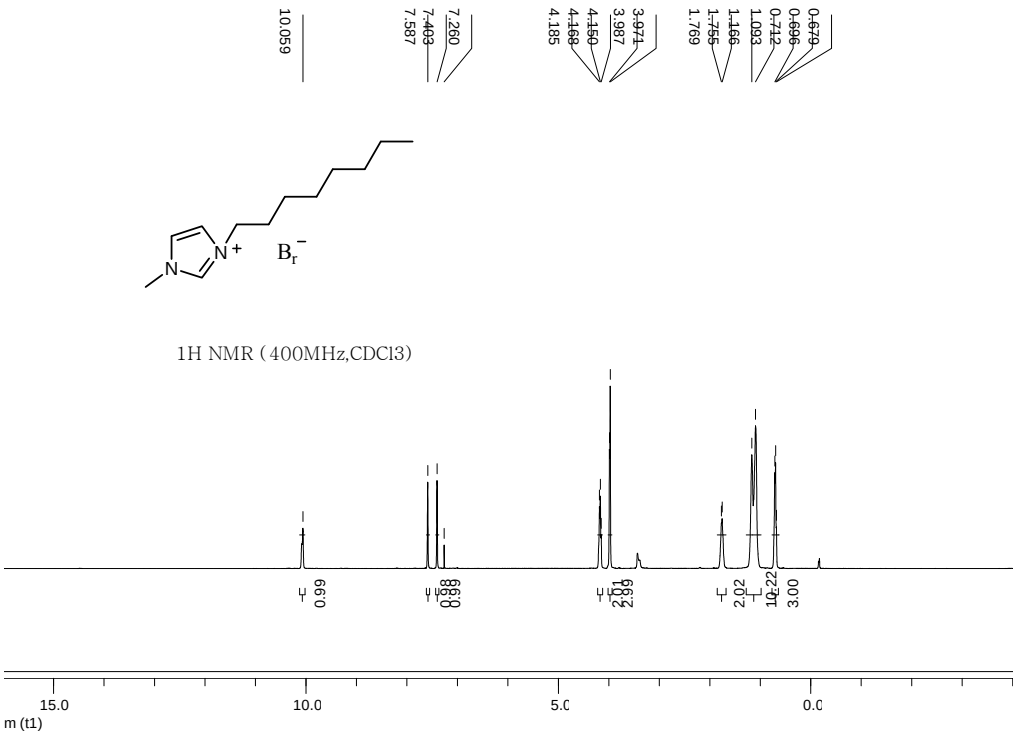
ESI-MS (4.8 kV): m/z (%) = 139.32 (100) $[M\text{-}BF_4]^+$

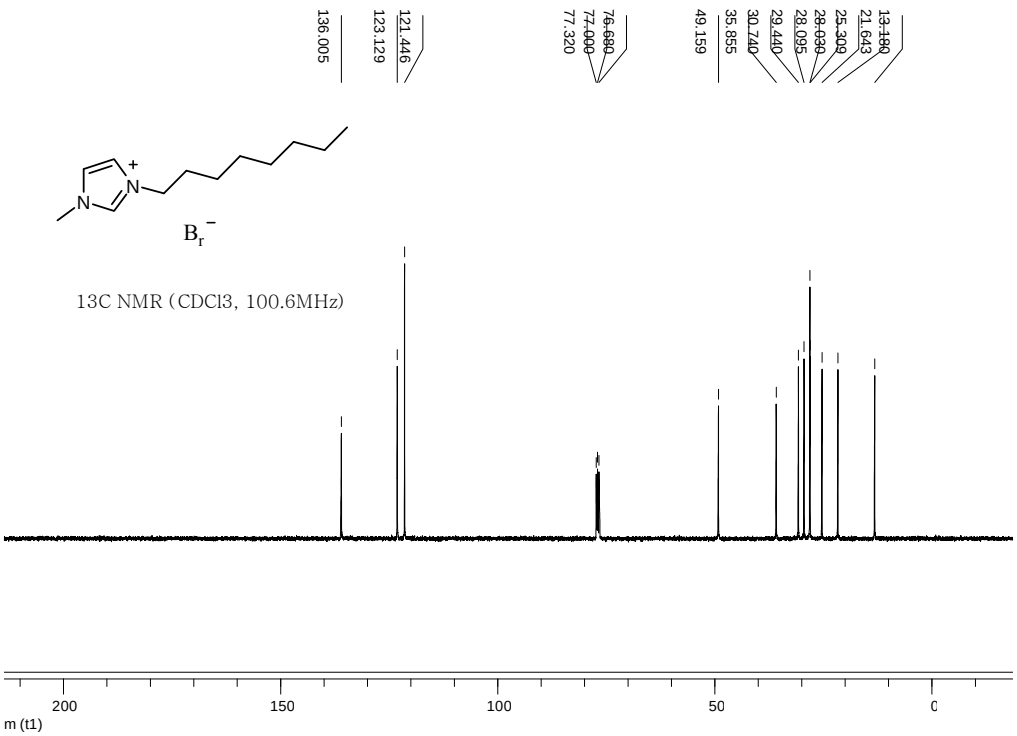


87.11 (100) $[M\text{-}C_8H_{15}N_2]^-$

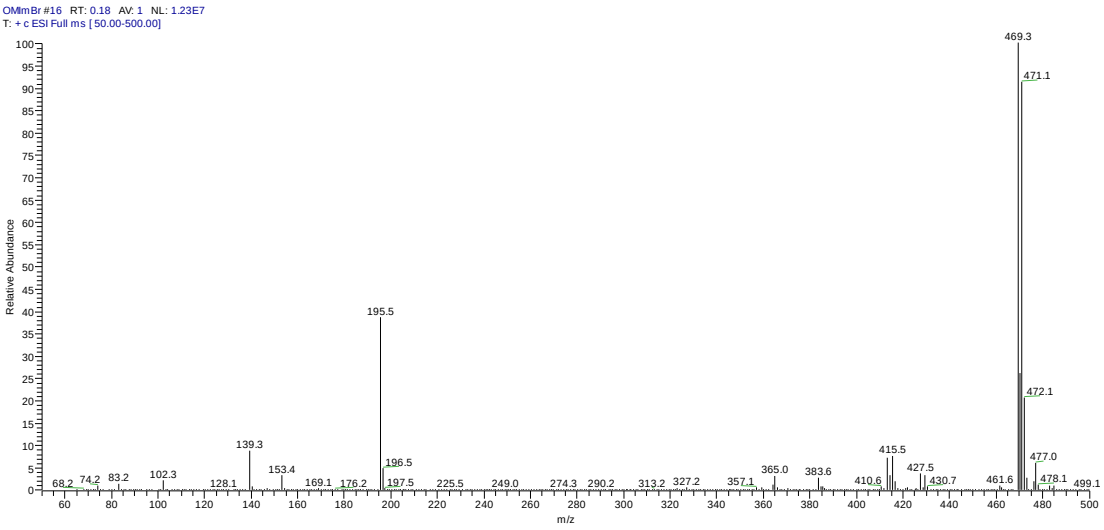


[C_8MIm]Br: 1-Butyl-3-methylimidazolium bromide

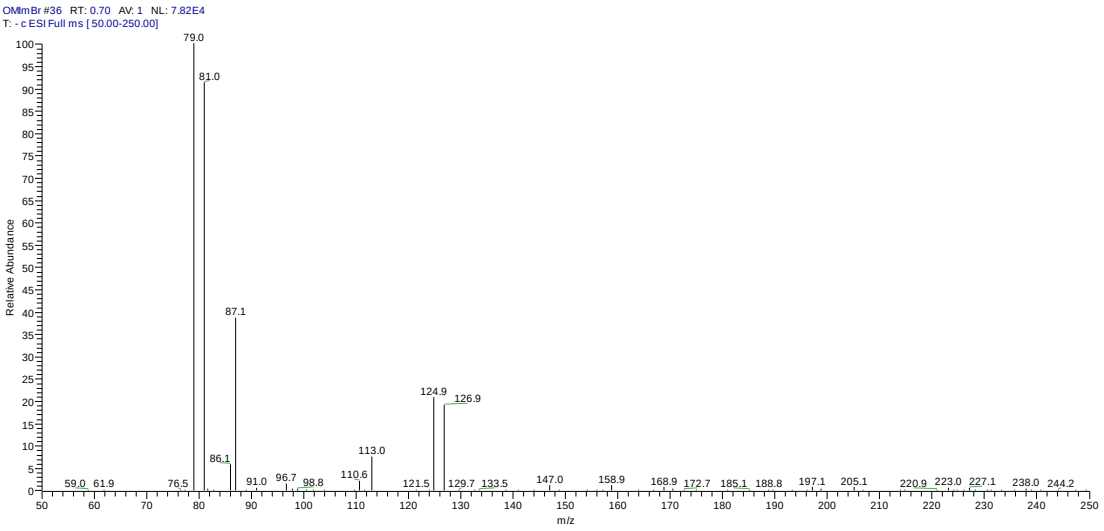




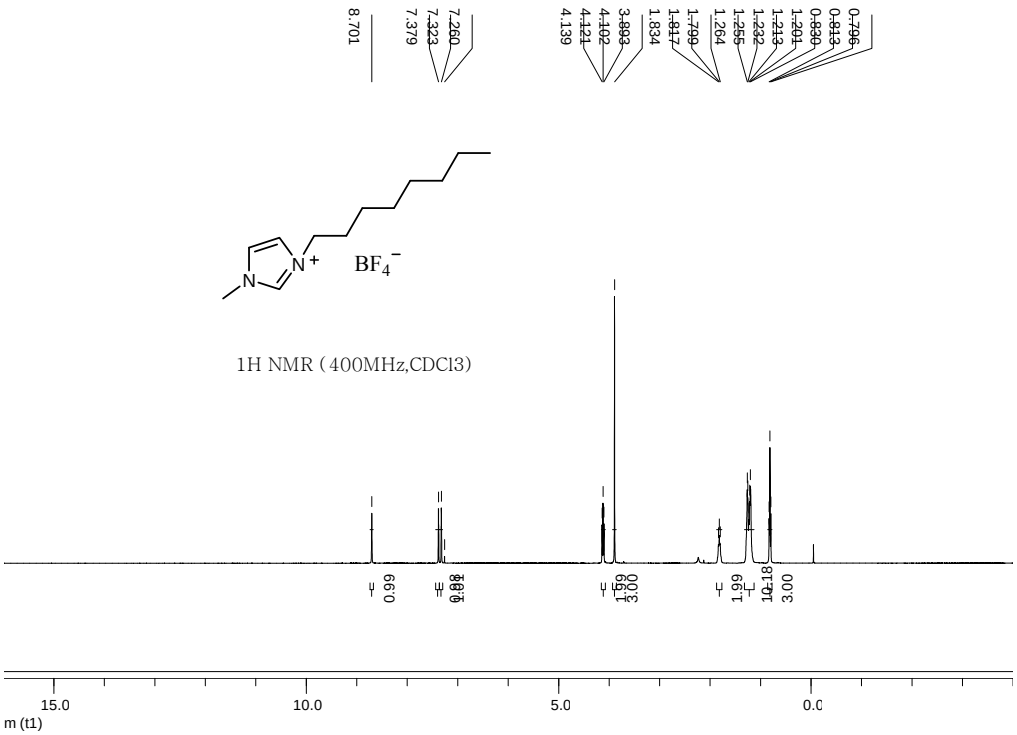
ESI-MS (4.8 kV): m/z (%) = 195.46 (100) $[M-Br]^+$

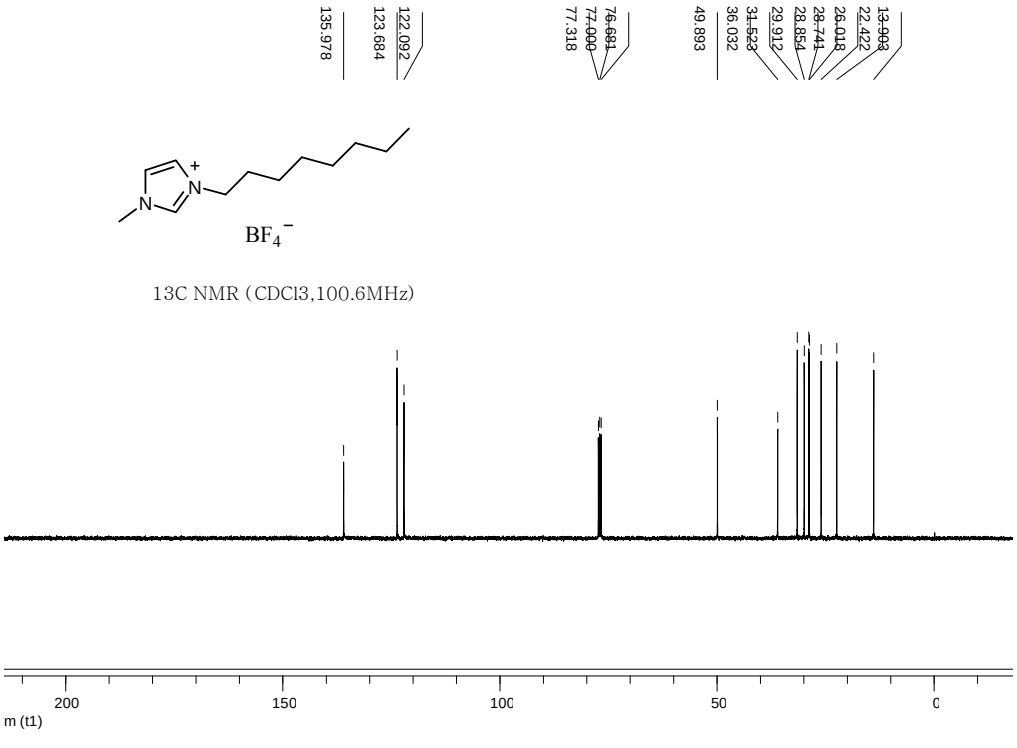


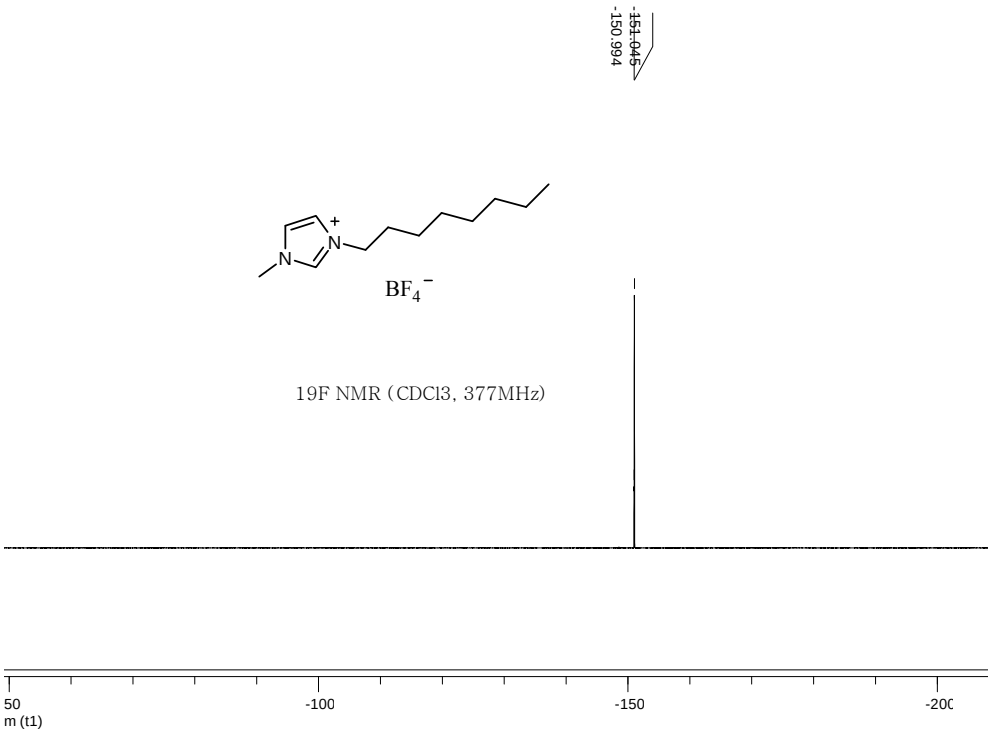
79.03 (100) $[M-C_{12}H_{23}N_2]^-$



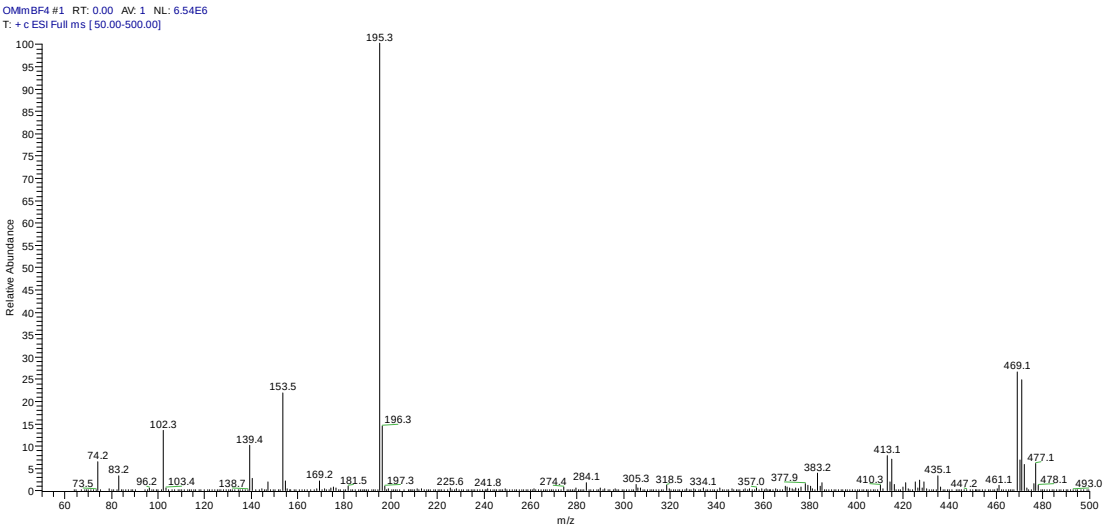
$[C_8MIm]BF_4$: 1-Octyl-3-methylimidazolium tetrafluoroborate



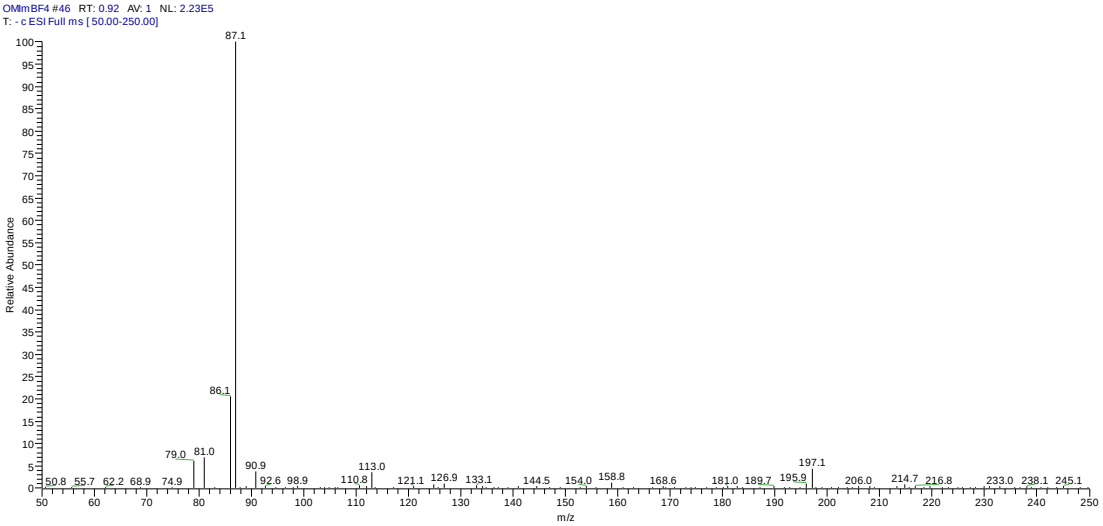




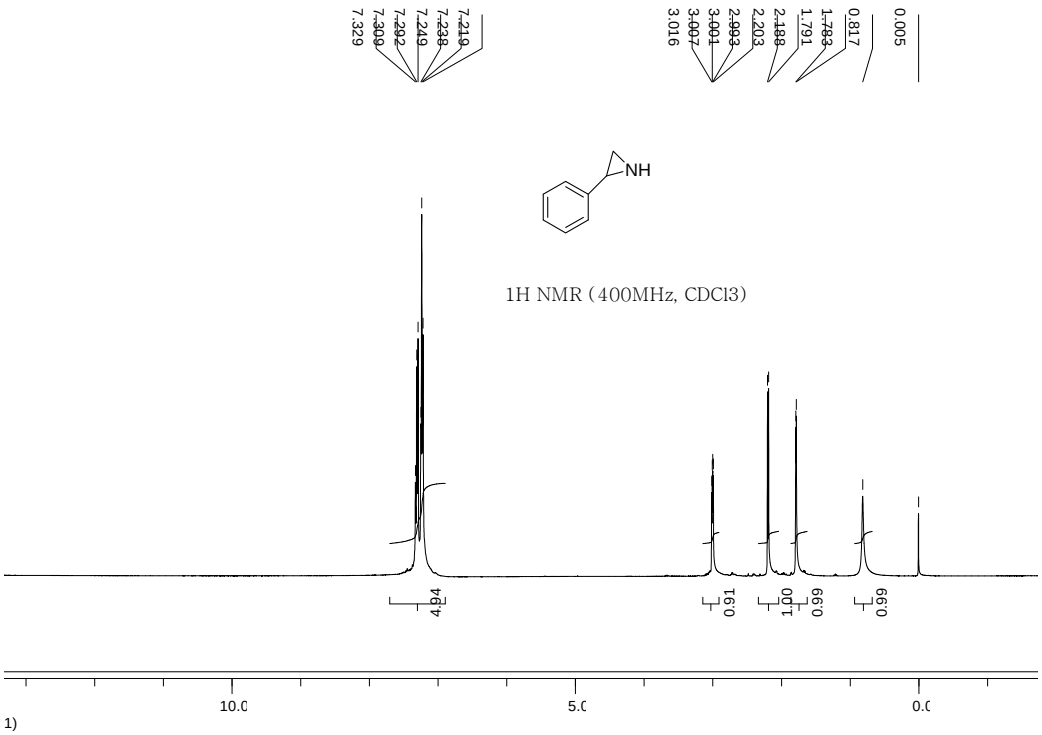
ESI-MS (4.8 kV): m/z (%) = 195.39 (100) [M-BF_4]$^+$

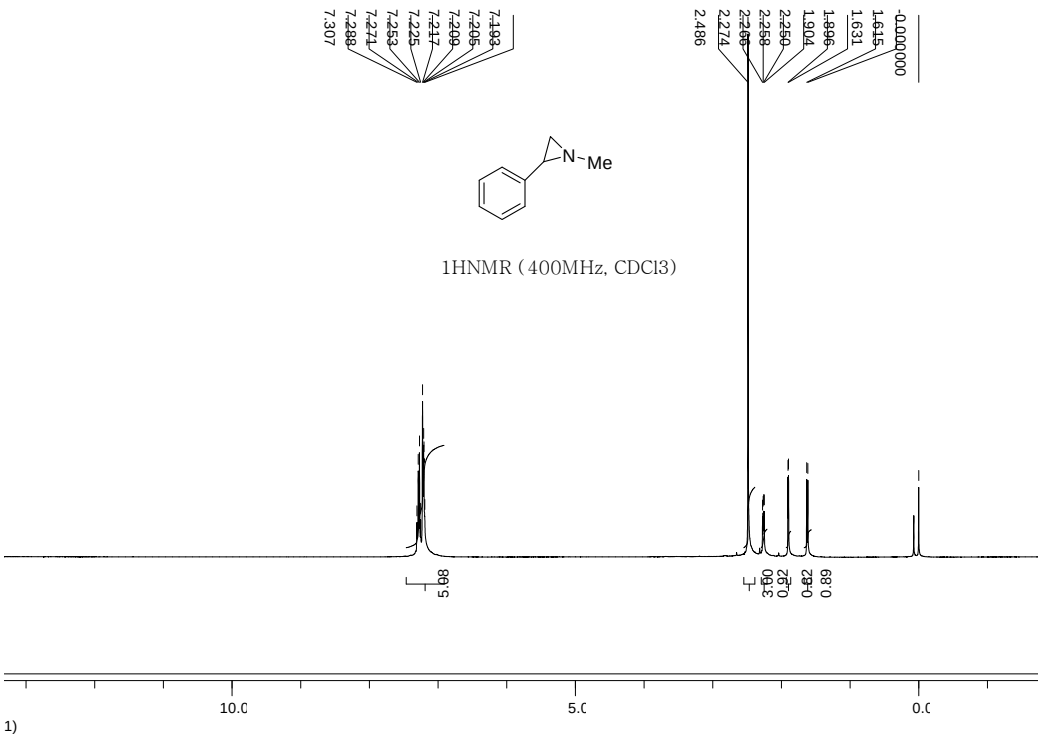


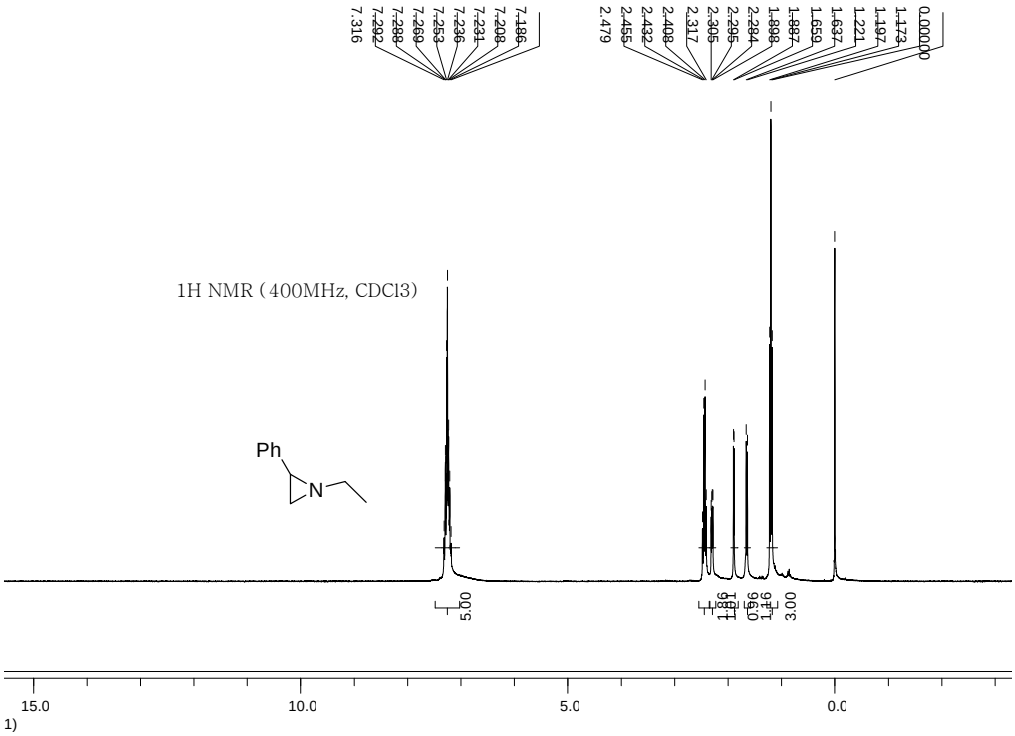
87.10 (100) [M-$C_{12}H_{23}N_2$]$^-$

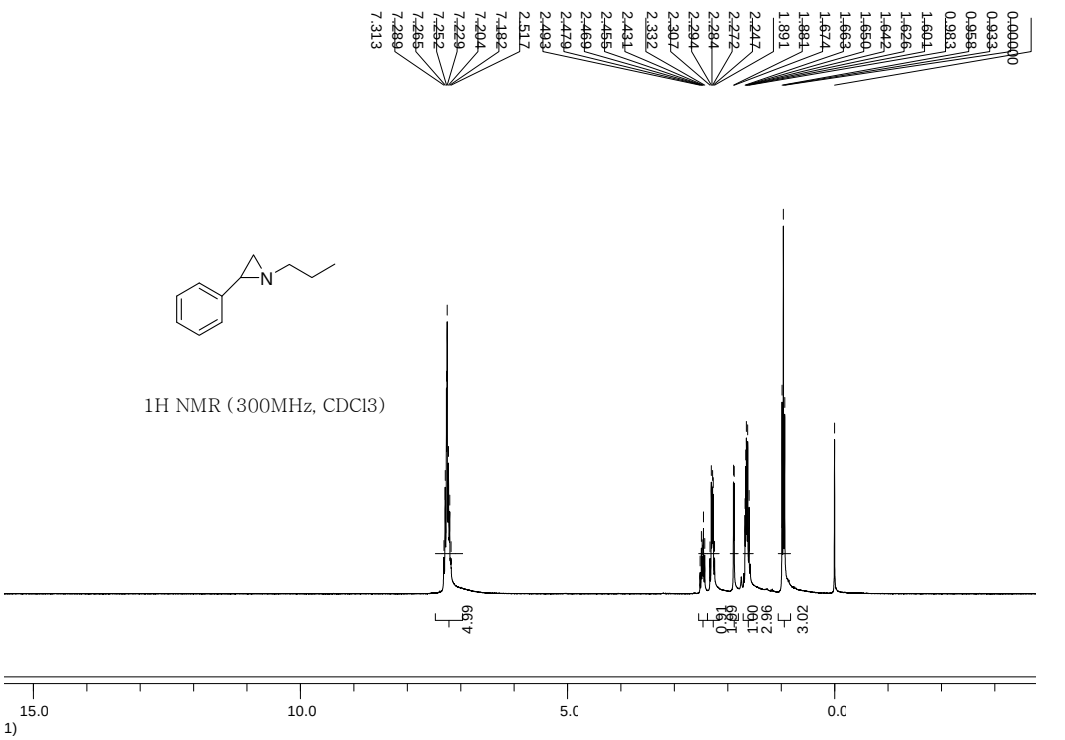


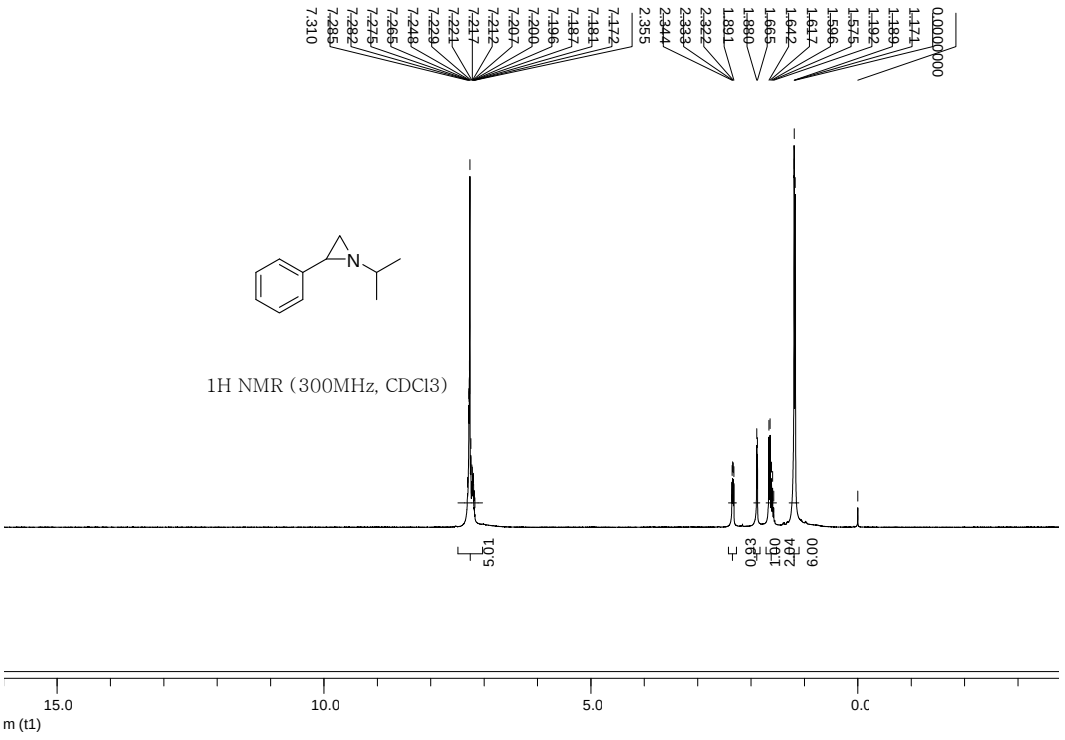
10. The ^{1}H NMR charts for aziridines

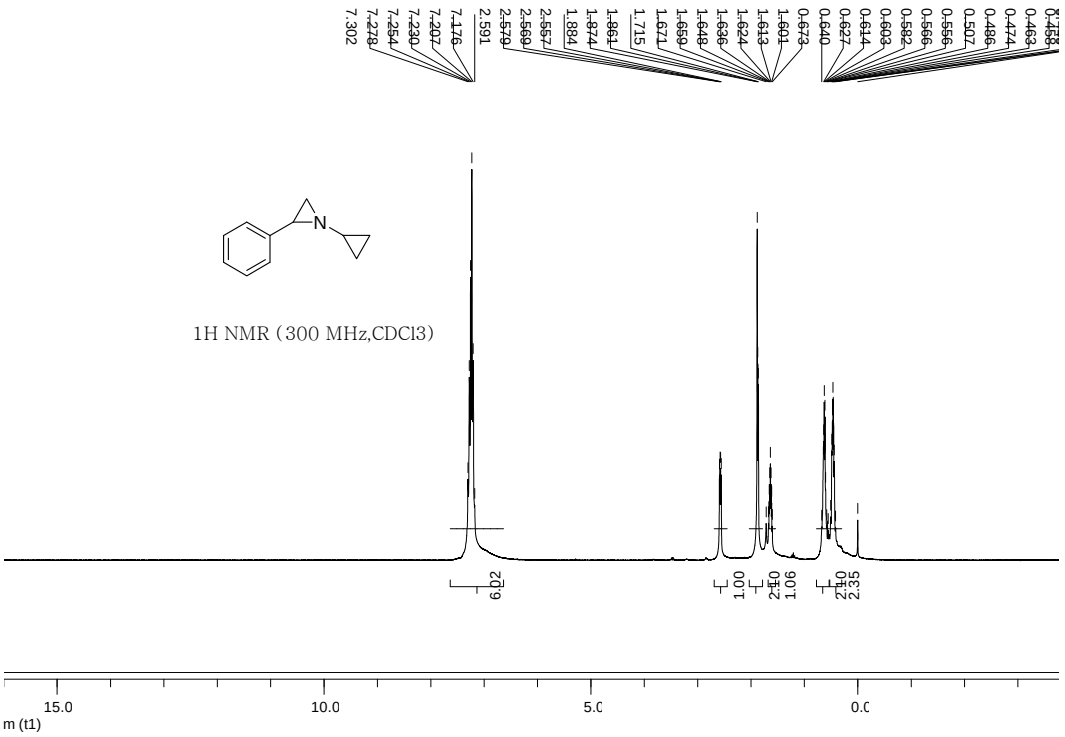


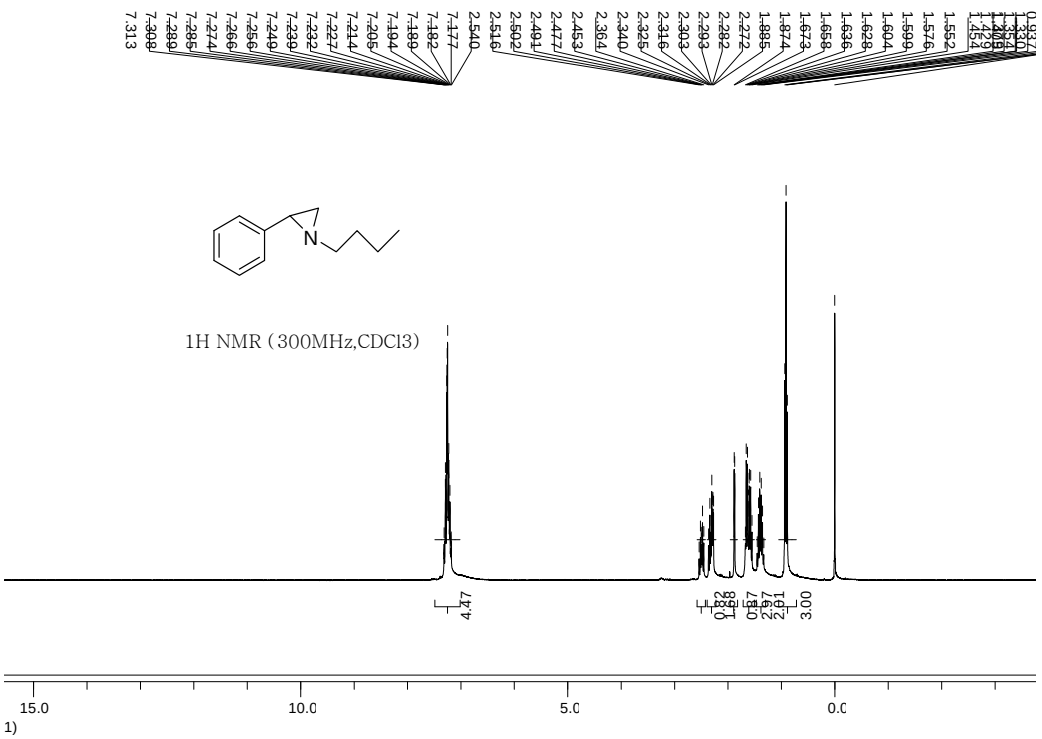

7.307
7.288
7.271
7.253
7.225
7.217
7.209
7.206
7.193
2.486
2.274
2.266
2.258
2.250
1.904
1.896
1.631
1.615
0.000000
N
Me
1HNMR (400MHz, CDCl3)
5.00
3.00
2.00
0.98
10.0
5.0
0.0
1)

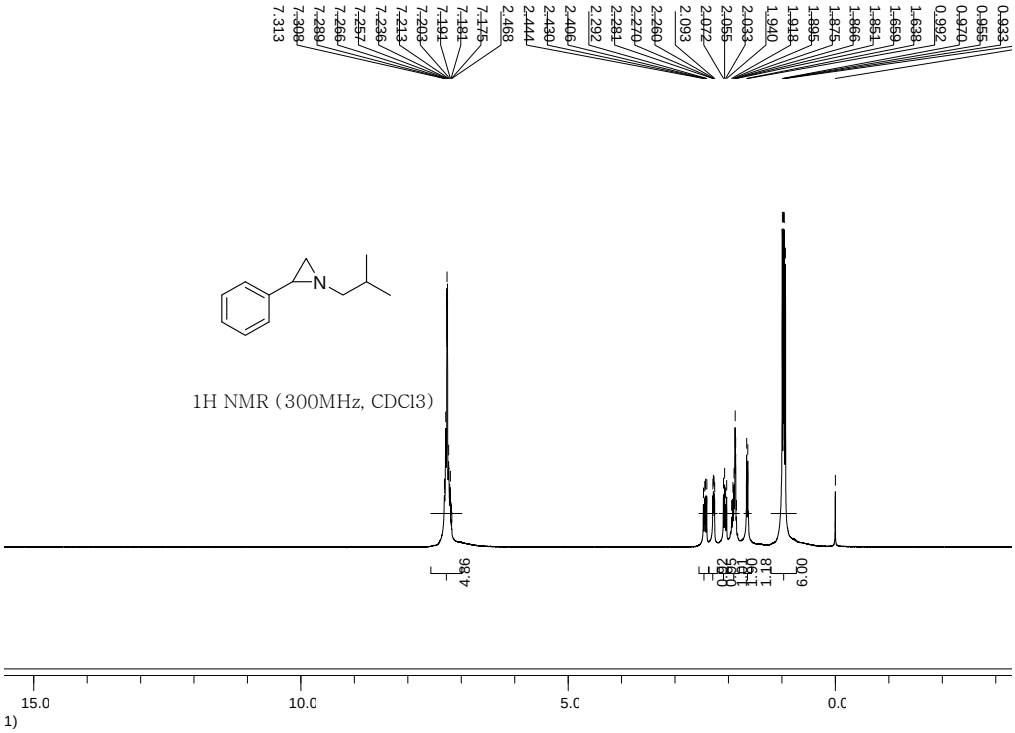

7.316
7.292
7.288
7.269
7.253
7.236
7.231
7.208
7.186
2.479
2.455
2.432
2.408
2.317
2.305
2.295
2.284
1.898
1.887
1.659
1.637
1.221
1.197
1.173
0.000000
1H NMR (400MHz, CDCl3)
Ph
N
5.00
1.86
1.96
3.00
15.0
10.0
5.0
0.0
1)


1H NMR (300MHz, CDCl3)

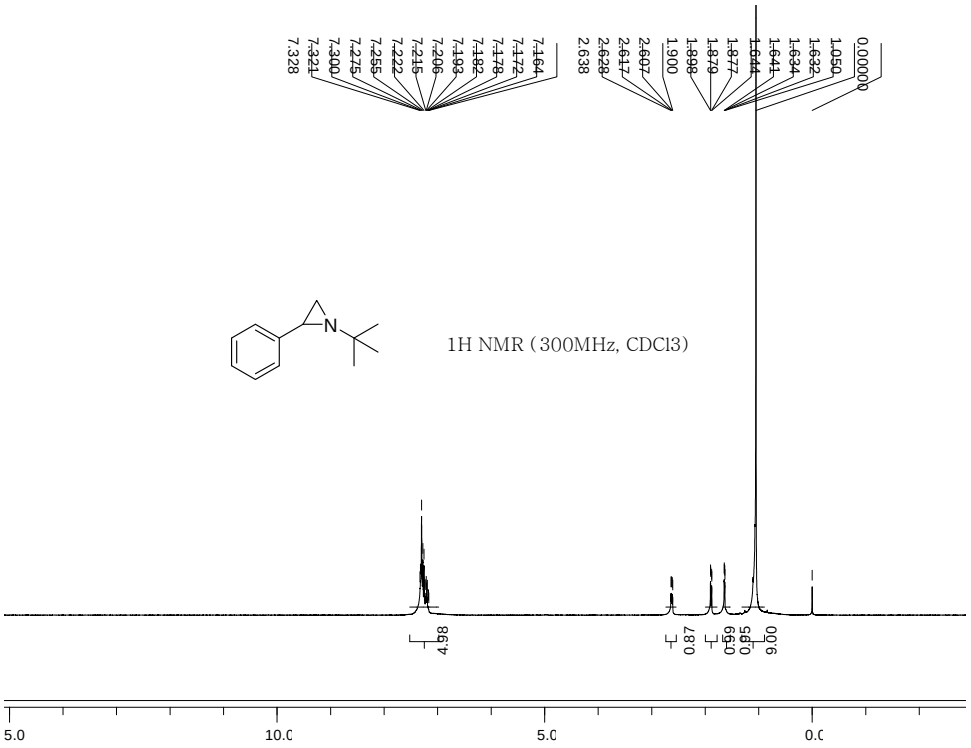

1H NMR (300MHz, CDCl3)

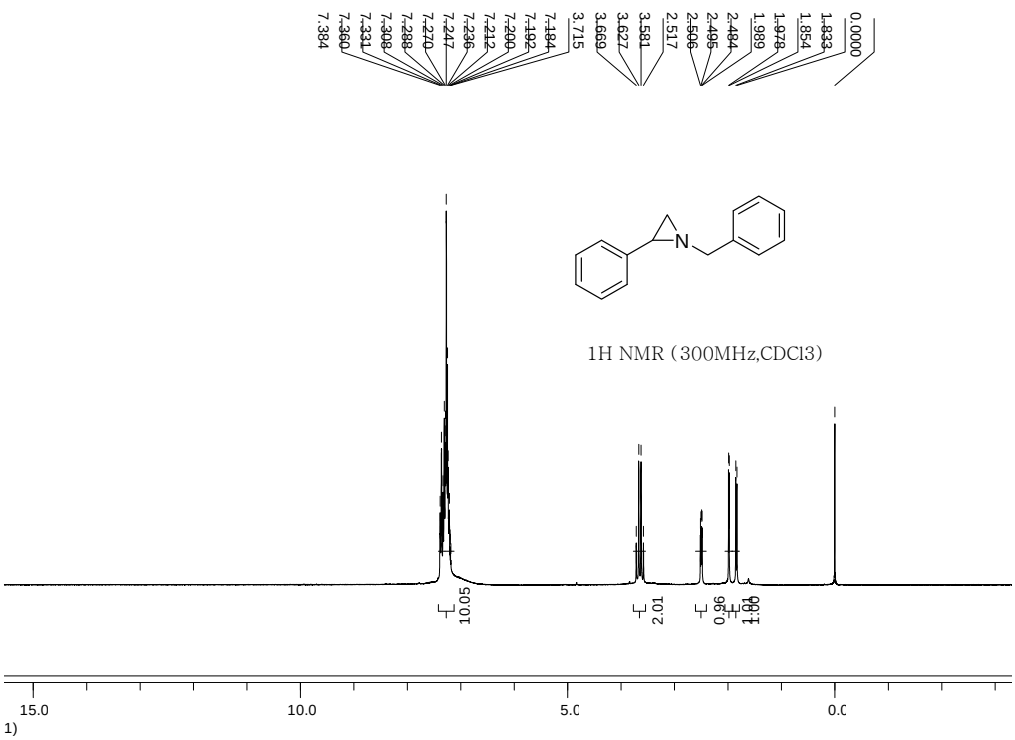

1H NMR (300 MHz,CDCl3)
6.02
1.00
2.10
1.06
2.10
2.35
15.0
10.0
5.0
0.0
m (t1)


1H NMR (300MHz,CDCl3)
4.47
0.82
1.88
0.87
2.97
2.01
3.00
15.0
10.0
5.0
0.0
1)



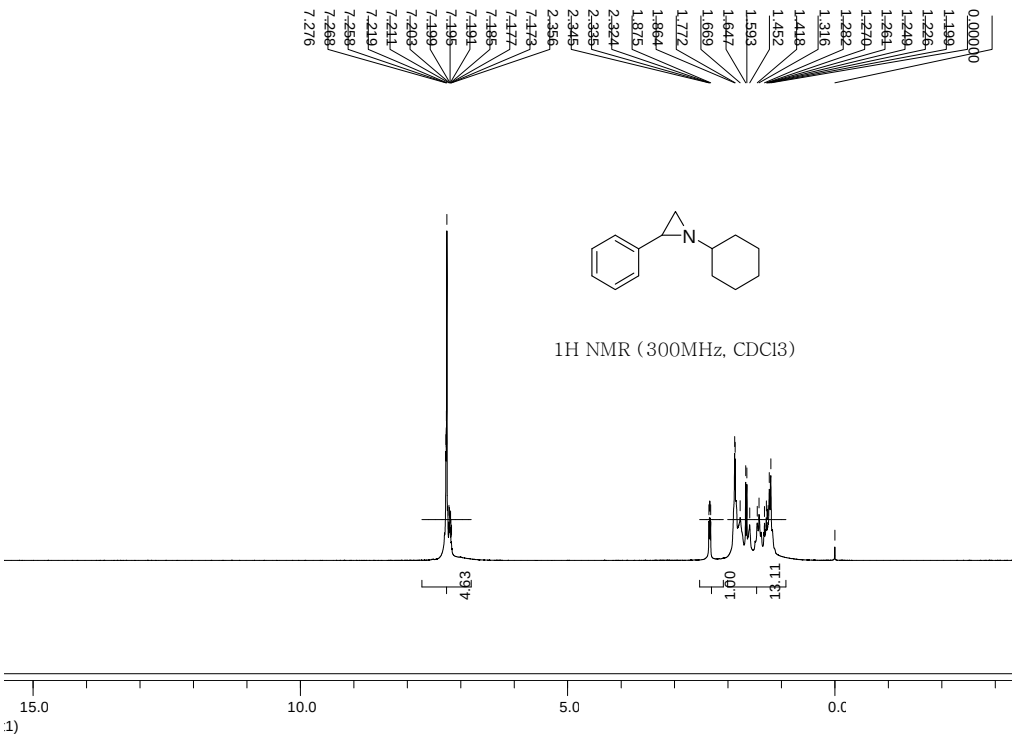
1)





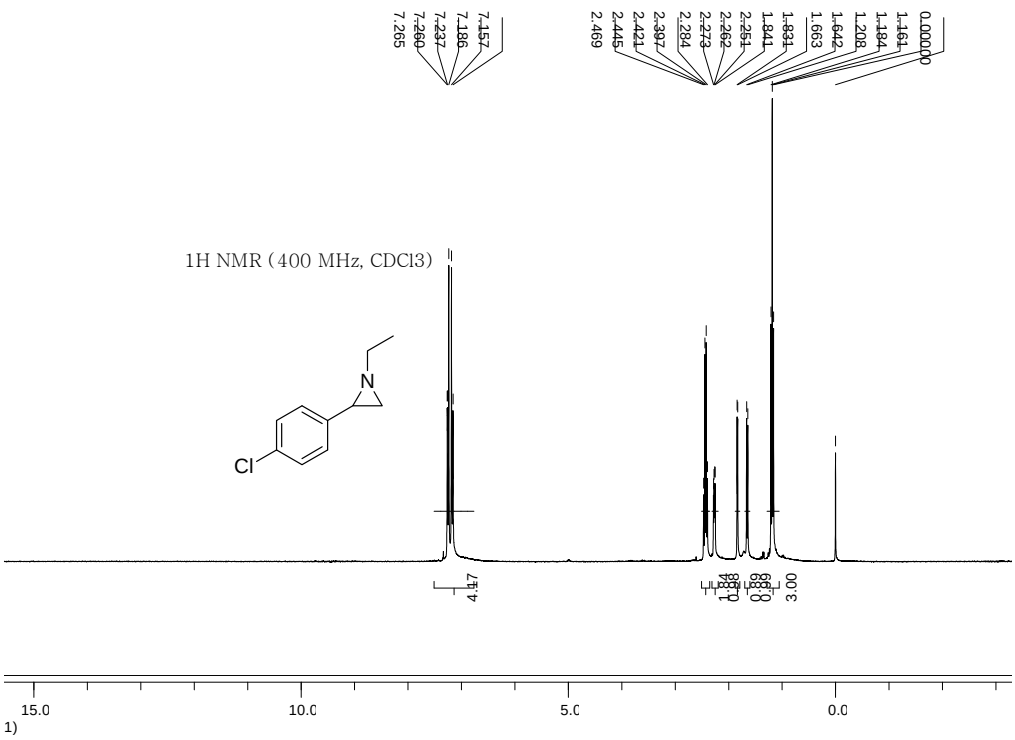
1H NMR (300MHz,CDCl3)

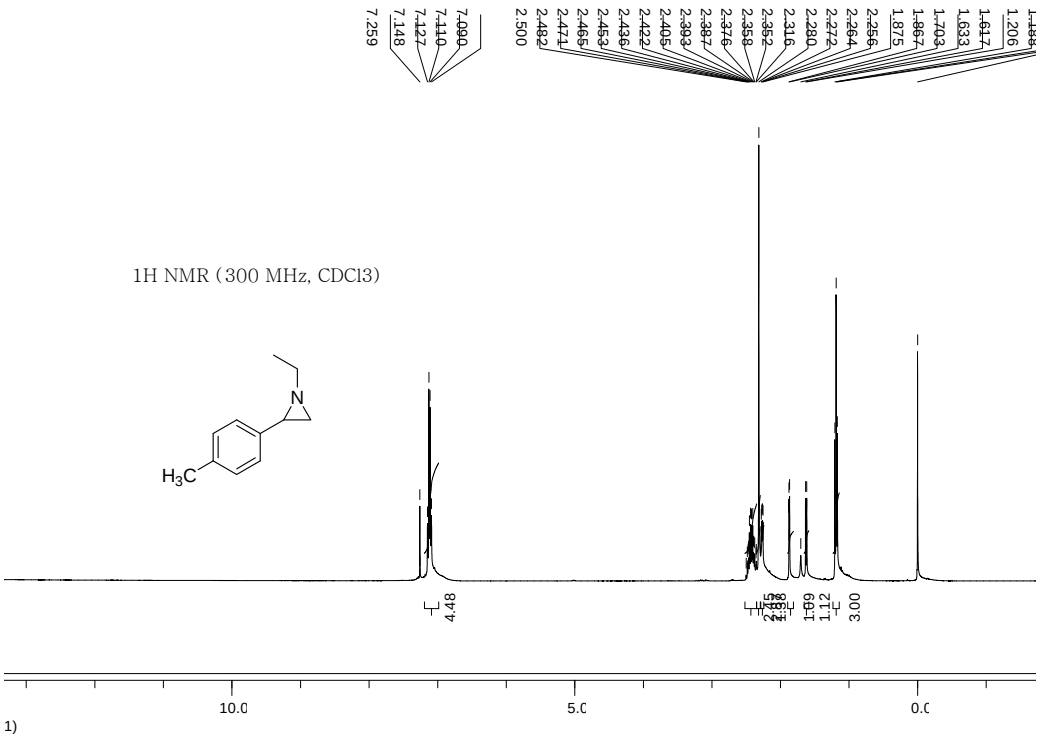
1)



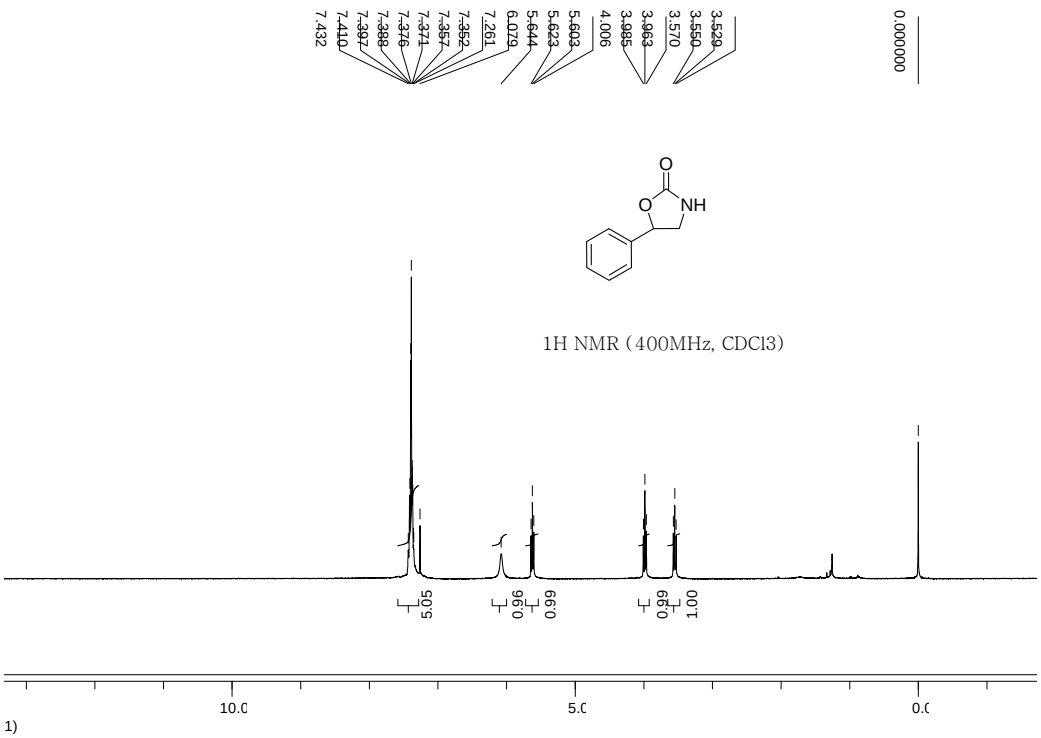
1H NMR (300MHz, CDCl3)

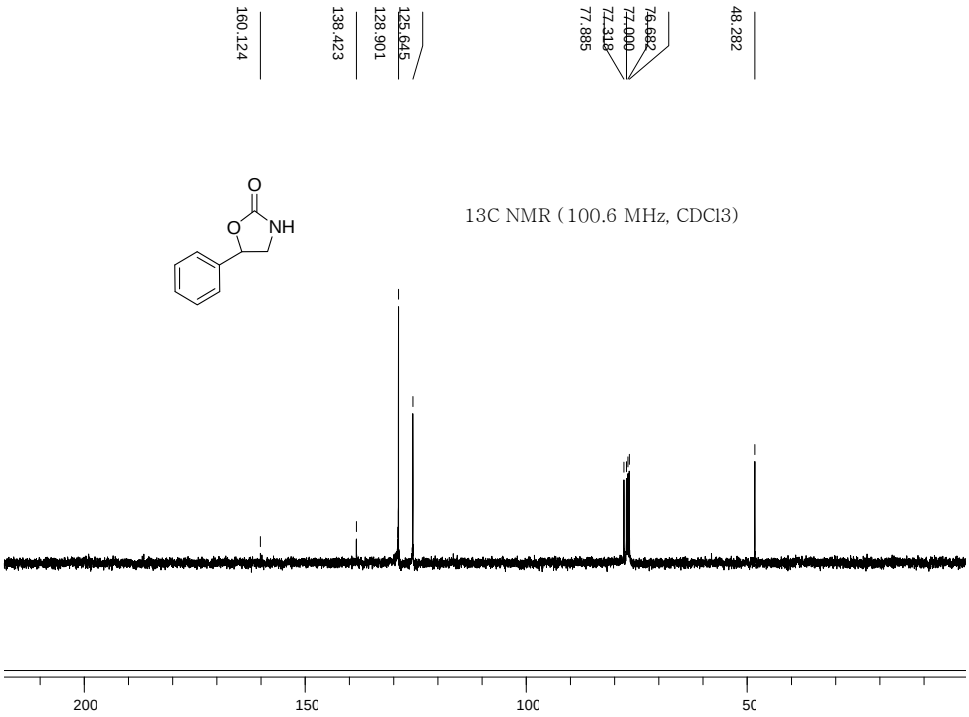
1)

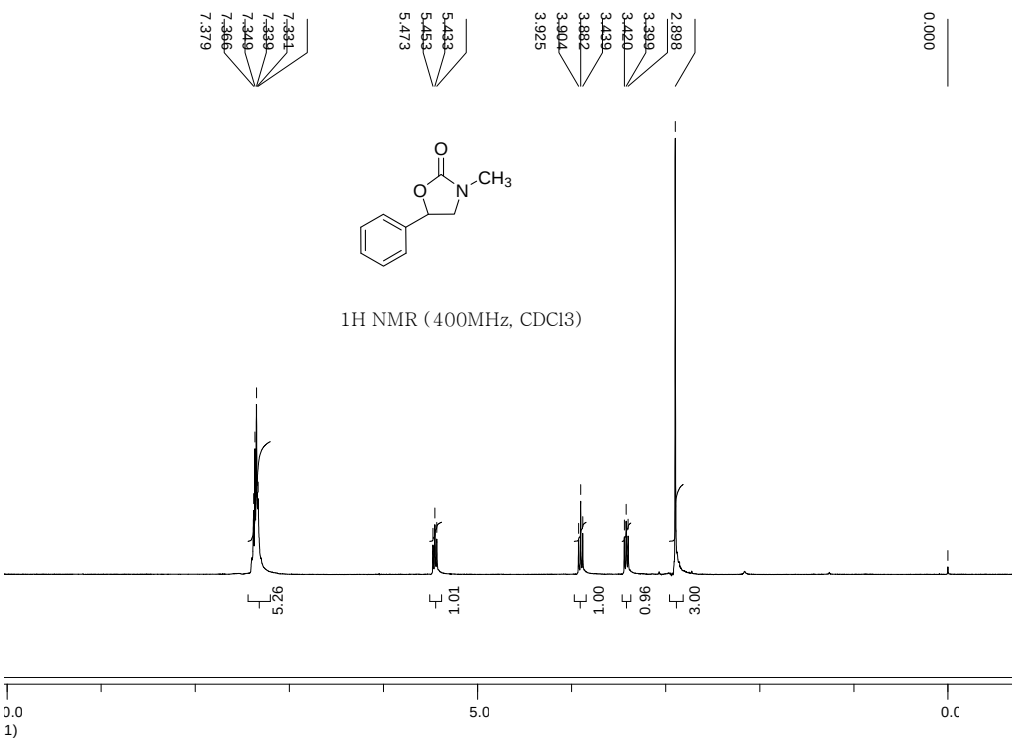

1H NMR (400 MHz, CDCl3)
Cl
N
15.0
10.0
5.0
0.0


1H NMR (300 MHz, CDCl3)
H3C
N
10.0
5.0
0.0

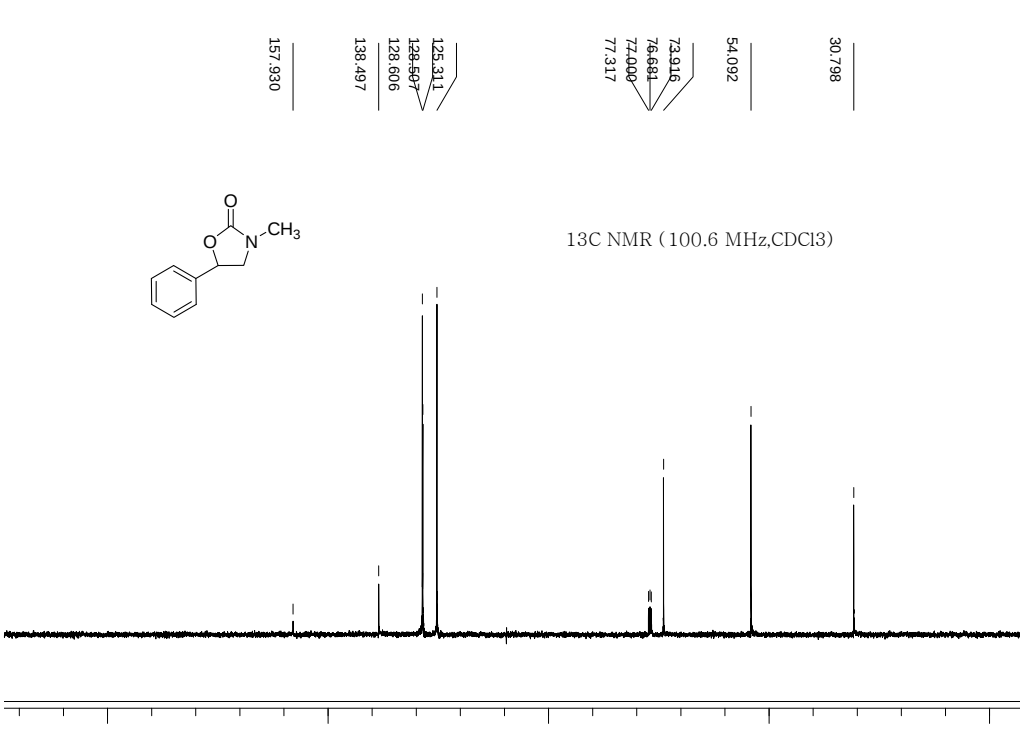
11. The ^{1}H NMR and ^{13}C NMR Charts for oxazolidinones



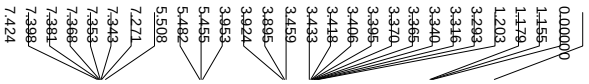


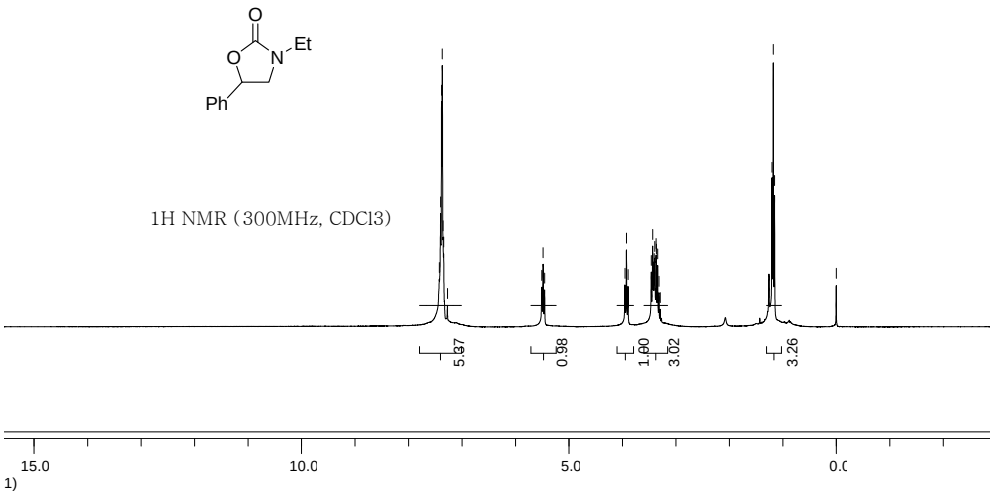


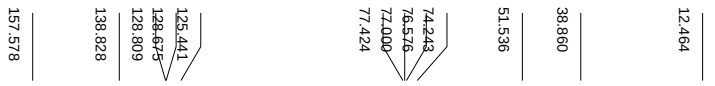
1H NMR (400MHz, CDCl3)

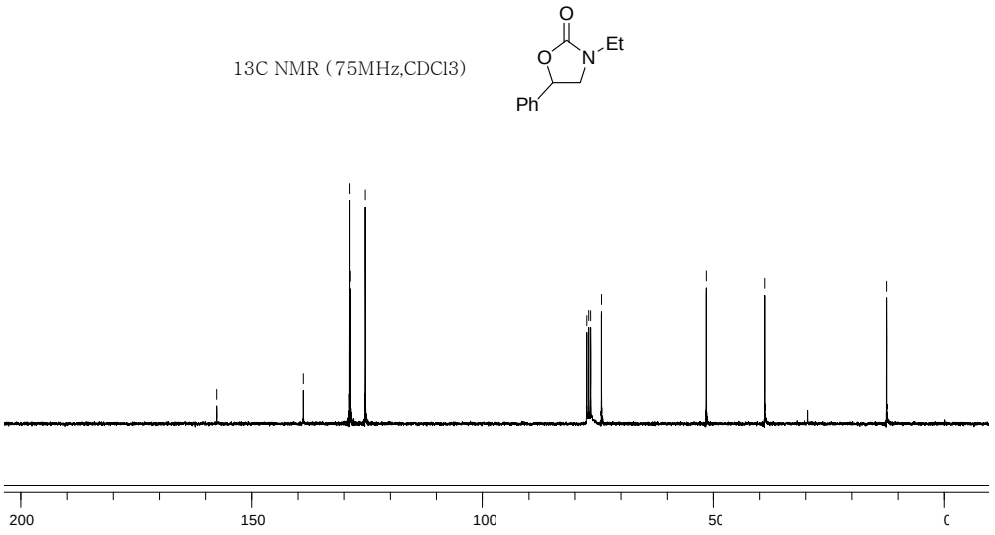


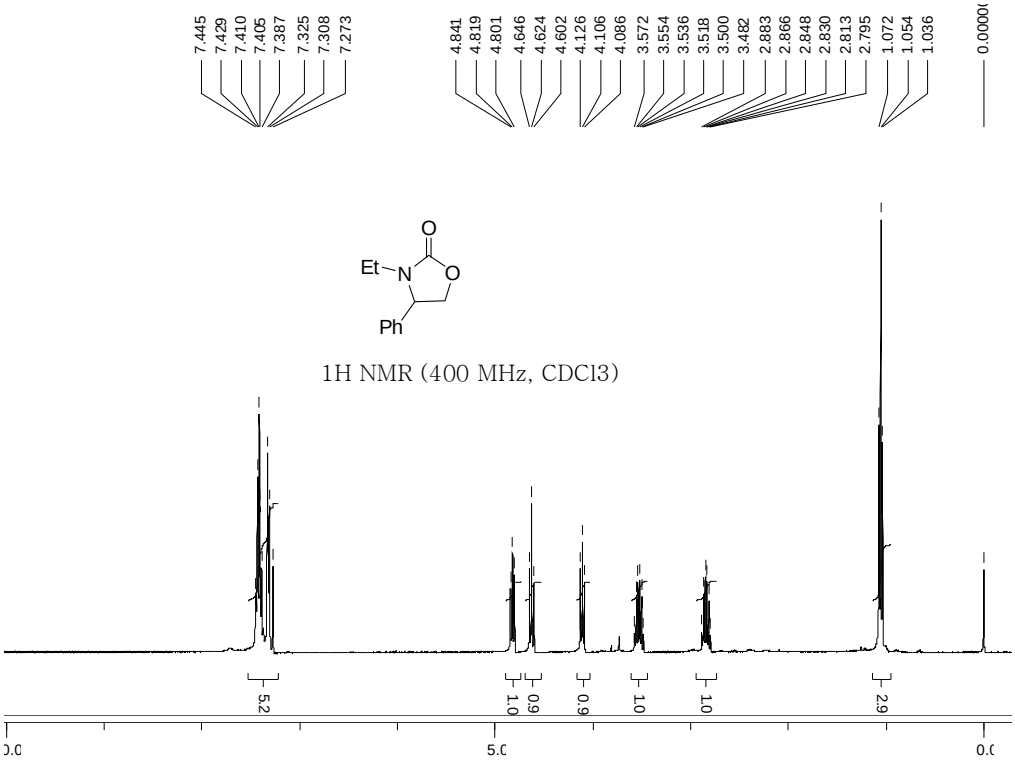
13C NMR (100.6 MHz,CDCl3)

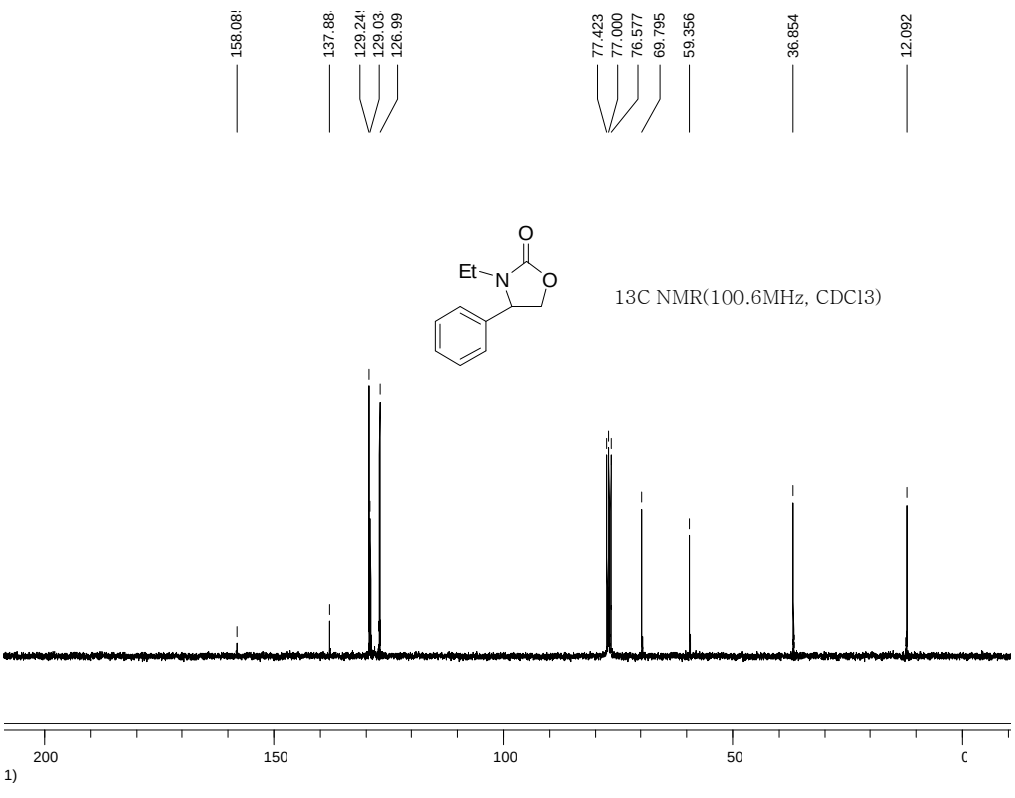

7.424
7.398
7.381
7.368
7.353
7.343
7.271
5.508
5.482
5.455
3.953
3.924
3.895
3.459
3.433
3.418
3.406
3.396
3.370
3.365
3.340
3.316
3.293
1.203
1.179
1.155
0.00000

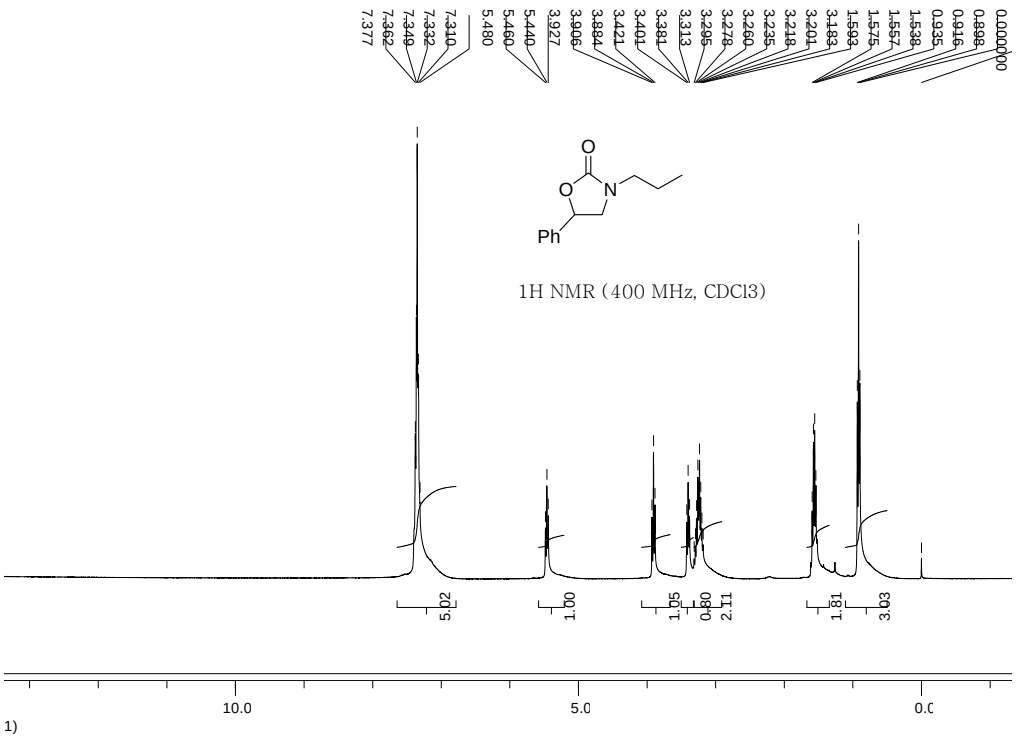

O
O
N
Et
Ph
1H NMR (300MHz, CDCl3)
5.47
0.98
1.00
3.02
3.26
15.0
10.0
5.0
0.0
1)

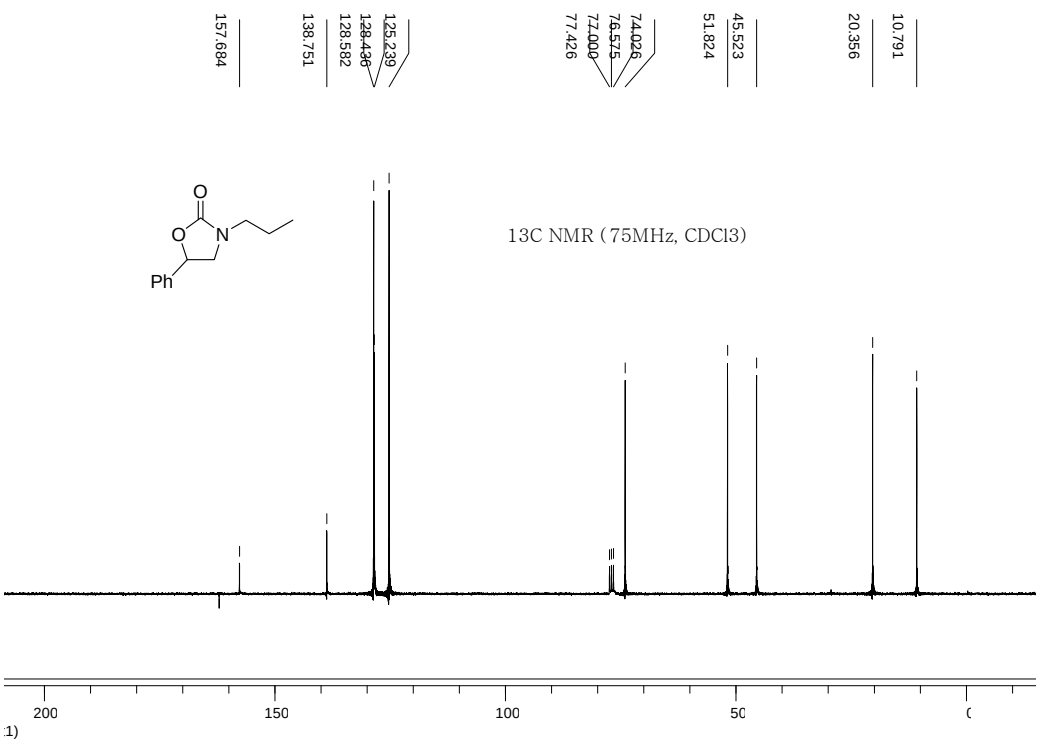

157.578
138.828
128.809
128.675
125.441
77.424
77.000
76.576
74.243
51.536
38.860
12.464

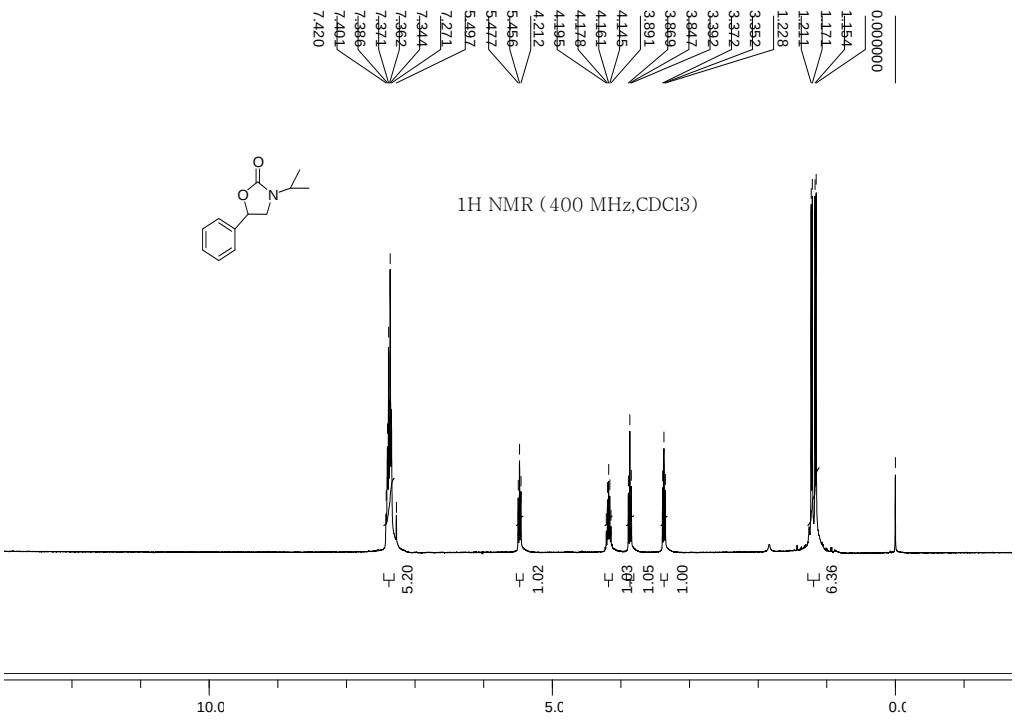

13C NMR (75MHz,CDCl3)
O
O
N
Et
Ph
200
150
100
50
0

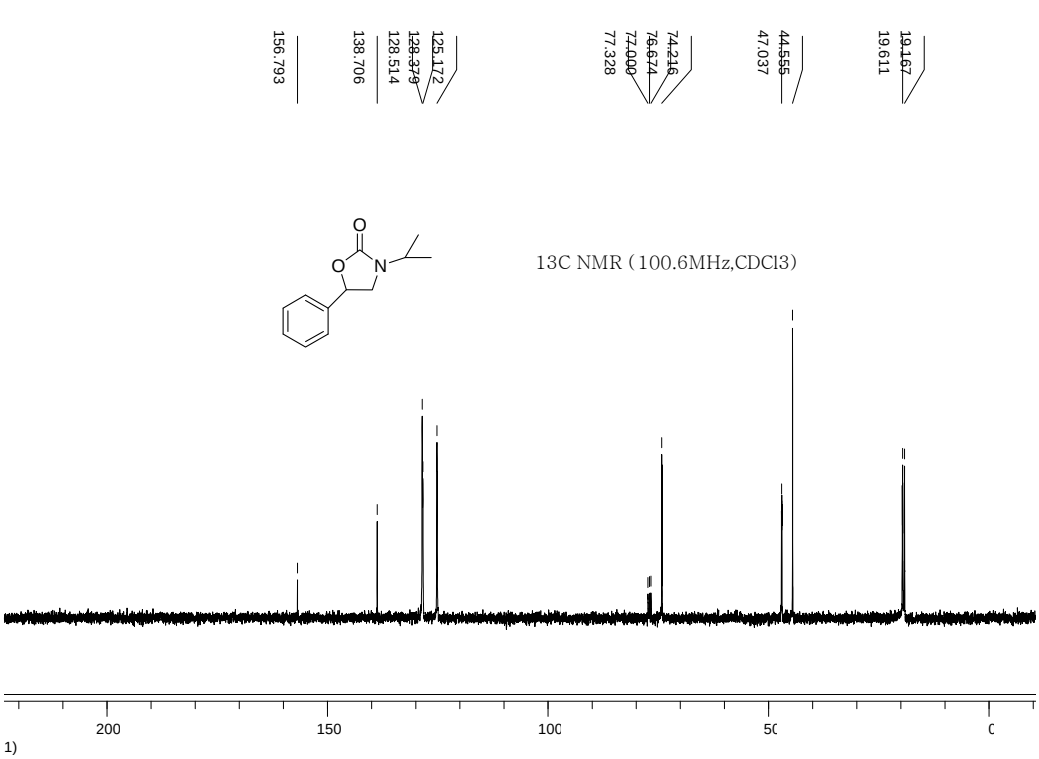

7.445
7.429
7.410
7.405
7.387
7.325
7.308
7.273
4.841
4.819
4.801
4.646
4.624
4.602
4.126
4.106
4.086
3.572
3.554
3.536
3.518
3.500
3.482
2.883
2.866
2.848
2.830
2.813
2.795
1.072
1.054
1.036
0.0000
O
Et
N
O
Ph
1H NMR (400 MHz, CDCl3)
5.2
1.0
0.9
0.9
1.0
1.0
2.9
5.0
0.0


158.08
137.88
129.24
129.03
126.99
77.423
77.000
76.577
69.795
59.356
36.854
12.092
O
Et
N
O
13C NMR(100.6MHz, CDCl3)
200
150
100
50
0
1)

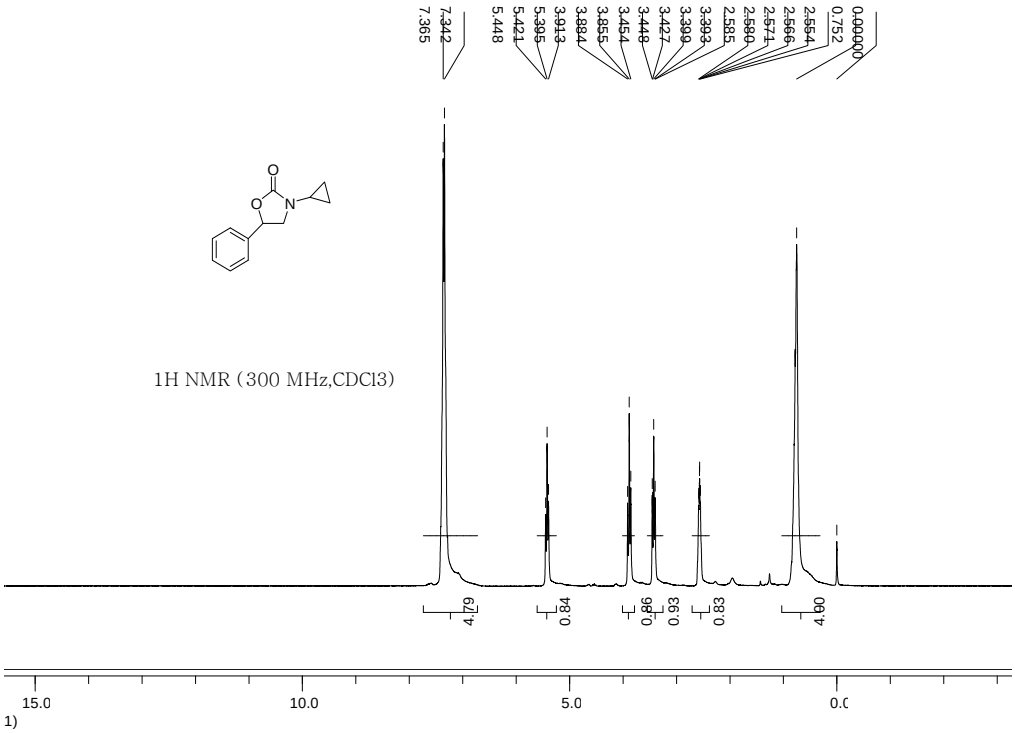

7.377
7.362
7.349
7.332
7.310
5.480
5.460
5.440
3.927
3.906
3.884
3.421
3.401
3.381
3.313
3.295
3.278
3.260
3.235
3.218
3.201
3.183
1.593
1.575
1.557
1.538
0.935
0.916
0.898
0.000000
O
O
N
Ph
1H NMR (400 MHz, CDCl3)
5.02
1.00
1.05
0.80
2.11
1.81
3.03
10.0
5.0
0.0

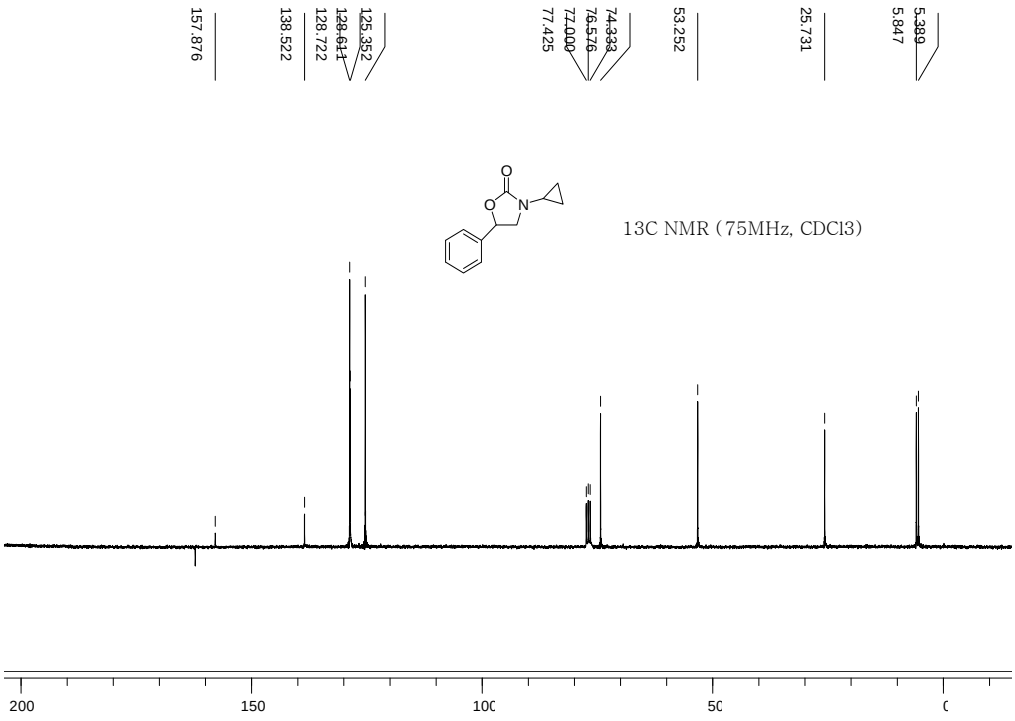

157.684
138.751
128.582
128.436
125.239
77.426
77.000
76.575
74.026
51.824
45.523
20.356
10.791
O
O
N
Ph
13C NMR (75MHz, CDCl3)
200
150
100
50

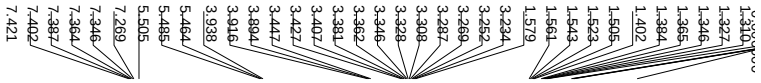

7.420
7.401
7.386
7.371
7.362
7.344
7.271
5.497
5.477
5.456
4.212
4.195
4.178
4.161
4.145
3.891
3.869
3.847
3.392
3.372
3.352
1.228
1.211
1.171
1.154
0.000000
1H NMR (400 MHz,CDCl3)
5.20
2.07
1.03
1.05
1.00
6.36
10.0
5.0
0.0

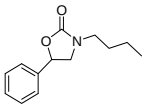

156.793
138.706
128.514
128.379
125.172
77.328
77.000
76.674
74.216
47.037
44.555
19.611
19.167
13C NMR (100.6MHz,CDCl3)
200
150
100
50
0

1)

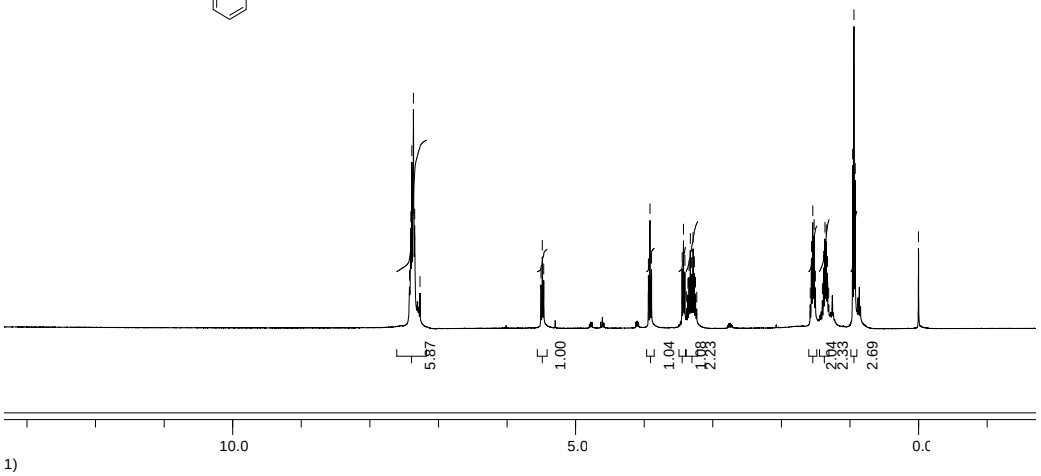

7.365
7.342
5.448
5.421
5.395
3.913
3.884
3.855
3.454
3.448
3.427
3.399
3.393
2.585
2.580
2.571
2.566
2.564
0.752
0.00000
1H NMR (300 MHz,CDCl3)
4.79
0.84
0.98
0.93
0.83
4.00
15.0
10.0
5.0
1)


157.876
138.522
128.722
128.611
125.352
77.425
77.000
76.576
74.333
53.252
25.731
5.847
5.389
13C NMR (75MHz, CDCl3)
200
150
100
50

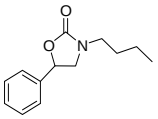




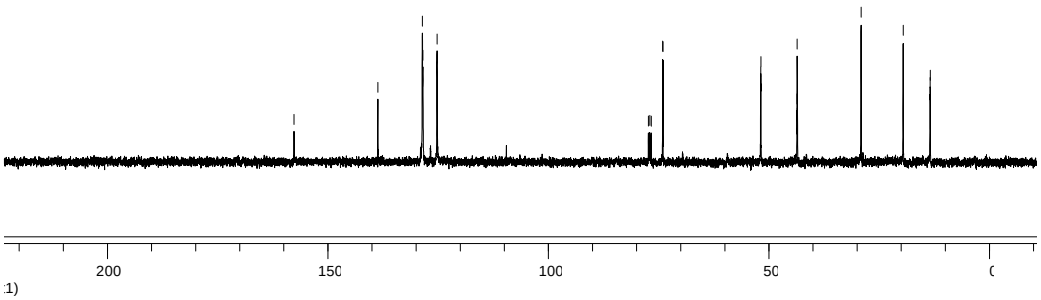
1H NMR (400 MHz, CDCl3)



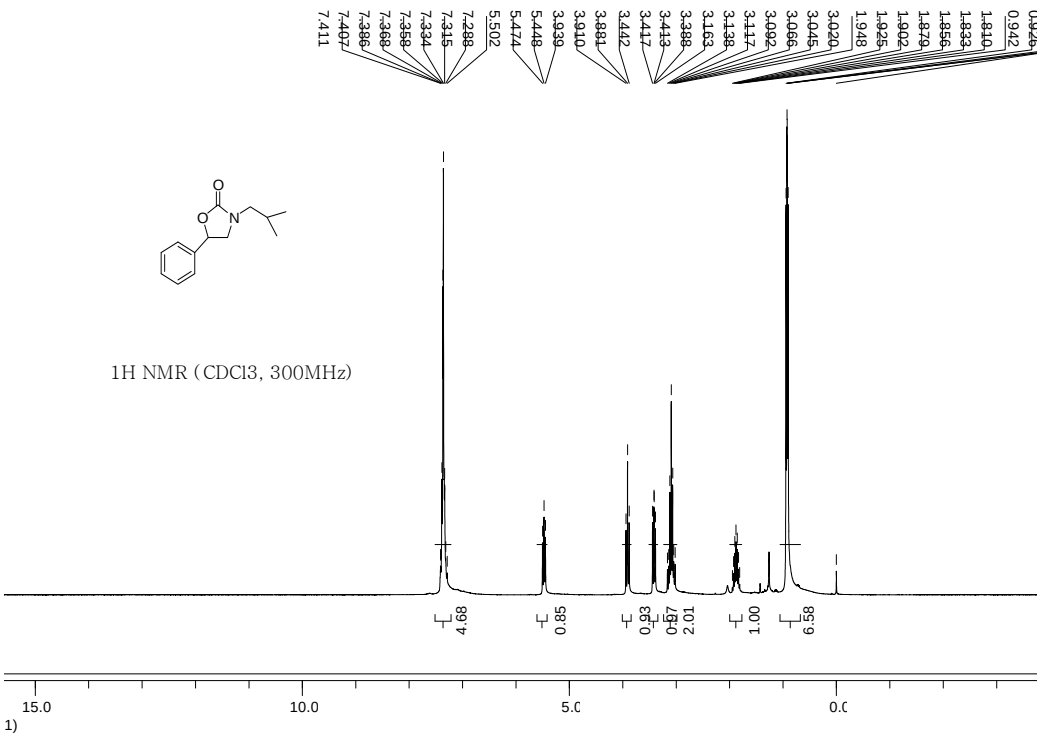
1)



13C NMR (100.6MHz, CDCl3)

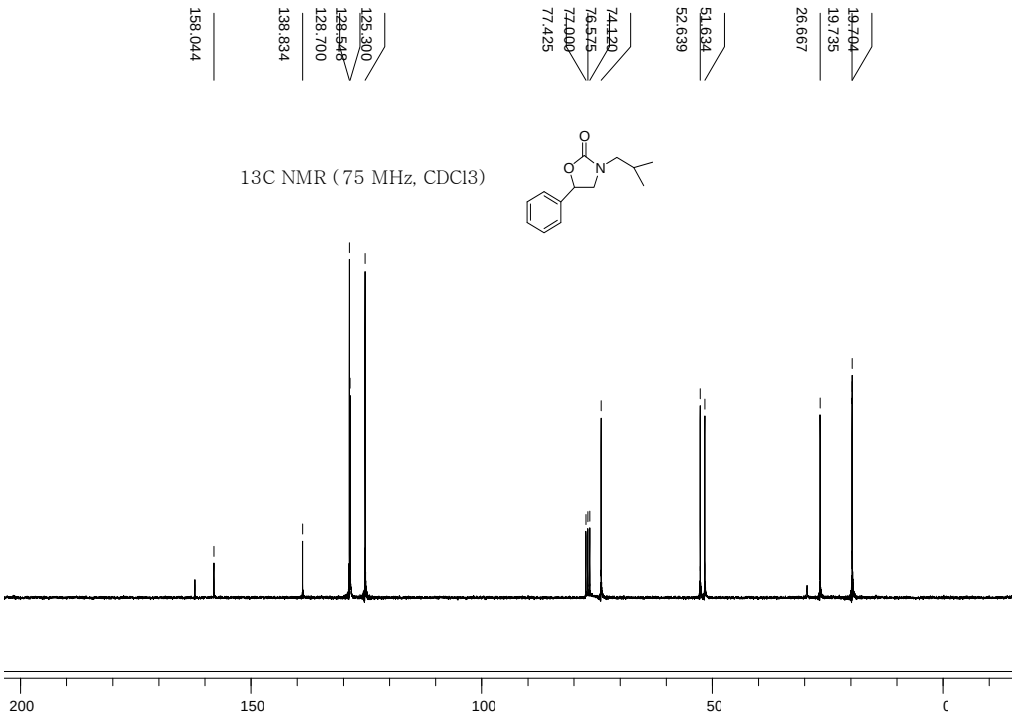


1)

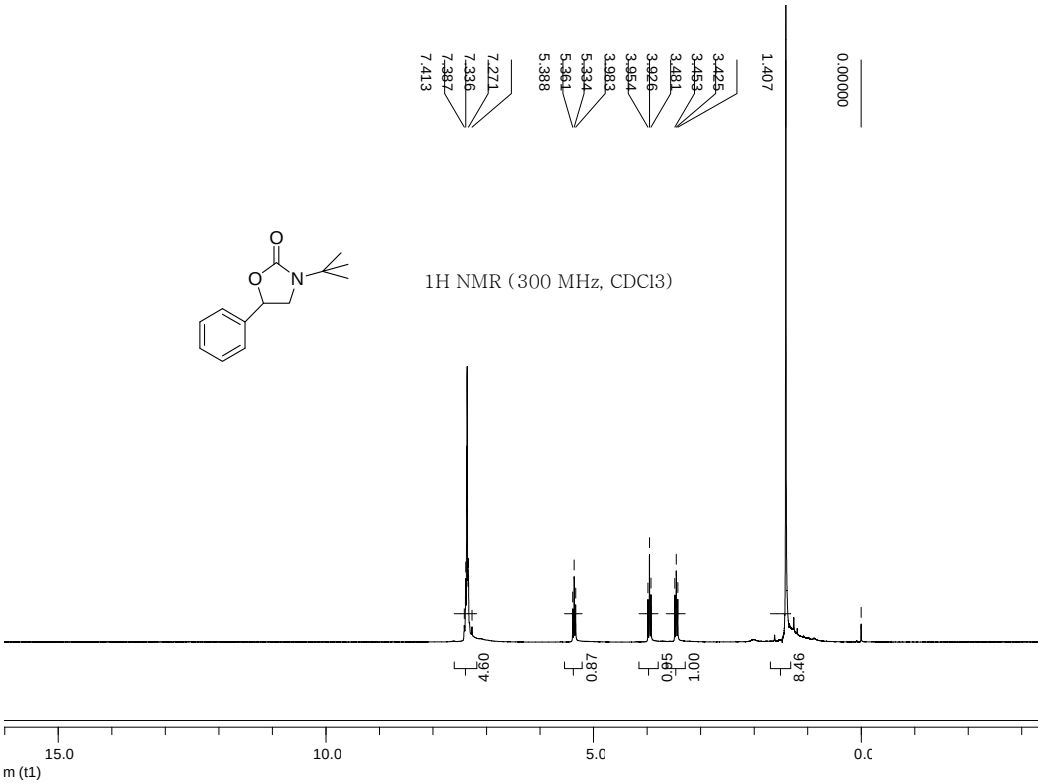


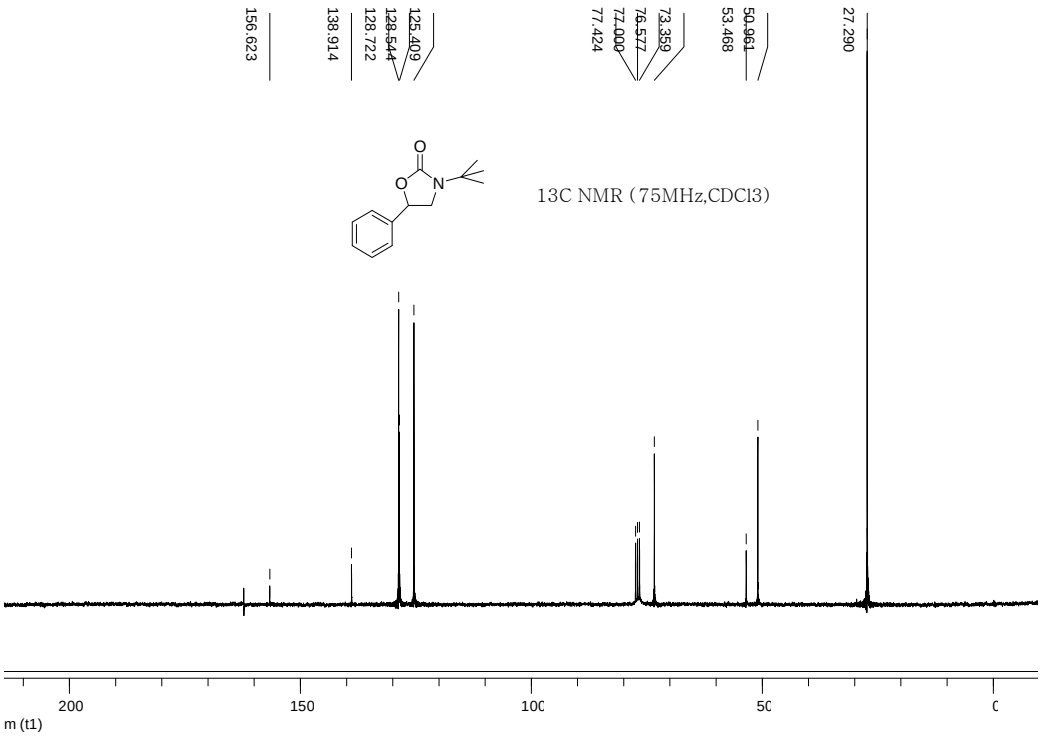
1H NMR (CDCl3, 300MHz)

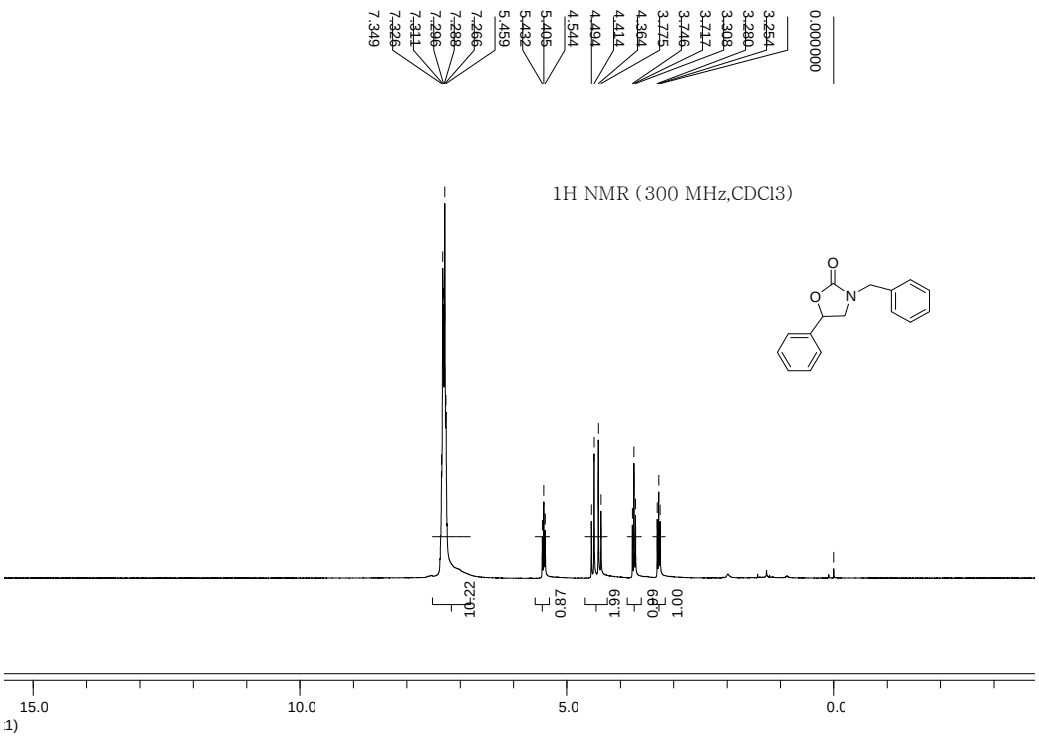
1)

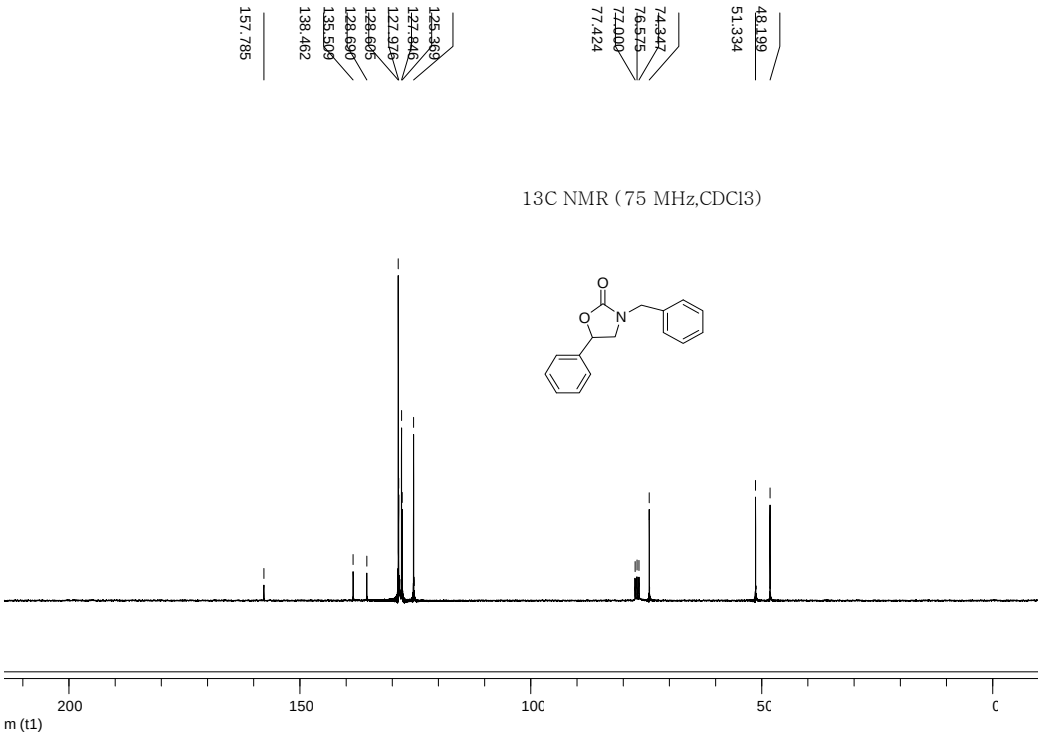


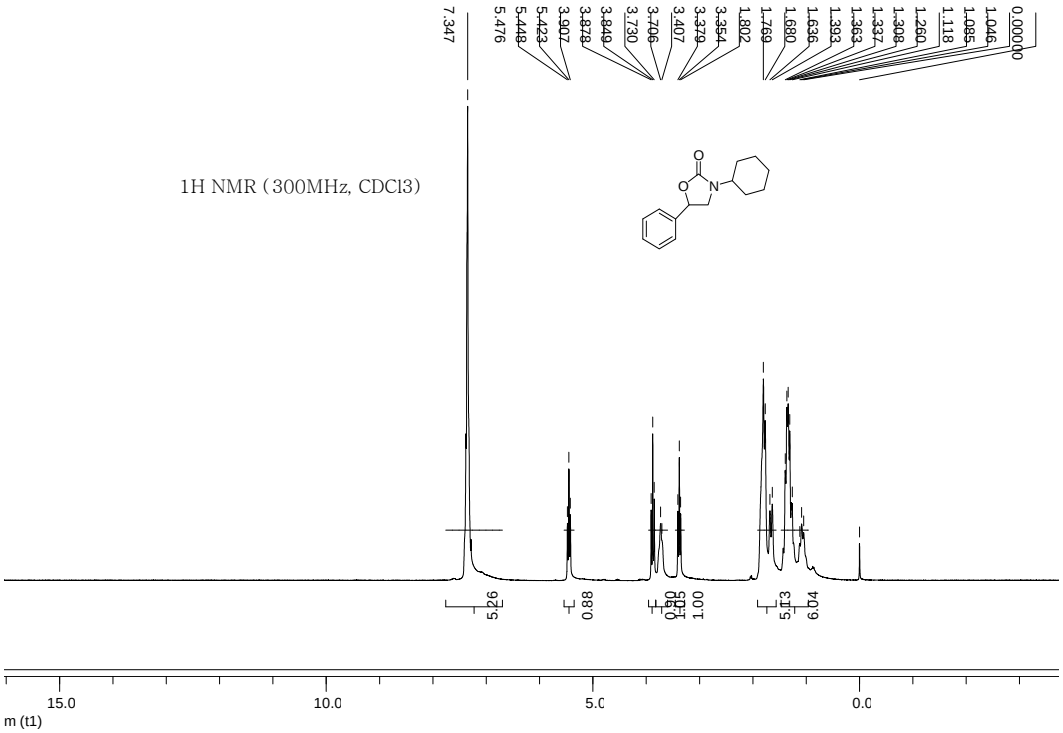
13C NMR (75 MHz, CDCl3)

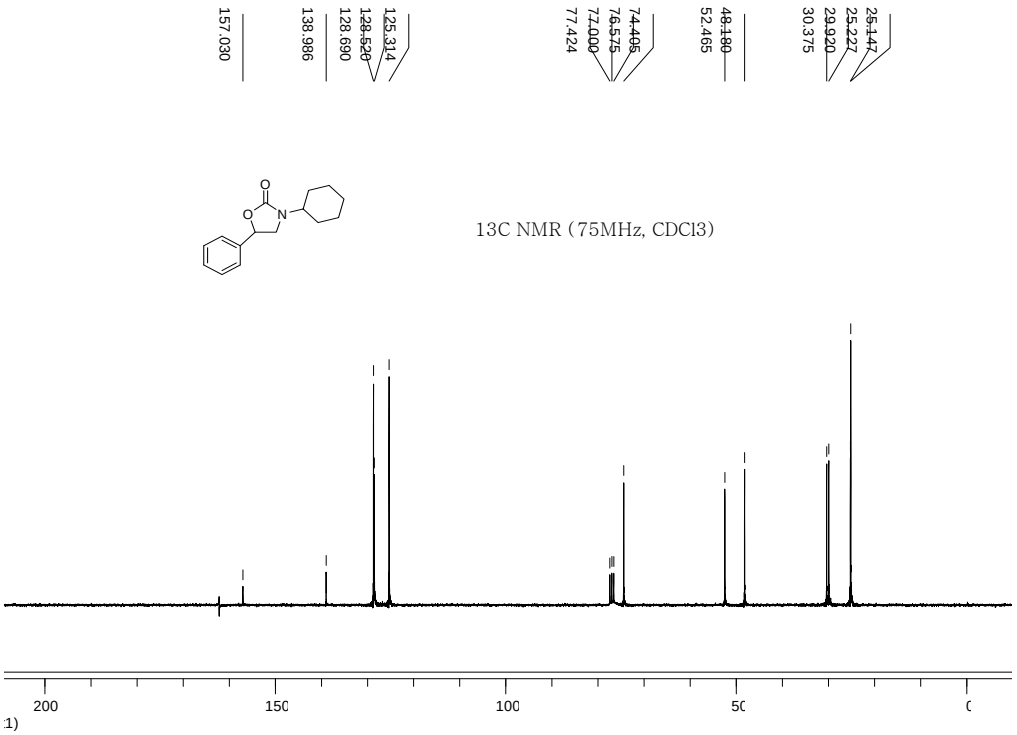

7.413
7.387
7.336
7.271
5.388
5.361
5.334
3.983
3.954
3.926
3.481
3.453
3.425
1.407
0.0000
1H NMR (300 MHz, CDCl3)
4.60
0.87
0.95
1.00
8.46
15.0
10.0
5.0
m (t1)

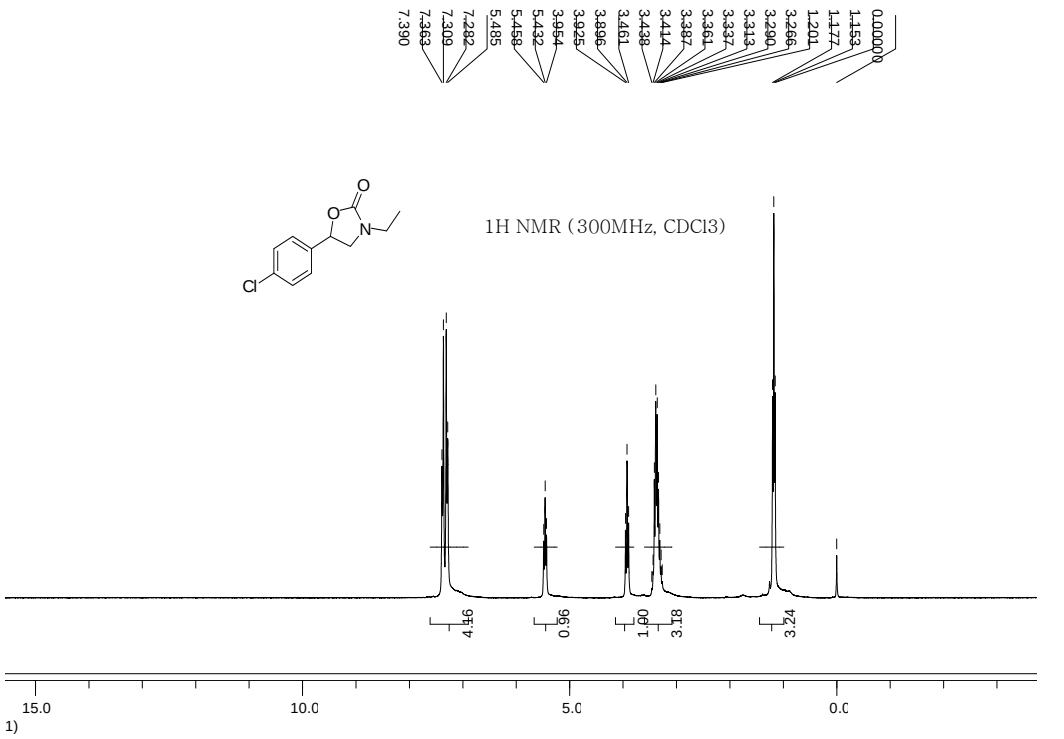

156.623
138.914
128.722
128.544
125.409
77.424
77.000
76.577
73.359
53.468
50.961
27.290
13C NMR (75MHz,CDCl3)
200
150
100
50
m (t1)

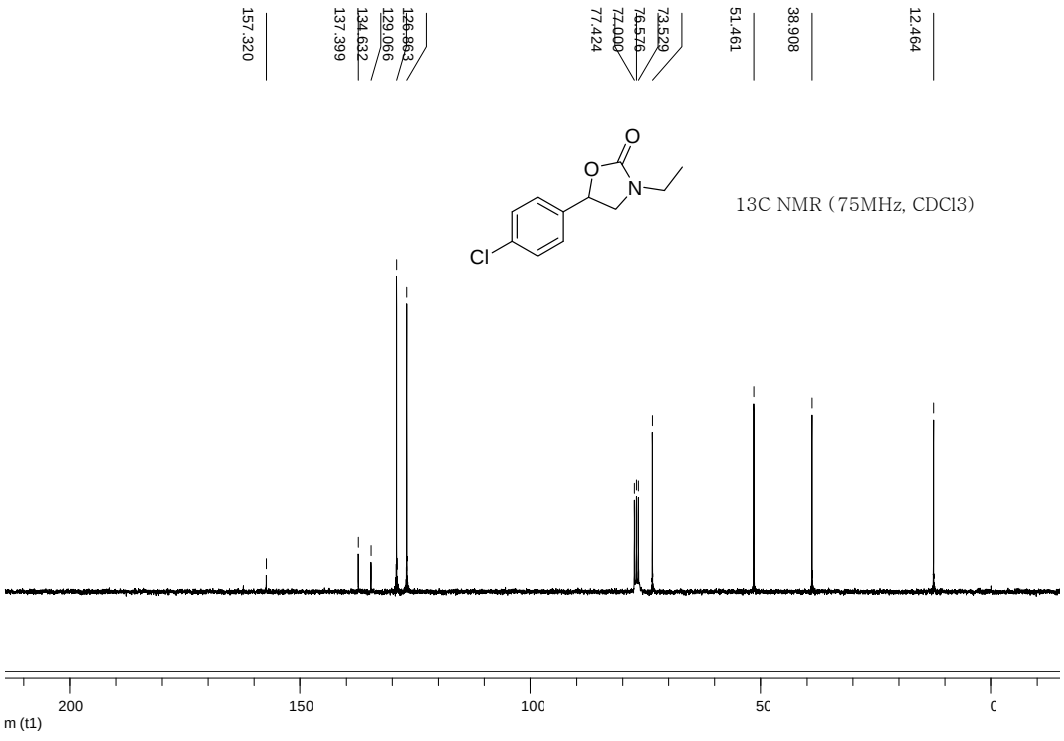

7.349
7.326
7.311
7.296
7.288
7.266
5.459
5.432
5.405
4.544
4.494
4.414
4.364
3.775
3.746
3.717
3.308
3.280
3.254
0.000000
1H NMR (300 MHz,CDCl3)
O
O
N
10.22
0.87
1.99
0.89
1.00
15.0
10.0
5.0
0.0
1)

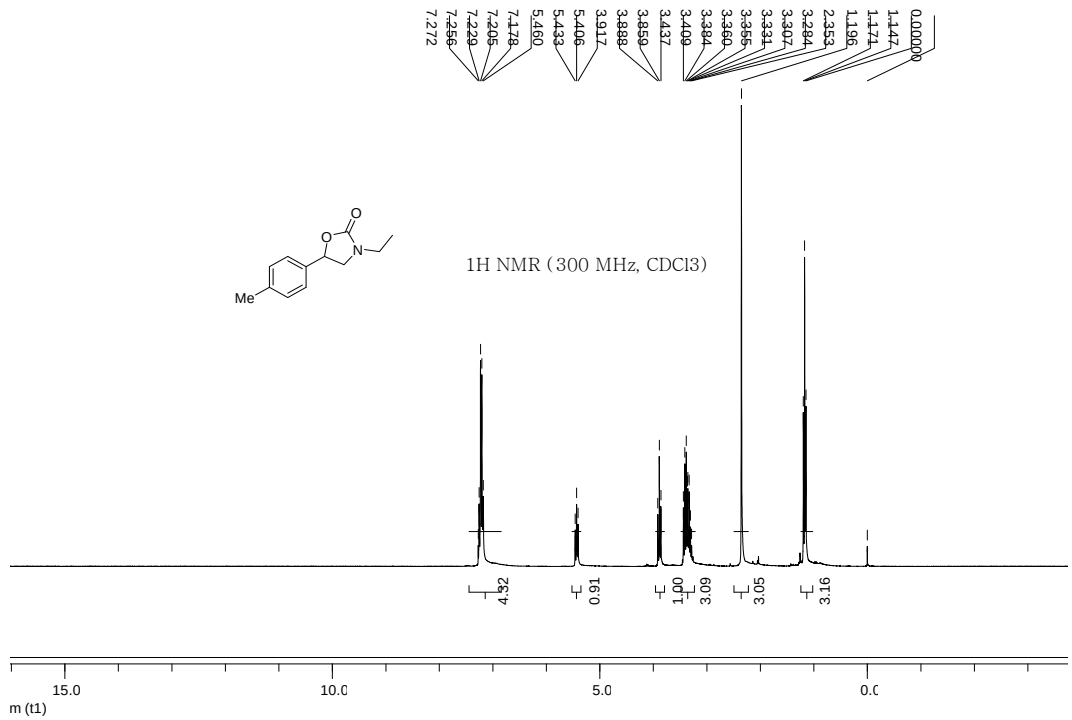

157.785
138.462
135.509
128.690
128.605
127.976
127.846
125.359
77.424
77.000
76.575
74.347
51.334
48.199
13C NMR (75 MHz,CDCl3)
O
O
N
200
150
100
50
0
m (t1)

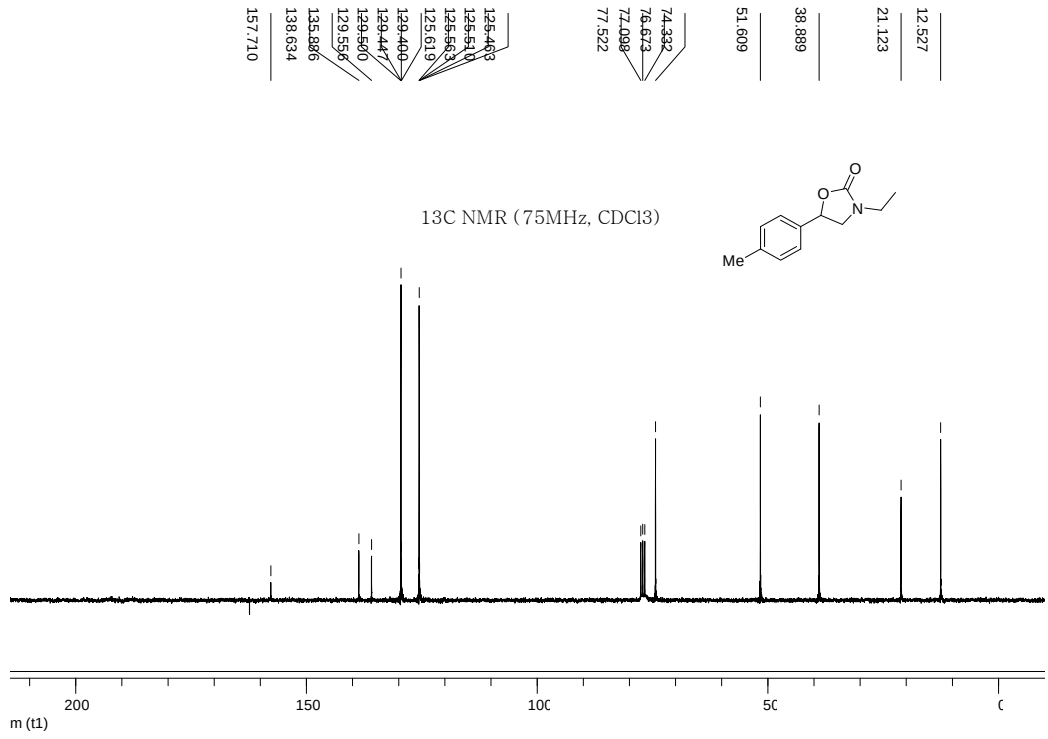

1H NMR (300MHz, CDCl3)
7.347
5.476
5.448
5.423
3.907
3.878
3.849
3.730
3.706
3.407
3.379
3.354
1.802
1.769
1.680
1.636
1.393
1.363
1.337
1.308
1.260
1.118
1.085
1.046
0.00000
0.96
0.88
1.00
3.15
6.04
15.0
10.0
5.0
0.0
m (t1)


13C NMR (75MHz, CDCl3)
157.030
138.986
128.690
128.526
125.314
77.424
77.000
76.575
74.405
52.465
48.180
30.375
29.920
25.227
25.147
200
150
100
50
1)


7.390
7.363
7.309
7.282
5.485
5.458
5.432
3.954
3.925
3.896
3.461
3.438
3.414
3.387
3.361
3.337
3.313
3.290
3.266
1.201
1.177
1.153
0.00000
1H NMR (300MHz, CDCl3)
Cl
4.46
0.96
1.00
3.18
3.24
15.0
10.0
5.0
0.0
1)


157.320
137.399
134.632
129.066
126.863
77.424
77.000
76.576
73.529
51.461
38.908
12.464
13C NMR (75MHz, CDCl3)
Cl
200
150
100
50
0
m (t1)


7.272
7.256
7.229
7.205
7.178
5.460
5.433
5.406
3.917
3.888
3.859
3.437
3.409
3.384
3.360
3.356
3.331
3.307
3.284
2.353
1.196
1.171
1.147
0.00000
1H NMR (300 MHz, CDCl3)
Me
4.32
0.91
1.00
3.09
3.05
3.13
15.0
10.0
5.0
0.0
m (t1)


157.710
138.634
135.886
129.556
129.500
129.447
129.400
125.619
125.563
125.513
125.463
77.522
77.098
76.673
74.332
51.609
38.889
21.123
12.527
13C NMR (75MHz, CDCl3)
Me
200
150
100
50
0
m (t1)

12. The ^{1}H NMR charts of dimer of 1a